WHAT EVERY ARCHITECT / ENGINEER (A&E) SHOULD KNOW

ABOUT METAL PLATE CONNECTED WOOD FLOOR / ROOF TRUSSES ©

John E. Meeks, P.E. © Draft

A discussion about pre-engineered, prefabricated, Metal Plate Connected Wood Trusses and how they may be integrated into a structural system to meet the expectations of today ' s practicing Architects and Engineers.

First, a little quiz…

TRUE OR FALSE?

Architects and Engineers do not have to know how to design wood truss systems. The truss manufacturer has access to highly specialized engineering software that can design any reasonable wood truss system, and will provide this service free of charge. ☐ T ☐ F

Architects and Engineers do not have to worry about wood roof / floor truss design loadings. The truss designer has access to building code minimums and can design the trusses accordingly. The truss designer can look at the building elevations and roof plan for determining snow drift loadings and/or wind uplift needs. ☐ T ☐ F

It isn ' t necessary for Architects and Engineers to draw a wood roof/floor truss framing plan to go along with the floor plan dimensions. This work can be left entirely to the Truss Placement Plan developed by the manufacturer of the wood trusses. ☐ T ☐ F

There is no need for the A&E ' s to sweat the details of load bearing support conditions for wood trusses. The truss manufacturer usually has truss designers capable of handling these problems. If there is need for an added column, beam or girder, the truss designer can show it on his Truss Placement Plan. ☐ T ☐ F

Connections between the wood trusses and their supports are not the A&E ' s problems. The truss designer has the capability of determining these connection requirements. ☐ T ☐ F

Connections between the roof / floor deck (diaphragm) and the wood trusses are not the A&E ' s responsibility. The truss designer will determine what these connections should be and will specify how they are to be placed, spaced and applied. ☐ T ☐ F

The need for permanent bracing between wood trusses is part of the analysis done by the truss designer and should be shown on the truss drawings. The A&E is not responsible for these details or their connections. ☐ T ☐ F

Temporary bracing during installation of the wood trusses is not the A&E ' s problem. It is up to the truss designer to specify locations and spacing of temporary bracing. ☐ T ☐ F

If you answered " TRUE " to any of the above statements, it is important for you to continue reading the following clarifications and explanations. All of the above statements are FALSE.

The wood truss industry, through it ' s national industry voices, the *Truss Plate Institute, Inc. (TPI)* and the *Wood Truss Council of America (WTCA)* have recognized ongoing misunderstandings in the industry and have published many documents aimed at clarifying the responsibilities of the individuals and organizations in the design process involving metal plate connected wood trusses.

With the hope of clearing up mistaken positions, this writer has recalled many years of discussions and questions arising during and after wood truss seminar presentations. How closely do these seminar questions and answers relate to the TRUE/FALSE statements above?

FREQUENTLY ASKED QUESTIONS.

Q1.) Building Designers and Contractors were among the first to recognize the easy and economical use of metal plate connected wood trusses to form an infinite variety of roof / floor shapes and conditions. Is it true that the Building Designers (A&E) need only define the roof / floor shape desired, and leave the design of the truss system up to the the Truss Manufacturer and the Contractor ?

A1.) No, it is not. The Truss Manufacturer usually has access to extensive truss engineering capacity, but this capability is limited to the design of individual truss components only, not a complete roof/floor structural system. It is up to the Building Designer to properly use these engineered truss components in a complete roof/floor truss system.

Q2.) If the Truss Manufacturer provides a Truss Placement Plan to locate and identify every individual truss component, why should the Building Designer draw a roof/floor framing plan? Isn ' t this a duplication of effort?

A2.) In some cases it may seem a duplication of effort, but the Building Designer ' s framing plan is essential for a successful interpretation of the intent of the Building Designer (A&E). The Building Designer is responsible by law to know how the building structure is designed and how it will respond to and support the loadings and environmental requirements of local building codes. It is essential that a roof/floor framing plan be prepared by the Building Designer to show how these many loads and conditions will be directed to the ground. From the Building Designer ' s framing plan, the Truss Manufacturer prepares the Truss Placement Plan, which should then be approved or disapproved by the Building Designer as meeting the intent of the plans and specifications. This approval should take place before any trusses for the project are manufactured.

Q3.) If the Truss Manufacturer has access to the local building code, why shouldn ' t it be their responsibility to apply these loads properly to the roof/floor structure?

A3.) The Truss Manufacturer does not design buildings. The Truss Manufacturer does not know how the Building Designer intends to handle dead, live, snow, wind, seismic, and miscellaneous loadings. It is up to the Building Designer to show the intent of the roof/floor loadings on the framing plans, from which the Truss Manufacturer can develop a Truss Placement Plan with individual truss components designed for each identified truss shown on the Truss Placement Plan. It is the Building Designer ' s responsibility to show all necessary loadings that will be applied to the roof/floor system and how these loadings will be conducted to the ground.

Q4.) In order to provide a proper platform from which the Truss Manufacturer may confidently provide a Truss Placement Plan with individual truss component designs, what should the Building Designer show on the roof/floor framing plans ?

A4.) Reference: *Wood Truss Council of America* publication, *Standard Responsibilities in the Design Process Involving Metal Plate Connected Wood Trusses, (WTCA 1-1995).* Scope and Definitions described in this reference are used throughout this presentation (*WTCA 1-1995 - Section 1 Scope and Definitions*).

WTCA 1-1995 - Section 2.0 Owner responsibilities.

The Owner, directly or through its representatives, which may include the Contractor and/or Building Designer, is responsible to; (a) review and approve each Truss Design Drawing; (b) review and approve the Truss Placement Plan; (c) resolve and approve all design issues arising out of the preparation of each Truss Design Drawing and Truss Placement Plan; and (d) coordinate the return of each approved Truss Design Drawing and Truss Placement Plan to the Truss Manufacturer prior to truss manufacturing.

In most cases, the Building Designer (A&E) is the owner ' s representative on the project. However, in

some instances, the Owner does not hire the services of a qualified building design professional. In that event, the Owner assumes the responsibilities normally addressed by the Building Designer, usually with the aid of the Contractor. This suggests that the Owner, acting in consort with the Contractor, has the knowledge, background and experience to practice Architecture or Engineering without a license. State regulations would normally not issue a building permit under these conditions. However, some States do recognize that an Owner may build his own building, provided the work is done according to applicable building codes. In many instances, this kind of project ends up being in trouble from start to finish, due to misunderstandings among the various personalities involved, often resulting in litigation.

The Owner / Building Designer responsibilities are listed in greater detail in *WTCA 1 - 1995*, Section 3.0, Building Designer Responsibilities, as follows:

WTCA 1-1995 - Section 3.0 Building Designer Responsibilities.

3.1 The Building Designer is responsible to design a structure suitable to ensure that the intended function of each Truss is not affected by adverse influences including, but not limited to, moisture, temperature, corrosive chemicals and gases.

Q5.) Why does the truss manufacturer need to know about these adverse conditions?

A5.) These adverse influences may have a long term effect on the performance of wood trusses, i.e. moisture creates conditions conducive to softwood decay; high temperature can cause decreased capacity of wood members; corrosive chemicals and gasses may affect zinc coated steel connector plates. For instance, an ocean exposure can cause connector plate corrosion. The Building Designer must be aware of such conditions so that corrective measures may be incorporated into the truss component designs for the building.

3.2 The Building Designer is responsible to prepare the Construction Design Documents, showing all trussed areas, which must provide as a minimum the following information:

3.2.1 All truss orientations and locations.

Q4) Sometimes, after the Building Designer has done a roof/floor framing plan, the Truss Manufacturer will submit a layout that may change the direction and locations of some trusses to provide a more economical solution. Why should the Building Designer show truss orientations and locations when the Truss Manufacturer may submit a Truss Placement Plan that differs from the Building Designer ' s framing plan?

A4.) It is important that the full intent of the Building Designer ' s layout be transferred to the Truss Placement Plan. The Building Designer usually has specific reasons for the framing plan developed in the Construction Design Documents, and the initial submittal may include a misunderstanding, which should be corrected by the Building Designer. However, the Truss Manufacturer ' s submittals may also include helpful improvements to the framing plan which may have been overlooked by the Building Designer. That is why it is so important for the submittals to pass through proper channels, for final approval before manufacturing.

3.2.2 Information to fully determine all truss profiles.

Q5.) If a Building Designer shows a roofing plan with slopes, hips, overhangs, ridge and valley lines, isn ' t this enough information to develop all truss profiles ?

A5.) Not necessarily. Although very useful, a roofing plan alone does not usually show framing. For the Truss Manufacturer to produce a proper Truss Placement Plan, with properly engineered truss components, it is necessary for the Building Designer to show span and spacing of trusses, locations of supporting columns, beams, girders, and/or load bearing walls. It is also necessary to show any raised or dropped ceiling areas and/or internal accessible attic spaces.

3.2.3 Adequate support of the truss and all truss bearing conditions.

Q6.) It has been my experience, as a Building Designer, that the Truss Manufacturer will sometimes add columns or beams or load bearing walls that are not shown on my framing plan, explaining that the trusses would be more economical if done their way. What do I do about this problem ?

A6.) If the change produces a need for including the cost of design, labor and materials for adding wood or steel columns, bearing walls, and associated foundations, the revised layout may not result in an overall savings to the owner. The Building Designer has the ultimate option of accepting or rejecting the proposed revisions, and should show this choice on the returned (disapproved) Truss Placement Plan.

3.2.4 Permanent bracing design for the structure, including the trusses, except as provided in Sections **3.4** and **6.2.12.**

Q7.) How does the Building Designer become responsible for permanent bracing for the wood roof/floor truss system? Isn ' t this the responsibility of the Truss Manufacturer ' s Truss Designer?

A7.) The overall building structure is the lawful responsibility of the State registered design professional, the Building Designer (A&E). The individual wood truss component design responsibility can be specifically delegated by the Building Designer to the Truss Designer, but the responsibility for overall truss permanent bracing remains with the Building Designer. The Building Designer is the only design professional fully knowledgeable about all of the aspects of the overall building design. Rows of lateral and/or diagonal bracing must be shown on the Building Designer ' s framing plan. Some guidance for permanent bracing is recommended in TPI ' s publication, *Handling, Installing and Bracing Metal Plate Connected Wood Trusses (HIB-91)*. Additional information on the design and installation of permanent bracing, written with the Building Designer in mind is reviewed in detail in the WTCA publication, *Commentary for Permanent Bracing of Metal Plate Connected Wood Trusses (P Brace).*

Note that if the roof/floor truss system was to be designed using steel bar joists, the steel or concrete deck, deck connectors, steel bar joists (designed by the joist manufacturer) and number of rows of bar joist bridging would be designed by the Building Designer for a complete steel framing system. Similarly, for wood construction, the wood sheathing, connectors, wood trusses (designed by a delegated truss engineer) and wood truss bracing, must be designed by the Building Designer for a complete wood truss system.

Q8.) Referring to **Section 3.4**, Who is responsible for the permanent lateral bracing to prevent buckling of individual truss members due to design loads?

The need for permanent lateral bracing or support for certain individual truss members (chords or webs) is determined by the Truss Designer, and is specified in detail on the individual truss component design drawings. This bracing is intended to prevent bowing or buckling of individual truss members under design loads and enables the truss component to perform as designed. Since this is part of the truss design process, these braces are carefully specified by the Truss Designer on the individual truss design drawings.

The Truss Designer must rely upon the Building Designer to specify how the lateral bracing ia to be anchored or restrained to prevent multiple identical members from buckling out of the plane of the trusses, at the same time. Permanent diagonal bracing at intervals in the plane of the braced member is one way to accomplish this restraint. Other methods are mentioned in **SECTION 3.4** and in (HIB-91) and (PBrace).

Some steel plate manufacturers offer patented steel alternatives to wood lateral bracing which can be furnished by the Truss Manufacturer and delivered with or attached to the truss components, for installation by the contractor as the trusses are erected. These alternative lateral braces are only part of the bracing and must be used in conjunction with wood diagonal bracing as described in (HIB-91).

3.2.5 The location, direction and magnitude of all dead and live loads applicable to each Truss including, but not limited to: roof, floor, partition, ceiling loads, insulation, suspended loads, concentrated loads, mechanical equipment loads, fire sprinkler, attic, storage, wind, snow drift, and seismic loads.

Q9.) On some complex roof/floor structural systems the Building Designer would spend many hours doing the truss designers ' job. What is the point of specifying pre-engineered wood trusses, if the Building Designer has to provide all the dead, live, snow , wind and seismic loadings ?

A9.) If the Building Designer is doing a proper job for his/her client, the above described loadings must be considered. The Building Designer, working with the Owner, determines the project conditions. The Building Designer is the only professional with adequate information to determine design loadings for the roof/floor trusses. This information must be shown on the roof/floor framing plans for the Truss Manufacturer ' s use. Once the loadings are known, the Truss Manufacturer ' s Truss Designer may

undertake the structural design of every truss component in the roof/floor system for all loads and combinations of loads as specified by the code.

Connectors between two or more wood members, all of which are designed or specified by the Truss Designer, should be designed by the Truss Designer and supplied by the Truss Manufacturer with the trusses. Connectors between two or more wood members, one or more of which are not designed or specified by the Truss Designer, should be designed or specified by the Building Designer. For instance, a wood truss connection to a concrete tie beam should be designed and specified by the Building Designer. A wood truss connection to a wood truss girder should be designed and specified by the Truss Designer. A wood truss connection to a wood load-bearing wall should be designed and specified by the Building Designer (assumes the wood bearing wall is designed by the Building Designer).

3.2.6 All Truss anchorage designs required to resist uplift, gravity, and lateral loads.

Q 10.) How does the Building Designer know these design values before the Truss Designer has completed individual truss component design drawings ?

A 10.) In most cases the Building Designer knows the design loadings as described above and may estimate anchorage requirements within acceptable tolerances. These values can be checked against the Truss Designer ' s more accurate reactions when submittals are received from the Contractor.

In other cases, the Building Designer may know Truss Manufacturers in the community who will be able to provide helpful information for estimating anchorage requirements.

3.2.7 Allowable vertical and horizontal deflection criteria.

Q 11.) Usually, the building code specifies allowable deflection. Why should the Building Designer specify anything other than the allowable deflections ?

A 11.) In many instances, the code allowable deflections are acceptable. However, the Building Designer is the only professional who may realize that the owner ' s floor and/or wall finishes (for instance, ceramic tile of marble) may require more stringent deflection limits, or that the owners are very sensitive to floor vibration, (bounce) in which case the Building Designer may specify more restrictive limits on deflection.

3.2.8 Proper transfer of design loads affecting the trusses.

Q 12.) The Building Designer may have wind or seismic loads to transfer from roof/floor systems into shear walls, transfer beams, portal frames, or drag beams. How does the Building Designer handle these conditions?

A 12.) If these kinds of lateral loads are to be transferred to the truss system, the loadings for each truss should be shown on the roof/floor framing plan. The Truss Designer has the capability to add these forces to the truss design and adjust individual truss members and their connectors accordingly, but the connections between the transferred load and the truss system should be designed by the Building Designer.

3.2.9 Adequate connections between Truss and non-Truss components, except as noted in Section **6.2.9**.

Q 13.) How does the Building Designer know which connectors will be designed by the Truss Manufacturer and which connectors will be designed by the Building Designer ?

A 13.) Truss-to-truss connections, truss-to-truss girder connections, ply-to-ply connectors for multi-ply truss girders, are all designed and specified by the Truss Designer. All truss to non-truss connectors (for instance, truss to bearing walls, truss to steel beams, truss to masonry) are designed and specified by the Building Designer.

3.3 The Building Designer is responsible to review and approve the Truss Placement Plan and each Truss Design Drawing for conformance with the requirements and intent of the Construction Design

Documents, the effect of each Truss Design Drawing and Truss Placement Plan on other parts of the structure, and the effect of the structure on each Truss.

Q 14.) Why is the Building Designer responsible for approval of the Truss Placement Plan and each Truss Design Drawing ? What does this approval mean ?

A 14.) Referring to **Section 3.3**, the Building Designer, or **Section 2.1**, the Building Owner, acting through his design professional (A&E), must review the Truss Placement Plan and each individual Truss Design Drawing for compliance with the intent of the Building Designer ' s framing plan, as part of the Construction Design Documents. The approval means the Building Designer or Building Owner approves the loadings used and the concept and intent of the truss submittals, but not the actual truss component designs.

This is only a part of the many overall approvals required by the Building Designer on behalf of the Owner. As the Building Owner ' s representative and primary design professional, the Building Designer (A&E) usually co-ordinates and approves all shop drawings and submittals received from the Contractor.

WTCA 1-1995 - Section 4.0 Contractor Responsibilities.

4.1 The Contractor must provide to the Truss Manufacturer the Construction Design Documents and all revisions and supplements thereto.

Q 15.) Why does the Contractor need so many copies of the A&E ' s drawings and specifications?

A 15.) The Contractor is responsiblefor coordinating the work of all sub-contractors and material suppliers, most of whom will require construction Design Documents for preparation of their respective drawings and submittals for approval before manufacturing or shipping products.

4.2 The Contractor has the responsibility to review and approve the Truss Placement Plan and each Truss Design Drawing for conformance with the requirements and intent of the Construction Design Documents, and the effect of the Truss Placement Plan and each Truss Design Drawing on other trades involved in the construction of the structure and the effect of the other trades on the Trusses.

Q 16.) Why does the Contractor have to approve the Truss Placement Plan, when the Building Designer is supposed to approve all shop drawings ?

A 16.) The Contractor is responsible for coordination of all trades and safety during construction. The Contractor is also responsible for all dimensions of the building under construction. Since the Trusses must be pre-fabricated to fit in specific places on the building, it is the Contractor ' s responsibility to verify the truss dimensions against the Construction Design Documents and the actual field conditions. Field conditions may dictate dimensional changes or adjustments which must be passed on to those suppliers or subcontractors affected.

4.3 The Contractor has the responsibility to coordinate the review, approval and return of each Truss Design Drawing and Truss Placement Plan by the Building Designer.

Q 17.) Why does the Contractor have to coordinate these items when they could be managed by the Building Designer ?

A 17.) The Contractor has the responsibility to coordinate everything on the job site. It is custom and practice in the construction industry for the Prime or General Contractor to coordinate the approval and return of all shop drawings or product submittals for the project.

4.4 The Contractor has the responsibility to provide the approved Truss Design Drawings, approved Truss Placement Plans and any supplemental information provided by the Truss Manufacturer to the individual or organization responsible for the installation of the Trusses (sub-contractor, if any).

4.5 The Contractor has the responsibility to comply with the field storage, handling, installation, permanent bracing, anchorage, connections and field assembly requirements of the Construction Design Documents.

4.6 It is the Contractor ' s responsibility to determine and install the temporary bracing for the structure, including the Trusses.

Q 18.) Are not items **4.4, 4.5, 4.6,** the Contractor ' s responsibility on any project involving wood trusses?

A 18.) Yes, it is the Contractor ' s responsibility to coordinate the activities and safety of all workmen, sub-contractors, and material suppliers on the project. It is essential that the truss erector has current approved Truss Placement Plans for the proper installation of the trusses. The Contractor should see that the trusses are properly received, stored, handled and erected. Proper installation requires adequate and properly placed temporary bracing. The Contractor should use no less than the temporary bracing recommendations which are described in HIB-91.

Some steel plate manufacturers offer patented steel alternatives to wood lateral bracing which can be furnished by the Truss Manufacturer and delivered with or attached to the truss components for installation by the Contractor as the trusses are erected, in conjunction with wood diagonal and cross bracing as described in HIB-91.

WTCA 1 - 1995 - Section 5.0 Truss Manufacturer Responsibilities.

5.1 The Truss Manufacturer must communicate the design criteria from the Construction Design Documents to the Truss Designer.

5.2 Where required by the Construction Design Documents, the Truss Manufacturer must prepare the Truss Placement Plan, providing as a minimum the location assumed for each Truss based on the Truss Manufacturer ' s interpretation of the Construction Design Documents.

5.3 The Truss Manufacturer must submit to the Contractor the Truss Placement Plan, as may be required and each Truss Design Drawing for review and approval.

Q 19.) As the Building Designer, how do I know which of the many Truss Manufacturers in my area received the contract to furnish pre-engineered wood trusses to my project, and how do I know the choice was a good one?

A 19.) Most Building Designers are called upon by sales representatives of many local truss manufacturers. The choice of Truss Manufacturer is usually up to the Contractor, without seeking approval by the Building Designer or Owner. The selected Truss Manufacturer obtains copies of the Construction Design Documents (plans and specifications) which becomes the basis for the Truss Placement Plan and individual truss designs for each truss. Some communication by telephone between the Truss Designer and the Building Designer usually occurs before the submittals are completed. Upon receipt of the Truss Manufacturer ' s package of submittals from the Contractor, the Building Designer can make a value judgement upon the selection of Truss Manufacturer. The review and approval (or rejection) of the Truss Manufacturer ' s submittal package, will usually indicate the competency of the Truss Manufacturer and the Truss Designer.

5.4 The Truss Manufacturer must manufacture the Trusses in accordance with the final approved Truss Design Drawings using the quality criteria for Metal Plate Connected Wood Trusses established by the ANSI/TPI 1-1995 *" National Design Standard for Metal Plate Connected Wood Truss Construction. "*

Q 20.) Why doesn ' t the Truss Manufacturer show the permanent truss system bracing on the Truss Placement Plan ?

A 20.) The permanent bracing for wood trusses is part of the Building Designer ' s structural design and should be shown on the Construction Design Documents. Some guidance for the Building Designer in design of permanent bracing is presented in the WTCA publication *" Commentary for Permanent Bracing of Metal Plate Connected Wood Trusses "* (WTCA - P Brace). The Truss Placement Plan, however, is a non-engineered product that simply shows where each individual truss component must be placed. It is not a substitute for the Building Designer ' s framing plan. The Contractor must install the trusses

according to the Truss Placement Plan by the Truss Manufacturer and install the permanent bracing according to the Building Designer ' s framing plan. Temporary bracing, during the erection process, should be installed as needed by the Contractor, in accordance with the recommendations of HIB-91. It is possible, in many cases, to arrange the temporary bracing so that it may be left in place as permanent bracing.

WTCA 1 - 1995 - Section 6.0 Truss Designer Responsibilities

6.1 The Truss Designer must prepare the Truss Design Drawings in conformance with the requirements set forth in the latest approved edition of ANSI/TPI 1-1995 *" National Design Standard for Metal Plate Connected Wood Truss Construction. "*

The design loadings described below (in **6.2.4**) should be determined by the Building Designer and shown on the Construction Design Documents. Every wood truss will have some, but not necessarily all, of the loads shown below. The Truss Design Drawings then become a reflection of the Building Designer ' s intent, but the drawings must be reviewed and approved by the Building Designer before the trusses are manufactured. The physical size and shapes of the trusses which will conform to the intent of the Construction Design Documents, is the responsibility of the Truss Designer.

6.2 For each Truss Design Drawing, the Truss Designer must set forth as a minimum the information described below:

6.2.1. Slope or depth, span and spacing;

6.2.2. Location of all joints;

6.2.3. Required bearing widths;

6.2.4. Design loadings as applicable:

6.2.4.1 Top chord live load (including snow loads);

6.2.4.2. Top chord dead load;

6.2.4.3. Bottom chord live load;

6.2.4.4. Bottom chord dead load;

6.2.4.5. Concentrated loads and their points of application, and

6.2.4.6. Controlling wind and earthquake loads;

6.2.5. Adjustments to lumber and metal connector plate design values for conditions of use;

6.2.6. Each reaction force and direction:

6.2.7. Metal connector plate type, size, thickness or gage, and the dimensioned location of each metal connector plate except where symmetrically located relative to the joint interface;

6.2.8. Lumber size, species and grade for each member;

6.2.9. Connection requirements for:

(a) Truss to Truss girder;

(b) Truss ply to ply connection for multiply trusses;

(c) Field splices;

6.2.10. Maximum axial compression forces in the Truss member to enable the Building Designer to

design the size, connections and anchorage of the permanent continuous lateral bracing. Forces may be shown on the Truss Design Drawing or on supplemental documents; and

6.2.12. Required permanent Truss member bracing location.

All of the items listed in SECTION 6.0 are subject to acceptance and approval by the Building Designer prior to manufacturing. Changes in loadings or other conditions after the approval process, may result in cost revisions. Overall approvals by the Building Designer before manufacturing are essential for proper project progress.

7.0 Other Responsibilities

7.1 Any party who cuts or damages a truss shall be responsible for securing the engineering required for the repair and for subsequent costs.

END

References:

1. Wood Truss Council of America. 1995. - Standard Responsibilities in the Design Process Involving Metal Plate Connected Wood Trusses (WTCA 1-1995).

2. American National Standard - Truss Plate Institute, Inc. 1995. - National Design Standard for Metal Plate Connected Wood Truss Construction (ANSI/TPI 1-1995).

3. Wood Truss Council of America, 1999. - Commentary for Permanent Bracing of Metal Plate Connected Wood Trusses. (WTCA - P Brace).

4. Truss Plate Institute, Inc. 1991. - Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses (HIB-91).

5. Truss Plate Institute, Inc. 1991. - HIB-91 Summary Sheet - Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses (HIB-91 S).

6. Truss Plate Institute, Inc. 1989. - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses (DSB-89).

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