Standard Design Responsibilities – Wood Trusses and Engineered Lumber

An Overview of Methods to Help Provide Safer Buildings and Jobsites
Introduction

This program will discuss:

1. Standard Design Responsibilities and Authority
2. Documents
3. Techniques and Methods of Bracing Metal Plate Connected Wood Trusses
Part 1: Design Responsibilities

- Determined By:
  - Industry Agency Standards:
    - ANSI (American National Standards)
    - TPI (Truss Plate Institute)
    - SBCA (Structural Building Component Association) (Formerly WTCA)
  - Project Specifications From the Building Designer
What Are The Standards?

- TPI Standards are often referenced as a “blanket” metal plate connected truss specification.

ANSI/TPI 1-2007 Chapter 2
What Are The Standards?

TPI Standards are often referenced as a “blanket” structural wood product specifications

What do they say?
Both Standard Documents, in part,
Define the Building Designer, The Truss Manufacturer, and the Erecting Contractor
And
The Responsibilities of Each party.

- They are BY REFERENCE, included in the Codes
Who Are These People?

According to ANSI/TPI 1-2007

- **Building Designer**: “The OWNER shall engage a Registered Design Professional (RDP) /Building Designer to Prepare the Construction Documents. In the absence of a mandate to use an independent RDP/Building Designer, the Owner shall assume the role of Building Designer.” (Section 2.2)
Who Are These People?

According to ANSI/TPI 1-2007

- **Contractor**: “The OWNER shall engage a Contractor to store, handle and install the Trusses for the building in compliance with any and all Legal Requirements”. (Section 2.3)
- **Requirements of the Contactor** (Section 5.0)
Who Are These People?

According to ANSI/TPI 1-2002

- **Truss Designer**: “The individual or organization responsible for the design of Trusses.” (Section 6.0)

- **Truss Manufacturer**: “An individual or organization engaged in the manufacturing of Trusses.” (Section 7.0)
What are the Standards?

- ANSI / TPI 1 –2007: Chapter 2
  - Differentiates between the responsibilities of the **BUILDING DESIGNER**:
    - Overall loads
    - Permanent Bracing
    - Load Transfer
  - The **TRUSS MANUFACTURER**:
    - Component design and Fabrication
    - Compression Member (anti-buckling) Bracing (now called “RESTRAINT”) requirements
    - Product Labeling
  - The **CONTRACTOR**:
    - Installation **including** handling and temporary bracing.
What are the Standards For Documents?

ANSI / TPI 1-2007

- Section 6.0 through 6.6 Covers Design Drawing Requirements and “Seal” requirements.
  - Sealed Cover Sheet (sec. 6.3)
  - Truss Placement Diagram “When the Truss Placement Diagram serves only as a guide for Truss Installation, it does not require the seal of the Truss Design Engineer” (sec. 6.4) emphasis added

- DOES NOT OVERRULE SPECIFICATION
What are the Standards For Documents?

ANSI / TPI 1-2007

- Section 7.0 through 7.12 Cover Truss Manufacturer Requirements
  - Truss Placement Diagram: “When the Truss Placement Diagram serves only as a guide for Truss Installation, it does not require the seal of the Truss Design Engineer or RDP” (sec. 7.4) emphasis added
  - In-Plant Truss Inspections: (IBC Chapter 17 “Special Inspections” (Sec. 7.11)
- DOES NOT OVERRULE SPECIFICATION (Section 8.0)
What are the Standards For Documents?

ANSI / TPI 1-2007

- These Standards should also apply to Engineered Wood Products (EWP)
  - **Except** In-Plant Truss Inspections: (IBC Chapter 17 “Special Inspections” (Sec. 7.11) EWP Materials: LVL, I-Joists, etc. are *Manufactured Products* and require ES approvals to meet Code Requirements.
- **DOES NOT OVERRULE SPECIFICATION** (Section 8.0)
Document Requirements:

- TPI/ANSI 1-2007 Section 6.5 and IRC 1603
- Very Important to check:
  - Job Name and Location
  - Loads and Code Used
  - Plate Manufacturer and Product Fabricator
  - Lateral Web Restraint
  - Plate Location and size
  - Connections
  - Bearing Size
  - Number of Plies
SAMPLE ROOF SHOP DRAWING

SAMPLE ROOF SHOP DRAWING KEY

1. Unique number assigned to each job
2. Three digit truss label
3. Quantity of trusses with this label
4. Files of the truss type; one unless a girder truss
5. Top chord dimensions accumulative along top (dimensions are in feet-inches-sixteenths)
6. Top chord dimension of each overhang, panel point, or pitch break (dimensions are in feet-inches-sixteenths)
7. Metal connector plate size and slot orientation
8. Pitch or slope
9. Vertical height excluding overhang (dimensions are in feet-inches-sixteenths)
10. Heel height (dimensions are in feet-inches-sixteenths)
11. Joint numbers
12. Bottom chord dimensions accumulative along top (dimensions are in feet-inches-sixteenths)
13. Bottom chord dimension of each bearing location, panel point, or pitch break (dimensions are in feet-inches-sixteenths)
14. Loading in pounds per square foot broken down into top chord live and dead loads (TCLL & TCDL) and bottom chord live and dead loads (BCLL & BCDL)
15. Spacing (in feet-inches-sixteenths) building codes and allowable increases
16. Top chord, bottom chord & web Combined Stress Index
17. Live load and total load deflection
18. Lumber sizes and grades
19. Bracing requirements see HLB-01 for additional requirements
20. Reactions at specified joints and bearing size (in feet-inches-sixteenths)
21. Loading in addition to what appears in the loading box
## LOADS

Analyzing for a Joint Member
Primary Load Group - Residential - Living Areas (psf): 40.0 Live at 100% Duration, 10.0 Dead

<table>
<thead>
<tr>
<th>Type</th>
<th>Class</th>
<th>Live</th>
<th>Dead</th>
<th>Location</th>
<th>Application</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point load</td>
<td>Snow</td>
<td>200</td>
<td>100</td>
<td>0</td>
<td>POINT LOAD FROM ROOF</td>
<td></td>
</tr>
<tr>
<td>Point load</td>
<td>Floor</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>EXTERIOR WALL DEAD LOAD</td>
<td></td>
</tr>
</tbody>
</table>

### SUPPORTS

<table>
<thead>
<tr>
<th>Input Width</th>
<th>Deadening Length</th>
<th>Vertical Resilience (H)</th>
<th>Ply</th>
<th>Depth</th>
<th>Rolling Depth</th>
<th>Detail</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.50&quot;</td>
<td>3.50&quot;</td>
<td>1000 / 1200 / 1400</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>3.50&quot;</td>
<td>3.50&quot;</td>
<td>1960 / 1790 / 1810</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

- See TJ SPECIFIERS/Builders Guide for details
- H: Face Mount Hanger; E: Blocking

### HANGERS: Simpson Strong-Tie Connectors

<table>
<thead>
<tr>
<th>Support</th>
<th>Model</th>
<th>Slope</th>
<th>Slope</th>
<th>Reverse Flanges</th>
<th>Top Flange</th>
<th>Top Flange</th>
<th>Support Wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RTJ</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>0.12</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- Nailing for Support 1: Face: 10-10d, Top L: 10d, Member: 1-6d

### HOLE SIZES

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Height</th>
<th>Width</th>
<th>Left End To Top Hole Center</th>
<th>Span</th>
<th>Design Load</th>
<th>Control</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>8&quot;</td>
<td>10'</td>
<td>8&quot;</td>
<td>8'</td>
<td>Span1</td>
<td>220 lb</td>
<td>80 lb</td>
<td>Passed (31.5%)</td>
</tr>
</tbody>
</table>

### PROJECT INFORMATION

- Operator Information:
  - Wood Structures Inc.
  - 120 Pierpont Ave.
  - Saratoga, CA 95336
  - Phone: 800-442-2420
  - Fax: 800-442-2420

- Copyright © 2008 JHBartlett, a Weyerhaeuser Business

- Additional contact information: Weyerhaeuser, 1000 Elwell, Monroe, WA 98272

- Additional note: This product meets or exceeds the set design controls for the application and loads listed.
Placement (installation/location) drawings do not require “seals” by the truss designer. (see IBC 2304.4.1.3) “Truss placement diagrams shall not be required to bear the seal or signature of the truss designer”.

Sealing of work not performed or directly supervised may be a violation of the Law because the installation (placement) drawings are typically produced by technicians employed by the fabricator.
Load Requirements:

- **Come From Codes**
  - **Live Loads:**
    - Based on Use
    - Location
    - Building Shape
  - **Dead loads:**
    - Developed from construction Materials
    - Foreseeable Future Changes
Load Requirements:

- Live Load requirements should not change with construction types!
  - “stick” frame must carry the same loads as TRUSSES or ENGINEERED LUMBER
  - INCLUDING UNBALANCED
DETERMINATION OF LOAD IS THE RESPONSIBILITY OF THE BUILDING DESIGNER

- Code Officer must confirm that the loads specified by the Building Designer Meet Code Minimums!
- Truss Manufacturer must build product to meet the specification requested by the BUYER.
- Engineered Lumber Dealer must supply products ordered by the BUYER.
Wind Load Requirements are Important!
As are Snow Loads!
No, Indeed. Snow Loads are Nothing to Guess at!
Code Requirements:

- Know your Code!
- Know the differences between Ground Snow (Pg) and Flat Roof Snow (Pf)
- Are you going to enforce unbalanced (per ASCE 7) or Require Ground load as NET on roof (as IRC)?
- Know the wind load Requirements!
Code Requirements:

- Know your Town
- Does it fit in the Prescriptives of the IRC?
- Know the elevation and exposure
- Know the wind load Requirements!
Calculations

- Adjustments for:
  - Elevation – 2.1lbs/100ft to 2500
  - Ground to roof generally .70
  - Exposure
  - Thermal
  - Importance
To assist the Building Designer in the determination of appropriate roof snow loads, the following worksheet is suggested:

- **LOCAL GROUND SNOW LOAD (Pg):** From Code or Case Study
  - Adjustment for Roof (Pf) $\times 0.70$
  - Adjustment for Exposure (Ce) from chart (0.8 to 1.3) $\times ___$
  - Adjustment for Thermal (Ct) from chart (0.85 to 1.2) $\times ___$
  - Adjustment for Importance (Ci) from chart (0.8 to 1.2) $\times ___$

- Net Uniform Roof Loading: (Pf) $\square$

- Drift and Unbalanced Areas (Describe areas and additional loads) $\square$
- Attic Floor Loading (Describe Area and uniform loads) $\square$
- Rooftop Mechanical Loads (Describe location and load) $\square$
# Exposure Adjustments (Ce)

<table>
<thead>
<tr>
<th>Exposure:</th>
<th>Fully Exposed</th>
<th>Partially Exposed</th>
<th>Sheltered</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A.</strong> Large City Centers with at least half the buildings over 70 feet in height</td>
<td>N/A</td>
<td>1.1</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>B.</strong> Urban and suburban areas, wooded areas and other terrain with closely spaced objects having the size of single family dwellings or larger</td>
<td>0.9</td>
<td>1.0</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>C.</strong> Open Terrain with scattered obstructions having heights less than 30 ft. (flat open country)</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>D.</strong> Category C exposed to wind flowing over open water for at least 1 mile.</td>
<td>0.8</td>
<td>0.9</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- **Fully Exposed:** Roofs exposed on all sides with no shelter from terrain, higher structures or trees.
- **Partially Exposed:** All other roofs.
- **Sheltered:** Roofs located tight among conifers.
# Thermal Factor (Ct)

<table>
<thead>
<tr>
<th>Thermal Factor (Ct)</th>
<th>Ct</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Structures Except Those Listed Below</td>
<td>1.0</td>
</tr>
<tr>
<td>Structures kept just above freezing and those with cold, ventilated roofs with R 25 between heated and ventilated spaces (Typical Residential Construction)</td>
<td>1.1</td>
</tr>
<tr>
<td>Unheated and those structures deliberately kept below freezing</td>
<td>1.2</td>
</tr>
<tr>
<td>Heated structures with R 2 or less (Greenhouses, etc.)</td>
<td>0.85</td>
</tr>
</tbody>
</table>
## Importance Factor (Ci)

<table>
<thead>
<tr>
<th>Importance Factor</th>
<th>(Ci)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Buildings Representing low hazards to human life: Agricultural, Unoccupied, Storage, etc.</td>
<td>0.8</td>
</tr>
<tr>
<td>II All Buildings except those listed in Category I, III, and IV</td>
<td>1.0</td>
</tr>
<tr>
<td>III Buildings representing a major hazard in the event of failure; asmbly areas, schools, etc.</td>
<td>1.1</td>
</tr>
<tr>
<td>IV Buildings and other structures designated as essential facilities.</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Wind Speed

**Figure 9.26--continued**

**BASIC WIND SPEEDS FOR 10-YEAR MEAN RECURRANCE INTERVAL**

(continued)

- Values are essential design 3-second gust wind speeds in miles per hour at 35 feet above ground for Exposure C category.
- Linear interpolation between wind contours is permitted.
- Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
- Mountainous terrains, gorges, ocean promontories and special wind regions shall be examined for severe wind conditions.
Part 3: Bracing and Handling

- Keeping the Jobsite Safe During Installation
- Keeping the Product Undamaged
- Installing the Product so it Performs as Designed
Bracing Types: Standard Responsibilities

- Compression Member Bracing (Now called Restraint)
  - By Truss Designer*
- Temporary (Installation) Bracing
  - By Building Designer* and Truss Installer* (Contractor)
- Permanent Bracing
  - By Building Designer*

* May be redesignated by Specification
Bracing Types:

- **Member Restraint** (formerly called Compression Member Bracing):
  - Holds members in proper alignment relative to forces within the member.
  - Should include web bracing and chord bracing of all compressive members.
  - Is part of the COMPONENT DESIGN.
  - May be minimized or eliminated by careful choice of grade, species and size of webs and chord members.
  - Will be shown and noted on design drawings by truss designer.
IMPORTANT BRACING INFORMATION

TO: ERECTOR/BUILDERS
FROM: WOOD STRUCTURES INC.
SUBJECT: CONTINUOUS LATERAL BRACING

Permanent Continuous Lateral Bracing is an integral part of your roof system. It is imperative that you study the enclosed drawings, as they clearly show which truss members require continuous lateral bracing and at what locations on your truss drawings.

Failure to install permanent continuous bracing can reduce the effective load carrying capacity of your roof system by as much as 80%.

Notes:
1) Continuous lateral brace must lap a minimum of two trusses.
2) Lateral brace must be restrained at each end of the building.
3) Bottom chord bracing is required at 10’ - 0” O.C. minimum.
4) Lateral brace may be attached at either side of specified web.
Dramatically reduce truss installation costs.
Eliminate some altogether!

Reduce Costs of...
- Truss installation by 45%
- Crane time & expense by 35%
- Temporary bracing lumber by over 67%
- Time spent hoisting up temporary bracing by over 67%

Eliminate Altogether...
- Time spent cutting temporary bracing lumber
- Time spent de-nailing (or disposing of) temporary bracing lumber
- Time spent tearing down temporary lateral bracing

All you need is the right tool.

The STABILIZER® spaces & braces in one step with just a hammer
16" & 24" STABILIZER® Available

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**ALTERNATIVE BRACING INFORMATION**

Trusses in some roof systems (E: hip ends) are not conducive to installation of lateral bracing. As an alternative in these special cases, installation of "T" bracing is recommended. "T" bracing is, however, an alternative and should only be used in these special cases and is not intended to be used in lieu of an achievable lateral bracing system.

**"T" BRACING CHART**

<table>
<thead>
<tr>
<th>Ply of Truss</th>
<th>Lateral Bracing Required</th>
<th>Replace With</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 ROW</td>
<td>2 X 4 &quot;T&quot; Brace</td>
</tr>
<tr>
<td>1</td>
<td>2 ROWS</td>
<td>2 X 6 &quot;T&quot; Brace</td>
</tr>
<tr>
<td>2</td>
<td>1 ROW</td>
<td>2 x 8 &quot;T&quot; Brace</td>
</tr>
<tr>
<td>3</td>
<td>2 ROWS</td>
<td>2 x 8 &quot;T&quot; Brace</td>
</tr>
<tr>
<td>4</td>
<td>1 ROW</td>
<td>2 x 8 &quot;T&quot; Brace</td>
</tr>
<tr>
<td>4</td>
<td>2 ROWS</td>
<td>2 x 8 &quot;T&quot; Brace</td>
</tr>
</tbody>
</table>

"T" brace must be the maximum length achievable without causing damage to Joint connector plates.
**Bracing Types:**

- **Temporary Bracing:**
  - Provides stability for the individual components until whole system is erected.
  - Prevents Dangerous Toppling.
  - Suggested techniques in BCSI
  - For jobs up to **60’**. *See section 2.5 of TPI/ANSI 1-2007*
  - Must hold components **PLUMB**.
  - Must brace compression members.
  - 2 X 4 lumber or Proprietary Steel Bracing should be minimum.
Bracing Types:

- Permanent Bracing:
  - Holds components in proper position relative to other parts of the structure.
  - Is part of overall lateral load transfer system (wind, seismic, etc.) of the building.
  - Anchors compressive member bracing.
  - Includes ceiling plane, roof plane, and sectional plane perpendicular to the components within the trusses, and all planes below.
Handling is Important, Too! Both to avoid damage and personal injury.
Contents of BCSI

B1 – Handling, Installation, Restraining and Bracing of Trusses
B2 – Truss Installation and Temporary Restraint/Bracing
B3 – Permanent Restraint/Bracing of Chords and Web Members
B4 – Construction Loading
B5 – Truss Damage, Jobsite Modifications and Installation Errors
B6 – Reserved
B7 – Temporary and Permanent Restraint/Bracing of Parallel Chord Trusses
B8 – Using Toe-nailed Connections to Attach Trusses at Bearing Locations
B9 – Multi-Ply Trusses
B10 – Post Frame Truss Installation & Temporary Restraint/Bracing
B11 – Fall Protection and Trusses
Tips for Safer, Better Braced Projects:

- Follow the Standards from TPI, ANSI and SBCA
- **Or:** Specify Responsibilities in Project Documents – *and enforce them onsite.*
- **Most of All:**
  - *Encourage Communication between all parties:*
    - Owner
    - Design Team
    - Truss Supplier
    - Contractor and Framer
Tips for the Inspector:

★ Make sure the Documents are correct:
Correct Product at the correct Job and product Design matches the drawings
★ Make sure the products are placed and braced correctly
★ Look for Damage caused by poor handling or by subcontractors
★ Look for the TPI (or other) inspected plant certification on trusses, ES number on EWP
Questions?
Thank You