# Wood Truss Bracing

by Dr. Frank E. Woeste, P. E.

While metal-plate-connected (MPC) wood trusses have become to a large extent the standard way to frame residential and light-commercial structures, the responsibility for bracing design is still fuzzy for some truss users. For example, one common misconception is that the truss design drawings contain *permanent bracing design specifications* for the roof system. The purpose of this article is to clarify the bracing design responsibilities when using MPC wood trusses.

Permanent Truss Bracing

Permanent bracing is required to stabilize the truss members (chords and webs) in the vertical plane of each truss for the life of the structure. Permanent bracing must be designed to resist design loads that are specified by the *Building Designer*. With respect to wood trusses, ANSI/TPI 1-1995 defines the Building Designer as follows:

> **2.2 BUILDING DESIGNER**
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> Building Designer - is the design professional individual or organization having responsibility for overall building design, in accordance with the state's statutes and regulations governing the professional registration and certification of architects or engineers. This responsibility includes but is not limited to foundation design, structural member sizing, load transfer, bearing conditions, and the structure's compliance with applicable building codes. Also referred to as registered architect or engineer, building designer, and registered building designer, but hereinafter will be referred to as building designer.

The responsibility for permanent truss bracing design is stated in ***ANSI/TPI 1-1995 National Design Specification for Metal Plate Connected Wood Truss Construction***. ANSI/TPI 1-1995 was adopted by the three model codes, and thus it is the appropriate code reference for matters involving MPC wood trusses unless the local authorities have alternate provisions. Section 2.2.2 (d) and (e) of ANSI/TPI 1-1995 specifically addresses permanent truss bracing:

> **2.2.2** As this Standard does not cover the design for the complete structural system of a building, the Building Designer shall provide for the following in the design and detailing of the building:
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> (a) Truss deflections
> (b) Truss movement due to moisture and temperature change
> (c) Truss supports and anchorage accommodating horizontal, vertical or other reactions or displacements

(d) Permanent truss bracing to resist wind, seismic and any other lateral forces acting perpendicular to the plane of the truss
(e) Permanent lateral bracing as specified by the Truss Designer, to prevent buckling of the individual truss members due to design loads.

ANSI/TPI 1-1995 contains additional information on permanent truss bracing and can be purchased from the Truss Plate Institute (608) 833-5900.

The *Truss Designer* specifies on the *Truss Design Drawings* the members that are assumed to be sheathed and the assumed points of lateral support for members without sheathing, if support is required. For example, if a 10-foot web is overstressed in compression, then the truss designer may indicate on the *Truss Design Drawing* that the center of the web is to be braced against lateral movement. It is up to the *Building Designer* to determine how that point should be stabilized under the specified design loads. The most common way is to use a continuous lateral brace (CLB) in combination with diagonal braces at some interval. The Building Designer must determine the spacing of the diagonal braces needed to stabilize the CLB's. Figure 5.3.3.2(c) of ANSI/TPI 1-1995 depicts how a CLB is stabilized in the roof structure by the use of diagonal braces.

Another option for stabilizing the center of the example web is the use of a T-brace, usually a 2x4. Typically, T-braces extend the full length of the web minus a few inches on each end. The *Building Designer* must specify the T-brace size, grade, length, and nailing schedule. The advantage of the T-brace approach is that only one member is needed to brace a point on a truss member versus the CLB approach that requires <u>both</u> a CLB and diagonals. In instances where only one truss of a kind is installed and neighboring webs (or chords) don't line up, a T-brace may be the only practical option.

Some *Building Designers* incorrectly assume that if a brace is attached to the "bracing points" shown on *Truss Design Drawings*, then the roof system is braced. The fallacy of this assumption can be explained by the concept of "load paths." When a CLB is only nailed to a series of webs (or chords), it does connect the webs but the CLB has no load path. The CLB is free to translate in space, either left or right, with no resistance. The CLB must be stabilized by connecting additional members to it, that transfer loads to another part of the roof structure, that is connected to yet another part, and so on. When diagonals are used to stabilize CLB's, the load path would be

- Web to CLB
- CLB to diagonal(s)
- Diagonal(s) to truss panel points
- Truss panel points to roof, ceiling, or other diaphragm
- and eventually to the foundation.

A new publication, *Commentary for Permanent Bracing of Metal Plate Connected Wood Trusses,* is available from the Wood Truss Council of America (WTCA) by calling (608) 274-4849. This 26-page document points to typical cases where permanent bracing is needed, and gives some strategies for providing the required lateral support to members.

In summary, when a *Truss Design Drawing* shows that a point on a truss member is to be laterally restrained (by the assumptions of the truss design), then the *Building Designer* must provide a design for the lateral restraint of the point and the forces generated by the restraint must have a load path to the building foundation. When compression member is braced by only one CLB, it is a common practice to assume that 2% of the axial member force is required to stabilize the member. The contractor is responsible for installing the permanent bracing design for the roof system.

Temporary Bracing

As life-safety is involved, the importance of effective temporary truss bracing can not be overstated. The responsibility for temporary bracing design and installation is also stated in ANSI/TPI 1-1995:

> **5.1 GENERAL**
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> Metal plate connected wood trusses are planar structural components. Structural performance depends on the trusses being installed vertically, in-plane, at specific spacing, and being properly braced. The installer is responsible for receipt, storage, erection, installation, field assembly, and bracing.

Four industry documents currently provide recommendations for temporary bracing. The documents include DSB-89 Recommended Design Specifications for Temporary Bracing of Metal Connected Wood Trusses (TPI, 1989), HIB-91 Commentary and Recommendations for Handling, Installing, and Bracing Metal Plate Connected Wood Trusses Pocketbook (TPI, 1991), HIB-91 Summary Sheet (TPI, 1991), and HIB-98 Post Frame Summary Sheet (TPI, 1998). All documents are available from the Truss Plate Institute.

Alpine Engineered Products, Inc.(1996) in cooperation with WTCA produced a temporary bracing video that contains a segment on "buckling behavior" of a compression chord. A 60-foot parallel chord roof truss was placed in a testing laboratory, and inadequately braced by a series of temporary lateral braces only. The bottom chord was loaded with buckets containing weights that simulated the weight of truss installers. With one bucket lowered onto the

bottom chord, no noticeable truss movement was visible in the video. Next, the second bucket was lowered onto the truss. The top chord slowly buckled into the classic S-shape, with the chord severely bending between points of lateral support. Finally, a third bucket was lowered onto the truss and the truss violently collapsed. Reviewing this sequence can be very educational for erection personnel. The video can be purchased on the Internet at WWW.WOODTRUSS.COM, or by calling WTCA.

Frank E. Woeste, P. E. is a professor of wood construction and engineering at Virginia Tech University, Blacksburg. He specializes in the engineering and performance of wood buildings. He can be contacted by e-mail at fwoeste@vt.edu
or by telephone (540)231-6093.