Foreword

"The only limit to the use of truss construction is one's imagination."

Since the 1950s when the modern metal plate connected wood truss—known more simply as a "truss"—was first manufactured, its use in construction has increased tremendously due to significant savings of time and money. Trusses have the additional advantage of superior engineering when compared to conventional "stick" framing techniques.

The story of the truss, as part of the roof or floor of a home or commercial structure, begins in the imagination of the building designer as he/she prepares the construction design documents for the project. It continues when the contractor provides the truss manufacturer with a set of the construction design drawings, and the truss manufacturer communicates the design criteria from these drawings to the truss designer. The truss designer takes this information and designs the truss using sophisticated software created specifically for that purpose. The resulting truss design drawings provide the truss manufacturer with the information necessary to select the required grade and species of lumber and cut it to exact sizes and shapes, select truss plates of specified sizes, and arrange these pieces on the truss manufacturer's jig table. Once the plates have been pressed into the lumber, the completed truss is delivered to the jobsite where it is hoisted by the contractor onto the bearing walls and braced securely in place. After the sheathing and any other permanent bracing is applied, the truss begins its job supporting the loads applied to it, efficiently transferring these loads to the walls and beams that support it.

The truss industry sells more than $4 billion worth of trusses each year. Today, trusses are used in 58% of new residential roofs, 8% of residential floors, 71% of multi-family roofs, and 26% of multi-family floors. The truss industry's market share levels will continue to increase, due to economic efficiency of trusses and their ability to be creatively designed for a variety of complex load and span conditions.

As there are many professionals who work with trusses beyond those who manufacture them, contained herein is information to assist architects, engineers, builders, building trades, building officials, fire officials and others in the effective, economical and safe use of trusses.

This document contains general information about trusses, and is not intended to take the place of professional architectural, or engineering services. Further information on issues discussed in this document can be found in the *Metal Plate Connected Wood Truss Handbook*, also available from The Wood Truss Council of America (WTCA). Individuals are encouraged to contact WTCA with any questions they have regarding this document or wood trusses.

WTCA's Mission

WTCA is committed to promoting the common interests of all engaged in the manufacture of wood trusses and related components to ensure growth, continuity and increased professionalism in our industry. Fundamental to this is promoting the safe, economic and structurally sound use of trusses in all applications.

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Cover photos taken from WTCA's
Framing the American Dream® II
project, which highlighted the many creative uses of trusses and wall panels.

Phase I: Building Design

As the name implies, the Building Designer is responsible for the structural design of a building, including specifying structural member sizing and location, load transfer, building profiles, anchorage and connections, etc. See WTCA 1-1995, *Standard Responsibilities in the Design Process Involving Metal Plate Connected Wood Trusses*, for more information.

Design Loads

Load is defined as a force or other actions that arise on structural systems from the weight of all permanent construction, occupants and their possessions, environmental effects, differential settlement and restrained dimensional changes.

The building designer must specify both live and dead loads to ensure trusses are designed properly. Minimum live load requirements are included in the building codes, varying by location and use. Standard design for wood trusses assumes a uniform distribution of loads applied to the top and bottom chords. Each truss design drawing depicts the design loads to which the truss has been designed. The loads specified in a design should always be checked for accuracy. Loads are usually described in terms of pounds per square foot (psf).

Dead Load

Dead load is defined as the gravity load due to all permanent structural and nonstructural components of a structure, such as the truss itself, walls, floors, roofs, interior partitions, stairways, and fixed service equipment.

Unit dead loads are specified by the building designer. In the absence of specified loads, unit loads can be determined from the actual weights of specified materials.

Live Load

Live load is defined as the load superimposed by the use and occupancy of the building or structure including impact, but not including dead load or environmental loads such as wind load, snow load, or earthquake (seismic) load.

Concentrated Load

If a truss will be supporting significant concentrated loads such as air conditioning units, sprinklers, etc., the weight and placement of these loads must be set forth in the construction design documents so they can be taken into account in the truss design.

Snow Load

Roof snow loads are vertical loads induced by the weight of snow, assumed to act on the horizontal projected length on the roof of the structure.

Wind Load

Wind loads are those lateral loads placed on the entire structure due to wind pressure and suction, considered more frequently in coastal areas and/or in structures with high pitched roofs.

Impact Load

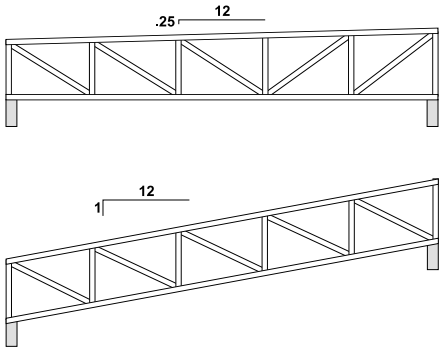
Impact loads result from moving machinery, elevators, crane-ways, vehicles or other similar forces and kinetic loads.

Earthquake (Seismic) Load

Seismic loads are those lateral loads placed on the entire structure due to ground movements during a seismic event.

Roof Ponding

Ponding occurs when water is not able to drain from a flat roof, may cause excessive deflection in the roof trusses. Proper draining must be designed into the roof structure by the building designer to avoid this phenomenon, by way of a slight slope to the roof trusses, as shown below, or other drainage.



Two configurations of roof trusses designed to eliminate ponding on flat roofs.

Weight of Construction Materials: Roof, Ceiling & Floor

CONSTRUCTION MATERIAL	WEIGHT (psf)
Composition Roofing	
3-15 and 1-90 lb.	2.2
Fir Sheathing (Based on 36 pcf)	
Plywood:	
3/8"	1.1
1/2"	1.5
5/8"	1.8
3/4"	2.3
11/8"	3.4
Decking:	
2"	4.3
OSB:	
1/2"	1.7
5/8"	2.0
3/4"	2.5
Miscellaneous Decking Materials	
Vermiculite Concrete (1" thick)	2.6
Corrugated Galvanized Steel:	
20 gal.	1.8
22 gal.	1.5
Asphalt shingles	2.5
Wood Shingles	2.0
Clay Tile	9.0 - 14.0
Floors	
Linoleum or Soft Tile	1.5
3/4" Ceramic or Quarry Tile	10.0
GYP-CRETE (3/4")	6.5
Ceilings	
Acoustical Fiber Tile	1.0
1/2" Gypsum Board	2.2
5/8" Gypsum Board	2.8
Plaster (1" thick)	8.0
Metal Suspension System (incl. tile)	1.8
Wood Suspension System (incl. tile)	2.5

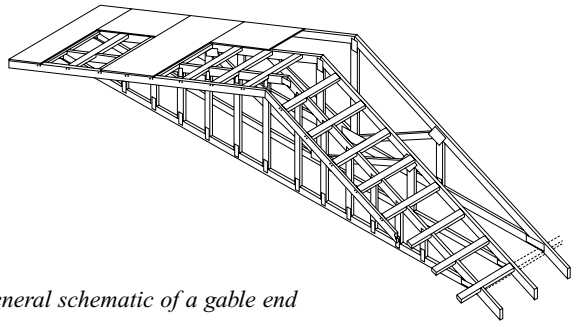
We suggest the addition of 1.5 psf for miscellaneous dead loads. Refer to local building code for live load design requirements.

Trusses in Roof Systems

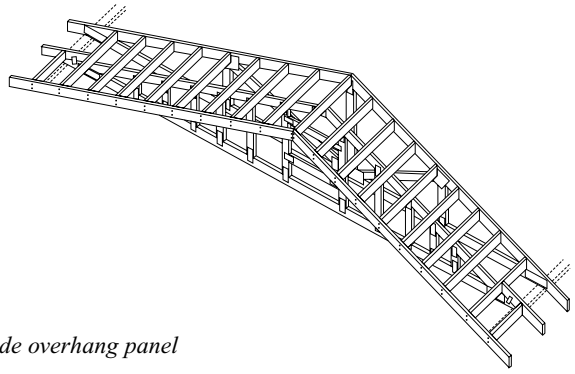
There are several significant advantages to using trusses in roofs: 1) all the engineering is done before construction, ensuring proper flow of loads through the building; 2) it is easier to create hip, valley or more complex roof systems; and 3) money is saved by reducing installation time. This section outlines several different roof systems that utilize trusses.

Gable-End Truss Systems

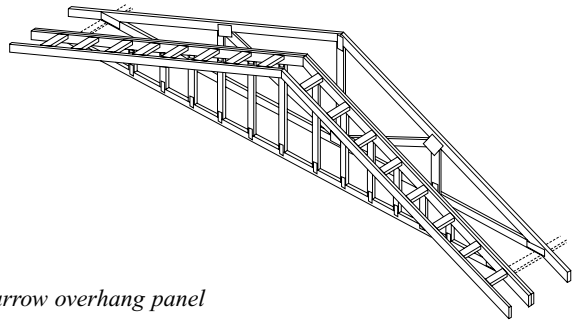
Generally, gable ends are not designed as structural trusses when there is a continuous bearing wall beneath them. The web design or framing pattern is determined by the type of siding—either horizontal or vertical—and the need for a louver in the end of the building. The type of gable required is controlled by the amount of end overhang and the need to match a soffit line. Shown below are three examples of gable end systems, provided courtesy of Alpine Engineered Products, Pompano Beach, Florida.



General schematic of a gable end

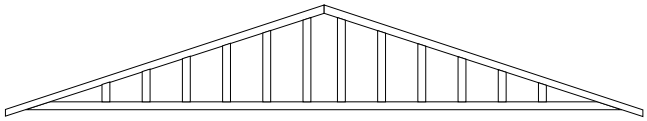


Wide overhang panel

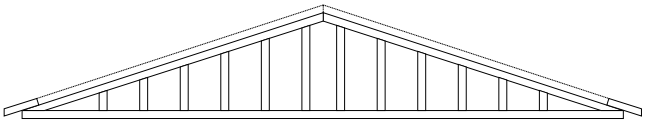


Narrow overhang panel

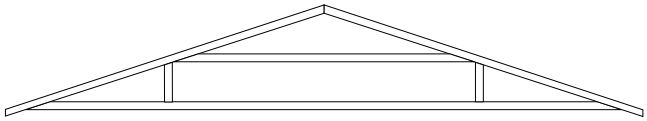
Shown below are a few examples of gable-end trusses. Please note plates are not shown for clarity.



Typical Gable-End Truss



Drop Top Gable-End Truss



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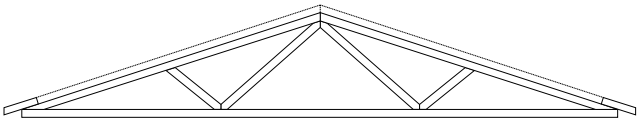
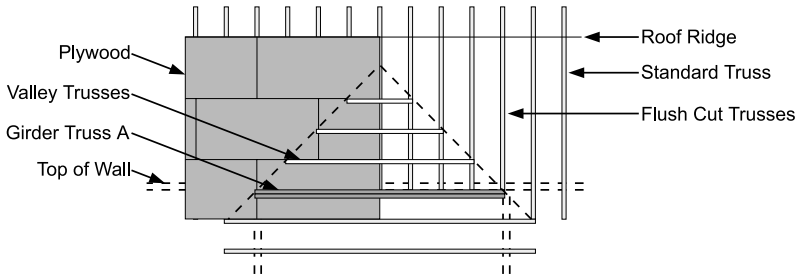


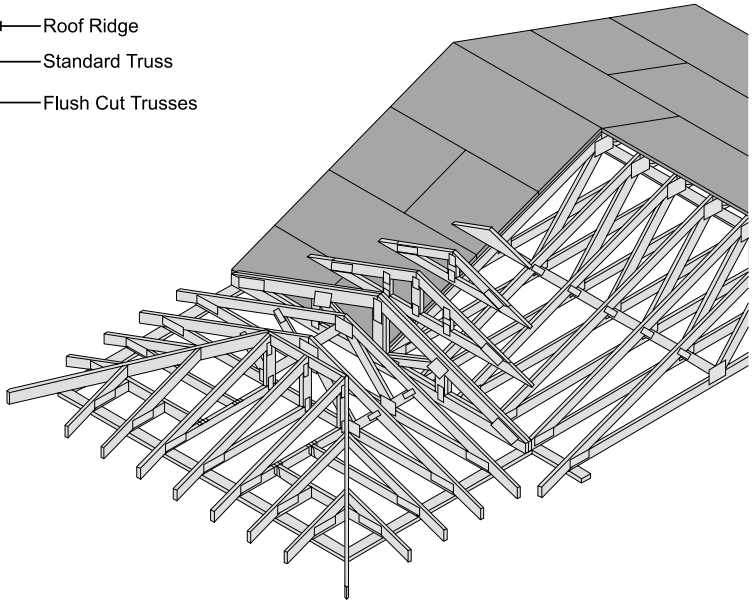
Typical Fink, Storage

Girder and Valley Truss Systems

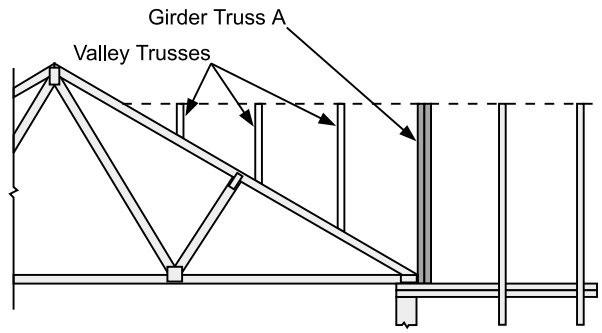
The girder truss is used to eliminate an interior load bearing partition on L, T, U and H-shaped houses by supporting the plumb-cut end of the main roof trusses at the intersection of the two roofs. Valley truss members are set on top of the existing main roof trusses to form the ridge line and connect the two roof structures together.



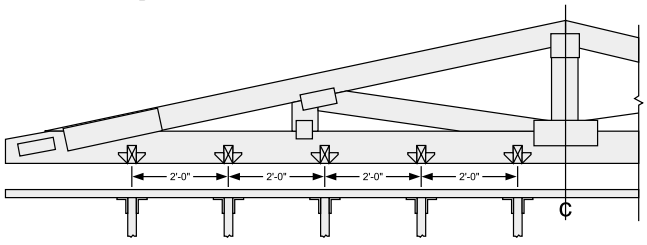
Plan view



Valley truss system. Provided courtesy of Alpine Engineered Products, Pompano Beach, Florida.



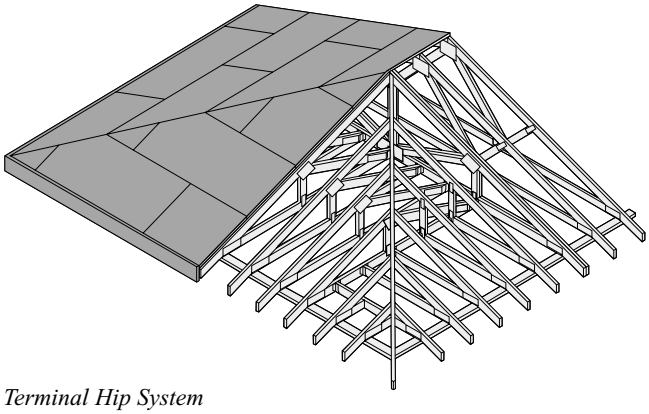
Side view



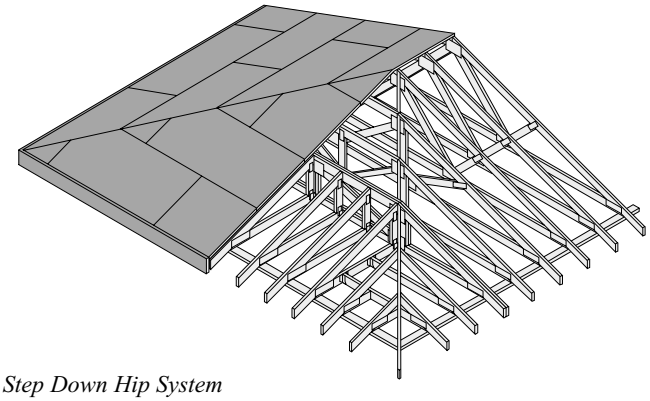
Side view of Girder Truss A. Also shows the connections of common trusses to the girder truss.

Hip Truss Systems

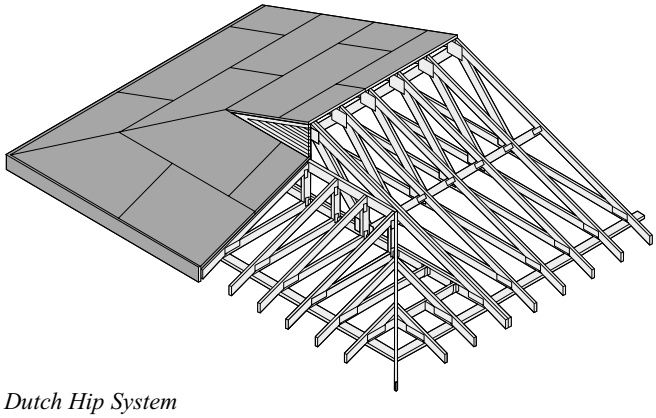
The hip roof affords symmetry of architectural appearance. The eave line extends around all sides of the building and eliminates the use of gable ends. Manufacture and detailing of all the hip truss parts aids in speed of field construction. Graphics below are provided courtesy of Alpine Engineered Products, Pompano Beach, Florida.



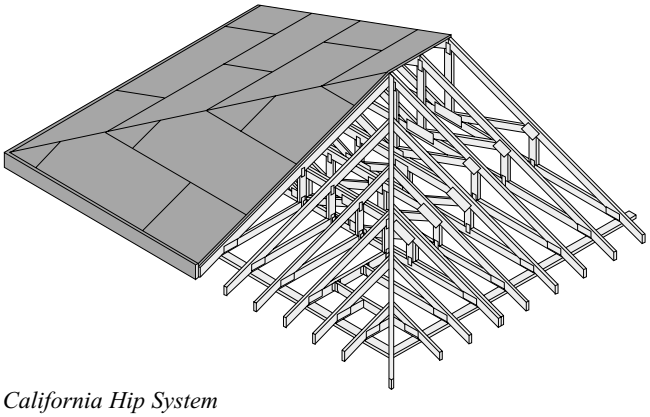
Terminal Hip System
(also Jack Truss System)



Step Down Hip System



Dutch Hip System
(also Boston Hip or Hip Louver)



California Hip System

Typical Truss Specification

SECTION 06192 FABRICATED WOOD TRUSSES

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.

1.03 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 (NDS®), 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% 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 (NDS®).
   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 AWPA 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 in 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, jigging 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. Toppling shall be prevented 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 the 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.

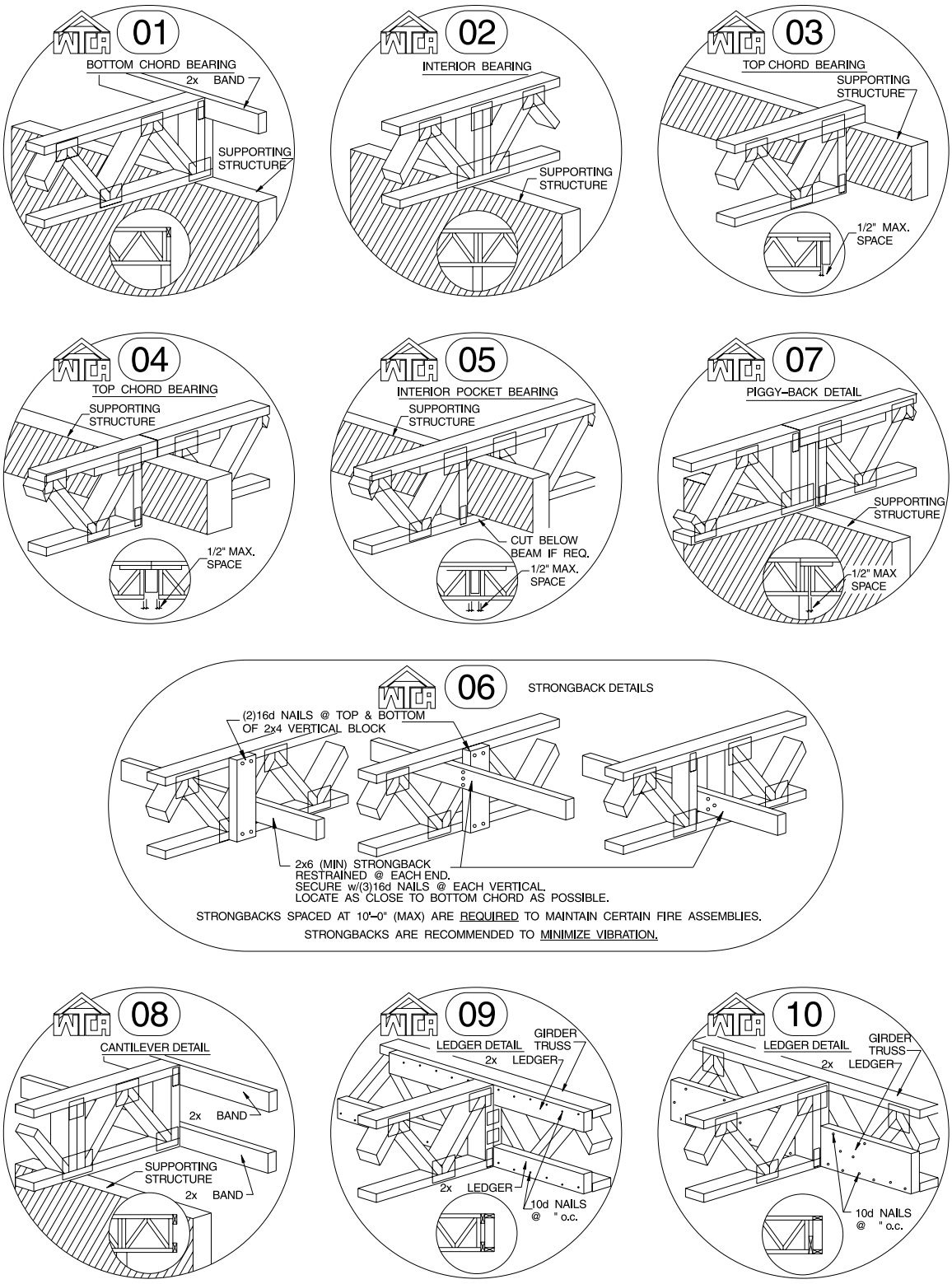
I. Trusses shall be permanently braced in a manner consistent with good building practices and in accordance with the requirements of the Construction Design Documents. Trusses shall furthermore be anchored or restrained to prevent out-of-plane movement so as to keep all truss members from simultaneously 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.

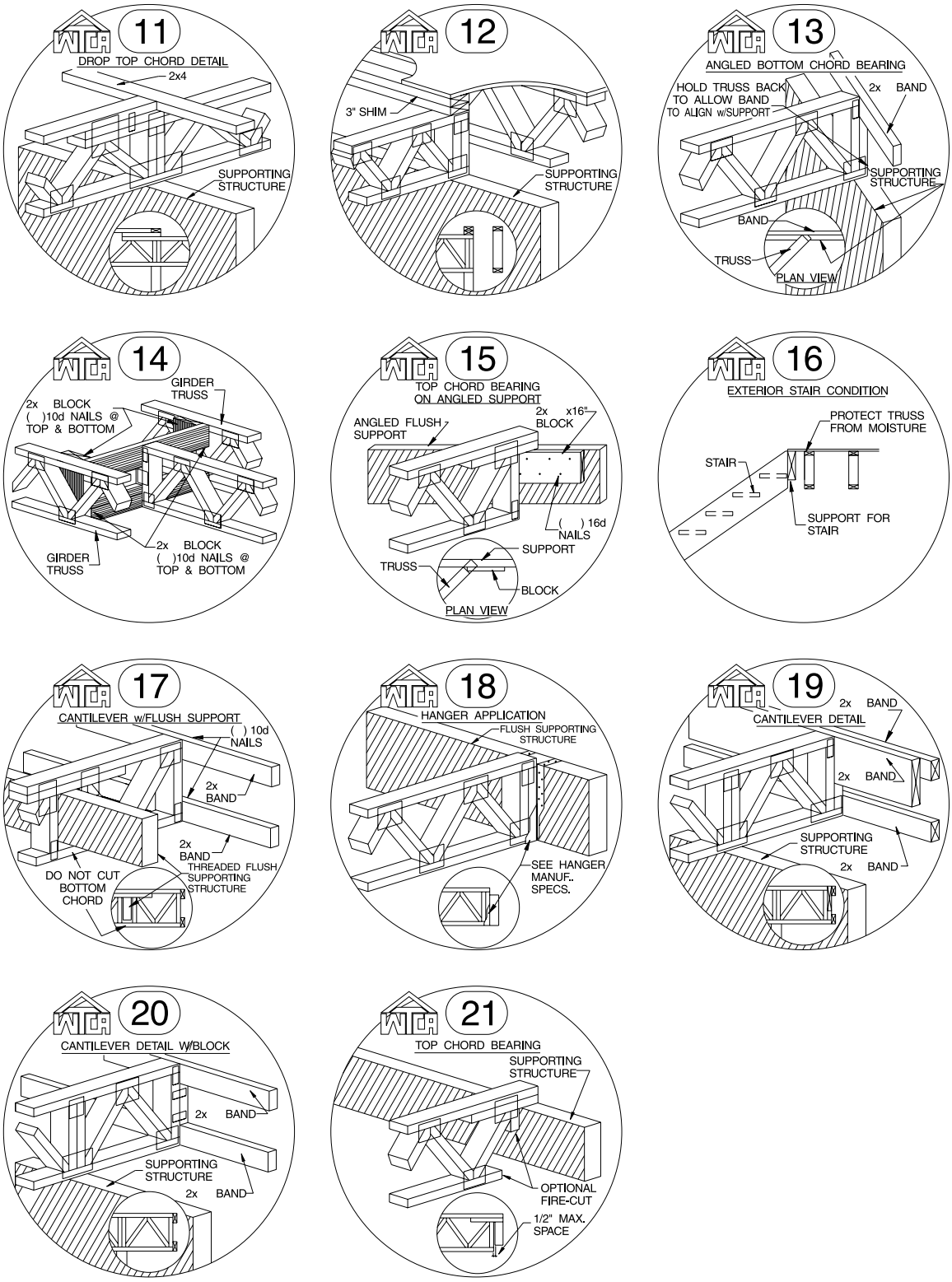
Construction Details

The details shown on this and the following pages are available from WTCA in electronic format. WTCA's Standard Details can be downloaded for free from WTCA's website—**www.woodtruss.com** or obtained from WTCA on diskette for $10 plus shipping & handling.

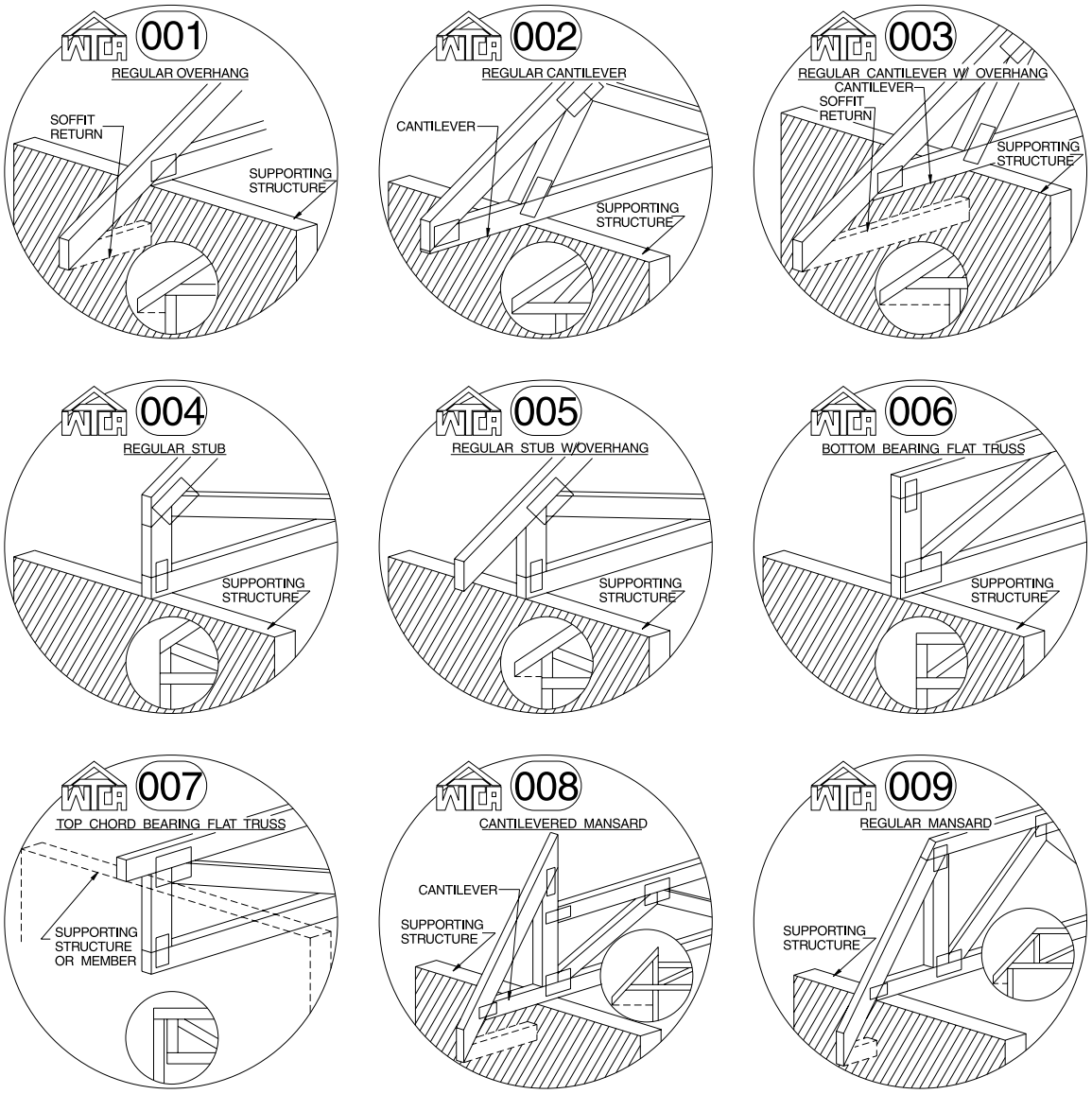
Floor Truss Details



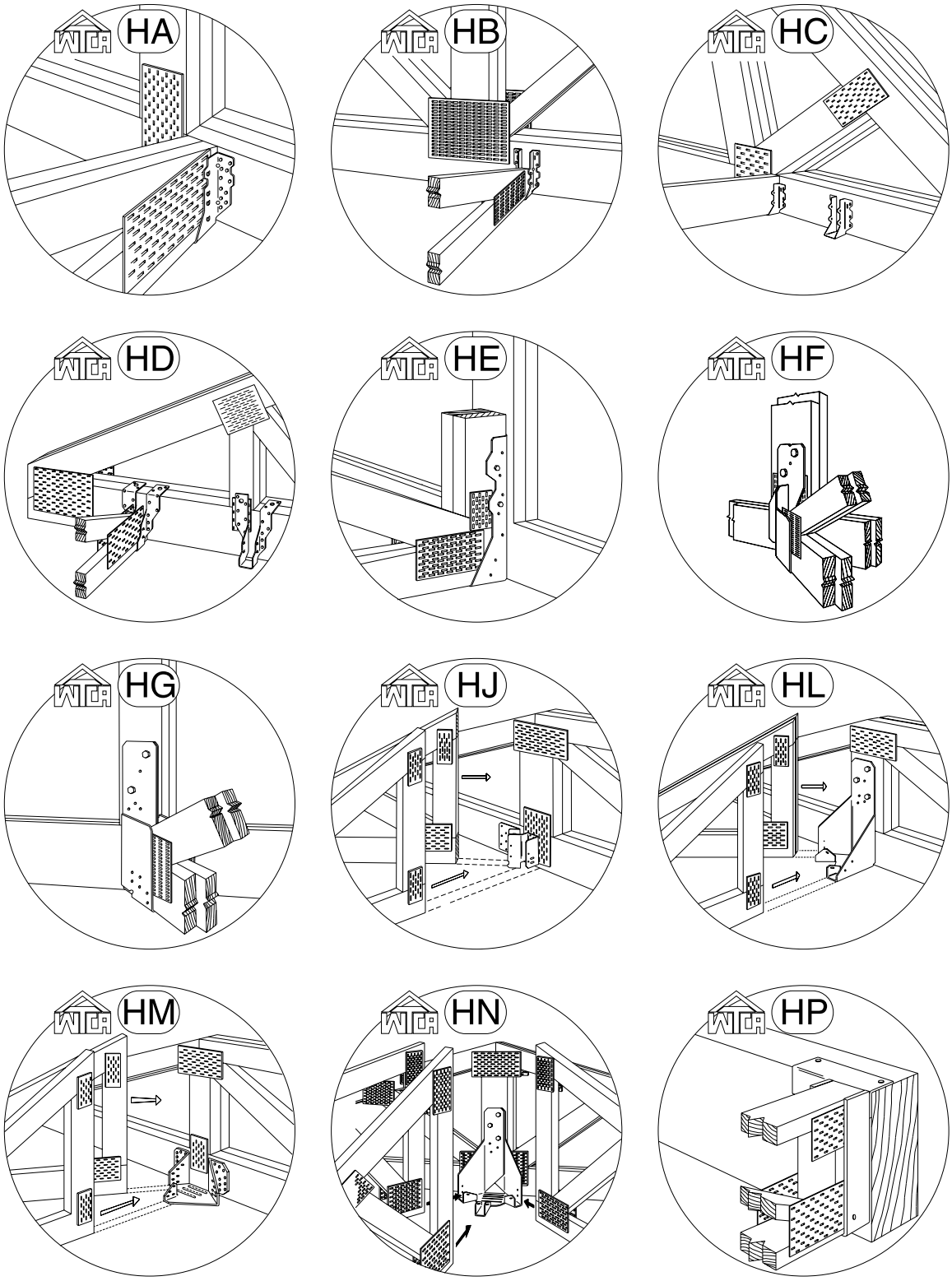
Floor Truss Details Continued



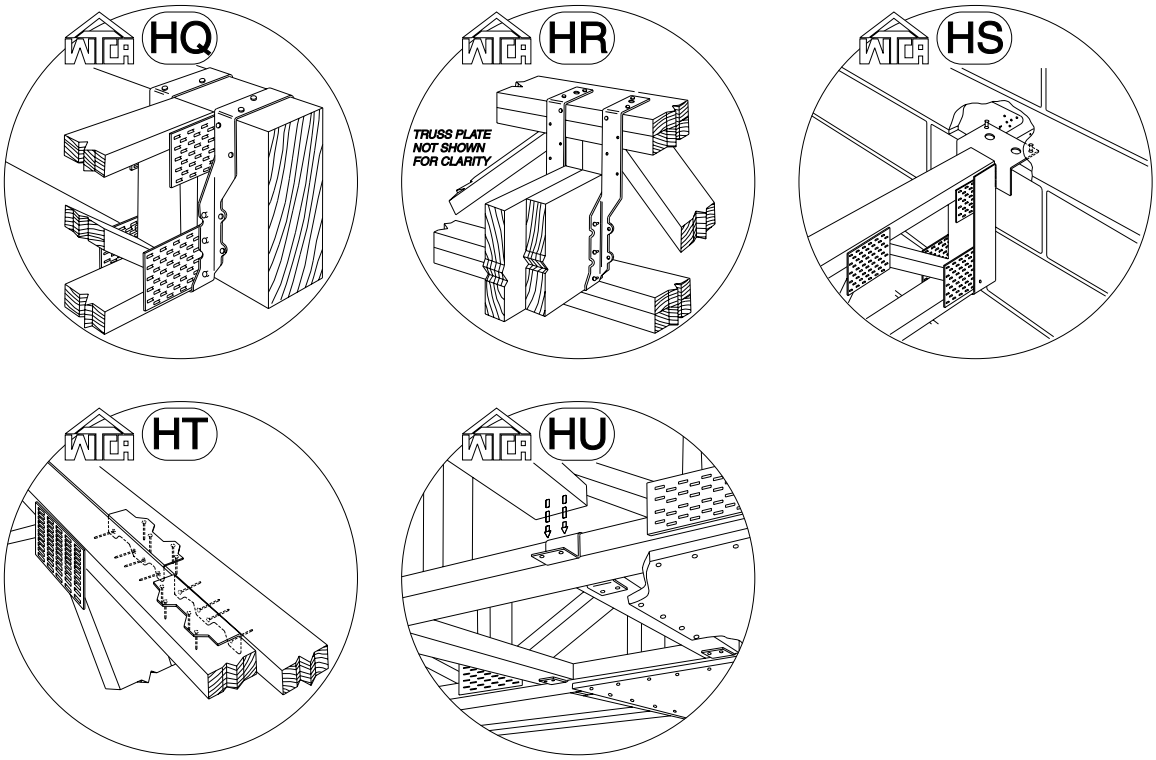
Roof Truss Details



Hanger Details



Hanger Details Continued



Design Comparisons

One very important step in the process of designing a structure is optimizing the design to accomplish the following goals:

- Minimize cost.
- Make the construction process easier and more efficient for the builder.
- Improve layout to eliminate footers, columns, beams, bearing walls and headers where possible.

On the following pages are two actual examples of architectural designs being optimized through the utilization of trusses. Pages 14 and 15 show a conventionally framed design redesigned to accommodate the use of trusses, and pages 16 and 17 show a truss design that was optimized.

For more information on the savings gained when comparing stick framing to truss and wall panels, see WTCA's document What We Learned by *Framing the American Dream*®.

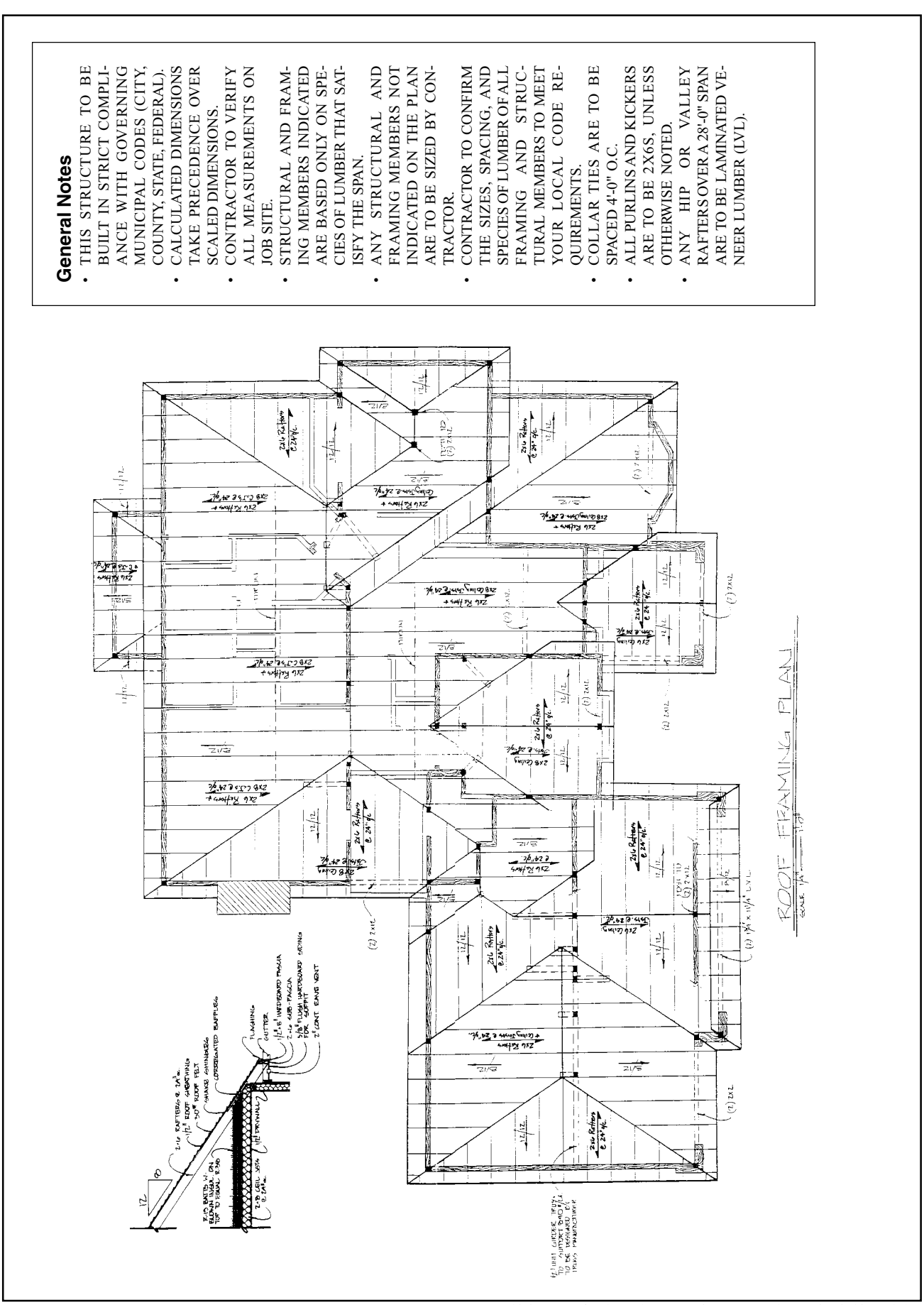


Figure 1a shows the composite of an actual design by a building designer that specified conventional framing techniques.

Provided courtesy of Design Basics Inc., Omaha, NE. Composite reproduced with permission.

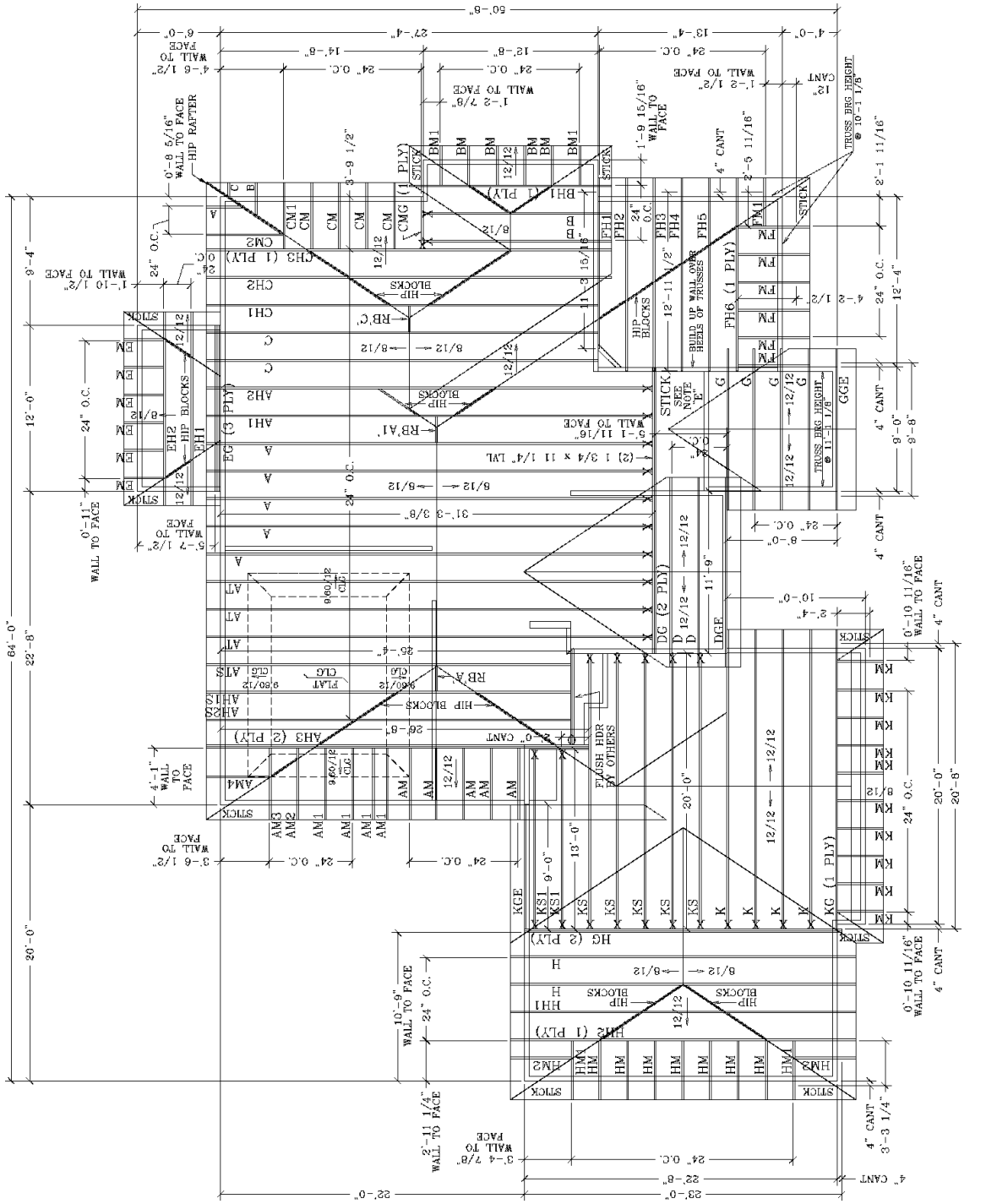


Figure 1b shows the design in Figure 1a converted to use trusses for the roof and floor. This resulted in a savings in field labor and significant savings in materials.

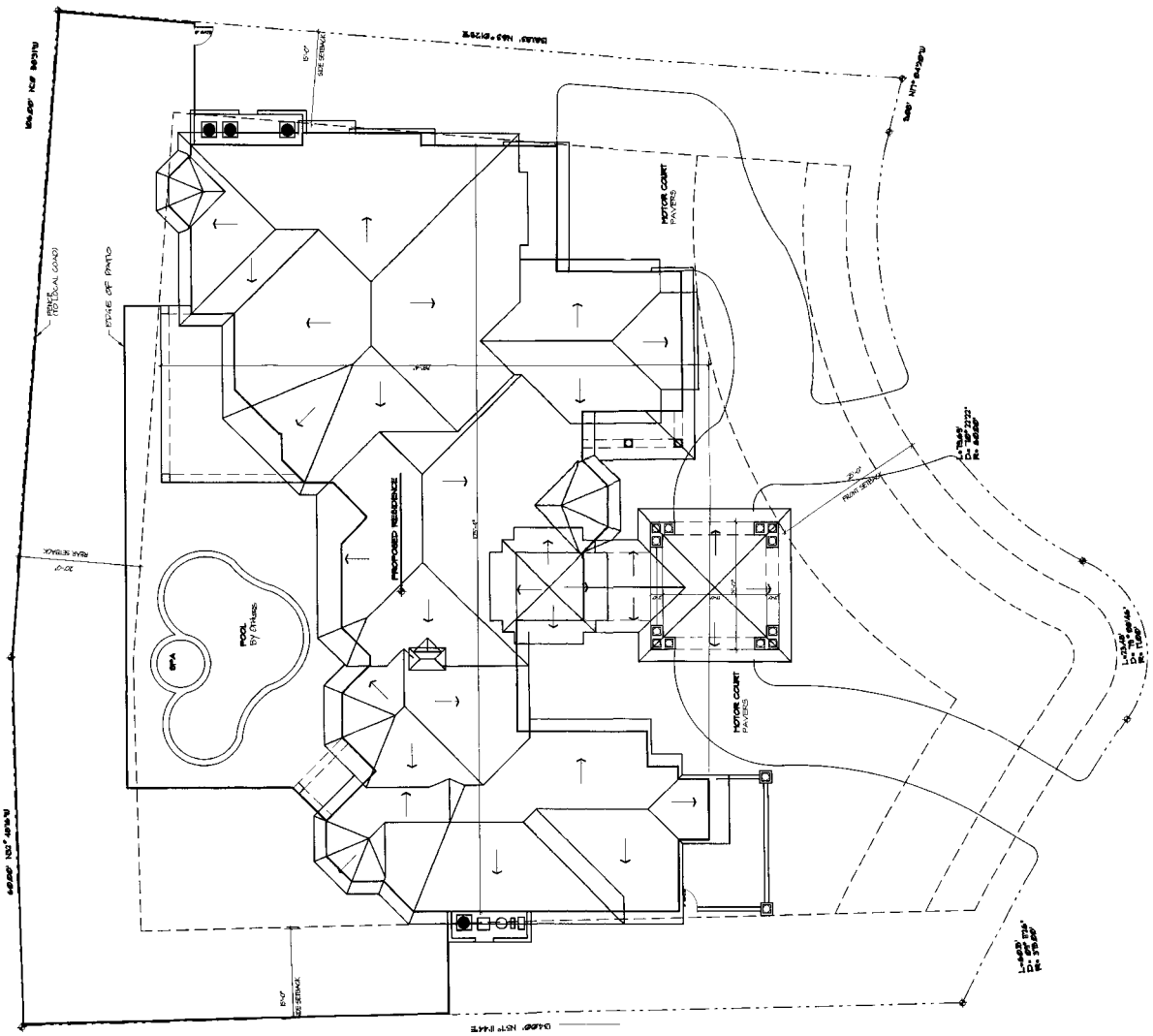


Figure 2a shows a roof design by an architect. This is an ideal application for engineered framing techniques.

Provided courtesy of Stene Associates Architects, Fort Lauderdale, FL. Composite reproduced with permission.

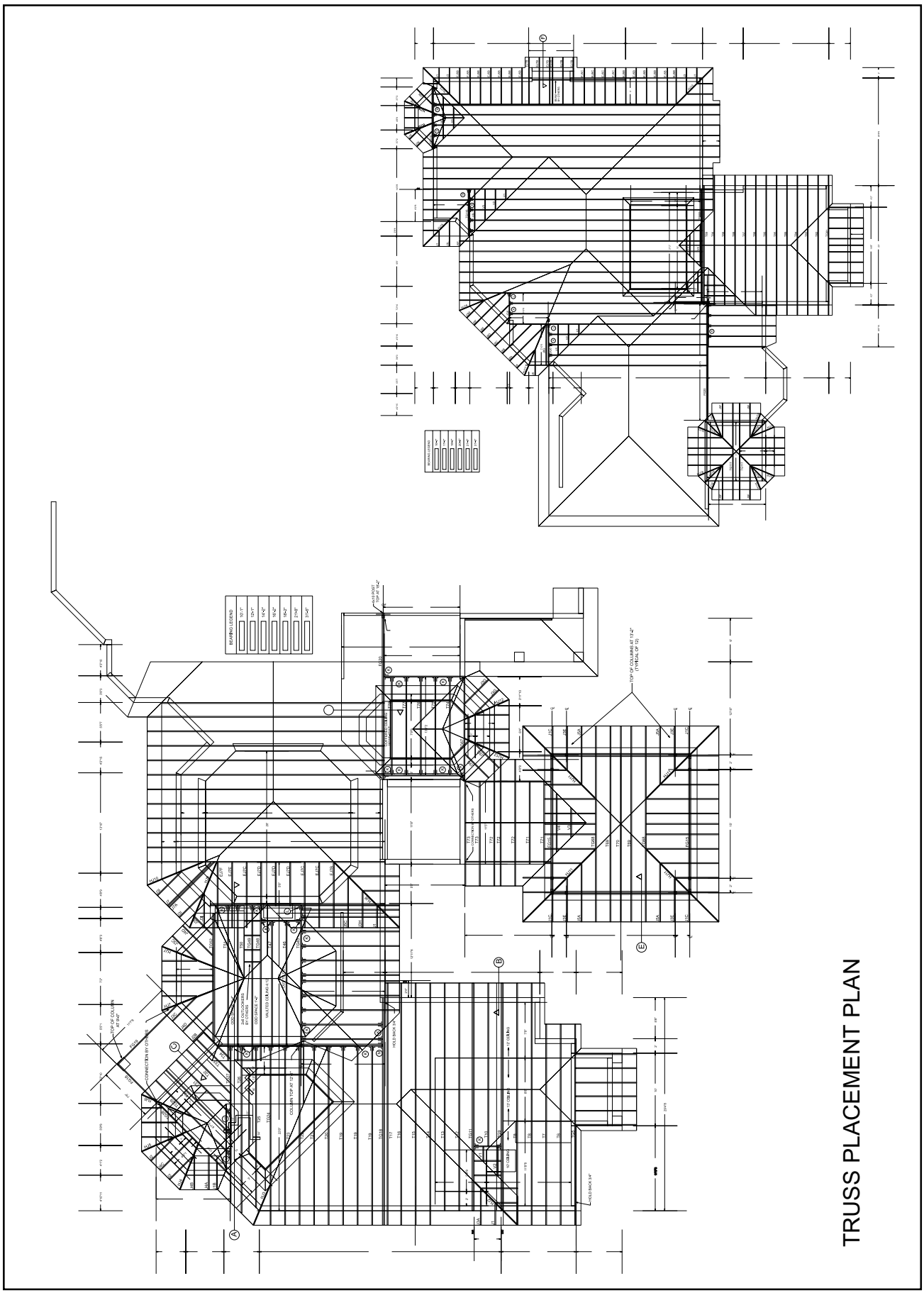


Figure 2b shows the same design as 2a after design of the roof systems is optimized.

Phase II: Working with a Truss Designer

Communicating the Design

Care must be taken that the required information is set forth in the construction design documents, to allow the truss design to be provided most efficiently:

- all truss orientations and locations
- desired slope or depth, span and spacing of trusses
- bearing width
- all design loads (see Design Loads, p. 3)
- truss anchorage to resist uplift, gravity and lateral loads
- allowable vertical and horizontal deflection criteria
- connections between truss and non-truss components

The building designer must also make provisions for cross and lateral bracing, bracing to transfer truss member buckling forces to the structure, and bracing to resist wind, seismic or other horizontal loads.

Typical Truss Design Drawings

The next two pages contain two typical truss design drawings—one for a pitched chord truss and one for a parallel chord truss. Significant features of each of these drawings are highlighted and defined in the key.

This key defines drawing elements highlighted on the following two pages.

Key

A. Slope or depth, span and spacing [6.2.1[1]/8.2.1(a)[2]]

B. Location of all joints [6.2.2[1]/8.2.1(b)[2]]

C. Required truss bearing widths [6.2.3[1]/8.2.1(c)[2]]

D. Design loads as applicable: [6.2.4[1]/8.2.1(d)[2]]
- Top chord live load (including snow loads)
- Top chord dead load
- Bottom chord live load
- Bottom chord dead load
- Concentrated loads and their points of application
- Controlling wind and earthquake loads

E. Adjustments to lumber and metal connector plate design values for conditions of use [6.2.5[1]/8.2.1(e)[2]]

F. Each reaction force and direction [6.2.6[1]/8.2.1(f)[2]]

G. Metal connector plate type, size, thickness or gage, and the dimensioned location of each metal connector plate except where symmetrically located relative to joint interface [6.2.7[1]/8.2.1(g)[2]]

H. Lumber size, species, and grade for each member [6.2.8[1]/8.2.1(h)[2]]

I. Axial and Bending stress indices CSI (Combined Stress Index), which shows structural "efficiency" of a member, and has a maximum of 1.00

J. Calculated deflection ratio and/or maximum deflection for live and total load [6.2.10[1]]

K. Maximum axial forces in the Truss members 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 [6.2.11[1]/2.2.2(e) & 5.3.3[2]]

L. Required permanent Truss member bracing location [6.2.12[1]/2.2.2(e) & 5.3.3[2]]

M. Connection requirements for:
- Truss to Truss girder
- Truss ply to ply
- Field splices

[6.2.9[1]/8.2.1(i) & 5.4.1[2] (Note: there are no examples of this on either drawing.)]

[1] Sections of WTCA 1-1995 containing more information
[2] Sections of the latest ANSI/TPI 1 containing more information

Job Name: MADISON JOB **Truss ID: T1** **Qty: 20** **Drwg:**

BRG	X-LOC	REACT	SIZE	REQD
1	0- 2-12	1843	5.50"	3.67"
2	32- 9- 4	1843	5.50"	3.67"

TC	FORCE	AXL	BND	CSI
1	-2998	.10	.41	.51
2	-2699	.06	.38	.44
3	-2571	.05	.49	.54
4	-1920	.02	.49	.51
5	-1920	.02	.49	.51
6	-2571	.05	.49	.54
7	-2699	.06	.38	.44
8	-2998	.10	.41	.51

BC	FORCE	AXL	BND	CSI
1	2593	.54	.24	.78
2	2129	.44	.16	.60
3	2129	.44	.23	.68
4	2129	.44	.23	.68
5	2593	.54	.24	.78

WEB	FORCE	CSI	WEB	FORCE	CSI
2-11	-382	.16	6-13	-724	.97
4-11	474	.20	6-14	474	.20
4-13	-724	.97	8-14	-382	.16
5-13	1217	.43			

TOP CHORD 2x4 SPF 1450F-1.3E
BOT CHORD 2x4 SPF 1450F-1.3E
WEB 2x4 HF STUD
2x4 SPF #2 4-13, 13-5, 13-6

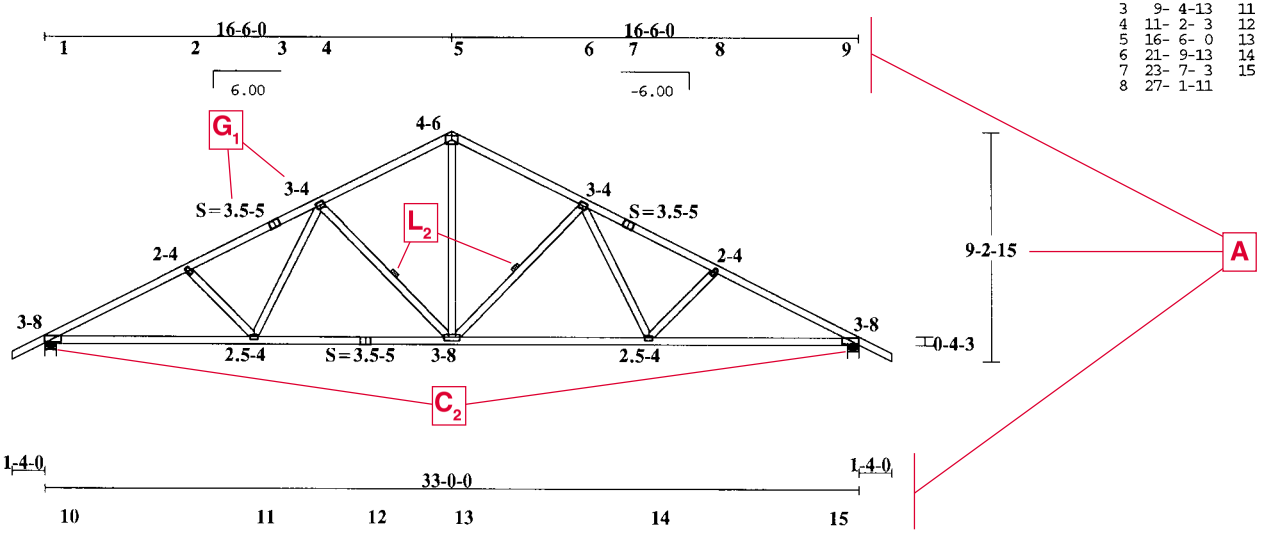
Plating spec : ANSI/TPI - 1995
THIS DESIGN IS THE COMPOSITE RESULT OF MULTIPLE LOAD CASES.
BOCA SNOW LOAD DESIGN CRITERIA:
GSL 35 psf, Exp. .8, Imp. 1.0

☒ Continuous lateral WEB bracing (CLB), for equal segments OR scab brace.

UPLIFT REACTION(S) :
support 1 -539#
support 2 -539#
This truss is designed using the ANSI/ASCE 7-93 Wind Specification
Bldg Enclosed = Yes, End Zone = No
Hurricane/Ocean Line = No , Exp Category = C
Bldg Length = 50.00ft, Bldg Width = 33.00ft,
Mean roof height = 19.30ft, MPH = 90
Classification = 3, Dead Load = 20.0 psf

MAX DEFLECTION (span) :
L/999 IN MEM 11-12 (LIVE)
L= -.23" D= -.15" T= -.38"

===== Joint Locations =====			
1	0- 0- 0	9	33- 0- 0
2	5-10- 5	10	0- 0- 0
3	9- 4-13	11	8- 6- 4
4	11- 2- 3	12	13- 0- 0
5	16- 6- 0	13	16- 6- 0
6	21- 9-13	14	24- 5-12
7	23- 7- 3	15	33- 0- 0
8	27- 1-11		



PROFESSIONAL ENGINEER REGISTERED 9999 STATE OF XX JANE S. DOE

The seal on this drawing indicates acceptance of professional engineering responsibility solely for the truss component design shown. The suitability and use of this component for any particular building design is the responsibility of the building designer, per ANSI/TPI 1-1995 Section 2.

All plates are 20 gauge Truswal Connectors unless preceded by "18" for 18 gauge or "H" for 16 gauge.

Example Created For

WTCA

WARNING ***Read all notes on this sheet and give a copy of it to the Erecting Contractor.***

This design is for an individual building component. It has been based on specifications provided by the component manufacturer and done in accordance with the current versions of TPI and AFPA design standards. No responsibility is assumed for dimensional accuracy. Dimensions are to be verified by the component manufacturer and/or building designer prior to fabrication. The building designer shall ascertain that the loads utilized on this design meet or exceed the loading imposed by the local building code. It is assumed that the top chord is laterally braced by the roof or floor sheathing and the bottom chord is laterally braced by a rigid sheathing material directly attached, unless otherwise noted. Bracing shown is for lateral support of components members only to reduce buckling length. This component shall not be placed in any environment that will cause the moisture content of the wood exceed 19% and/or cause connector plate corrosion. Fabricate, handle, install and brace this truss in accordance with the following standards: 'TRUSCOM MANUAL', by Truswal, 'QUALITY CONTROL STANDARD FOR METAL PLATE CONNECTED WOOD TRUSSES' - (QST-88), 'HANDLING INSTALLING AND BRACING METAL PLATE CONNECTED WOOD TRUSSES' - (HIB-91) and 'HIB-91 SUMMARY SHEET' by TPI. The Truss Plate Institute (TPI) is located at 583 D'Onofrio Drive, Madison, Wisconsin 53719. The American Forest and Paper Association (AFPA) is located at 1250 Connecticut Ave, NW, Ste 200, Washington, DC 20036.

Job #: 1234		Truss: T1	
Chk:			
Dsgnr: SAK		Date: 1/14/98	
TC Live	30.0 psf	DurFacs L=1.15 P=1.15	
TC Dead	10.0 psf	Rep Mbr Bnd 1.15	
BC Live	.0 psf	O.C.Spacing 2- 0- 0	
BC Dead	10.0 psf	Design Spec TPI	
TOTAL	50.0 psf	Seqn 09.15.97- 25505	

Figure 3a shows an example of a truss design drawing for a pitched chord truss. See Key on opposite page.

Job Name: MADISON **Truss ID: FT1** **Qty: 18** **Drwg:**

BRG	X-LOC	REACT	SIZE	REQD
1	0- 1-12	1100	3.50"	1.50"
2	19-10- 4	1100	3.50"	1.50"

TOP CHORD 4x2 SPF 2400F-2.0E
BOT CHORD 4x2 SPF 2400F-2.0E
WEB 4x2 HF STUD
PLATE VALUES PER ICBO RESEARCH REPORT #1607.

☒ If rigid sheathing is not directly attached to the bottom chord, adequate lateral bracing may be required (by others). For floor applications, 2x6 strongback bridging is recommended at 10'-0" O.C.

This design based on chord bracing applied per the following schedule:
max o.c. from to

TC	FORCE	AXL	BND	CSI
1	0	.00	.16	.16
2	-3841	.14	.16	.30
3	-3841	.19	.17	.36
4	-4952	.23	.06	.29
5	-4961	.30	.17	.47
6	-4952	.23	.06	.29
7	-3841	.19	.17	.36
8	-3841	.14	.16	.30
9	0	.00	.16	.16

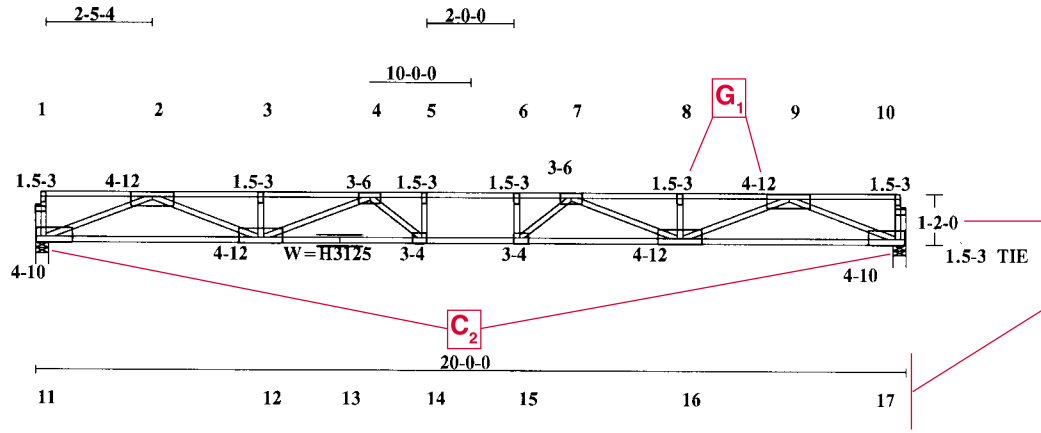
BC	FORCE	AXL	BND	CSI
1	2220	.22	.08	.30
2	4726	.47	.05	.52
3	4726	.47	.05	.52
4	4961	.49	.05	.54
5	4726	.47	.05	.52
6	2220	.22	.08	.30

WEB	FORCE	CSI	WEB	FORCE	CSI
1-11	-125	.03	6-15	-166	.04
2-11	-2414	.67	7-15	296	.13
2-12	1756	.76	7-16	-960	.27
3-12	-250	.06	8-16	-250	.06
4-12	-960	.27	9-16	1756	.76
4-14	296	.13	9-17	-2414	.67
5-14	-166	.04	10-17	-125	.03

Panel Lengths :
Std = 2- 5- 4
4-5 1- 2- 4 6-7 1- 2- 4

MAX DEFLECTION (span) :
L/501 IN MEM 14-15 (LIVE)
L= -.47" D= -.17" T= -.64"

===== Joint Locations =====			
1	0- 0- 0	10	20- 0- 0
2	2- 8- 4	11	0- 0- 0
3	5- 2- 4	12	5- 2- 4
4	7- 8- 4	13	7- 0- 0
5	8-11- 4	14	8-11- 4
6	11- 0-12	15	11- 0-12
7	12- 3-12	16	14- 9-12
8	14- 9-12	17	20- 0- 0
9	17- 3-12		



PROFESSIONAL ENGINEER REGISTERED 9999 STATE OF XX JANE S. DOE

The seal on this drawing indicates acceptance of professional engineering responsibility solely for the truss component design shown. The suitability and use of this component for any particular building design is the responsibility of the building designer, per ANSI/TPI 1-1995 Section 2.

All plates are 20 gauge Truswal Connectors unless preceded by "18" for 18 gauge or "H" for 16 gauge.

Example Created For

WTCA

WARNING ***Read all notes on this sheet and give a copy of it to the Erecting Contractor.***
This design is for an individual building component. It has been based on specifications provided by the component manufacturer and done in accordance with the current versions of TPI and AFPA design standards. No responsibility is assumed for dimensional accuracy. Dimensions are to be verified by the component manufacturer and/or building designer prior to fabrication. The building designer shall ascertain that the loads utilized on this design meet or exceed the loading imposed by the local building code. It is assumed that the top chord is laterally braced by the roof or floor sheathing and the bottom chord is laterally braced by a rigid sheathing material directly attached, unless otherwise noted. Bracing shown is for lateral support of components members only to reduce buckling length. This component shall not be placed in any environment that will cause the moisture content of the wood exceed 19% and/or cause connector plate corrosion. Fabricate, handle, install and brace this truss in accordance with the following standards: 'TRUSCOM MANUAL', by Truswal, 'QUALITY CONTROL STANDARD FOR METAL PLATE CONNECTED WOOD TRUSSES' - (QST-88), 'HANDLING INSTALLING AND BRACING METAL PLATE CONNECTED WOOD TRUSSES' - (HIB-91) and 'HIB-91 SUMMARY SHEET' by TPI. The Truss Plate Institute (TPI) is located at 583 D'Onofrio Drive, Madison, Wisconsin 53719. The American Forest and Paper Association (AFPA) is located at 1250 Connecticut Ave, NW, Ste 200, Washington, DC 20036.

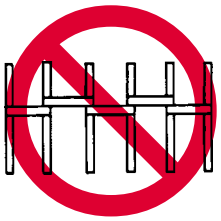
Job #: 12345		Truss: FT1	
Chk:			
Dsgnr: SAK		Date: 1/14/98	
TC Live	40.0 psf	DurFacs L=1.00 P=1.00	
TC Dead	10.0 psf	Rep Mbr Bnd 1.15	
BC Live	.0 psf	O.C.Spacing 2- 0- 0	
BC Dead	5.0 psf	Design Spec UBC	
TOTAL	55.0 psf	Seqn 09.15.97- 25514	

Figure 3b shows an example of a truss design drawing for a parallel chord truss. See Key on page 18.

Phase III: Using Trusses on the Job Site

Spacers and Bracing

One practice that should be avoided is using "spacers" (sometimes called "killer cleats") as the only form of truss bracing. A spacer is a piece of lumber cut to a length just larger than the space between two adjacent trusses (usually 28") to space the trusses. These pieces are then nailed to the trusses, connecting only two adjacent trusses. This configuration does not offer the lateral support that a single piece connected to at least six trusses can offer.



DO NOT USE SHORT BLOCKS TO BRACE INDIVIDUAL TRUSSES WITHOUT A SPECIFIC BRACING PLAN DETAILING THEIR USE

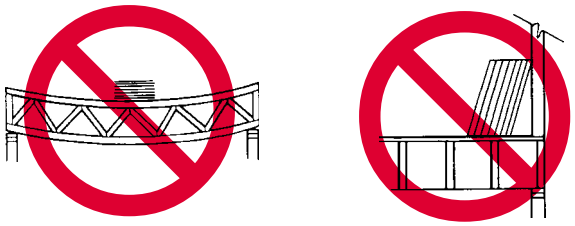
SPACERS ARE NOT BRACING, DO NOT FUNCTION LIKE BRACING, AND SHOULD NEVER BE USED AS THE SOLE MEANS OF BRACING.

Inadequate installation and bracing is the reason for most truss collapses. Proper installation and bracing is the final step for a safe and quality roof structure. For more detailed bracing information, see the *Metal Plate Connected Wood Truss Handbook*, Section 15, General Bracing & Installation Information, and TPI's *Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses*, HIB-91.

The Dangers of Overloading

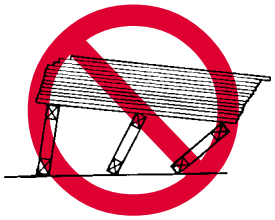
No single factor of abuse at the construction site has occurred more frequently than the overloading of installed roof and floor trusses with construction materials such as plywood, concrete block, drywall or roofing stacked in concentrated areas. This practice can create a permanent bow or sag in trusses, fracture plates, crack lumber, or lead to collapse. To avoid such problems, do the following:

- Ensure the weight of construction materials does not exceed what the trusses were designed to hold.
- Do not leave materials in a stack; spread them out over the truss system.
- Review warnings below.



NEVER OVERLOAD SMALL GROUPS OR SINGLE TRUSSES, POSITION LOAD OVER AS MANY TRUSSES AS POSSIBLE

NEVER STACK MATERIALS ON CANTILEVERED TRUSSES



NEVER STACK MATERIALS ON UNBRACED OR INADEQUATELY BRACED TRUSSES

NEVER STACK MATERIALS NEAR PEAK

For more information, see the *Metal Plate Connected Wood Truss Handbook*, Section 6.6, Construction Loads & Overloading, WTCA's *Job Site Warning Poster* and TPI's *Handling Installing and Bracing Metal Plate Connected Wood Trusses*.

Truss Damage & Repairs

Trusses are occasionally damaged when they are unloaded at the site on rough terrain. Usually, truss damage is the result of repositioning unbanded trusses at the delivery site, or careless handling during erection and installation.

Special Concerns

1. The truss manufacturer should be informed immediately of any damaged or field-modified trusses so the truss designer can prepare the repair drawings. Without proper repair detail drawings, repairs to damaged or field-modified trusses should not be attempted.
2. Trusses "domino" when they "roll over" toward one end of the building, each truss falling against the next. Hairline cracks, difficult to detect, frequently occur in trusses when they domino and strike wall plates or other surfaces. This type of damage may be extensive, and is nearly impossible to repair. Therefore, dominoed trusses typically need to be replaced.
3. Web members must never be removed from a truss under any circumstances. Removing a truss web member causes immediate deflection of the individual cut truss, and can contribute to the progressive collapse of the truss and possibly the structure. If a web member location interferes with some element in the building scheme, a truss designer must review the consequences of a field modification.
4. Web and chord members must never be drilled for holes or notched without the evaluation and approval of the truss designer. Drilling holes and notching may cause immediate deflection of the truss, and may also contribute to the collapse of the truss or the entire structure. If drilling or notching seems necessary, a truss designer must be contacted to review the consequences of such field modifications.

For more information, see the *Metal Plate Connected Wood Truss Handbook*, Section 19, Damaged Trusses, Installation Errors & Repairs.

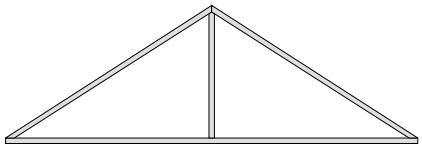
When trusses are incorrectly installed, repairs are usually necessary. The following are examples of common installation errors:

Common Installation Errors

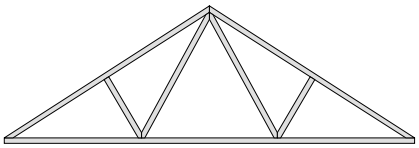
1. Cantilever trusses installed backwards.
2. Parallel chord trusses installed upside down.
3. Trusses, designed to rest on interior bearing walls, installed backwards.
4. Girder trusses not fastened together.
5. Girder trusses incorrectly fastened together. (Truss ply-to-ply connections are specified in the truss design drawing.)
6. Use of incorrect girder hangers.
7. Common trusses incorrectly fastened to truss girders. (Truss-to-truss connections are specified on the truss design drawing.)
8. Trusses installed in the wrong location.
9. Gable end trusses installed without continuous bottom chord support or web member bracing.
10. Unbraced and unsheathed truss top chords beneath overframing.
11. Conventionally framed hip ends of the building supported on common trusses not designed for hip framing. This condition requires a girder truss or special truss design for the specific load condition.
12. Trusses spaced wider than the design specifications.
13. Using two standard floor trusses at locations that required specially designed floor truss girders.
14. Cutting of trusses at the roof fireplace opening instead of installing the fireplace girder trusses designed for such openings.
15. Trusses with web members or chords drilled for the use of lag screws to support sprinkler loads that have not been included in the design of the truss.
16. Trusses with webs removed by plumbers and mechanical trades.
17. Trusses repaired without following the truss repair drawings provided by the truss designer.
18. Truss chord or web members drilled or notched for the passage of electrical wires, plumbing lines and/or mechanical ductwork.

Truss Types

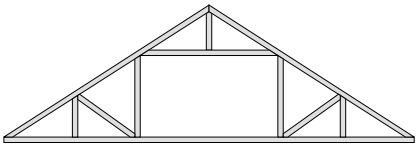
There are two basic types of trusses. The Pitched-Chord Truss is characterized by its usually triangular shape. Also called a "Roof Truss," this type is most often used for roof construction. The Parallel-Chord Truss gets it name from having parallel top and bottom chords. This type is often used for floor construction, and is referred to as a "Floor Truss." Shown below are 12 of the most common types of trusses used today. As can be seen, there is a great deal of flexibility that can be achieved in truss design. You may even recognize common uses of these trusses based on their shapes. Note: truss plates are not shown for simplicity.



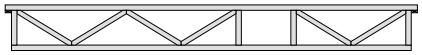
King Post. The most basic truss type. Used primarily for simple structures with short spans.



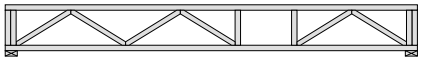
Fink. Provides for longer spans than the King Post, adding further design flexibility.



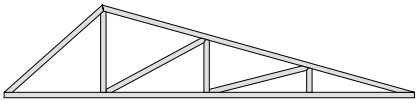
Attic Frame. The opening in the center makes this useful for storage or additional living space applications.



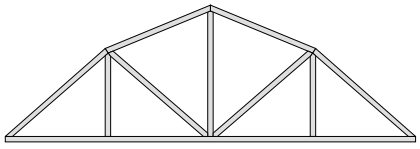
Flat - Top Chord Bearing. The top chord bearing feature can reduce the amount of wall area that needs to be sheathed.



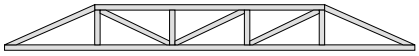
Flat - Bottom Chord Bearing. Also called parallel chord. The 4x2 configuration can be used for floors, and the 2x4 configuration can be used for either floor or roof applications.



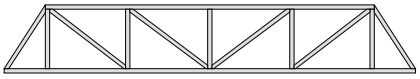
Double Pitch or Dual Pitch. An asymmetrical truss used where the designer wants a change in roof appearance. This truss begins to show the design flexibility roof truss construction provides.



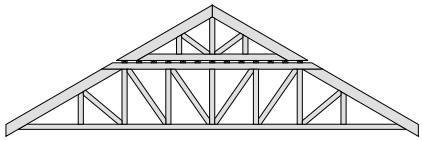
Gambrel. This truss is often used in agricultural buildings.



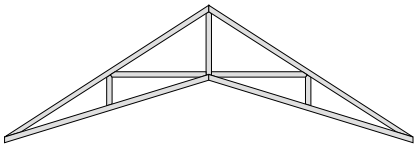
Hip. One piece of a hip roof system. See page 6 for details.



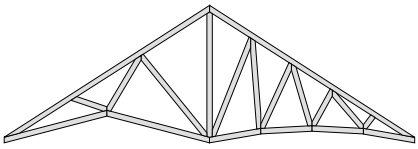
Mansard. This truss is used primarily for commercial buildings where a sloping roof facade hides mechanical units.



Piggyback. A combination of hip truss and triangular cap, overcoming size restrictions in manufacturing and shipping.



Scissors. Both top and bottom chords of this truss have a pitch to them. Often used to create a vaulted effect, such as in sanctuaries and auditoriums.



Special. This example illustrates the flexibility of design that trusses will accommodate. The only limit to the design is your imagination!

Industry Terminology

Listed below and on the following pages are industry terms and definitions, so that you can be more educated in trusses and related components. For definitions of truss types not listed herein, see page 23; for examples of roof systems, see pages 4-6.

Anchorage
The connection between the roof or floor framing members (e.g., trusses, bracing, etc.) and the building structure, which is required to transfer the forces from these members into the building.

ANSI/TPI 1
(American National Standard, National Design Standard For Metal Plate Connected Wood Truss Construction) A publication of the Truss Plate Institute (TPI), developed under the American National Standards Institute (ANSI) consensus process. Provides the analysis, design and manufacturing criteria for the metal plate connected wood truss industry.

ANSI/TPI 2
(American National Standard, Standard For Testing Performance For Metal-Plate-Connected Wood Trusses) A publication of the Truss Plate Institute (TPI), developed under the American National Standards Institute (ANSI) consensus process. Provides a consensus standard for testing and evaluating wood trusses designed and manu factured in accordance with ANSI/TPI 1.

Bearing
A structural support, usually a beam or wall that is designed by the building designer to carry the truss reaction loads to the foundation.

Bottom Chord
An inclined or horizontal member that establishes the bottom of a truss. An example of an inclined bottom chord member is the bottom chord of a scissors truss or a truss positioned between supports at different elevations.

Bracing
See Permanent Bracing and Temporary Bracing.

Bridging
Wood or metal members that are placed between trusses and joists in an angled position intended to spread the loads.

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

Camber
An upward curvature built into a truss bottom chord to compensate for deflection due to loading conditions.

Cantilever
The part of a truss that extends beyond its support, exclusive of overhang.

Center Bearing Truss
See Interior Bearing.

Chase Opening
Open panel in a floor or flat truss set on a pitch for the purpose of running utilities through it, such as heating and air conditioning ducts.

Clear Span (Clear Opening)
Generally indicates the inside or interior frame-to-frame dimensions. Not to be confused with span.

Clipped (End)
Same as stubbed or Stub Truss.

Combined Stress Index (CSI)
The summation of axial and bending stresses divided by their respective allowable stresses for a specific truss member. This ratio, or index, represents the structural "efficiency" of the member. The CSI shall not exceed 1.00.

Compression Chord
The chord members in a truss that resist compression forces.

Compression Parallel-To-Grain
Compression, endwise (parallel to the grain). The imposition of a compressive stress that acts in a direction parallel to the grain of the wood, as in a column.

Compression Perpendicular-To-Grain
Compression, sidewise (perpendicular to the grain). The imposition of a compressive stress that acts in a direction approximately perpendicular to the grain of the wood.

Construction Design Documents
Architectural drawings, structural drawings, mechanical drawings, electrical drawings, and any other drawings, specifications, and addenda that set forth the overall design of the structure and are issued by the building designer.

Contractor
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 storage, handling, and installation of the trusses.

Creep
Time-dependent deformation of a structural member under constant load.

Deflection
The amount a member sags or displaces under the influence of forces.

DSB-89
Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses, published by the Truss Plate Institute (TPI). Developed for use by architects and engineers to provide guidance for design specification for temporary bracing.

Duration of Load
The duration of stress or the time during which a load acts on a member. In wood, a design consideration for modifying allowable stresses, based on the accumulated loadings anticipated in the life of a structure.

Engineer-of-Record
The registered professional engineer responsible for the structural design of the structure and who produces the structural drawings included in the construction design documents.

Fire Retardant
Having or providing comparatively low flammability or flame spread properties.

Fireplace Truss
A truss that has a modified shape to allow for penetration of a roof chimney whose loads are supported by a fireplace master (girder) truss. This truss requires special engineering.

Heel Joint
The point on the truss where the top and bottom chords intersect.

HIB-91
Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses, published by the Truss Plate Institute (TPI). Provides recommendations and guidelines to contractors for handling, installing and bracing metal plate connected wood trusses for applications up to 2' on center.

Interior Bearing
Term used to describe supports that are interior to two exterior supports.

Joint
See Panel Point.

Kicker
Alternate expression for a truss web member cantilever strut.

Ladder Framing
Prefabricated wall panel fastened to the roof eave to create a sloped overhang.

Lateral Bracing
Members placed and connected at right angles to a chord or web member of a truss.

Level Return
Lumber filler placed horizontally from the end of an overhang to the outside wall to form a soffit.

Load-Bearing Wall
A wall specifically designed to transfer a roof load and/or upper floor load into the foundation.

Metal Connector Plate
A connector plate manufactured from ASTM A653/A653M, A591, A792, or A167 structural quality steel protected with zinc or zinc-aluminum alloy coatings or their stainless steel equivalent. The metal connector plate has integral teeth and shall be manufactured to various sizes (i.e., length and width) and thickness or gauges and shall be designed to laterally transmit loads in wood. Also known as truss plate, plate, metal plate, etc.

Nail-On Plate
Light-gauge cold-formed steel metal connector plates with pre-punched holes or, if cut to size, without holes having identifying marks through which nails are driven by hand or pneumatic means into the lumber. They are usually located on the near face and far face of the joint.

Nailer
A member fastened to another member by nails for reinforcement. Also called scab. [Used to thicken overhang for wide fascia.]

National Design Specification® (NDS®) For Wood Construction
Publication of the American Forest & Paper Association (AFPA) providing an appendix of lumber sizes, grades, species and allowable stresses.

Nominal Size
As applied to products such as lumber, traditionally the approximate rough-sawn commercial size by which it is known and sold in the market. Actual rough-sawn sizes may vary from the nominal. Reference to standards or grade rules is required to determine nominal/actual finished size relationships.

Overall Span
Outside of frame dimensions (not outside of veneer dimensions).

Overall Truss Depth
Vertical distance between bearing and the uppermost point of the peak.

Overhang
The extension of the top chord of a truss beyond the outside of the bearing support.

Owner
The individual or organization for whom a structure is designed.

Panel
The chord segment defined by two adjacent joints.

Panel Length
The distance between the centerlines of two consecutive joints along the top or bottom chord.

Panel Point
The location on a truss where the web members intersect the top and bottom chord.

Parallel Chord Truss
A truss with top chord slope less than 1.5/12. Also called Floor Truss.

Peak
Point on the truss where the sloped chords meet.

Permanent Bracing
The bracing installed for the purpose of providing support at right angles to the plane of the truss to hold every truss in the position assumed for it in the design. Permanent bracing should also resist lateral forces imposed on the completed building by wind load or seismic load.

Pitch
(1) The incline angle of the roof described as the ratio of the total rise of the roof to the total width of the structure. For example, a 10' rise and a 30' width gives a roof pitch of one third. The roof pitch is also designated as the angle that the top chord makes with the lower chord such as a 20° pitch or a 45° pitch. (2) A term applied to resin occurring in the wood of certain conifers.

Plumb Cut
A top chord end cut to provide for vertical (plumb) installation of fascia.

Ply
One truss of a multiple-piece girder truss.

Profile Drawing
Sketches of truss profiles used by a mechanical engineer to determine where mechanical ducts, piping, etc., are located.

Purlin
A horizontal member attached perpendicular to the truss top chord for support of the roofing (e.g., corrugated roofing or plywood and shingles). Also called Piggy-Back.

Reaction
The total load transferred from the uniform load (PSF) applied to the floor truss deck, then into the floor truss, and, ultimately, to the floor truss bearing or support.

Rise
Vertical distance from the bottom of the bottom chord to bottom (inside) of the top chord.

Roof Jack
A relatively short and usually monopitched truss used to frame the hip end of a hip roof system.

Scupper
Roof drain.

Set Back
The distance from the outside edge of the wall exclusive of veneer to the face of a hip girder truss.

Shop Drawing
Drawings of roof trusses prepared by the truss manufacturer from truss design drawings used to manufacture trusses.

Slider
Two inch dimension lumber inserted between the top and bottom chords at the heel joint in the plane of the truss to reinforce the top or bottom chord.

Span
Term generally used to communicate out-to-out span or overall span of a truss design. Sometimes also indicates center line to centerline of bearing.

Splice
Location at which two chord members are joined together to form a single member. It may occur at a panel point or between panel points.

Square Cut
End of top chord perpendicular to the slope of the member. Cut made at 90° to the length of the member.

Stacked Chords
Term used for agricultural trusses when two members are positioned on top of each other to create a bottom chord.

Stress
Force per unit of area.

Strongback
Two inch dimensional framing member attached perpendicular to floor trusses—often through the chase opening—and placed vertically against the vertical web.

Stub Truss
Pitched truss with one end truncated or "stubbed" from the normal heel position.

T-Brace
A brace consisting of stress-graded lumber or structural bands nailed directly to the member requiring a brace, and with the width of the member perpendicular to the width of the brace.

Temporary Bracing
The bracing installed for the purpose of holding trusses true to line, dimension and plumb. In addition, temporary bracing holds trusses in a stable condition until permanent truss bracing and other permanent components that contribute to the overall rigidity of the roof or floor are in place. Temporary bracing may consist of ground bracing, continuous lateral sheets or ties, diagonals, cross-bracing or similar items. See the latest edition of ANSI/TPI 1 for more information.

Top Chord
An inclined or horizontal member that establishes the top member of a truss.

Top Chord Bearing
The bearing condition of a parallel chord truss that bears on its top chord extension. Can also apply to a sloping chord truss bearing on a top chord extension.

Truss
An engineered structural component, assembled from wood members, metal connector plates and other mechanical fasteners, designed to carry its own weight and superimposed design loads. The truss members form a semi-rigid structural framework and are assembled such that the members form triangles.

Truss Design Drawing
The graphic depiction of an individual truss prepared by the truss designer that prescribes truss geometry, materials and load conditions (e.g., span, slope, panel point locations, lumber, plate type, size and location, design loads, spacing, forces, etc.).

Truss Designer
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's statutes and regulations governing the professional registration and certification of architects or engineers. Also referred to as truss engineer, design engineer, registered engineer, and engineer.

Truss Manufacturer (Truss Fabricator)
An individual or organization regularly engaged in the manufacturing of trusses.

Truss Placement Plan
The drawing identifying the location assumed for each truss based on the truss manufacturer's interpretation of the construction design documents.

Truss Spacing
The on-center distance between trusses.

Valley Truss
Not a truss, but traditionally called so. A set of triangular components used to frame the shape of dormers and to complete the roof framing where trusses intersect at perpendicular corners. Valley members usually require support at a maximum distance of 24".

Web Member
Members that join the top and bottom chords to form the triangular patterns typical of trusses. These members typically carry axial forces.

X-Brace
Bracing that resembles the letter "X".

Further Information
For a more complete listing of terminology, see the *Metal Plate Connected Wood Truss Handbook*, Appendix B: "Glossary of Terms."

Notes:

Disclaimer