Clarifying Permanent Bracing Issues

Design Community and Structural Building Components Industry Collaborate on Documents

Part 1

By Kirk Grundahl, P.E. and Emily Patterson

For years, permanent bracing of metal plate connected wood trusses in the web member plane, and in locations where an unsupported top or bottom chord also have high compression forces, has been a bit of a no man's land. The lack of clearly understood requirements, the assumption that it was someone else's job and the inability to get paid for undertaking the design of this bracing has naturally created friction between members of the design community and truss manufacturers. But wait – work between the design community and the structural building components industry has forged the way for clarifying this often passionate issue. Through collaborative projects, members of the National Council of Structural Engineers Associations (NCSEA), Truss Plate Institute (TPI) and WTCA – Representing the Structural Building Components Industry, addressed ways to improve the process of specifying bracing as it relates to trusses and, more generally, specifying trusses. The first in a series, this article will take a look at documents that address bracing requirements.

Courtesy of the International Code Council (ICC). For more information, visit ***www.iccsafe.org****.*

Working together, the design community and structural building components industry developed a comprehensive approach to the business and engineering issues that both industries face. Their work focused on the creation of three documents, which harmonize language used, design requirements and permanent bracing concepts. These collaborative efforts began with the work that NCSEA and WTCA undertook to revise section 2303.4 of the IBC 2006 (updated with 2007 supplement language below).

> **2303.4.1.1 Truss design drawings**. The written, graphic and pictorial depiction of each individual truss shall be provided to the building official for approval prior to installation. Truss design drawings shall also be provided with the shipment of trusses delivered to the job site. Truss design drawings shall include, at a minimum, the information specified below:
>
> 1. Slope or depth, span and spacing;…
>
> 12. Required permanent individual truss member restraint and method per Section 2303.4.1.2, unless a specific truss member permanent bracing plan for the roof or floor structural system is provided by a registered design professional.

2303.4.1.2 Permanent individual truss member restraint. Where permanent restraint of truss members is required on the truss design drawings, it shall be accomplished by one of the following methods:

1) The trusses shall be designed so that the buckling of any individual truss member is resisted internally by the individual truss through suitable means (i.e., buckling reinforcement by T-reinforcement or L-reinforcement, etc.). The buckling reinforcement of individual members of the trusses shall be installed as shown on the truss design drawing or on supplemental truss member buckling reinforcement details provided by the truss designer.

2) Permanent individual truss member restraint and diagonal bracing shall be installed using standard industry lateral restraint and diagonal bracing details in accordance with generally accepted engineering practice. Locations for lateral restraint shall be identified on the truss design drawing.

Courtesy of the Truss Plate Institute. For more information, visit ***www.tpinst.org****.*

Subsequently, these organizations started consensus work with TPI on ANSI/TPI 1-2007 Chapter 2 *Standard Responsibilities in the Design and Application of Metal Plate Connected Wood Trusses*. Consensus work for ANSI/TPI 1-2007 took about one and a half years, and concluded with ANSI approval on February 1, 2008. The consensus work focused on reaching substantial agreement between many interests. This process required that all views and objections be considered and that a concerted effort be made toward finding a resolution.

The most critical piece of work in the early stages of these discussions involved creating a common set of definitions. Once established, these definitions formed the foundation for these documents' truss related discussions, and they will also form the foundation for this and subsequent articles in this series (text courtesy of TPI).

> **2.1 GENERAL PURPOSES**
>
> The purpose of this Chapter of the Standard is to define and draw attention to the 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.

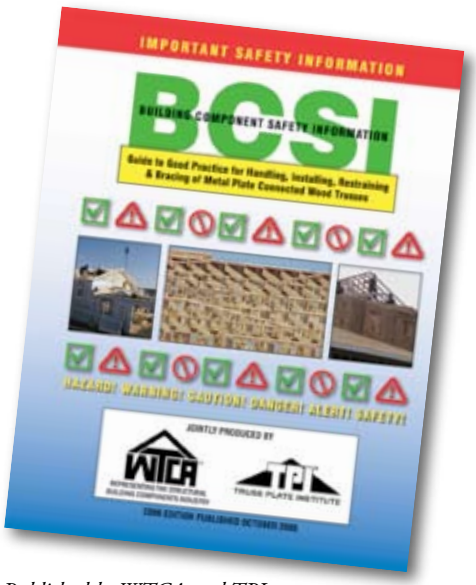
The "2.2 DEFINITIONS" section includes the following terms:

> **Building Designer:** Owner of the Building or the person that contracts with the Owner for the design of the Framing Structural System and/or who is responsible for the preparation

of the Construction Documents. When mandated by the Legal Requirements, the Building Designer shall be a Registered Design Professional.

Contractor: Owner of a Building, or the person who contracts with the Owner, who constructs the Building in accordance with the Construction Documents and the Truss Submittal Package. The term "Contractor" shall include those subcontractors who have a direct contract with the Contractor to construct all or a portion of the construction.

Owner: Person having a legal or equitable interest in the property upon which a Building is to be constructed, and: *(1)* either prepares, or retains the Building Designer or Registered Design Professional to prepare the Construction Documents; and *(2)* either constructs, or retains the Contractor to construct the Building.



Published by WTCA and TPI, BCSI is a Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses.

Around the same time that these projects were underway, WTCA also began significant revisions to the new *Building Component Safety Information – Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses* (BCSI) booklet, which it publishes with TPI. In particular, some of BCSI's most significant changes dealt with Chapter 3 entitled *BCSI-B3 – Permanent Restraint/Bracing of Chords & Web Members* and its corresponding B-Series Summary Sheet (B3). (For more information, visit **www.sbcindustry.com/b3.php**.) B3 begins by providing a key warning with respect to the importance of permanent bracing.

To see more definitions from this section, visit:
www.sbcindustry.com/terminology.php

Additional terms defined in the document include:

BCSI
BCSI-B1
BCSI-B2
BCSI-B3
Construction Documents
Cover/Truss Index Sheet
Diagonal Bracing
Framing Structural System
Lateral Restraint
Permanent Building Stability Bracing
Permanent Individual Truss Member Restraint
Registered Design Professional
Truss
Truss Design Drawing
Truss Design Engineer
Truss Designer
Truss Placement Diagram
Truss Submittal Package

WARNING! The proper installation of wood trusses is extremely critical to the lifetime performance of the Building. Depending on the experience of the Contractor it is strongly recommended that a meeting be held with the Building Designer to ensure that all Permanent Building Stability Bracing is identified and will be properly installed and to review the provisions of:

- the Construction Documents (i.e., architectural/structural plans and specifications),
- the Truss Submittal Package which includes:
- the Truss Design Drawings (TDD),
- the Truss Placement Diagram(s) (if/when required by the Contract),
- this BCSI document and/or B-Series Summary Sheets (when provided),
- any specific truss member permanent bracing plans that are provided for the roof or floor structural system,
- all special permanent bracing conditions like unsheathed top chords, long span scissors trusses, piggyback truss systems, all 60' or greater clear span assembly occupancies such as churches, gymnasiums, etc.

WARNING! Disregarding Permanent Individual Truss Member Restraint and Permanent Building Stability Bracing recommendations is a major cause of truss field performance problems and has been known to lead to roof or floor systems collapse. Failure to install the proper restraint and bracing will greatly increase the probability of truss performance problems or an accident resulting in property damage, personal injury or death.

continued on next page

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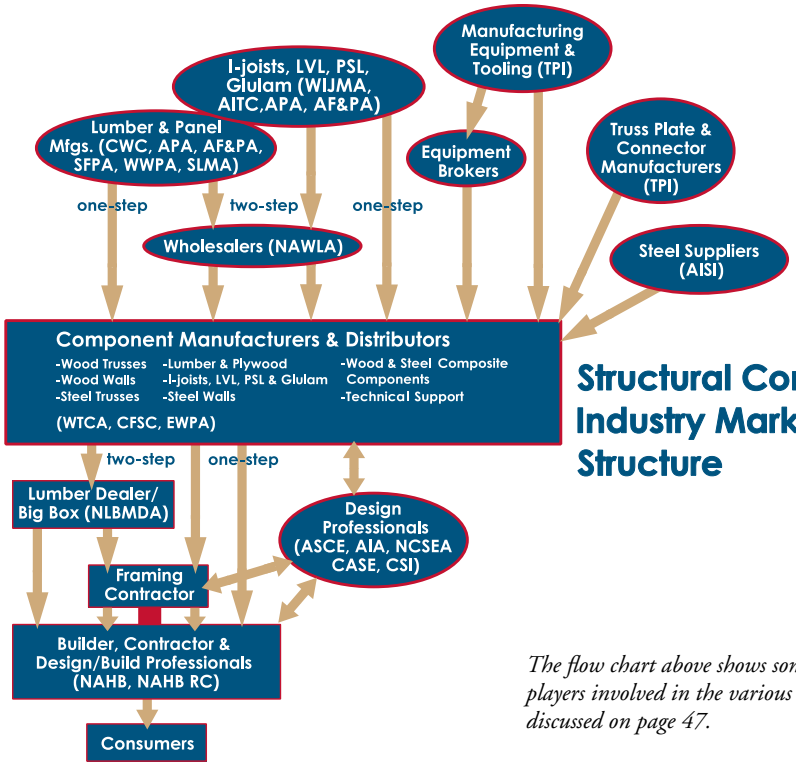
Work on these documents brought to the table many real-world issues encountered with all the parties and contractual relationships involved in the construction process. These endeavors are still works in progress that will continue to be revised so that the provisions are clear, implementable and result in safe construction. The 2006 IBC section 2303.4 language has been much improved through the 2007 supplement, ANSI/TPI 1-2007 Chapter 2 has been completed, and a new round of revisions are underway to BCSI.

In speaking with structural engineer John Mercer, P.E. of Mercer Engineering, it became clear that, for engineers who have not been intimately involved in all the improvements to the IBC, ANSI/TPI 1-2007 and BCSI, confusion and concern can surface. Hence, plans were initiated to create a series of articles that clarify the construction process that we undertake today.



Structural Component Industry Marketplace Structure

The flow chart above shows some of the players involved in the various business models discussed on page 47.

Find other WTCA resources at:
WTCA home page – www.sbcindustry.com
BCSI – www.sbcindustry.com/bcsi.php
BCSI-B3 – www.sbcindustry.com/b3.php
Bracing information – www.sbcindustry.com/bracing.php
Loads and truss design – www.sbcindustry.com/loads.php
Technical Notes – www.sbcindustry.com/common/kb/technotes.php
Technical information – www.sbcindustry.com/technical.php
Resources for design professionals – www.sbcindustry.com/designpro_gateway.php

Steel Version of B3 in Development

BCSI-B3 provides the standard industry details and guideline text for restraint and bracing of chords and web members. B3 is designed to be incorporated into the construction documents so that the structural framing plan can be printed on the reverse side.

WTCA's Cold-Form Steel Council (CFSC) is developing CFSBCSI – *Building Component Safety Information – Guide to Good Practice for Handling, Installing, Restraining & Bracing of Cold-Formed Steel Trusses* (CFSBCSI) booklet. This work includes creating a steel version of B3 and the other CFSBCSI-B Series Summary Sheets that summarize the main concepts of each chapter of CFSBCSI. Following the format and technical approach to the wood version of B3, CFSBCSI-B3 will provide standard industry bracing details and guideline text for the permanent restraint and bracing of the top chord plane, bottom chord plane and web member plane. CFSBCSI-B3 will also cover web member reinforcement, gable end frame restraint and bracing, and restraint and bracing for piggyback trusses. In addition, the document will include separate sections that provide guidelines for trusses with 2-foot and 4-foot on-center spacing. For more information, visit **cfsc.sbcindustry.com**.

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To start, let's identify the major players in this process. The primary actors in this play include:

1) The Building Owner.
2) The Building Designer, who is generally an Architect and has a contract with the Owner.
3) The Structural Engineer, who generally has a contract with the Building Designer.
4) The Contractor, who generally has a contract to construct the building with the Owner.
5) The building material supplier, who generally has a contract to supply materials to the Contractor.
6) The truss manufacturer (that has a relationship with a metal connector plate supplier and uses its related truss design software); the manufacturer generally has a contract with the building material supplier or the Contractor.
7) The Building Official.

This play is then acted out using a variety of project delivery models including:

1) **Short Circuit:** There is no Registered Design Professional involved in the process design or build process. A brief discussion of the importance of the Building Official's participation for correct construction and risk management will be included.
2) **Design-Bid-Build:** The Building Owner hires an Architect who hires the Structural Engineer and all communication is through the Architect to the owner. The owner hires the Contractor who contracts with a truss supplier to supply the structural components.
3) **Design-Build:** The Building Owner hires an architecture-structural engineering-contractor firm to undertake the project. This design-build firm contracts with a truss supplier to supply the structural components.
4) **Design-Truss Supply-Build:** The Building Owner hires a firm that does architecture, structural engineering, component manufacturing and rough framing to undertake the project. The entire firm is in charge of the process handling engineering, truss manufacturing and framing.

Our goal, as described above, is to harmonize the language and concepts used inside IBC, ANSI/TPI 1-2007 and BCSI to help create consistency from job to job. The forthcoming articles in this series will clarify pitfall issues in the project delivery process. Appropriate workflows – beginning with truss specification by a design professional to the truss design by a truss manufacturer – will be discussed. Unique pitfalls or breakdowns in the delivery process will be discussed to assist the reader in better understanding how proper workflow contributes to a successful project delivery process.▪

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