

Commentary to WTCA 1-1995 Standard Responsibilities in the Design Process Involving Metal Plate Connected Wood Trusses

I.

INTRODUCTION & GENERAL COMMENTARY

WTCA 1-1995, *Standard Responsibilities in the Design Process Involving Metal Plate Connected Wood Trusses*, has been developed through an open consensus-based committee approach spearheaded by the Engineering Review Committee of the Wood Truss Council of America (WTCA), a not-for-profit corporation. While not developed strictly in accordance with the consensus protocol of the American National Standards Institute, WTCA 1-1995 includes pertinent design responsibility criteria found in Chapters 2, 5 and 8 of American National Standard ANSI/TPI 1-1995, *National Design Standard for Metal-Plate-Connected Wood Truss Construction*, and has thus been added as an appendix to ANSI/TPI 1-1995. WTCA 1-1995 further incorporates many of the definitions and concepts utilized in ANSI/TPI 1-1995. ANSI/TPI 1-1995 is the first nationally recognized wood truss consensus design standard, and has been adopted by reference in BOCA's *National Building Code*, SBCCI's *Standard Building Code*, and ICBO's *Uniform Building Code*.

WTCA 1-1995 is intended as a comprehensive and thorough approach to the clarification of design responsibilities when wood trusses are incorporated into a building or structure. Although some confusion may exist in the construction industry concerning the delegation of such design responsibilities, from the wood truss industry's perspective the design responsibilities of truss manufacturers and truss designers are quite clear. The person or organization involved in the truss design, the truss designer, is responsible for the individual truss component design. The company manufacturing the trusses, the truss manufacturer, in turn accepts responsibility for the performance of the trusses it manufactures. Through this process, all of which is carefully defined in WTCA 1-1995, the truss manufacturer supplies an engineered product that will perform well if used in accordance with accepted engineering, and correct building, practices.

II.

SPECIFIC SECTION COMMENTARY

1.2.2 The definition of *Building Designer* is identical to that used in ANSI/TPI 1-1995. The term Building Designer, while it may include an architect (see definition of *Architect* in 1.2.1) or an engineer (see definition of *Engineer* in 1.2.5), is not restricted to architects or engineers, as many state and local laws do not require the involvement of a registered or licensed professional in the design of certain types of buildings or structures. In these instances, responsibility for compliance of the building or structure with all legal requirements rests with the Owner (see definition

of *Owner* in 1.2.6).

1.2.3 The Building Designer is deemed responsible for the design of a building and in particular, the building's structural system. The structural system of a building is the completed combination of structural elements that support the building's self weight, applicable occupancy live loads, and environmental loads (e.g. snow, wind, seismic, etc.). These elements may include beams, columns, structural members, and prefabricated structural components, including metal plate connected wood trusses (see definition of *Truss* in 1.2.7). These elements when combined form a building's structural system.

In designing the building and its structural system to comply with all legal requirements and to determine what structural elements may be used, the Building Designer prepares drawings and specifications, which are referred to as the *Construction Design Documents* (see definition of *Construction Design Documents* in 1.2.3). The Construction Design Documents must provide sufficient information to enable the construction trades responsible for supplying the structural elements used to construct the building (such as the *Truss Manufacturer* (see definition in 1.2.10) if trusses are to be used) to design these structural elements.

1.2.8 The definition of *Truss Designer* is identical to that used in ANSI/TPI 1-1995.

1.2.9 The trusses designed for use in a building's structural system are individually depicted in the *Truss Design Drawings*. Truss Design Drawings are not typical construction shop drawings as they do not set forth fabrication, assembly or installation details.

1.2.11 The *Truss Placement Plan*, if required, is prepared based on the Truss Manufacturer's interpretation of the Construction Design Documents and is meant to assist the Contractor (see definition of *Contractor* in 1.2.4) in correctly locating individual trusses in the structure. The Truss Placement Plan will reflect a truss identifying mark and perhaps other products supplied by the Truss Manufacturer so these products can be more easily identified by the Contractor during field erection. The Truss Placement Plan is not an engineered drawing and is not intended to replace the Construction Design Documents; it is only a guide for installation and requires no engineering input. Nevertheless, if the Truss Placement Plan is required, it must be reviewed and approved by the Contractor and the Building Designer.

2.1 The model building codes stipulate that the Owner is responsible for the structure and its compliance with the building code requirements. The Owner may choose to retain others, such as the Contractor and Building Designer, and through contract delegates the responsibility of code compliance to these individuals. At times, the Contractor may also function as the Building Designer. The allocation of design responsibilities to the Contractor in such instances is consistent with the model building codes - which state that building permit applicants (e.g. the Contractor) are responsible for ensuring the structure remains in full compliance with the building code. At times the Owner may also function as the Contractor and

quite possibly the Building Designer.

3.1 The Building Designer is responsible for the design of a building's structural system, which is comprised of structural elements such as beams, columns, structural members, prefabricated components (including trusses) and all the bracing required to achieve total structural integrity (see also 3.2.4). For specialty structural components such as trusses, the Building Designer may require the expertise of others, through the Construction Design Documents, to design such components. The Truss Manufacturer accepts the responsibility for the design and manufacture of the trusses in accordance with the Construction Design Documents, through his contract with the Contractor or Owner. An individual truss design is then undertaken by the Truss Designer on behalf of the Truss Manufacturer. The Truss Designer will either be an employee of the Truss Manufacturer or retained by the Truss Manufacturer through contract.

The Truss Designer graphically depicts the trusses that are designed in the Truss Design Drawings. If required by the laws of the state where the structure is constructed, the Truss Design Drawings are prepared by a licensed engineer, referred to as a Truss Design Engineer. The definition of Truss Designer is intended to include the term Truss Design Engineer.

The Building Designer is furthermore responsible for the measures to be undertaken during the design and construction of the structure to ensure that the structural elements used in the structure are not subjected to service conditions that may adversely affect their performance. Trusses may be used successfully in a wide variety of service conditions so long as the factors and conditions having the potential to adversely affect their long-term performance and structural integrity are adequately addressed by the Building Designer. For example, if trusses are to be used in a roof-ceiling or floor-ceiling assembly in areas of high moisture (e.g. above a swimming pool), appropriate measures must be planned to protect the trusses from the problems that elevated moisture can cause.

3.2.1 & 3.2.2 The Construction Design Documents must provide for a spatial definition for all trusses to be located in the structure, although it is not necessary for the Building Designer to specify the size of the truss chords and webs, web patterns, or the truss design.

3.2.3 Identification of intended truss bearing locations within the Construction Design Documents is critical to enable each truss to be designed and built to the correct dimensions and for the intended support conditions. Specification of intended bearing conditions also enables the Truss Manufacturer to ensure that each truss is provided with adequate bearing. It is the Building Designer's responsibility however, to ensure that the structural elements upon which the trusses will rest (e.g. wall, beam, column, etc.) have sufficient capacity to support each truss, and provide sufficient bearing length.

3.2.4 Properly designed permanent bracing is necessary to maintain the integrity of the structure, especially when the structure is subjected to lateral loads imposed by

wind or seismic forces. The design of all permanent bracing for the structure, including the trusses, is the responsibility of the Building Designer, as the loads resisted by permanent bracing must be transferred to, and supported by the structure.

Included as part of the permanent bracing for trusses is the continuous lateral bracing required to enhance the buckling capacity of certain truss compression members. The Truss Designer will set forth in the Truss Design Drawings, the maximum axial compression forces in the truss members, as well as the location(s) where this bracing is required. It is the responsibility of the Building Designer to design the size, connection and anchorage of the permanent bracing to the truss member, as well as to the supporting structure (*see also* 3.4).

3.2.5 To ensure that the structural capacity of the trusses designed by the Truss Designer is sufficient for the structure for which they are designed, all applicable design loads must be expressly stated in the Construction Design Documents. Simply referencing a section of a building code within the Construction Design Documents does not provide the Truss Manufacturer or others with the necessary or required information. Furthermore, special loading conditions for drifting snow or localized wind loading effects should be clearly indicated in the Construction Design Documents by text and/or diagram.

3.2.6 Contemporaneous preparation of the Construction Design Documents with that of the Truss Design Drawings would enable the Building Designer to more easily design support and bearing conditions, temporary and permanent lateral and diagonal bracing, and all the anchorage needed to resist uplift, gravity and lateral forces on the structure. However, as it is often impractical, or even impossible, for the Building Designer to obtain input from the Truss Designer at the time the Construction Design Documents are prepared, many engineering assumptions will need to be made by the Building Designer as he/she designs the structure. Accordingly, the Truss Design Drawings, when produced, may not exactly match with the assumptions used by the Building Designer. For example, it is very unlikely that the uplift loads calculated by the Building Designer will match the uplift loads developed by the Truss Designer. They should not be expected to be identical. For this reason, it is essential that the Truss Design Drawings be reviewed and approved by the Building Designer. Ultimately however, it is the responsibility of the Building Designer to specify appropriate uplift loads and connection requirements for use by the Contractor for all anchorage and connection requirements of the Trusses.

3.2.7 Vertical deflection criteria for structural elements used in various types of construction applications are provided by all three major model building codes. These criteria are intended to minimize damage of supported construction materials (e.g. plaster, gypsum board, etc.) and establish a minimum level of performance. Whether this minimum level of deflection performance is suitable however, to the Owner and those occupying the structure, is a highly subjective matter. Since trusses can be designed to meet virtually any deflection criteria, it is imperative that the Building Designer convey the expectations of the Owner by specifying the

required deflection criteria in the Construction Design Documents.

Horizontal deflection limitations are also critical for truss configurations utilizing dual pitched bottom chords (e.g. scissors trusses), as gravity loads applied to these trusses produce both vertical and horizontal deflection. The Building Designer must design the supporting structure and the truss-to-wall connection appropriately to account for any horizontal displacement.

3.2.8 The engineering term that best describes the intent of this section is "load paths." All truss loads must be accounted for by the Building Designer and properly transferred through the structural elements to the building's foundation.

3.3 As trusses are simply structural elements, the Truss Manufacturer and Truss Designer assume responsibility only for the internal design integrity of the individual trusses produced, and not the floor or roof systems (which are part of a building's structural system) in which the trusses are to be placed. As the design and performance of floor or roof systems is the responsibility of the Building Designer, he/she must review the individual truss designs to ensure that they work appropriately within such systems and the structure. In particular, the Building Designer is responsible for (a) determining that the Truss Design Drawings and Truss Placement Plan(s) (if required) have been prepared in accordance with the requirements of the Construction Design Documents, (b) verifying the design criteria utilized in the Truss Design Drawings, (c) evaluating the effects of the truss designs on the floor or roof systems, and (d) determining that the truss configurations set forth in the Truss Design Drawings are consistent with the Construction Design Documents.

4.1, 4.2, and 4.3 It is not contemplated that the Contractor is merely a conduit for passing the Truss Placement Plan (if required) and/or Truss Design Drawings from the Truss Manufacturer to the Building Designer for review and approval and then back to the Truss Manufacturer. While the Contractor is entitled to rely on the accuracy of the design calculations contained in the Truss Design Drawings, the Truss Design Drawings and the Truss Placement Plan(s) set forth the Truss Manufacturer's interpretation of the requirements of the trusses as set forth in the Construction Design Documents. Therefore, the Contractor must review and approve the Truss Design Drawings and the Truss Placement Plan to (a) determine if they comply with the intent of the Construction Design Documents, (b) check for any errors that may potentially lead to costly remedial work, and (c) plan for a systematic communication and coordination between the building trades with respect to truss placement and installation requirements, thereby greatly reducing the potential of having to cut and modify the trusses due to interference with plumbing, electrical, and/or HVAC runs and equipment.

4.4 In addition to the Truss Design Drawings and the Truss Placement Plan (if required), supplemental information may be provided by the Truss Manufacturer relating to handling, installation, placement, and temporary bracing of the trusses. The Contractor should provide such information to the truss installer prior to the arrival of the trusses to the job site. The recommendations provided in these

documents are offered as guidelines and are not to be interpreted as superior to the Building Designer's specifications or considered to be the only method for handling, installing, and temporary bracing the trusses.

4.5 & 4.6 Trusses are planar structural components whose structural performance depends upon being installed vertically, in-plane, at specific spacing, and being properly braced. Trusses can be easily damaged by improper field storage or handling during erection. Failure to adequately install and brace the trusses can also result in damage to the trusses, but more significantly, may also cause worker injury.

The majority of wood truss related accidents occur during truss installation. The principal causes of such accidents include: (a) inadequate and/or improperly located temporary bracing, (b) improperly installed and/or inadequate connection of the bracing to the truss, (c) improper and/or inadequate connection of the truss and/or bracing to the supporting structure, (d) overloading roof or floor trusses before the trusses have been permanently braced (e.g. stack of plywood), (e) overloading roof or floor trusses after installation is completed (e.g. stack of materials such as plywood, drywall, etc.), (f) improper or unauthorized field alterations, (g) installation of broken, damaged, or improperly repaired trusses, (h) improper truss alignment before bracing, (i) improperly designed or installed support structures (e.g. walls, beams, etc.), and (j) failure to provide during the installation process the required permanent compression member bracing at the locations shown on the Truss Design Drawings.

Educational materials providing recommendations on the handling, installation, and temporary bracing of trusses are available from the wood truss industry in the form of several documents including: TPI's, *Recommended Design Specifications For Temporary Bracing of Metal Plate Connected Wood Trusses* (DSB-89) and *Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses* (HIB-91, booklet and summary sheet), WTCA's *Jobsite Warning Poster*, and a WTCA video entitled, "*Handling, Installing and Bracing of Metal Plate Connected Wood Trusses.*" These materials are available through local Truss Manufacturers, TPI or WTCA. The recommendations provided in these documents are offered as guidelines and are not to be interpreted as superior to the Building Designer's specifications or considered to be the only method for handling, installing, and bracing of trusses.

5.1 The Truss Manufacturer typically receives the Construction Design Documents directly from the Contractor. From the information contained in the Construction Design Documents, the Truss Manufacturer develops truss design criteria and, if required, a Truss Placement Plan. The truss design criteria developed by the Truss Manufacturer are provided to the Truss Designer, who then uses this information to prepare the Truss Design Drawings. Some Truss Manufacturers directly employ Truss Designers; for others, the Truss Designers are retained on a contractual basis.

6.1 and 6.2 The Truss Design Drawings contain appropriate information to enable

the Building Designer, Contractor, and/or Owner to adequately review and verify that the Truss Design Drawings conform with the requirements and intent of the Construction Design Documents. Sufficient information is also provided to enable the Building Designer to design the size, connections, and anchorage of the permanent continuous lateral bracing (see 3.2.4). The Truss Design Drawings furthermore provide all the truss related information typically required by code officials for plan review and field inspection purposes.

Truss Designers do not review, or check for errors or omissions potentially contained within, the Construction Design Documents. The Truss Designer's scope of work is to simply design trusses that have adequate capacity for the design conditions shown on the Truss Design Drawings, so long as the Truss is spaced as referenced on the drawing (usually 24" on center) and the Truss is properly manufactured, installed and braced. In the absence of a professional Building Designer, or an understanding by the Building Designer of how loads are applied or how they flow through the structure to the foundation, the Truss Designer does not assume these responsibilities. Truss Designers also have no responsibility to evaluate the effect of the trusses on the structural system of the building. The Truss Design Drawings furthermore do not constitute a temporary or permanent bracing plan for the structure.

7.1 As trusses are engineered structural components, their structural integrity can be substantially altered by damaging, cutting, or modifying any of its members. Truss members may break if improperly handled during the unloading, storage, installation and erection phases of the project. If the trusses are cut or modified by the construction trades to avoid interference with other building components, the Contractor is responsible for securing the documentation required for repairing the Truss. The Truss Manufacturer should be informed immediately of any damaged, cut, or field modified trusses and may be able to assist in providing the required documentation.

**[SAMPLE TRUSS SPECIFICATIONS FOR ARCHITECTS AND ENGINEERS]
SECTION 06192 FABRICATED WOOD TRUSSES (LONG FORM)**

1.01 WORK INCLUDED

Design, manufacture and supply, wood trusses as shown on drawings and as specified.

1.02 DEFINITIONS

- A. "Building Designer" (e.g. Architect or Engineer) shall mean the individual or organization having responsibility for the overall building design in accordance with the state's statutes and regulations governing the professional registration of architects or engineers. This responsibility includes, but is not limited to, foundation design, structural member sizing, load transfer, bearing conditions, and compliance with the applicable building code.
- B. "Construction Design Documents" are the architectural drawings, structural

drawings, mechanical drawings, electrical drawings, and any other drawings, specifications, and addenda which set forth the overall design of the structure and issued by the Building Designer.

- C. "Contractor" shall be the individual or organization responsible for the field storage, handling, and installation of trusses, including, but not limited to, temporary bracing, permanent bracing, anchorage, connections, and field assembly. The term "Contractor" shall include those subcontractors who have a direct contract with the Contractor to perform all or a portion of the handling and installation of the trusses.
- D. "Truss" is an individual metal plate connected wood structural component manufactured by the Truss Manufacturer.
- E. "Truss Designer" is the design professional, individual, or organization, having responsibility for the design of metal plate connected wood trusses. This responsibility shall be in accordance with the state statutes and regulations governing the professional registration of architects or engineers.
- F. "Truss Design Drawing" shall mean the graphic depiction of an individual Truss prepared by the Truss Designer.
- G. "Truss Manufacturer" shall mean an individual or organization regularly engaged in the manufacturing of trusses.
- H. "Truss Placement Plan" is the drawing identifying the location assumed for each truss based on the Truss Manufacturer's interpretation of the Construction Design Documents.

1.3 DESIGN

- A. Trusses shall be designed in accordance with this specification and where any applicable design feature is not specifically covered herein, design shall be in accordance with the applicable provisions of the latest edition of the American Forest & Paper Association's ("AF&PA's") *National Design Specification for Wood Construction*, the Truss Plate Institute's (TPI's) *National Design Standard for Metal-Plate Connected Wood Truss Construction* (ANSI/TPI 1), and the legal requirements of the applicable local jurisdiction.
- B. Truss Manufacturer shall furnish Truss Design Drawings prepared in accordance with the statutes and regulations of the state where the trusses are to be installed.
- C. If required by the Construction Design Documents and the contract between the Contractor and the Truss Manufacturer, the Truss Manufacturer shall furnish a Truss Placement Plan which shall provide at a minimum the location assumed for each truss based on the Truss Manufacturer's interpretation of the Construction Design Documents
- D. All Truss Design Drawings and Truss Placement Plans shall be submitted to the Building Designer for review and approval prior to the manufacturing of the trusses.
- E. The Truss Design Drawings shall include as minimum information:

1. Slope or depth, span and spacing;
2. Location of all joints;
3. Required bearing widths;
4. Design loads as applicable: (a) top chord live load (including snow loads); (b) top chord dead loads; (c) bottom chord live loads; (d) bottom chord dead loads; (e) concentrated loads and their points of application; and (f) controlling wind and earthquake loads;
5. Adjustments to lumber and metal connector plate values for conditions of use;
6. Each reaction force and direction;
7. Metal connector plate type, size, thickness, or gauge, and the dimensioned location of each metal connector plate except where symmetrically located relative to the joint interface;
8. Lumber size, species, and grade for each member;
9. Connection requirements for: (a) truss-to-truss girder; (b) truss ply to ply; and (c) field splices;
10. Calculated deflection ratio and/or maximum deflection for live and total load;
11. Maximum axial compression forces in the truss members to enable the Building Designer to design the size, connection, and anchorage of the permanent continuous lateral bracing; and
12. Required permanent truss member bracing locations to prevent buckling of compression members.

2.01 MATERIALS

A. Lumber

1. Lumber used for trusses shall be in accordance with published values of lumber rules writing agencies approved by Board of Review of American Lumber Standards Committee. Lumber shall be identified by grade mark of a lumber inspection bureau or agency approved by that Board, and shall be as shown on the Truss Design Drawings.
2. Moisture content of lumber shall be no less than 7% nor greater than 19% at time of manufacturing.
3. Adjustment of value for duration of load or conditions of use shall be in accordance with AF&PA's *National Design Specification for Wood Construction*.
4. Fire retardant treated lumber, if applicable, shall meet specifications of truss design and ANSI/TPI 1 and shall be redried after treatment in accordance with AWWA Standards C20. Allowable values must be adjusted in accordance with NDS. Lumber treater shall supply certificate of compliance.

B. Metal Connector Plates:

1. Metal connector plates shall be manufactured by a Wood Truss Council of America ("WTCA") member plate manufacturer and shall not be less than .036 inches in thickness (20 gauge) and shall meet or exceed ASTM A653/A653M grade 33, and galvanized coating shall meet or exceed ASTM A924/924M, coating designation G60. Working stresses and steel are to be applied to effectiveness ratios for plates as determined by test and in accordance with ANSI/TPI 1.
2. In highly corrosive environments, special applied coatings or stainless steel may be required.
3. At the request of Building Designer, a WTCA member plate manufacturer shall furnish a certified record that materials comply with steel specifications.

2.02 MANUFACTURING

Trusses shall be manufactured in a properly equipped manufacturing facility of a permanent nature. Trusses shall be manufactured by experienced workers, using precision cutting, jiggling and pressing equipment and shall meet the quality requirements of ANSI/TPI 1. Truss members shall be accurately cut to length, angle, and true-to-line to assure proper fitting joints with tolerances set forth in ANSI/TPI 1.

3.01 HANDLING, INSTALLING, AND BRACING

- A. Trusses shall be handled during manufacturing, delivery, and by the Contractor at the job site so as not to be subjected to excessive bending.
- B. Trusses shall be unloaded in a manner so as to minimize lateral strain. Trusses shall be protected from damage that might result from on-site activities and environmental conditions. Prevent toppling when banding is removed.
- C. Contractor shall be responsible for the handling, erection, and temporary bracing of the trusses in a good workmanlike manner and in accordance with TPI's *Commentary and Recommendations for Handling, Installing, and Bracing Metal-Plate Connected Wood Trusses* (HIB-91, booklet) and the latest edition of ANSI/TPI 1.
- D. Apparent damage to trusses, if any, shall be reported to Truss Manufacturer prior to erection.
- E. Trusses shall be set and secured level and plumb, and in correct location. Plumb of each truss shall be held in correct alignment until specified permanent bracing is installed.
- F. Cutting and altering of trusses is not permitted. If any truss should become broken, damaged, or altered, written concurrence and approval by a licensed_design professional is required.
- G. Concentrated loads shall not be placed on top of trusses until all specified bracing has been installed and decking is permanently nailed in place. Specifically avoid stacking full bundles of plywood or other concentrated loads on top of trusses.
- H. Trusses shall be sufficiently braced during erection to prevent toppling or dominoing.

- I. Trusses shall be permanently braced in a manner consistent with good building practices and in accordance with the requirements of the Construction Design Documents. Trusses shall furthermore be anchored or restrained to prevent out-of-plane movement so as to keep all truss members from simultaneously buckling together in the same direction. Such permanent lateral bracing shall be accomplished by: (a) anchorage to solid end walls; (b) permanent diagonal bracing in the plane of the web members; or (c) other suitable means.
- J. Materials used in temporary and permanent bracing shall be furnished by Contractor.