ENCYCLOPEDIA OF TRUSSES

A GUIDE TO USING TRUSSES

PREFABRICATED STRUCTURAL WOOD

6p

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Alpine Engineered Products, Inc.

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PREFABRICATED STRUCTURAL WOOD

Since 1966 architects and builders have specified more than ten million roof and floor trusses engineered by the staff of Alpine Engineered Products, Inc. These trusses, manufactured by more than 550 plants, are used in one of every five homes built in the U.S. and Canada today, as well as in many commercial buildings.

Alpine maintains a leadership position in the industry through research, development, technical knowledge and customer oriented service. Our truss manufacturers are supported by more than 40 professional engineers in the U.S. representing all 50 states and the 10 provinces in Canada, and more than one hundred other design and computer technicians.

Alpine's truss design methodology is in accordance with national standards and is backed by extensive research and testing.

Truss manufacturers in the United States, Canada, the United Kingdom, Western Europe and South Africa depend on Alpine for truss assembly equipment, metal connector plates, truss design service, design software, connectors and anchors, and other truss related products.

The Encyclopedia of Trusses is intended as a guide to architects, engineers, building designers and contractors for suggested uses of trusses. The building code of jurisdiction and a truss design professional should be consulted before incorporating information from this publication into any structure. The contents herein are for the exclusive use of component manufacturers who use products from Alpine Engineered Products, Inc. in the sale and promotion of trusses.

Alpine Engineered Products, Inc., nor any of its divisions nor companies, does not warrant the recommendations and information contained herein as proper under all conditions and expressly disclaims any responsibility for damages arising from the use, application, or reliance on the recommendations contained herein.

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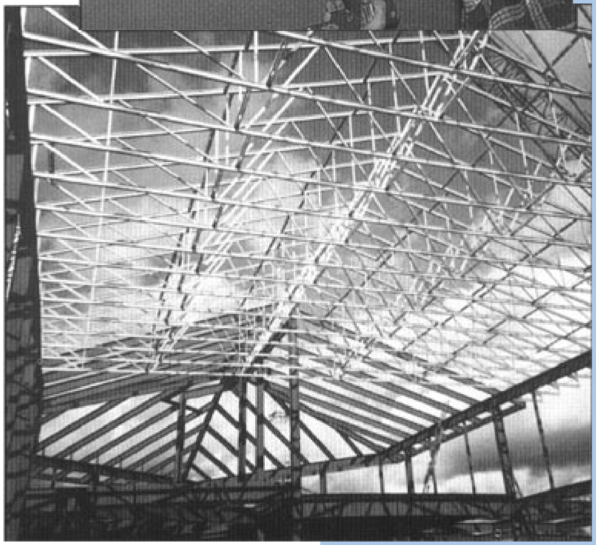
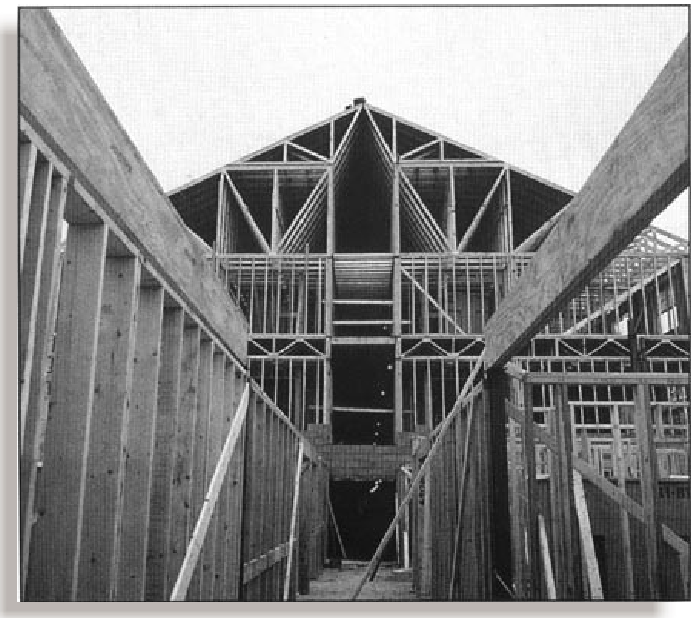


ALPINE

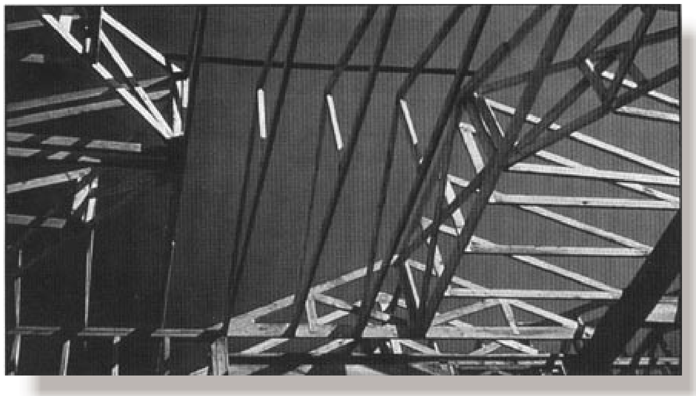
Special Benefits for Architects and Engineers

- Using Alpine's proprietary software, truss designers can produce engineered shapes that satisfy virtually any aesthetic and functional specification by the building design professional.
- Trusses offer simple solutions to complex designs and unusual conditions without inhibiting building design freedom.
- Nationally recognized standards for truss design and manufacturing of metal plate connected wood trusses have been adopted by major model building codes. This ensures a quality product.
- Truss manufacturers that use Alpine software are available for consultation when special framing situations arise.
- Alpine professional engineers are committed to providing the highest quality, cost efficient structural products for your clients.
- Wood trusses connected with Alpine metal plates enjoy an outstanding record of more than 30 years of proven performance and durability.



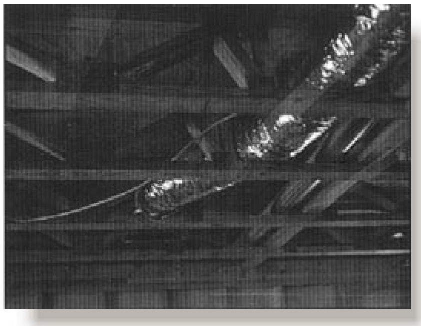
Special Benefits for Contractors

- The use of preassembled components generates less waste at the jobsite. This improves safety and reduces cleanup costs.
- Trusses are built in a computer-aided manufacturing environment to assure accuracy and quality.
- Industry standards for manufacturing and handling assure code-compliant.
- Trusses are lightweight and easy to install, requiring only normal construction tools.
- The wide nailing surface of 4x2 floor trusses safely speeds deck and flooring installation.
- Expenses are accurately controlled because truss costs can be predetermined. On-site losses from miscutting, theft and damage are virtually eliminated.
- Open web design allows easy installation of plumbing, electrical wiring and heating/cooling duct work.
- Trusses are available locally for fast delivery. More than 550 truss manufacturers throughout the United States and Canada are backed by the expertise of Alpine Engineered Products, Inc.



Special Benefits for the Owner

- The owner can enjoy peace of mind, knowing that the trusses have been professionally engineered and quality manufactured for the specific job.
- The resiliency of wood provides a floor system that is comfortable.
- Wood is a natural insulator because it is composed of thousands of individual cells, making it a poor conductor of heat and cold.
- Roof truss details such as tray, vaulted or studio ceilings improve the appearance and comfort of homes, offices, churches and commercial buildings.
- Floor trusses can conceal mechanical services, leaving a clear plane for ceiling installations. This is ideal for finished rooms in a lower level.
- Trusses provide clear spans so interior walls can be moved easily during remodeling or when making additions.



Check List of Information Needed by Truss Manufacturers to Design and Manufacture an Order of Trusses

- ❑ Building Code of Jurisdiction
- ❑ Building use
- ❑ Geometry
- ❑ Location and size of all points of bearing
- ❑ Center-to-center spacing of trusses
- ❑ Design loads
  - Uniform live and dead loads
  - Concentrated loads such as mechanical equipment or sprinklers
  - Special load cases
  - Environmental loads (wind, snow and seismic)
- ❑ Special conditions
  - Corrosive environments, etc.

A discussion of each item follows:

Building Code of Jurisdiction

Generally, local building codes are based on one of the national model codes. However, many local jurisdictions have variances that can have an impact on truss design. It is therefore important that the truss designer be informed of all codes of jurisdiction. The model codes referred to are: The BOCA *National Building Code*, published by the Building Officials Conference of America International (BOCA); the *Uniform Building Code*, published by the International Conference of Building Officials (ICBO); and the *Standard Building Code*, published by the Southern Building Code Congress International (SBCCI) and in Canada, the *National Building Code of Canada* (NBCC) as adopted by the various Provincial Authorities.

Building Use

Building regulations differ for various types of use and occupancy. Specify classification of use, such as single family residential, multi-family residential, offices, retail, manufacturing, churches, institutional (long-term care, nursing homes, schools, hospitals, jails, etc.) or agricultural (non-human occupancy).

Geometry

Furnish span (out-to-out of bearings, plus cantilevers, if any), slope, overhang conditions, etc., that form the profiles or external geometry of the trusses. Web configuration need not be furnished, as it is determined by the overall truss design. Also furnish any minimum lumber size requirements.

Bearings

Specify all exterior and interior points of bearing, showing location by dimension and size. Reaction forces at point of bearing may affect the required size of bearing surface to prevent crushing.

Spacing

Give center-to-center spacing of trusses. If trusses are spaced greater than 24 inches center-to-center, it is necessary to indicate the purlin spacing and method of attachment to the trusses.

Design (Specified) Loads

Truss design (specified) loads include both live and dead loads which may be uniformly distributed or may be concentrated at various locations.

LIVE LOADS: Live loads are non-permanent loads. Environmental loads produced by snow, wind, rain, or seismic forces are live loads. The weight of temporary construction materials and occupant floor loads are live loads. Live loads are usually uniform in their application and are set by building codes or building designer. Live loads will vary by location and use and should be furnished in pounds-per-square-foot, or other clearly defined format.

DEAD LOADS: Dead loads are the weight of the materials in the structure and any items permanently placed on the structure.

SPECIAL LOADS: Special loads can be live or dead. Examples of special loads might include mechanical units, poultry cages, cranes, sprinkler systems, moveable partition walls, etc. The weight, location and method of attachment must be provided to the truss designer.

Multiple load cases may be required in truss design.

Special Conditions

Some of the special conditions that are important to truss design include:

1) Jobsite conditions that may cause rough handling of the trusses.

2) High moisture or temperature conditions.

3) Use of trusses to transfer wind loads.

4) Fire resistance requirements.

5) Higher adjacent roofs that may discharge snow onto lower roofs.

6) Location from coastline, exposure and height above ground for wind.

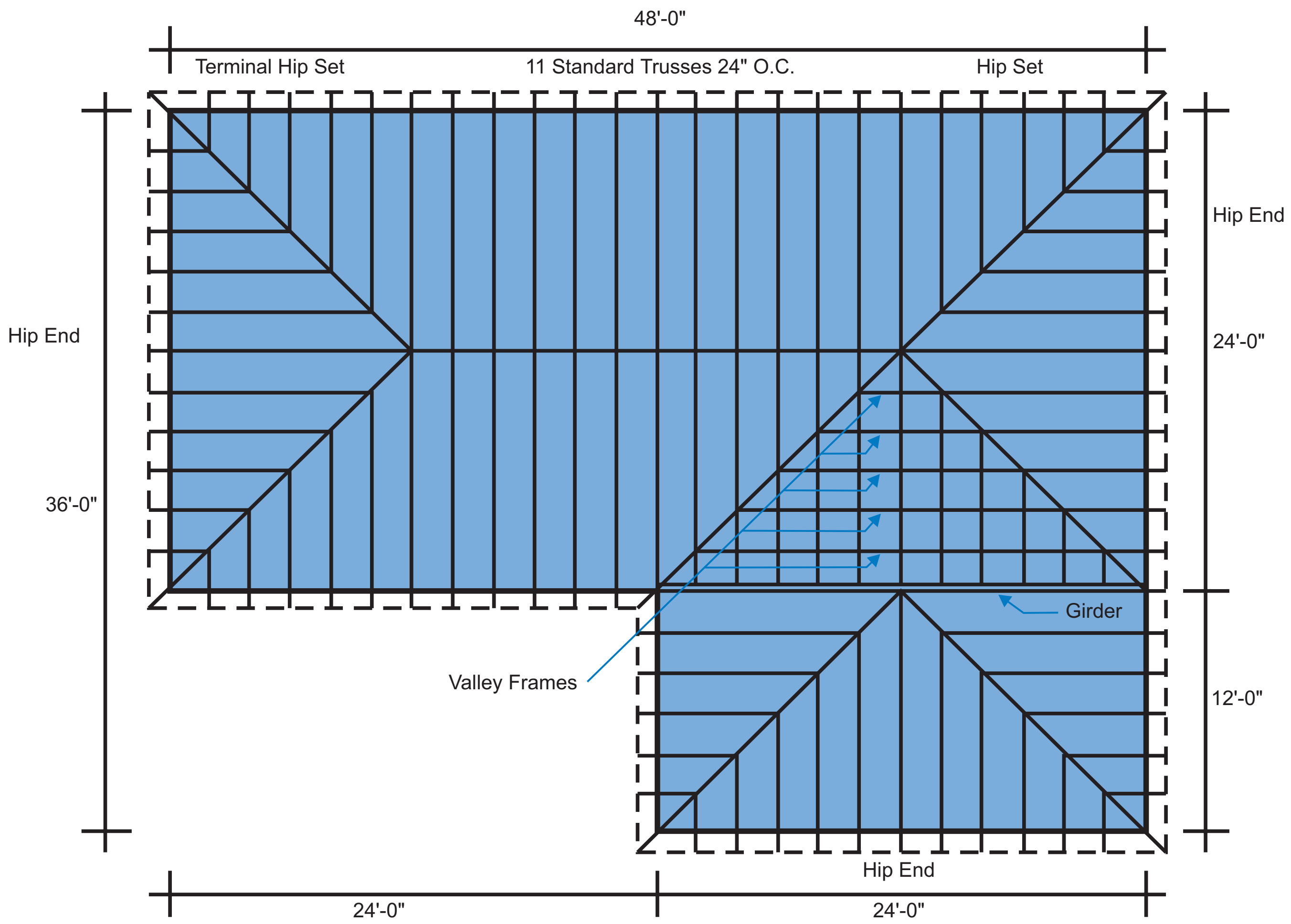
7) Parapets, signage or other obstructions that may cause snow drifting, or prevent the free run-off of water from the roof.

8) Any other condition that affects the load carrying ability of the roof or floor framing.

9) Floor trusses, office loads or ceramic tiles require special considerations during the building and truss design process.

Lack of information about any of these conditions could adversely affect the performance of the trusses.

To Figure Truss Requirements		Calculations	Truss Order
1	Determine the part of the larger rectangle requiring common trusses (distance from peak point to peak point) by subtracting the width or span from the length	48'-0" - 24'-0" = 24'-0" Distance requiring. Standard Trusses.	**FOR LARGE RECTANGLE**
			5 Standard 24'-0" trusses overhang on both ends.
			6 Standard 24'-0" Trusses clipped on one end.
2	Divide this distance by 2 (trusses are set 24" on center) and subtract one truss.	24'-0" ÷ 2 = 12 Trusses. 12 - 1 = 11.	1 Terminal Hip Set 24'-0" overhang both ends.
			1 Terminal Hip Set 24'-0" overhang one end.
3	Add the number of Hip Ends required.	2 Hip Ends.	
			FOR SMALLER RECTANGLE
4	No overhang on trusses to be carried by the girder.		1 Girder 24'-0" Span.
5	Determine the Multi-Ply Girder.	24'-0" Span Girder carrying 24-0" Span Trusses.	1 Terminal Hip Set, 24'-0" span, overhang on both ends.
6	Add one Hip End for the Projection.	1 Hip End.	1 Set of 5 Valley Frames.
7	Determine the number of Valley Frames.	Valleys for 24'-0" Span.	



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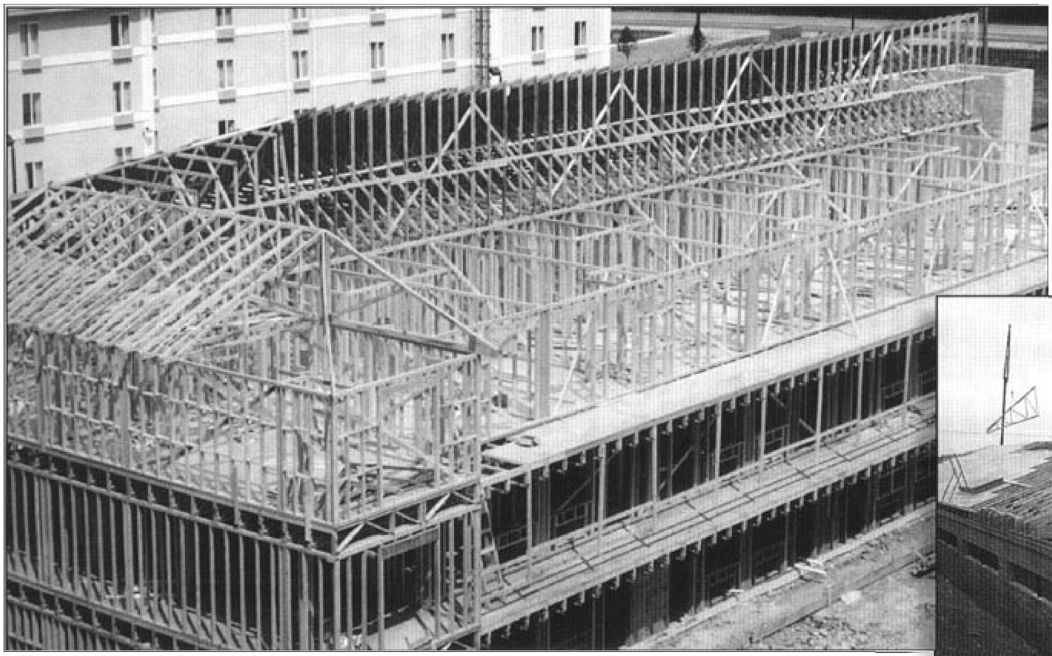
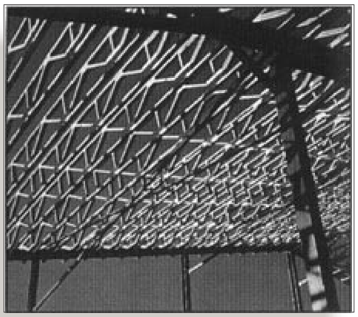
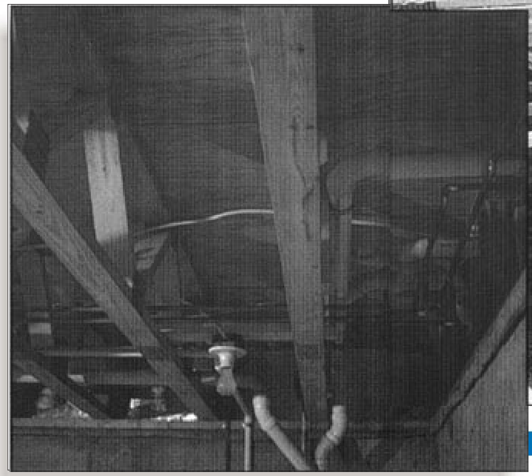
Framing With Roof Trusses



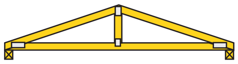


Framing With Floor Trusses

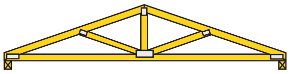


Truss Configurations

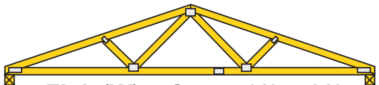
Wood trusses are pre-built components that function as structural support members. A truss commonly employs one or more triangles in its construction. The wood truss configurations illustrated here are a representative sampling.



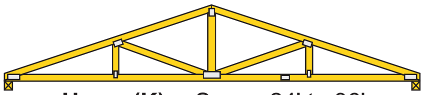
King Post -- Span Up to 16'



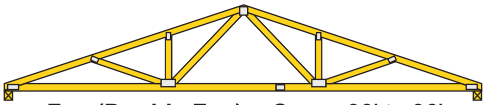
Queen Post (Fan) -- Spans 10' to 22'



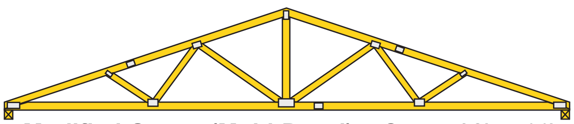
Fink (W) -- Spans 16' to 33'



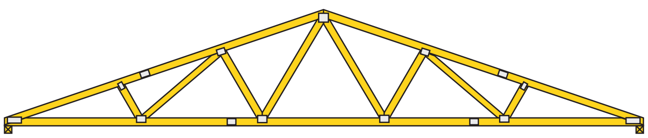
Howe (K) -- Spans 24' to 36'



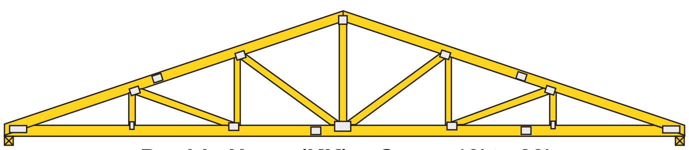
Fan (Double Fan) -- Spans 30' to 36'



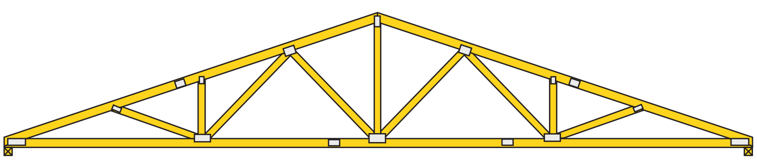
Modified Queen (Multi-Panel) -- Spans 32' to 44'



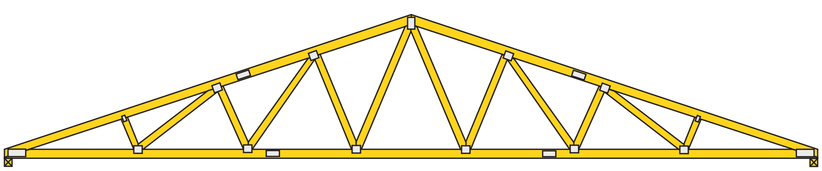
Double Fink (WW) -- Spans 40' to 60'



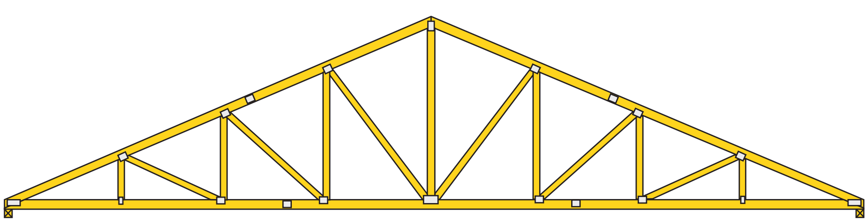
Double Howe (KK) -- Spans 40' to 60'



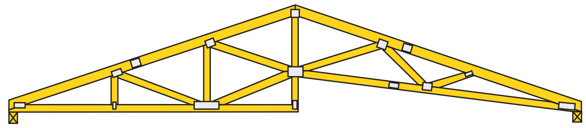
Modified Fan (Triple Fan) -- Spans 44' to 60'



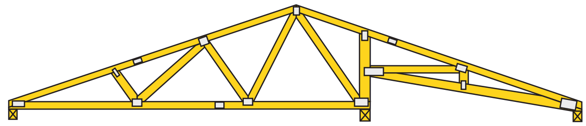
Triple Fink (WWW) -- Spans 54' to 80'



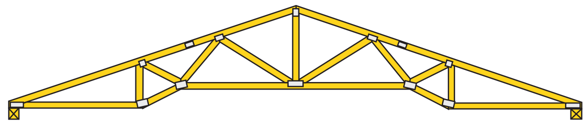
Triple Howe (KKK) -- Spans 54' to 80'



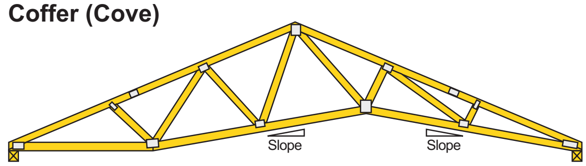
Vault - Two Bearing Points



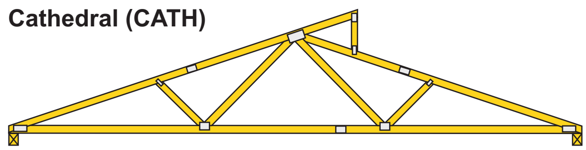
Vault - Three Bearing Points



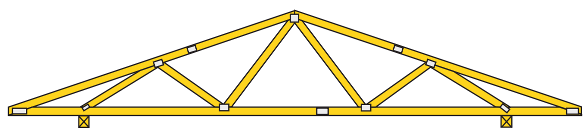
Coffer (Cove)



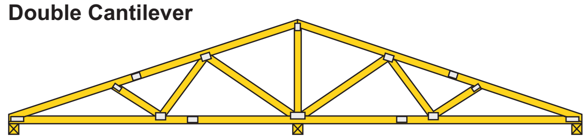
Cathedral (CATH)



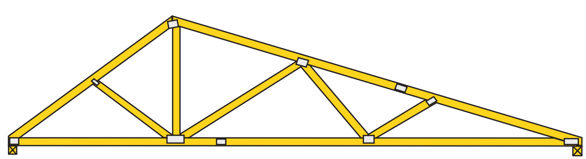
Clear Story



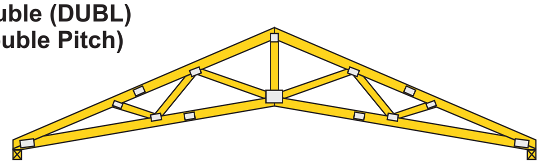
Double Cantilever



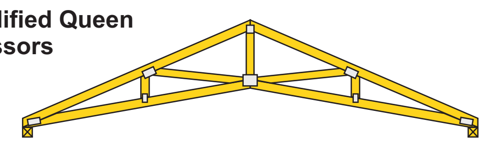
Tri-Bearing



Double (DUBL)
(Double Pitch)

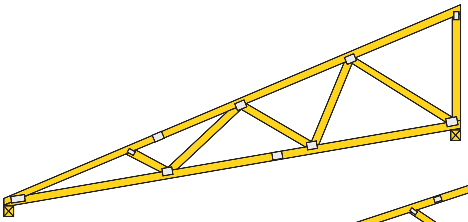


Modified Queen
Scissors

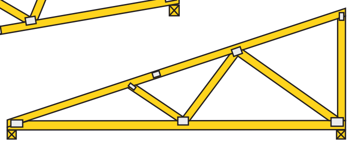


Howe Scissors

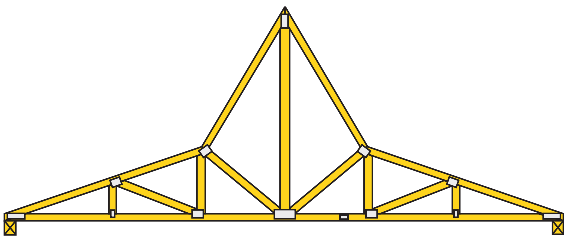
The number of panels, configuration of webs and length of spans will vary according to given applications, building materials and regional conditions. Always refer to an engineered drawing for the actual truss design.



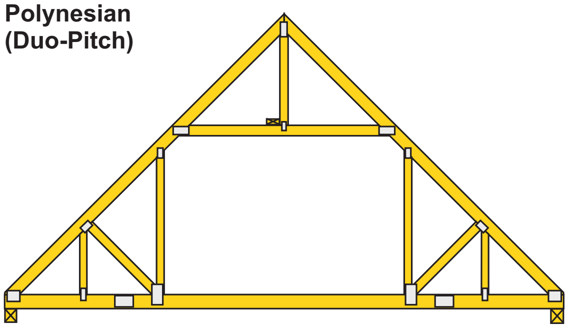
Scissors Mono



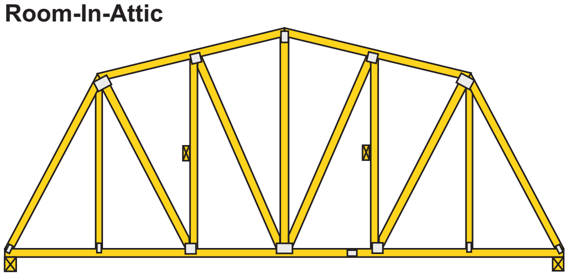
Mono



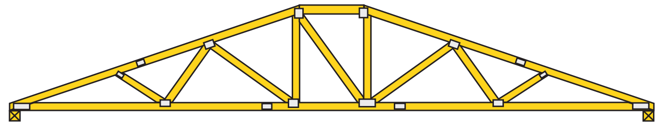
Polynesian (Duo-Pitch)



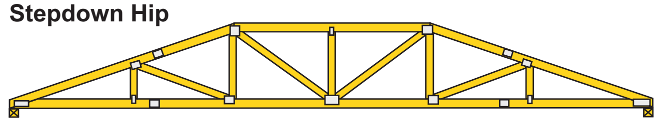
Room-In-Attic



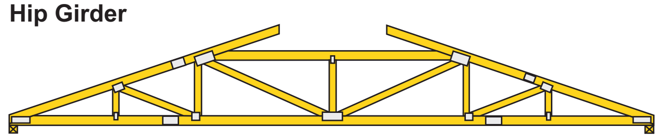
Gambrel



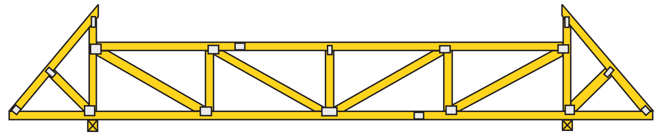
Stepdown Hip



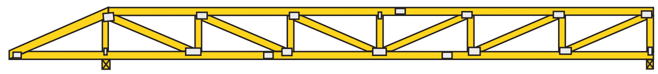
Hip Girder



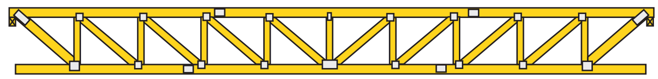
California Hip



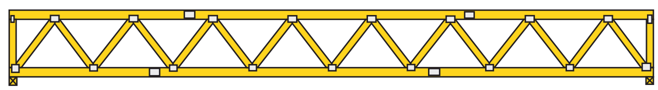
Double Cantilever With Parapets



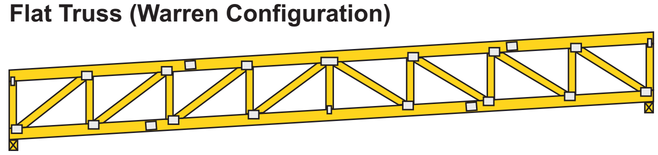
Flat Truss With Cantilever (Pratt Configuration)



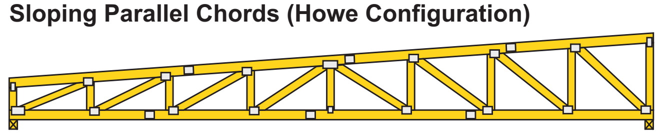
Top Chord Bearing Flat Truss (Pratt Configuration)



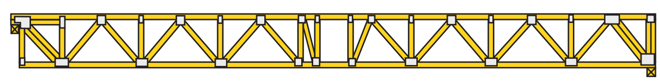
Flat Truss (Warren Configuration)



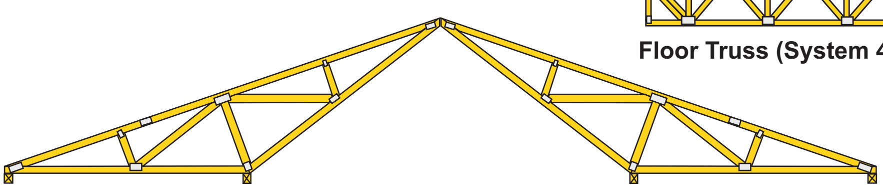
Sloping Parallel Chords (Howe Configuration)



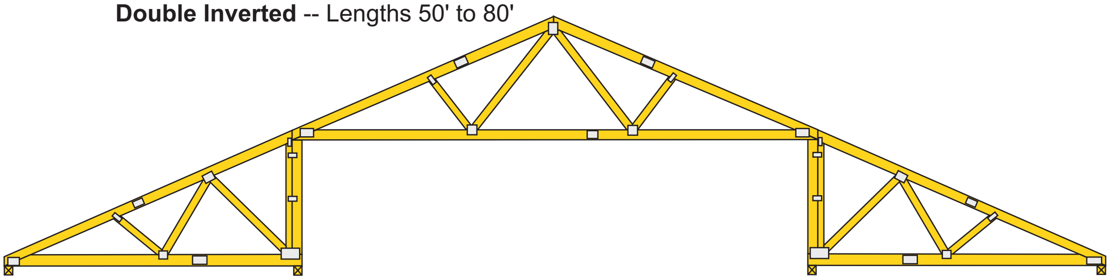
Sloping Top Chord (Howe Configuration)



Floor Truss (System 42 - Modified Warren Configuration)



Double Inverted -- Lengths 50' to 80'



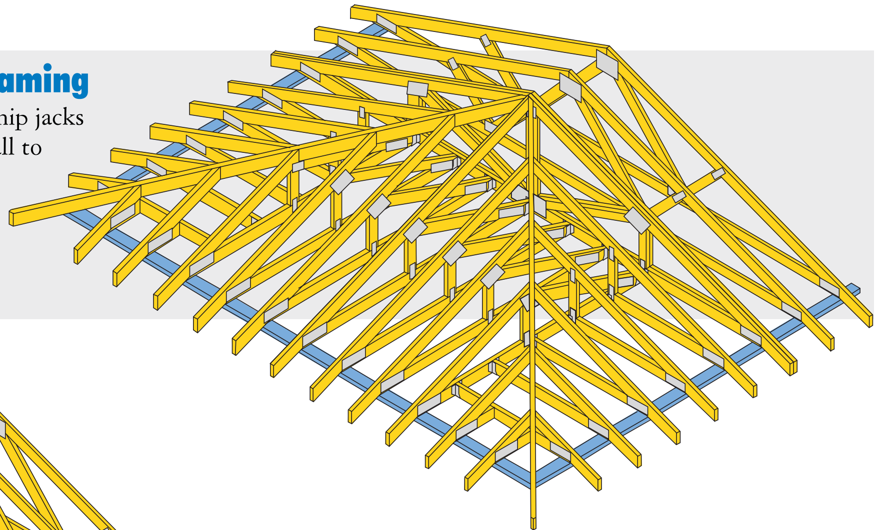
Three Piece Raised Center Bay -- Lengths 50' to 100'+

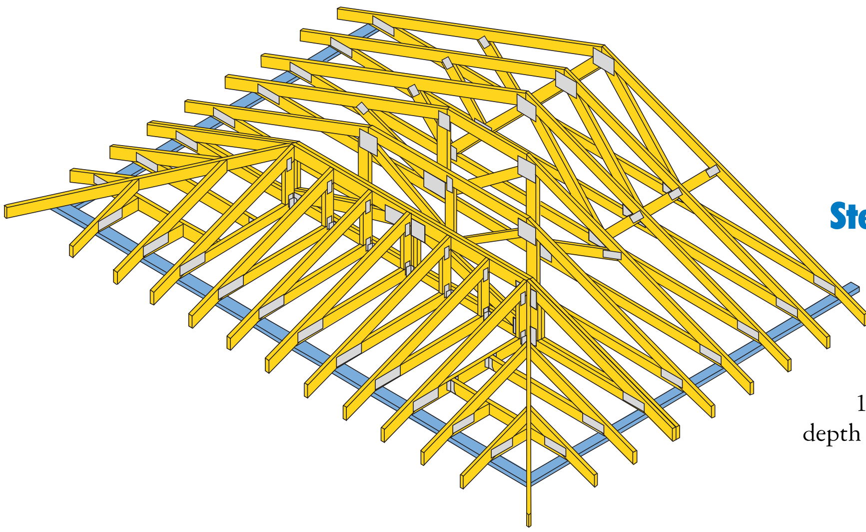
Hip Framing

Trussed hip framing offers the advantage of clear span, an eave or fascia line at the same elevation around the building, and the speed of pre-built components. The end slope may be equal to or different from the side slope. The ceiling line may be flat or sloped. Sloped ceilings have limitations, therefore, consult the truss designer.

Terminal Hip Framing

Best suited for relatively short spans of 26'-0" or less, the hip jacks extend directly to the peak. The distance from the end wall to the face of the girder is equal to one half the span, provided the slopes are equal. The last standard truss is designed as a girder to carry the loads transferred by the hip jack.



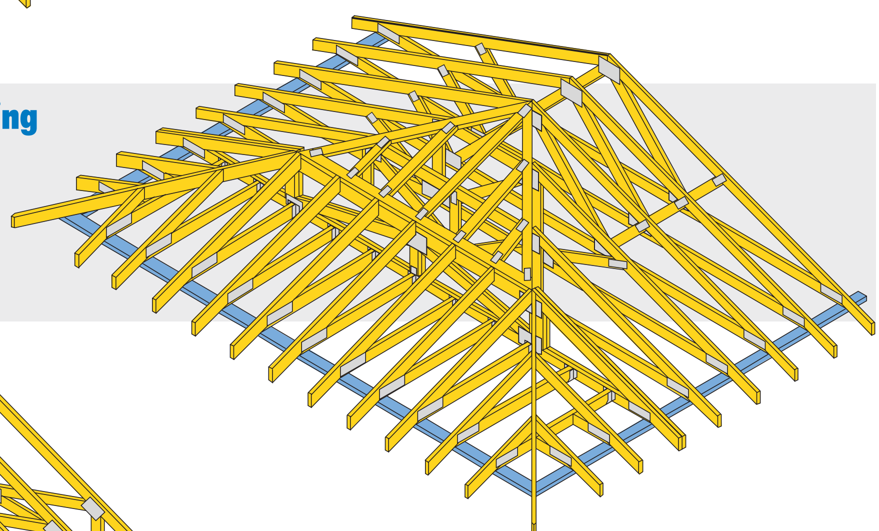


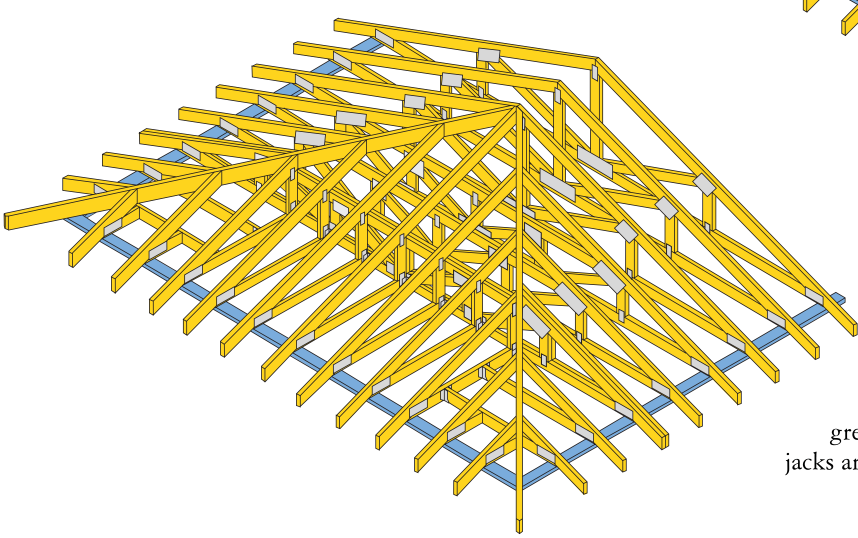
Step Down Hip Framing

Better suited for longer spans, the step down hip is the most versatile of all hip types. Each of the “step down” trusses is the same span and has the same overhang as the adjacent standard trusses, but decrease in height to form the end slope. The girder location is generally from 8 to 12 feet from the end wall and is determined by the span to depth ratio. The corner and end jacks are normally pre-built.

Midwest Hip Framing

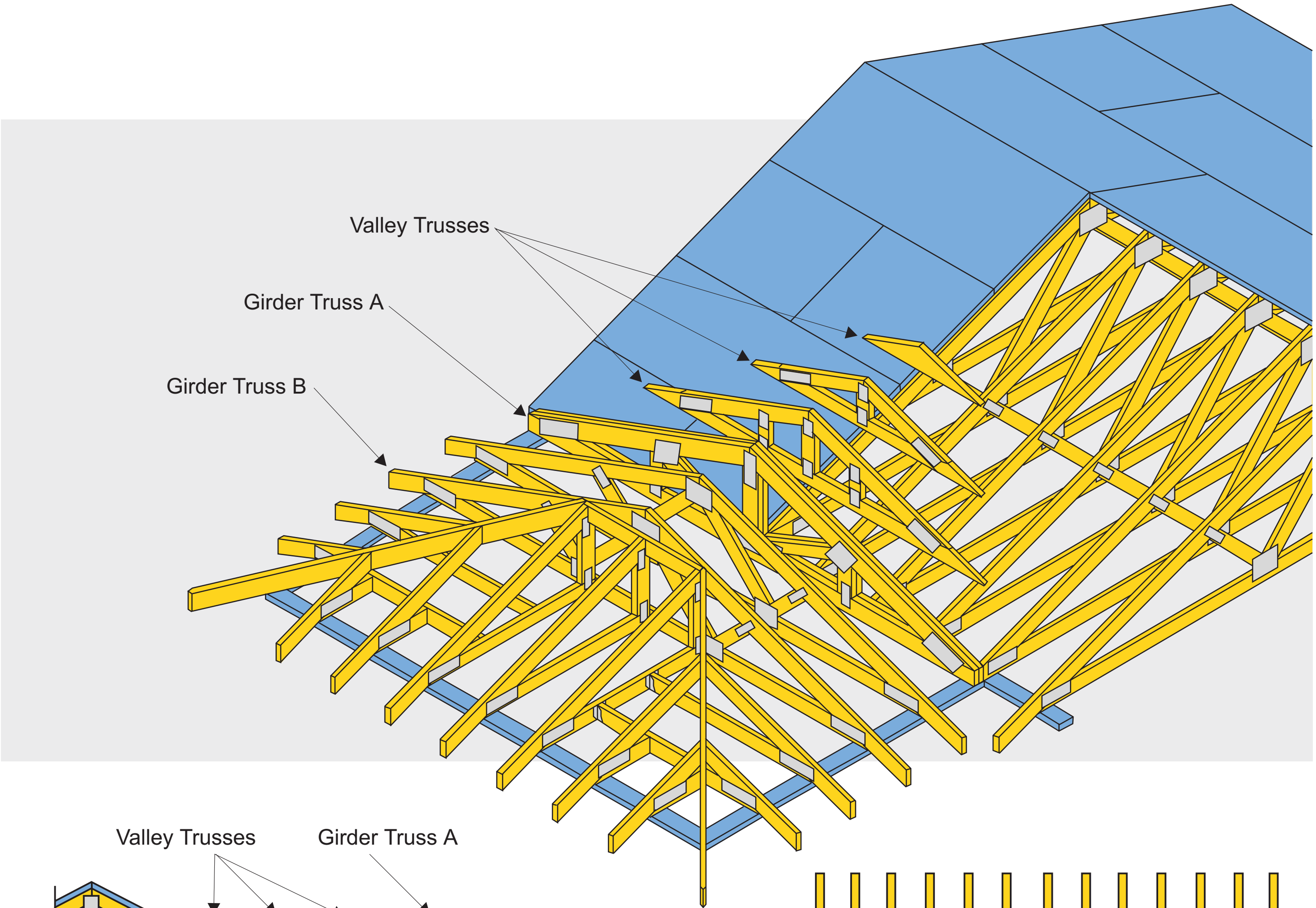
The Midwest type hip framing was developed to create a more uniform configuration of each of the trusses in the hip. This hip type also provides for a more uniform structure for attaching the decking. Spans achievable are in the mid range.

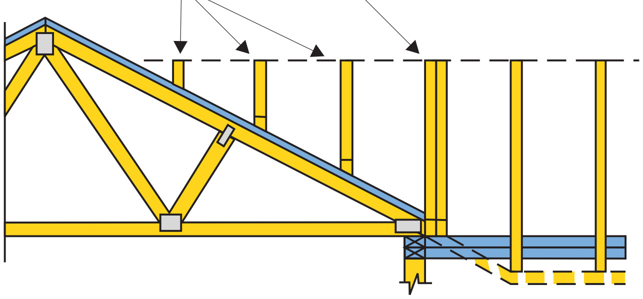


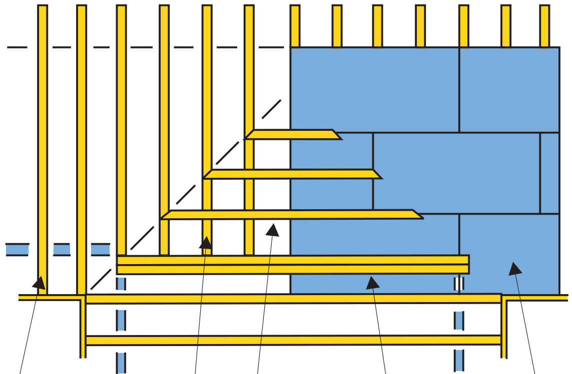


California Hip Framing

Although this type hip framing is used as an alternative to the step down hip, the California hip is similar in span capability and field installation. The base portion of each truss inside the girder is the same, except that the sloping top chord of each successive truss is extended upward greater amounts to form the slope intersection. Corner and end jacks are used to form the area outside the girder.







Girder Trusses

Girder trusses have two main purposes. The first (Girder Truss A) exists in L, T, H and U shaped buildings to eliminate the need for an interior load-bearing wall. The girder is used to support one end of the intersecting trusses. The trusses are carried on the bottom chord of the girder by hangers.

The second use of a girder truss (Girder Truss B) is to support perpendicular framing in hip roofs. In some plans girder truss A and B may be one in the same. The hip framing is carried on both the top and bottom chords of the girder truss by nailing or by hangers.

Girder trusses, because of the heavy loads they support, are generally multiple units with larger chord members than the adjacent trusses. Generally, because of the construction of girders, overhangs are not used.

The girder truss may also be designed for "drag strut" loads which are calculated and specified by the building designer.

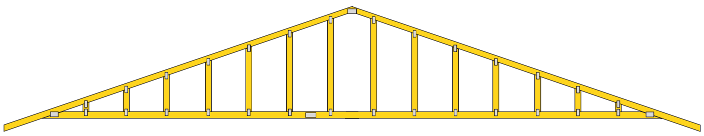
Valley Framing Sets

Valley framing sets are primarily used to form a ridge line by framing over the main roof where perpendicular building sections intersect.

Valley trusses are set directly on the main trusses. Sheathing is required for main trusses with 2x4 top chords, and is recommended for other top chord sizes, under valley frames to continue the lateral bracing of the main truss top chords. The bottom chords of the valley trusses are generally beveled to match the slope of the roof below.

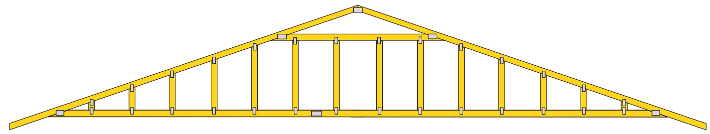
Gable Framing

Gable ends when not configured in triangles as a truss, are more related to stud walls. However, they are structural elements and are analyzed to resist wind and seismic loads as noted on the truss design. 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 end overhang and the need to match a soffit line.

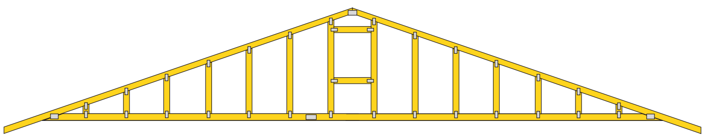


Standard Gable

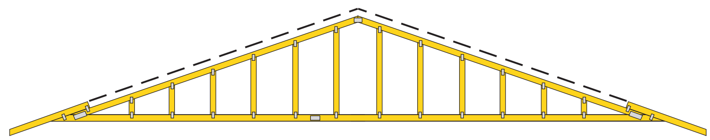
Stud spacing as necessary to support siding.



Standard Gable Framed For Triangular Louver

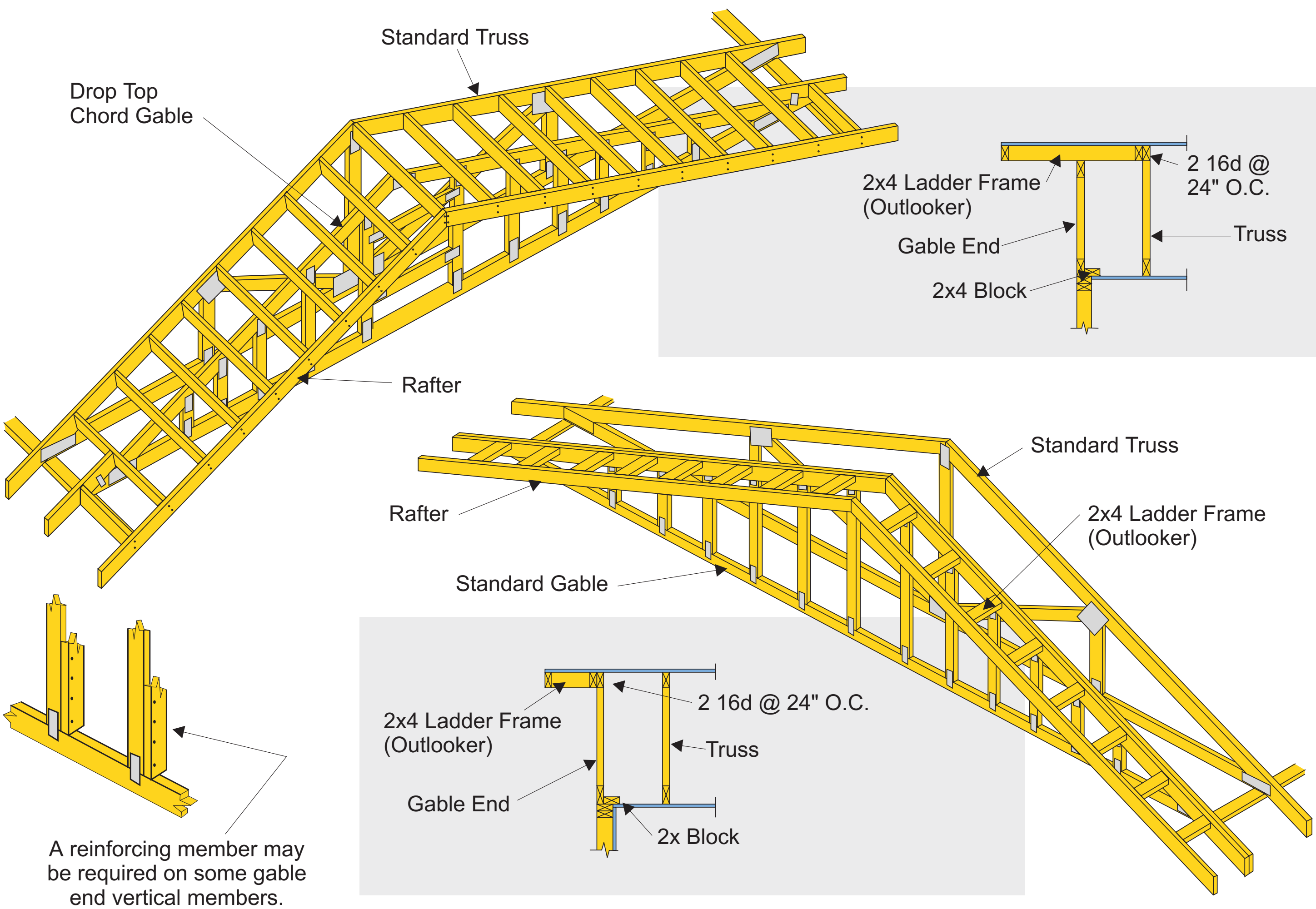


Standard Gable Framed For Rectangular Louver

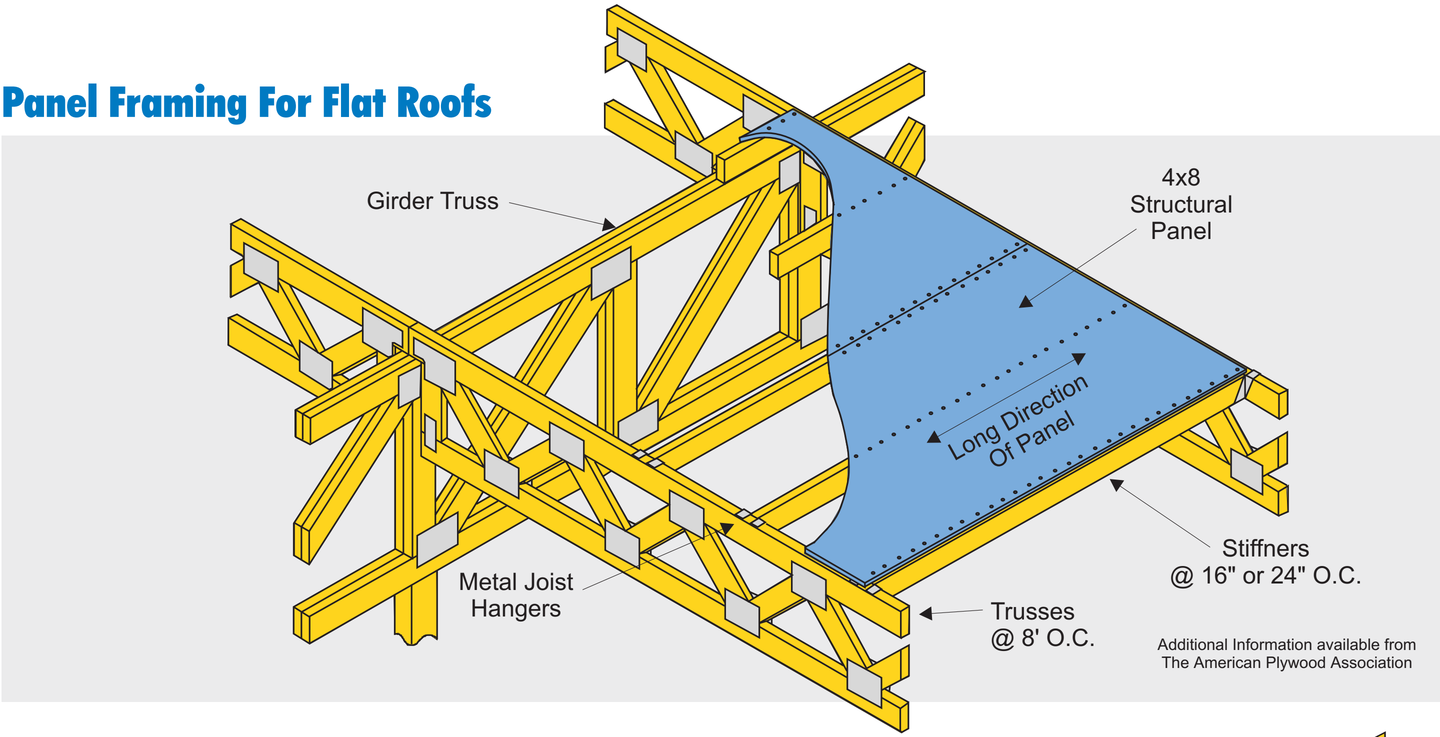


Dropped Top Chord Gable

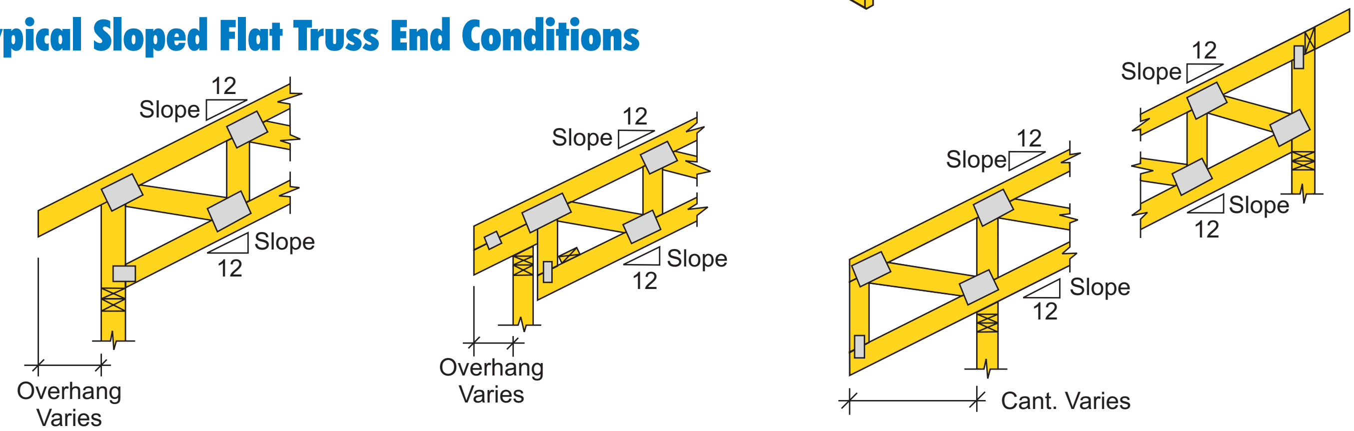
Illustrated with studs. Also available with framing for rectangular, square or triangular louver.

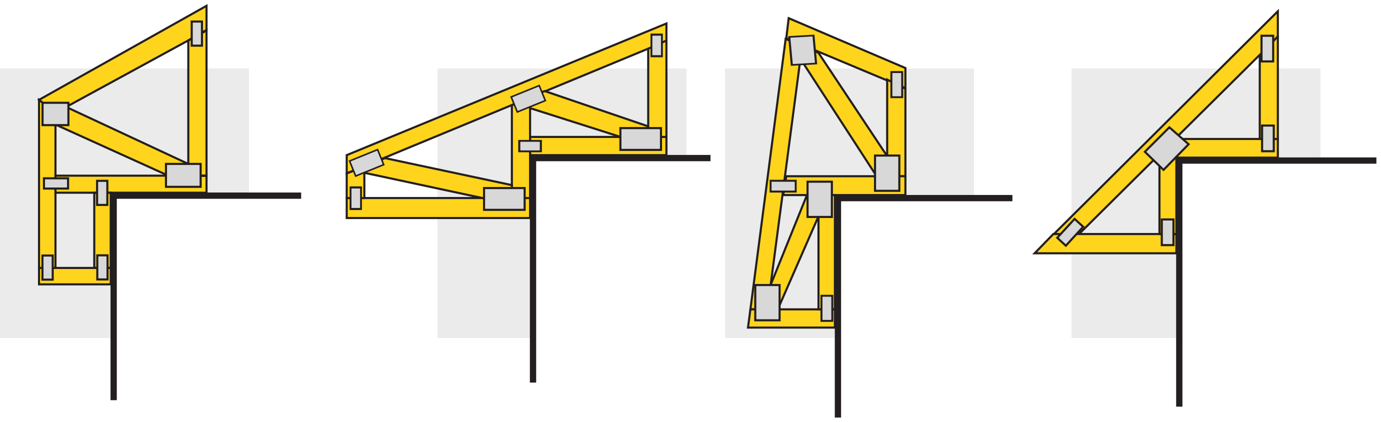


Panel Framing For Flat Roofs



Typical Sloped Flat Truss End Conditions





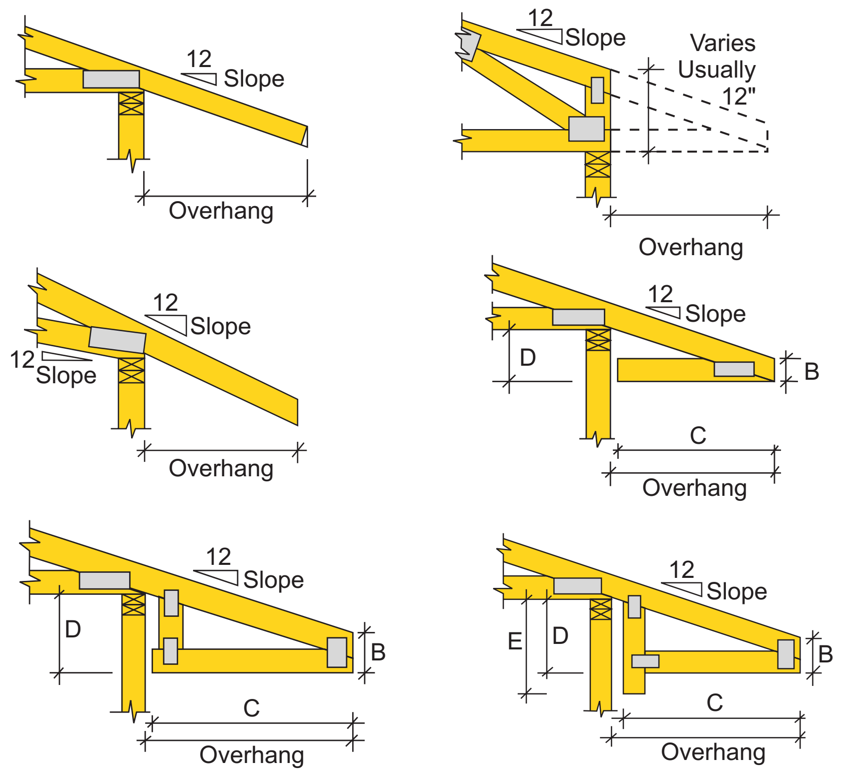
Mansard Frames

Mansard details are normally built onto the truss. However, there are design situations where it is more appropriate to have the mansard frame installed independent of the roof framing. Those occasions might be when the use of the building dictates a construction type requiring masonry exterior walls and a non-combustible roof, difficult erection and handling situations or remodeling. Building codes may require special load cases.

Cantilevers and Overhangs

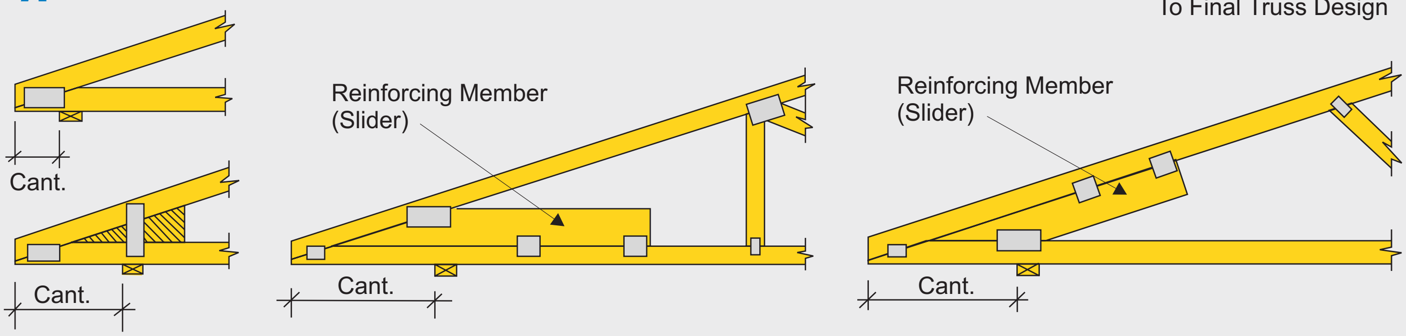
Cantilever conditions are common in truss designs. A cantilever exists when the bearing wall occurs inside of the truss overall length, excluding overhangs, such as to form a porch or entrance way.

When the bearing is located under the scarf line of the truss, no heel joint modification is needed. Wedge blocks or reinforcing members are used to stiffen the heel panel when the bearing is moved inside the scarf line. Wedge blocks act to stiffen the heel joint and are connected to the top and bottom chord with connector plates located over or just inside the bearing. Reinforcing members allow longer cantilevers by stiffening the top and bottom chords in the heel panel. Correct plating of reinforcing members varies from normal heel joints.

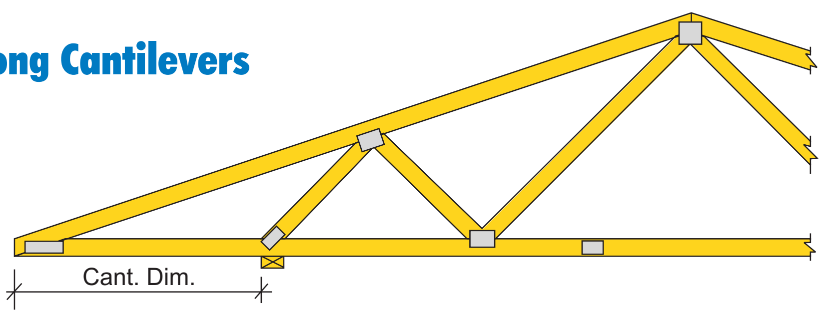


Typical Methods Used In Cantilever Conditions

Exact Method Subject To Final Truss Design

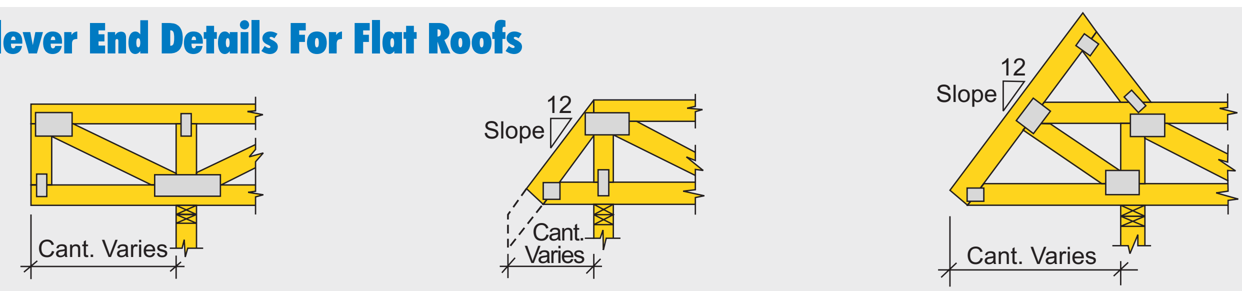


Long Cantilevers



The additional web (strut) is added when the cantilever distance is too long for use with the wedge block or reinforcing member. This member often requires continuous lateral bracing (CLB).

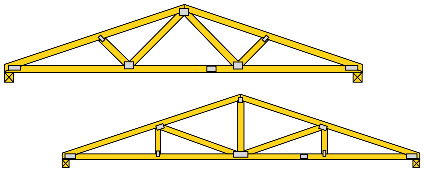
Cantilever End Details For Flat Roofs



Alpine truss designs are engineered to meet specific span, configuration and load conditions. The shapes and spans shown here represent only a fraction of the millions of designs processed by Alpine engineers.

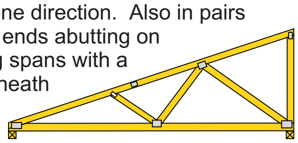
Total load(PSF)	55			47			40			40		
Duration factor	1.15			1.15			1.15			1.25		
Live load(PSF)	40 snow			30 snow			20 snow			20 **		
Roof type	shingle			shingle			shingle			shingle		
	55 1.15 30 snow tile									**construction or rain, not snow load		
Top Chord	2x4	2x6	2x6	2x4	2x6	2x6	2x4	2x6	2x6	2x4	2x6	2x6
Bottom Chord	2x4	2x4	2x6	2x4	2x4	2x6	2x4	2x4	2x6	2x4	2x4	2x6

Common -- Truss configurations for the most widely designed roof shapes.



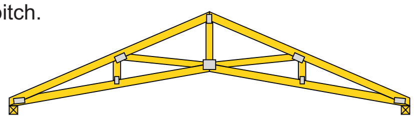
Pitch	Spans in feet to out of bearing											
2/12	24	24	33	27	27	37	31	31	43	33	33	46
2.5/12	29	29	39	33	33	45	37	38	52	39	40	55
3/12	34	34	46	37	39	53	40	44	60	43	46	64
3.5/12	39	39	53	41	44	61	44	50	65	47	52	70
4/12	41	43	59	43	49	64	46	56	69	49	57	74
5/12	44	52	67*	46	58	69*	49	66	74*	53	66	80*
6/12	46	60*	69*	47	67*	71*	51	74*	76*	55	74*	82*
7/12	47	67*	70*	48*	72*	72*	52*	77*	77*	56*	80*	83*

Mono -- Used where the roof is required to slope only in one direction. Also in pairs with their high ends abutting on extremely long spans with a support underneath the high end.



2/12	24	24	33	25	27	38	27	31	41	29	32	44
2.5/12	28	29	40	29	32	43	31	37	46	33	37	49
3/12	30	33	45	31	37	47	34	42	50	36	42	54
3.5/12	33	37	49*	34	41	51*	36	46	54*	39	46	58*
4/12	35	41	52*	36	45*	54*	39	50*	58*	42*	49*	62*
5/12	38*	47*	57*	39*	51*	59*	42*	56*	63*	45*	54*	68*

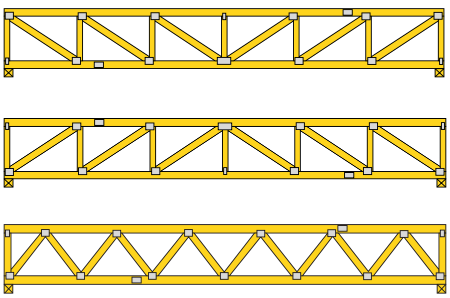
Scissors -- Provides a cathedral or vaulted ceiling. Most economical when the difference in slope between the top and bottom chords is at least 3/12 or the bottom chord pitch is no more than half the top chord pitch.



6/12 - 2/12 ‡	40	43	59*	42	49	62*	45	56*	66	48	57*	71*
6/12 - 2.5/12 ‡	37	38	52	38	44	57*	41	50	61*	44	52	66*
6/12 - 3/12 ‡	33	33	45	35	38	52	38	43	56*	40	46	60*
6/12 - 3.5/12 ‡	28	28	38	32	32	44	34	37	50	36	39	54
6/12 - 4/12 ‡	22	22	31	26	26	36	30	30	41	32	32	44

‡ Other pitch combinations available with these spans
For Example, a 5/12 - 2/12 combination has approx. the same allowable span as a 6/12 - 3/12

Flat -- The most economical flat truss for a roof is provided when the depth of the truss in inches is approximately equal to 7% of the span in inches.

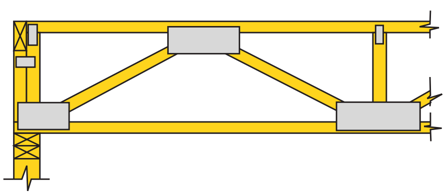


Total load(PSF)	55			47			40			40		
Duration factor	1.15			1.15			1.15			1.25		
Live load(PSF)	40 snow			30 snow			20 snow			20 rain or constn.		
Top Chord	2x4	2x6	2x6	2x4	2x6	2x6	2x4	2x6	2x6	2x4	2x6	2x6
Bottom Chord	2x4	2x4	2x6	2x4	2x4	2x6	2x4	2x4	2x6	2x4	2x4	2x6
Depth	**Spans in feet to out of bearing**											
16"	23	24	25 §	25 §	25 §	25 §	25 §	25 §	25 §	25 §	25 §	25 §
18"	25	27	28	27	27	29 §	29 §	29 §	29 §	29 §	29 §	29 §
20"	27	28	30	28	28	32	31	30	33 §	32	31	33 §
24"	29	30	33	31	31	35	34	33	38	35	34	40
28"	32	32	36	34	33	39	37	36	42	38	37	44
30"	33	33	38	35	35	40	38	37	44	40	39	45
32"	34	34	39	36	36	42	39	39	45	41	40	47
36"	36	36	42	39	38	45	42	41	48	43	43	50
42"	39	39	45	41	41	48	44	44	52	45	46	54
48"	40	42	49	43	44	52	46	47	56	46	49	58
60"	44	47	55	46	49	58	48	53	63	49	55	65
72"	45	51	60	48	54	64	51	57	68	51	59	69

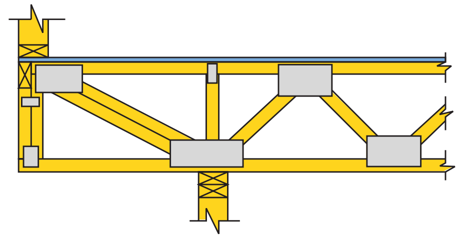
§ = Span Limited by length to depth ratio of 24

NOTES: These overall spans are based on NDS 91 with 4" nominal bearing each end, 24" o.c. spacing, a live load deflection limited to L/240 maximum and use lumber properties as follows: 2x4 f_b=2000 psi f_t=1100 psi E=1.8x10^6 2x6 f_b=1750 psi f_t=950 psi f_c=1900 psi E=1.8x10^6. Allowable spans for 2x4 top chord trusses using sheathing other than plywood (e.g. spaced sheathing or 1x boards) may be reduced slightly. Trusses must be designed for any special loading such as concentrated loads from hanging partitions or air conditioning units, and snow loads caused by drifting near parapet or slide-off from higher roofs. To achieve maximum indicated spans, trusses may require six or more panels. Trusses with an asterisk (*) that exceed 14' in height may be shipped in two pieces. Contact your local Alpine truss manufacturer or office for more information.

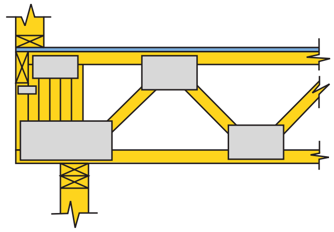
Framing With Trusses: Floors



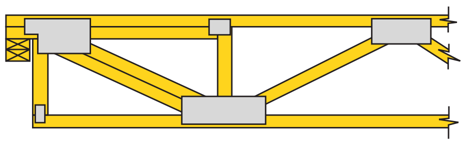
Bottom chord bearing on a stud wall.



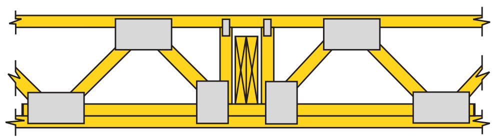
Cantilever with an exterior wall on the end.



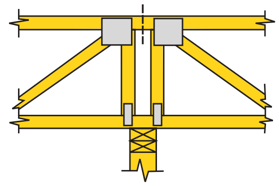
Bottom chord bearing
with short cantilever.



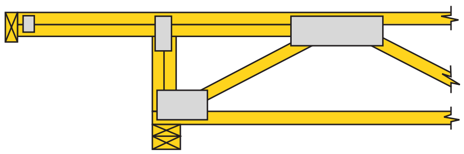
Top chord bearing on stud wall
with KL connector plate.



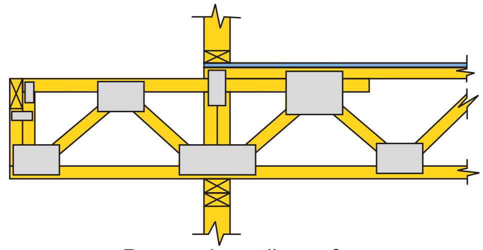
Floor truss designed to carry an interior header.



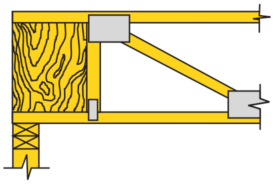
Interior bearing on wall



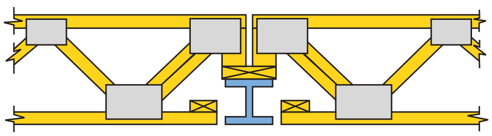
Overhang on a floor truss used on a roof.



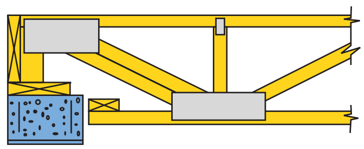
Dropped cantilever for
use on exterior balconies.



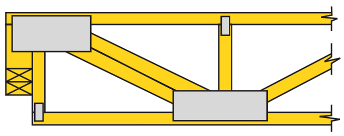
Trimmable end condition
for special applications.



Interior top chord bearing with
a variable end height.

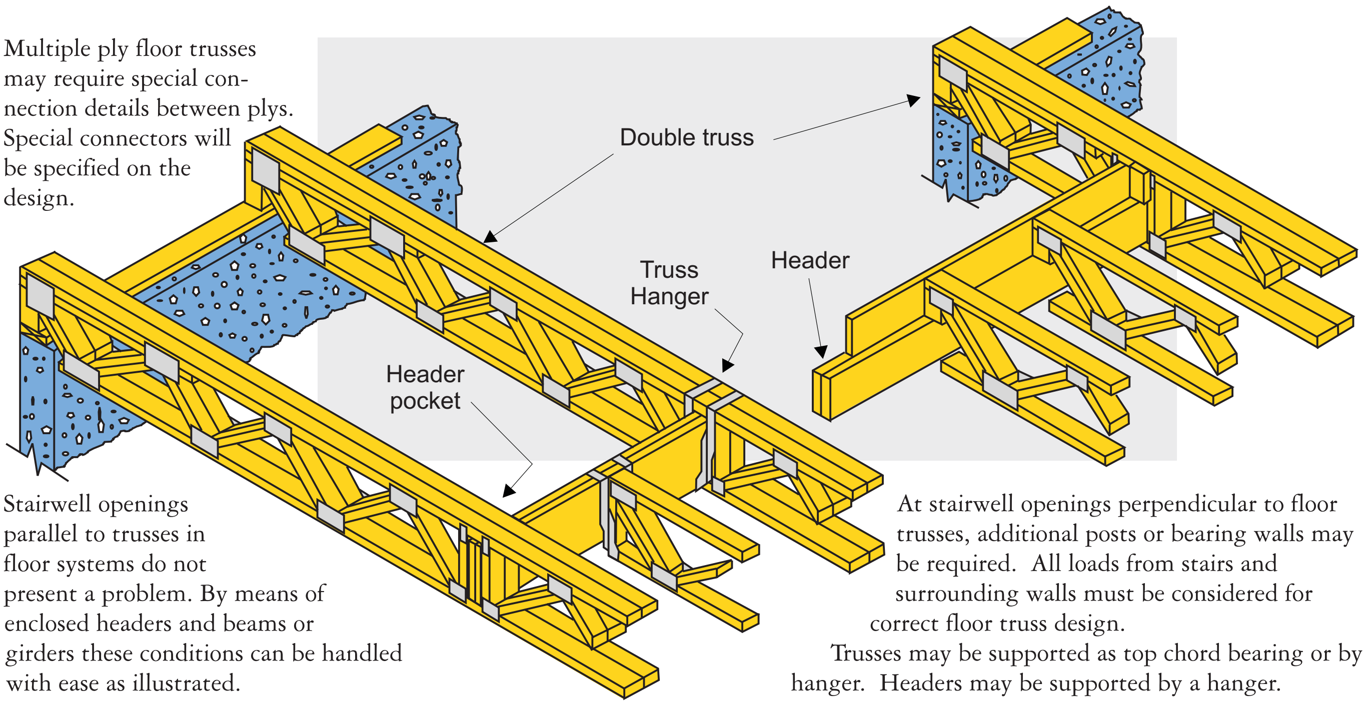


Top chord bearing with
a variable end height.



Top chord bearing on stud wall
with variable end height.

Multiple ply floor trusses may require special connection details between plys. Special connectors will be specified on the design.



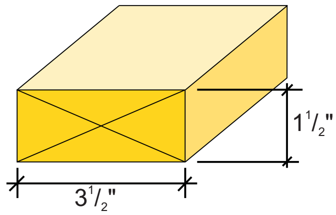
Stairwell openings parallel to trusses in floor systems do not present a problem. By means of enclosed headers and beams or girders these conditions can be handled with ease as illustrated.

At stairwell openings perpendicular to floor trusses, additional posts or bearing walls may be required. All loads from stairs and surrounding walls must be considered for correct floor truss design.

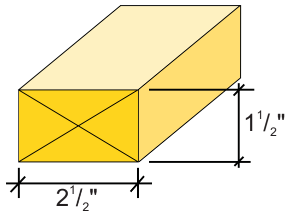
Trusses may be supported as top chord bearing or by hanger. Headers may be supported by a hanger.

These allowable spans are based on NDS 91. Maximum deflection is limited by L/360 or L/480[1] under live load. Basic Lumber Design Values are $F_{(b)}$=2000 psi $F_{(t)}$=1100 psi $F_{(c)}$=2000 psi E=1,800,000 psi Duration Of Load = 1.00. Spacing of trusses are center to center (in inches). Top Chord Dead Load = 10 psf. Bottom Chord Dead Load = 5 psf. Center Line Chase = 24" max. Trusses must be designed for any special loading, such as concentrated loads. Other floor and roof loading conditions, a variety of species and other lumber grades are available.

4x2 Lumber



3x2 Lumber



40 PSF Live Load / 55 PSF Total Load

Center Spacing	Deflection Limit	4x2: 12"	14"	16"	18"	20"	22"	3x2: 12"	14"	16"	18"	20"	22"
16" o.c.	L/360	22'2"	24'11"	26'10"	28'8"	30'4"	31'11"	19'0"	20'9"	22'4"	23'10"	25'3"	26'7"
	L/480	20'2"	22'7"	24'11"	27'2"	29'4"	31'5"	18'0"	20'2"	22'4'	23'10"	25'3"	26'7"
19.2" o.c.	L/360	20'9"	22'8"	24'4"	26'0"	27'6"	29'0"	17'3"	18'9"	20'3"	21'7"	22'10"	24'1"
	L/480	18'11"	21'3"	23'6"	25'7"	27'6"	29'0"	16'11"	18'9"	20'3"	21'7"	22'10"	24'1"
24" o.c.	L/360	18'5"	20'1"	21'7"	23'1"	24'5"	25'9"	15'2"	16'7"	17'10"	19'1"	20'2"	21'3"
	L/480	17'7"	19'9"	21'7"	23'1"	24'5"	25'9"	15'2"	16'7"	17'10"	19'1"	20'2"	21'3"

Truss Depth

60 PSF Live Load / 75 PSF Total Load

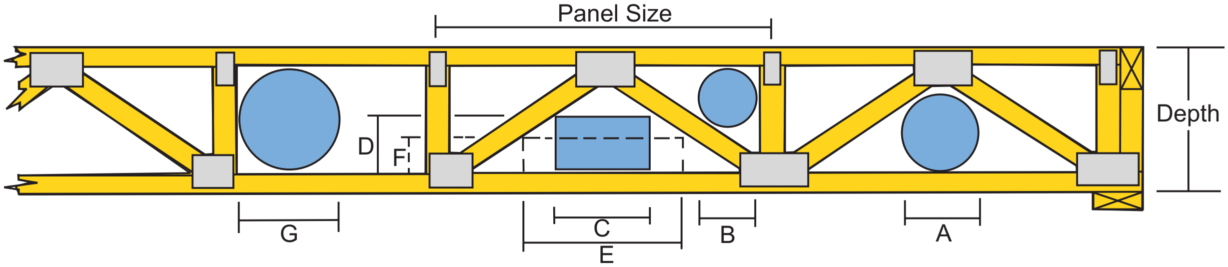
Center Spacing	Deflection Limit	4x2: 12"	14"	16"	18"	20"	22"	3x2: 12"	14"	16"	18"	20"	22"
16" o.c.	L/360	19'4"	21'4"	23'0"	24'6"	26'0"	27'4"	16'3"	17'9"	19'2"	20'5"	21'8"	22'9"
	L/480	17'7"	19'9"	21'10"	23'9"	25'8"	27'4"	15'9"	17'8"	19'2"	20'5"	21'8"	22'9"
19.2" o.c.	L/360	17'9"	19'4"	20'10"	22'3"	23'7"	24'10"	14'9"	16'1"	17'4"	18'6"	19'7"	20'7"
	L/480	16'7"	18'7"	20'6"	22'3"	23'7"	24'10"	14'9"	16'1"	17'4"	18'6"	19'7"	20'7"
24" o.c.	L/360	15'9"	17'2"	18'6"	19'9"	20'11"	22'0"	13'0"	14'2"	15'3"	16'4"	17'3"	18'2"
	L/480	15'4"	17'2"	18'6"	19'9"	20'11"	22'0"	13'0"	14'2"	15'3"	16'4"	17'3"	18'2"

85 PSF Live Load / 100 PSF Total Load

Center Spacing	Deflection Limit	4x2: 12"	14"	16"	18"	20"	22"	3x2: 12"	14"	16"	18"	20"	22"
16" o.c.	L/360	16'11"	18'6"	19'11"	21'3"	22'6"	23'8"	14'1"	15'5"	16'7"	17'8"	18'9"	19'9"
	L/480	15'8"	17'7"	19'5"	21'2"	22'6"	23'8"	14'0"	15'5"	16'7"	17'8"	18'9"	19'9"
19.2" o.c.	L/360	15'4"	16'9"	18'1"	19'3"	20'5"	21'6"	12'9"	13'11"	15'0"	16'0"	16'11"	17'10"
	L/480	14'9"	16'6"	18'1"	19'3"	20'5"	21'6"	12'9"	13'11"	15'0"	16'0"	16'11"	17'10"
24" o.c.	L/360	13'8"	14'10"	16'0"	17'1"	18'1"	19'1"	11'3"	12'3"	13'3"	14'1"	14'11"	15'9"
	L/480	13'8"	14'10"	16'0"	17'1"	18'1"	19'1"	11'3"	12'3"	13'3"	14'1"	14'11"	15'9"

(1) Vibration Control -- Research by Virginia Tech indicates that L/480 live load deflection criteria provides a high degree of resistance to floor vibration (bounce). The building designer desiring this benefit may choose to specify an L/480 live load deflection criteria to be used for the floor trusses.

Duct Openings For Fan Style Floor Trusses With 4x2 or 3x2 Chords & Webs



Typical Duct Opening Sizes For 4x2 Fan Style Floor Trusses

Depth	Panel Size	A	B	C	D	E	F	G
10	60	$4\frac{1}{2}$	$4\frac{1}{4}$	11	$4\frac{1}{2}$	16	4	7
11	60	$5\frac{1}{4}$	$5\frac{1}{4}$	12	$5\frac{1}{2}$	15	5	8
$11\frac{7}{8}$	60	$7\frac{3}{4}$	$6\frac{3}{4}$	10	$6\frac{1}{4}$	14	$5\frac{1}{2}$	$8\frac{3}{4}$
12	60	$6\frac{1}{4}$	$6\frac{1}{4}$	14	6	20	5	9
13	60	$7\frac{1}{4}$	$7\frac{1}{4}$	12	7	$18\frac{1}{2}$	6	10
14	60	$8\frac{1}{4}$	$8\frac{1}{4}$	17	7	22	6	11
15	60	$9\frac{1}{4}$	$8\frac{1}{2}$	15	8	25	6	12
16	60	$10\frac{1}{4}$	$9\frac{1}{2}$	14	9	27	6	13
18	60	$12\frac{1}{4}$	$10\frac{1}{2}$	$14\frac{1}{2}$	$10\frac{1}{2}$	26	7	15
20	60	14	$11\frac{1}{2}$	$14\frac{1}{2}$	12	26	8	17
22	60	16	$12\frac{1}{2}$	15	13	30	8	19
24	60	18	$13\frac{1}{2}$	16	14	32	8	21
26	60	19	$14\frac{1}{2}$	18	15	34	8	23
30	60	22	16	20	17	32	10	24
36	60	25	$17\frac{1}{2}$	22	$19\frac{1}{2}$	36	10	24

All Dimensions In Inches

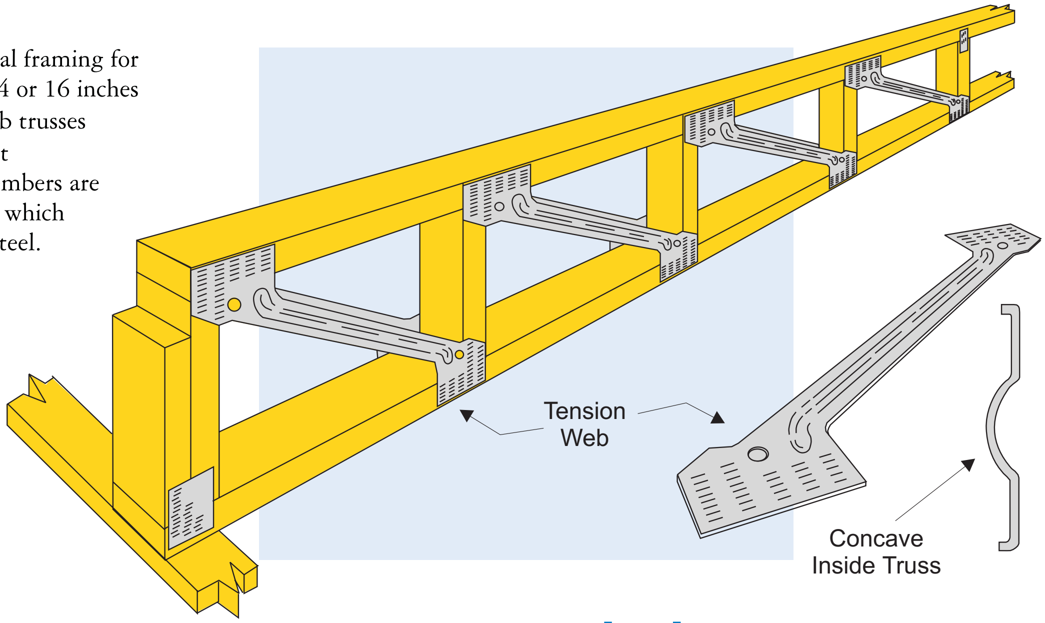
Typical Duct Opening Sizes For 3x2 Fan Style Floor Trusses

Depth	Panel Size	A	B	C	D	E	F	G
$9\frac{1}{2}$	36	$5\frac{1}{2}$	$4\frac{1}{2}$	8	$3\frac{1}{2}$	10	3	$6\frac{1}{2}$
$11\frac{7}{8}$	60	$7\frac{3}{4}$	$6\frac{3}{4}$	10	$6\frac{1}{4}$	14	$5\frac{1}{2}$	$8\frac{3}{4}$
$11\frac{7}{8}$	54	$7\frac{3}{4}$	$6\frac{1}{2}$	10	$6\frac{1}{4}$	14	$5\frac{1}{2}$	$8\frac{3}{4}$
12	54	$7\frac{3}{4}$	$6\frac{3}{4}$	10	$6\frac{1}{2}$	14	$5\frac{3}{4}$	9
13	54	$8\frac{3}{4}$	$7\frac{1}{2}$	12	7	16	6	10
14	54	$9\frac{3}{4}$	8	13	$7\frac{1}{4}$	16	$6\frac{3}{4}$	11
15	54	$10\frac{1}{2}$	$8\frac{1}{2}$	14	$7\frac{3}{4}$	17	$7\frac{1}{4}$	12
16	54	$11\frac{1}{2}$	$9\frac{1}{4}$	15	$8\frac{1}{4}$	18	$7\frac{3}{4}$	13
18	54	13	$10\frac{1}{4}$	16	$9\frac{1}{2}$	20	$8\frac{1}{4}$	15
20	54	$14\frac{1}{2}$	$11\frac{1}{4}$	17	$10\frac{1}{2}$	22	$8\frac{1}{2}$	17
22	54	16	12	18	11	24	9	19
24	54	$17\frac{1}{2}$	13	20	12	26	$9\frac{1}{2}$	21

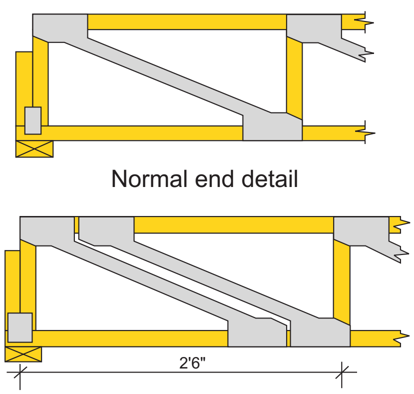
All Dimensions In Inches

Maximum duct dimensions are based on a truss plate width of 4 inches. Larger plate widths may cause a reduction in duct sizes. Chase sizes are maximum possible for centered openings.

Tension Web™ trusses provide economical framing for those applications where depths of 12, 14 or 16 inches (± 3/4") are appropriate. The Tension Web trusses consist of parallel wood chords with Pratt configuration webs. The vertical web members are wood, while the diagonal web members, which are in tension, are 20 gauge galvanized steel. This combination reduces deflection, sagging, and bounce in the floor assembly. The vertical members allow for easy attachment of strongback bracing.



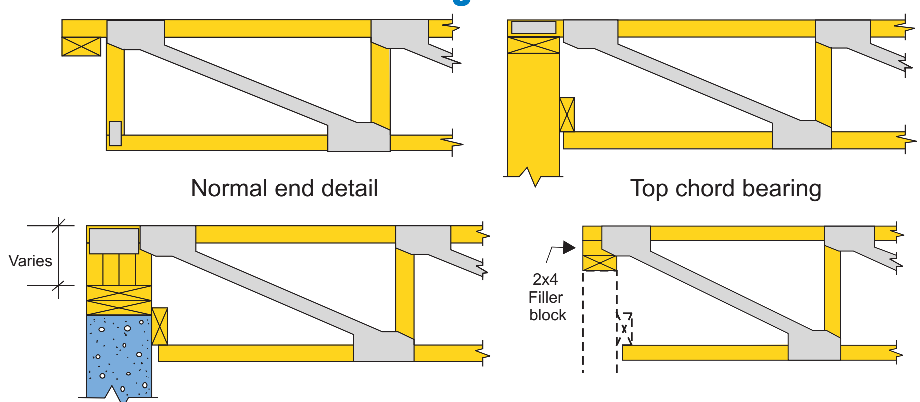
Bottom Chord Bearing Details



Normal end detail

Double web member

Top Chord Bearing Details



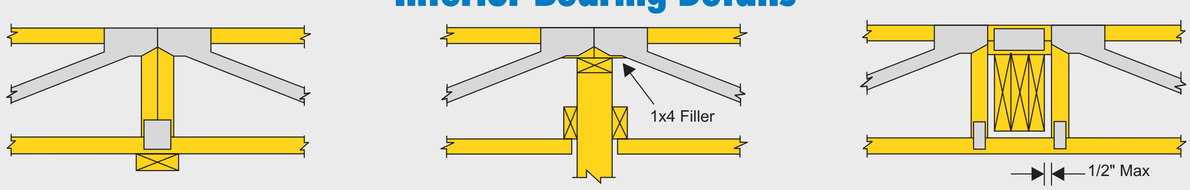
Normal end detail

Top chord bearing

Variable end height

2x4 Filler block

Interior Bearing Details

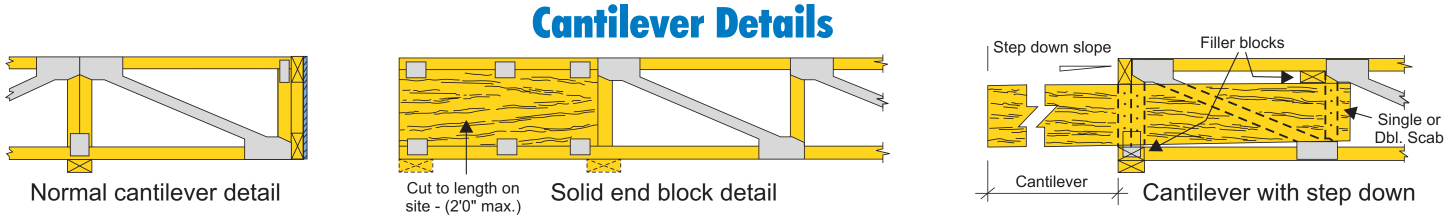


Normal interior bearing

Interior wall

Beam pocket detail

Cantilever Details

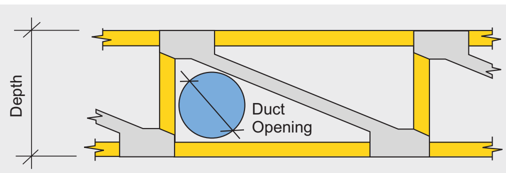


Normal cantilever detail

Solid end block detail

Cantilever with step down

Duct Openings For Tension Web Trusses



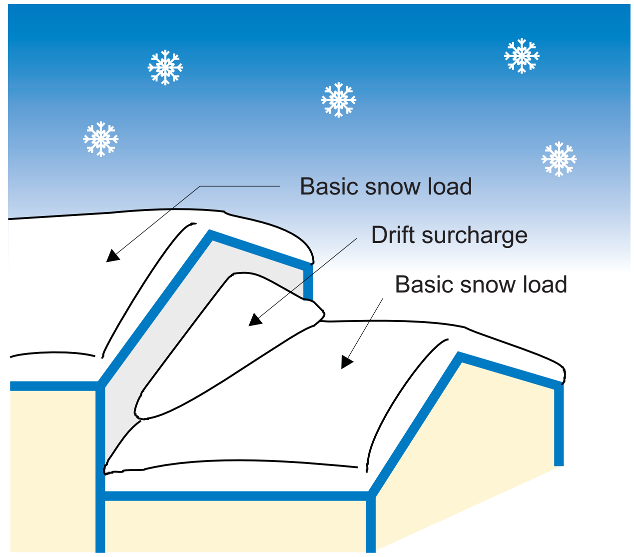
12" Truss Depth = 6" Duct Opening
14" Truss Depth = 7" Duct Opening
16" Truss Depth = 8" Duct Opening

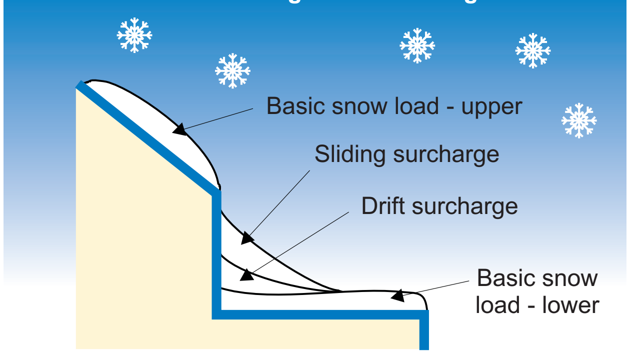
Snow Drifting

An important consideration in the roof design process is the potential for different snow load conditions. Roofs and buildings that include details or parapets and add-ons such as lean-tos or solar panels need to be designed for possible additional snow accumulation. Roof slope, surface material textures and insulation may also affect snow and ice accumulation.

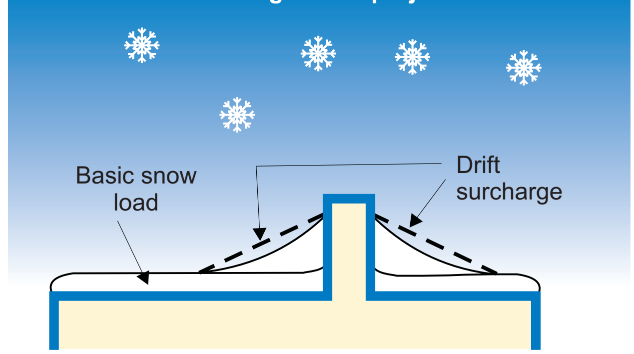
Annual snowfall also can be affected by regional characteristics such as mountains, flat land, and coastal and inland areas.

The American Society of Civil Engineers (ASCE) publishes ***Minimum Design Loads for Buildings and Other Structures (ASCE7)***, which contains a detailed proced-ure for determining snow drift load.

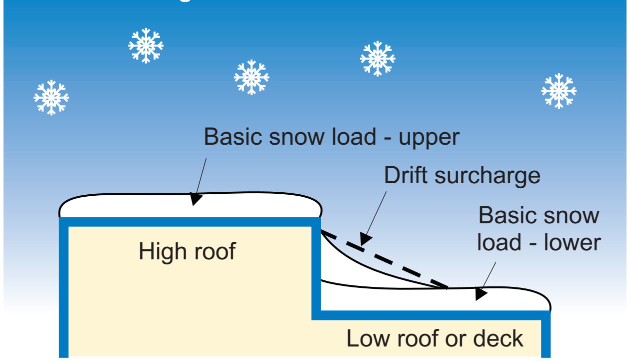




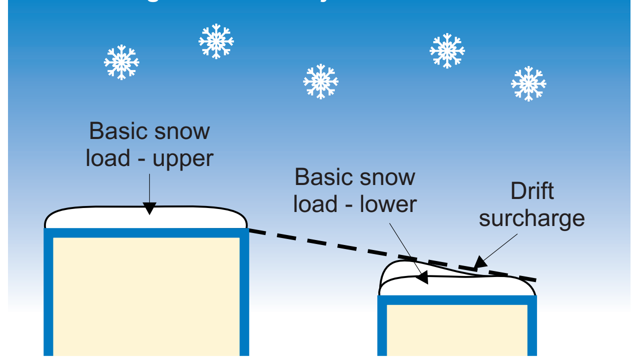
Additional surcharge due to sliding snow



Snow drifting at roof projections



Drifting snow on low roofs and decks



Drifting snow onto adjacent low structures

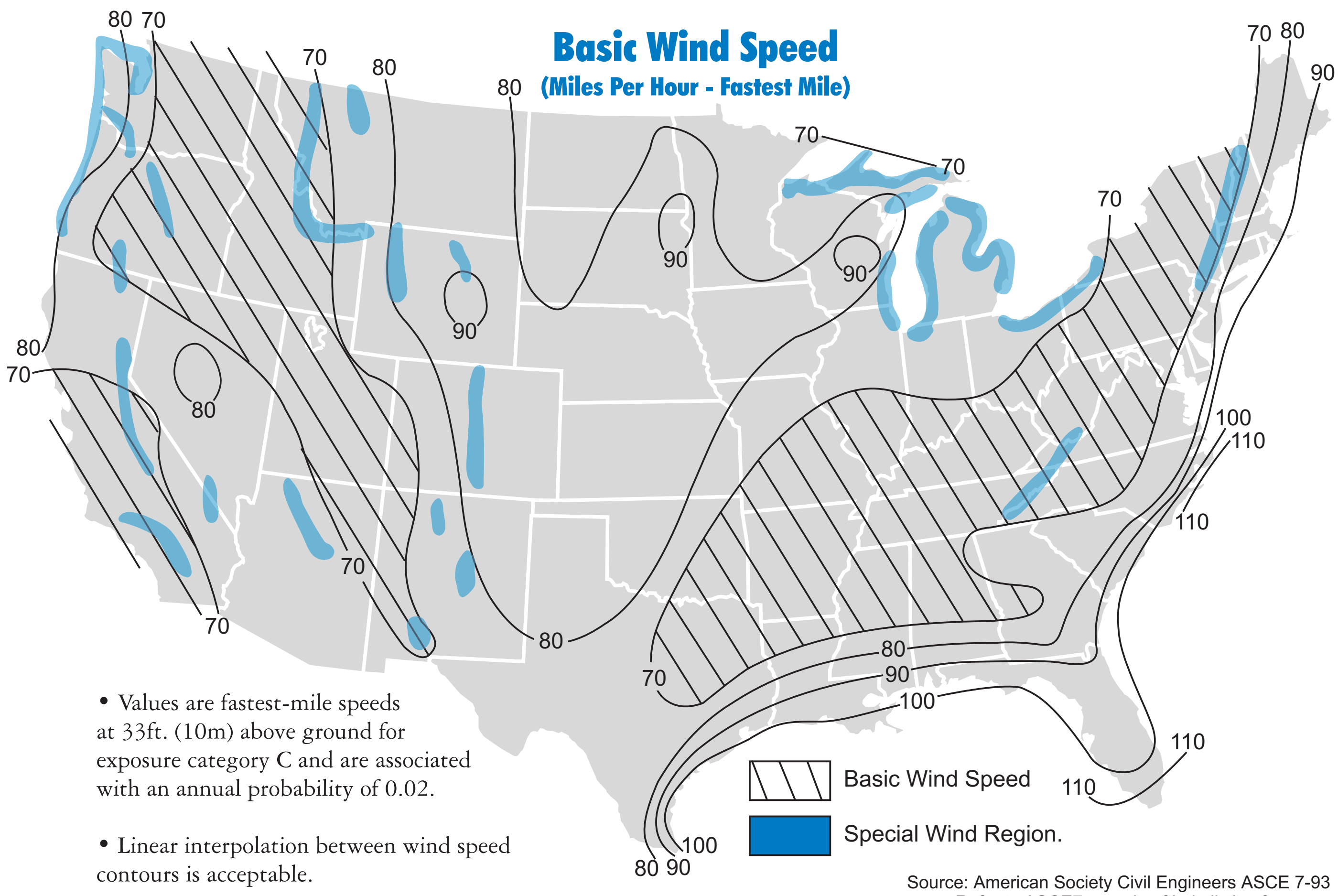
The diagrams above are adopted from the 1996 edition of the *National Building Code* published by the Building Officials and Code Administrators International (BOCA). They are used here to illustrate some of the situations that may be encountered when designing a roof system. Actual design procedure as outlined in the applicable code must be consulted when designing for snow.

Metal Plate Connected Wood Trusses have performed extremely well when subjected to high wind situations such as hurricanes, down bursts, and tornadoes. Recent extensive investigations of damage to buildings after hurricane Hugo, Andrew, Iniki, and other storms underscore the strong performance of MPCW trusses.

The wind load that is used for the design of trusses is dependent upon many factors.

The following is a partial listing of factors that may have an influence on the wind loads used for the design of a truss.

- Wind loads are usually required by the local code. This may be one of the major codes, South Florida Code, ASCE 7-93, ASCE 7-1995, or other specific local code requirement.
- Location of the building on the "Basic Wind Speed Map".
- Actual dead load on the trusses to be considered for wind analysis which is usually less than the gravity design dead load.
- Building porosity. Residential buildings are normally assumed to be closed. Agricultural buildings may be closed, partially closed or completely open.
- Exposure category for the building.
- Building application to determine importance factor.
- ASCE 7-95 includes adjustment factors for buildings sited on hills and escarpments. In addition, ASCE wind speeds are based on 3 second gust speed rather than fastest mile speed.
- If the building designer intends a girder truss to be used as a drag strut to transfer lateral loads, it is important that the loads be determined and noted by the building designer.
- It is important that the building designer specify the wind speed, porosity, exposure, and location of the building in addition to other considerations that will influence the design of the truss.
- Special fastening or anchoring devices may be required to attach trusses to the supporting member.



- Values are fastest-mile speeds at 33ft. (10m) above ground for exposure category C and are associated with an annual probability of 0.02.
- Linear interpolation between wind speed contours is acceptable.

Source: American Society Civil Engineers ASCE 7-93
Refer to ASCE7 or code of jurisdiction for final determination of design loads.

The fire resistance assemblies described below are based on full-scale tests conducted by recognized independent agencies in accordance with the requirements of ASTM E-119, ***Standard Method of Fire Tests of Building Construction and Materials***. When specifying to meet a given fire resistance requirement, the assembly must be constructed within the limits of the particular test specification referred to by number and source.

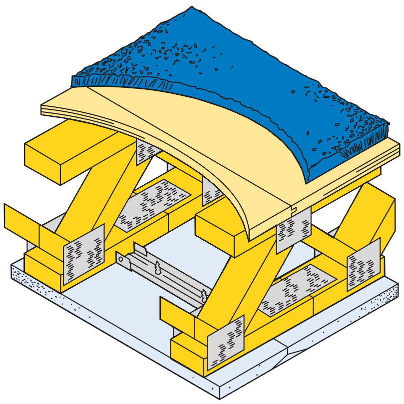
For additional information about fire resistant assemblies, request publication ***FR-Systems*** and/or ***Quick Reference*** from Alpine.

FR-Systems Fire Resistance Assemblies

Fire Resistance Assemblies with Wood Trusses
Evaluated by National Evaluation Service, NER-392

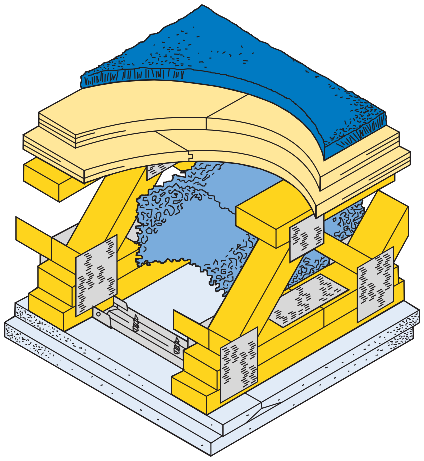
FR-System 1

1 Hour Floor-Ceiling Roof-Ceiling
Assembly without insulation



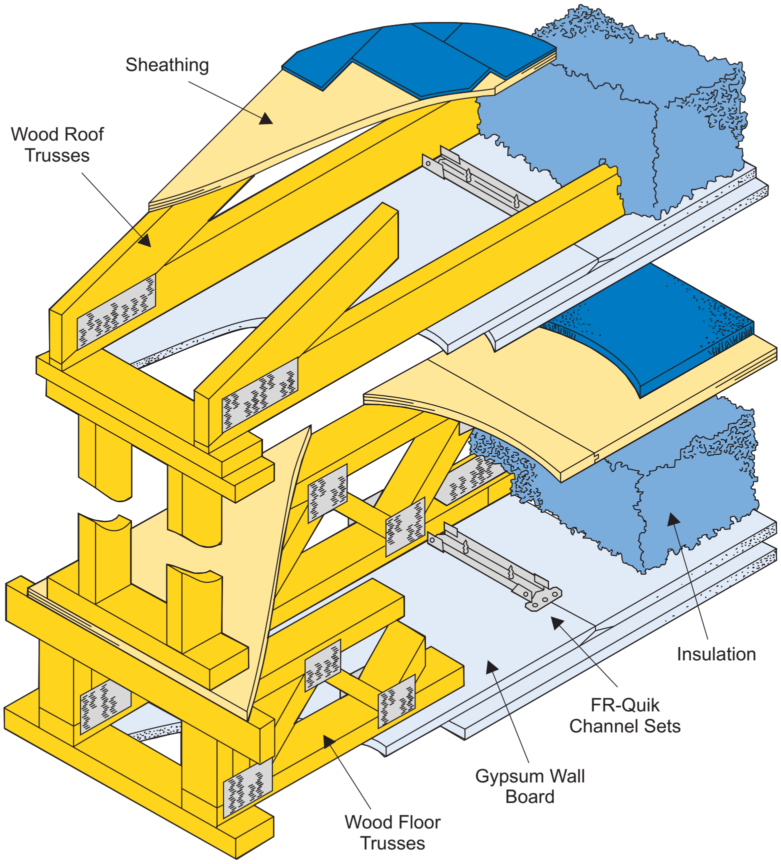
FR-System 2

2 Hour Floor-Ceiling Roof-Ceiling
Assembly with insulation



FR-System 3

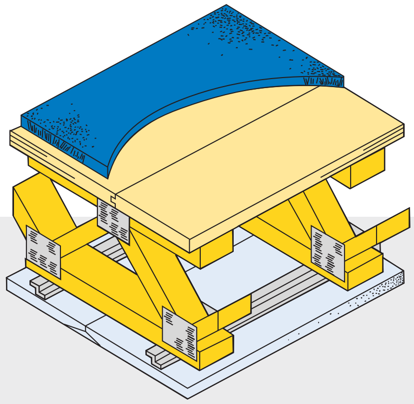
1 Hour Floor-Ceiling Assembly with Insulation
shown in both triangular and parallel chord truss applications



Other Assemblies

UL L528 & L 529

1 Hour Fire Resistive Assemblies



L528 is a one-hour fire resistance rated floor/ceiling assembly listed by Underwriters Laboratories, Inc. (UL) for the Truss Plate Institute (TPI). The assembly requires furring channels wired perpendicular to the truss bottom chord and 5/8" thick USG Type C gypsum wallboard screwed to the channels.
L529 is similar, except that the ceiling is a metal grid system with gypsum panels. Full specifications are available from UL or TPI.

Sound Control

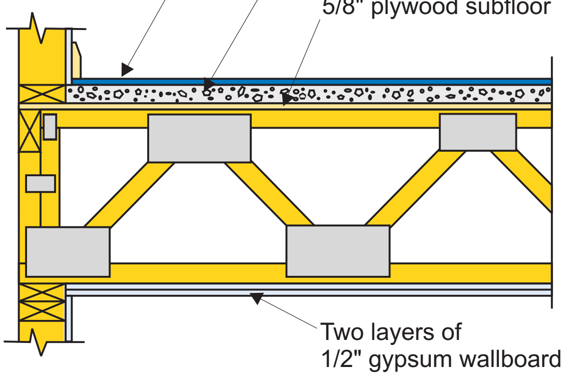
Ratings of floor-ceiling assemblies are determined by two methods. The Impact Insulation Class (IIC) is measured in accordance with ASTM Standard E-492. Airborne noise Sound Transmission Class (STC) is measured in accordance with ASTM Standard E-90.

Impact Noise

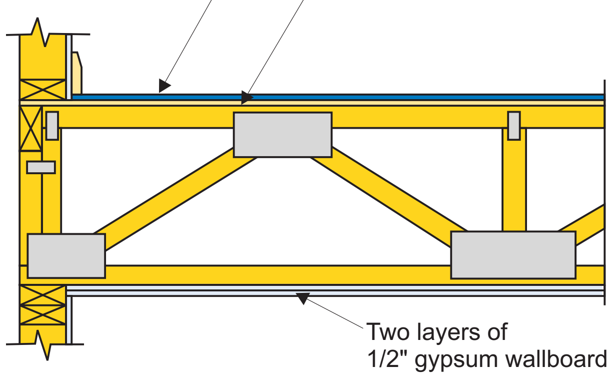
The IIC listing for floor-ceiling assemblies are generally shown for bare floors and for floors with carpet and pad. Although any carpet, with or without pad, will improve the IIC, a heavy wool carpet over a good quality pad will make a significant improvement. According to most tests, the addition of a 44 oz. Carpet over a 40 oz hair felt pad increases the IIC from 38 to 63.

Airborne Noise

ASTM Standard E-413 is used to determine the sound transmission class, STC. Some values listed for assemblies tested in 1970 or before were done under a different standard, however, the resulting STC will generally fall in the same range. Airborne sound control is most effective when air leaks and flanking paths in the assemblies are closed off. Assemblies should be airtight. Recessed fixtures should not be back-to-back in the same cavity. ASTM Recommended Practice E-497 provides good guidance for sound control.



Sound Transmission Class STC=46
Impact Insulation Class IIC=72
Intest No. 5-425-1



Sound Transmission Class STC=47
Impact Insulation Class IIC=72
Intest No. 5-425-3

Assembly Test	STC	IIC
Intest		
5-425-1	46	72
5-425-3	47	72
6-442-5	58 FSTC	---
6-442-2	---	53
6-442-3	---	74
87-729-13	59 FSTC	---
87-729-7	---	83 FIIC

Component materials of floor-ceiling assemblies vary greatly causing difficulty in assigning sound ratings. Contributing to the variations are such factors as depth of openings between members, weight of carpet, pads, or other floor coverings thickness of gypsum board etc.

SECTION 06192
FABRICATED WOOD TRUSSES

1.01 Work Included

A. Fabricate, supply and erect wood trusses as shown on the drawings and as specified. Work to include anchorage, blocking, curbing, miscellaneous framing and bracing.

1.02 Definitions

TRUSS: The term “truss” and “wood truss component” refer to open web load carrying assemblies suitable for support of roof decks or floors in buildings.
FABRICATOR: A manufacturer or fabricator who is regularly engaged in design and fabrication of wood truss components.
TRUSS INSTALLER: Builder, contractor or sub-contractor who is responsible for the field storage, handling and installation of trusses.

1.03 Design

A. Trusses shall be designed in accordance with these specifications and where any applicable design feature is not specified herein, design shall be in accordance with applicable provisions of latest edition of *National Design Specifications for Wood Construction (NDS)* American Forest and Paper Association (AFPA), and *National Design Standard for Metal Plate Connected Wood Truss Construction (ANSI/TPI 1)*, Truss Plate Institute (TPI), and code of jurisdiction.
B. Fabricator shall furnish design drawings bearing seal and registration number of a civil or structural engineer licensed in state where trusses are to be installed. Drawings shall be approved by Architect prior to fabrication.
C. Truss design drawings shall include as minimum information:
   1. Span, depth or slope and spacing of trusses;
   2. required bearing width;
   3. design loads, as applicable:
      a. top chord live load;
      b. top chord dead load;
      c. bottom chord live load;
      d. bottom chord dead load;
      e. concentrated loads and their points of application; and
      f. wind and seismic criteria;
   4. adjustment to lumber and plate design values for condition of use;
   5. reactive forces, their points of occurrence and direction;
   6. ALPINE plate type, gage, size and location of plate at each joint;
   7. lumber size, species and grade for each member;
   8. location of any required continuous lateral bracing;
   9. calculated deflection ratio and/or maximum deflection for live and total load;
   10. maximum axial forces in truss members;
   11. location of joints;
   12. connection requirements for:
      a. truss to truss girders;
      b. truss ply to ply; and
      c. field splices.

2.01 Materials

A. Lumber:
   1. Lumber used for truss members 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 design drawings.
   2. Moisture content of lumber shall be no less than 7 percent nor greater than 19 percent at time of fabrication.
   3. Adjustment of values for duration of load or conditions of use shall be in accordance with *National Design Specification for Wood Construction (NDS)*.
   4. Fire retardant treated lumber, if applicable, shall meet specifications of truss design and ANSI/TPI 1-1995, par 9.1.5 and shall be redried after treatment in accordance with AWPA Standard C20. Allowable values must be adjusted in accordance with NDS par 2.3.6. Lumber treater shall supply certificate of compliance.

B. Metal connector plates:
   1. Metal connector plates shall be manufactured by ALPINE and shall be not less than .036 inches in thickness (20 gage) and shall meet or exceed ASTM A653-94 grade 37, and shall be hot dipped galvanized according to ASTM A653-94, coating designation G60. Working stresses in steel are to be applied to effective ratios for plates as determined by test in accordance with Appendix E and F of ANSI/TPI 1-1995.
   2. In highly corrosive environments, special applied coatings or stainless steel may be required.
   3. At the request of Architect, ALPINE shall furnish a certified record that materials comply with steel specifications.

2.02 Fabrication

A. Trusses shall be fabricated in a properly equipped facility of a permanent nature. Trusses shall be fabricated by experienced workmen, using precision cutting, jigging and pressing equipment meeting requirements of ANSI/TPI 1-1995, Section 4. Truss members shall be accurately cut to length, angle and true to line to assure proper fitting joints within tolerances set forth in ANSI/TPI 1-1995, Section 4, and proper fit with other work.

3.01 Handling, Installation and Bracing

A. Trusses shall be handled during fabrication, delivery and at job site so as not to be subjected to excessive bending.
B. Trusses shall be unloaded on smooth ground to avoid lateral strain. Trusses shall be protected from damage that might result from on-site activities and environmental conditions. Prevent toppling when banding is removed.
C. Handle during installation in accordance with *Handling, Installing and Bracing Wood Trusses (HIB-91)*, TPI, and ANSI/TPI 1-1995. Installation shall be consistent with good workmanship and good building practices and shall be responsibility of Truss Installer.
D. Apparent damage to trusses, if any, shall be reported to Fabricator prior to installation.
E. Trusses shall be set and secured level and plumb, and in correct location. Trusses shall be held in correct alignment until specified permanent bracing is installed.
F. Cutting and altering of trusses is not permitted.
G. Concentrated loads shall not be placed atop trusses until all specified bracing has been installed and decking is permanently nailed in place. Specifically avoid stacking full bundles of decking or other heavy materials onto unsheathed trusses.
H. Erection bracing is always required. Professional advice should always be sought to prevent toppling or dominoing of trusses during installation.
I. The Contractor is responsible for obtaining and furnishing the materials used for installation and permanent bracing.

END SECTION

(Short Form)

SECTION 06192
FABRICATED WOOD TRUSSES

1.01 Work Included:

A. Fabricate, supply and erect wood trusses as shown on the drawings and as specified. Work to include anchorage, blocking, curbing, miscellaneous incidental framing and bracing.

1.02 Design:

A. Trusses shall be designed in accordance with *National Design Specification for Wood Construction, AFPA*, and *National Design Standard For Metal Plate Connected Wood Truss Construction, ANSI/TPI 1-1995*, and the Code of jurisdiction.
B. Fabricator shall furnish design drawings bearing the seal and registration number of design professional licensed in the state where trusses are to be installed.
C. Drawings shall be approved by Architect prior to fabrication.

2.01 Materials:

A. Lumber used shall be identified by grade mark of a lumber inspection bureau or agency approved by Board of Review of American Lumber Standards Committee, and shall be size, species and grade in accordance with design drawings.
B. Connector plates shall be by ALPINE and shall meet or exceed ASTM A653-94 requirements for structural steel.

2.02 Fabrication:

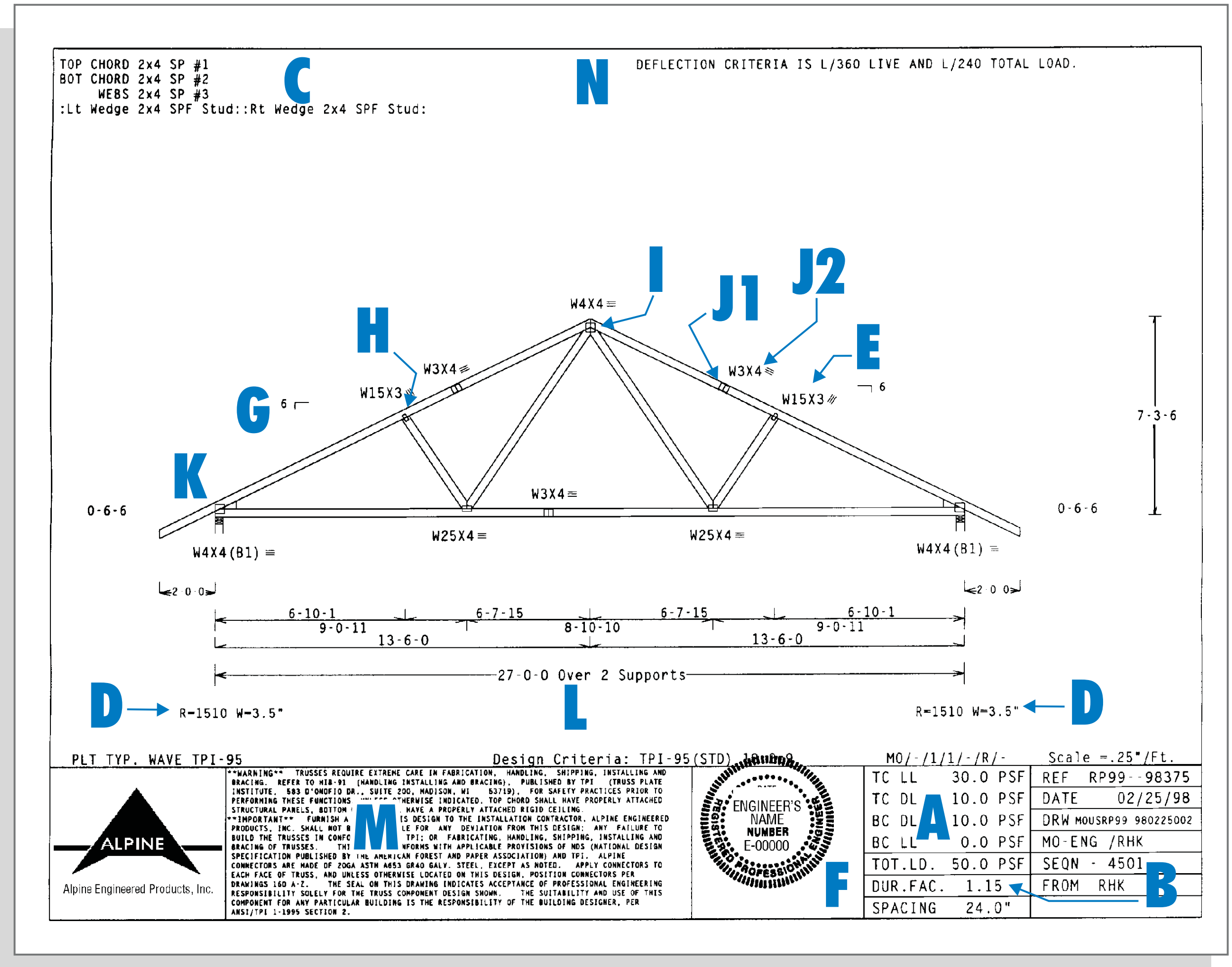
A. Trusses shall be fabricated as set forth in ANSI/TPI 1-1995 in accordance with the design drawings by an established fabricator.

3.01 Handling and Installation:

A. Trusses shall be handled during fabrication, delivery and at job site so as not to be subjected to excessive lateral bending.
B. Installation shall be in accordance with *Handling, Installing and Bracing Wood Trusses, HIB-91, TPI*. Trusses shall be set and secured level and plumb, and in correct location.
C. Trusses shall be sufficiently braced during installation to prevent toppling or dominoing. Install all bracing before placing concentrated loads atop trusses.
D. Cutting and altering of trusses is not permitted.

END SECTION

Typical Roof Truss Design



A Design Loading
Top and bottom chord dead and live loads (including snow load) in pounds per square foot as used in the analysis.

B Load Duration Factor
An adjustment of allowable design values of lumber and fasteners for load durations other than normal.

C Lumber Specifications
Lumber size, species and grade for each member as used in the analysis.

D Reaction
The force in pounds on the bearings produced by the truss at design load, and the bearing width.

E Connector Plates
The gage, series, size and orientation.

F Engineers Seal
Seal of the registered professional supervising the design

G Slope
The vertical rise in inches for every 12 inches of horizontal run.

H Panel Points
The joints of the truss where the webs intersect the chords

I Peak
The intersection of two chords where the slope changes from positive to negative. Generally at the centerline of the truss.

J1 & J2 Splices
Where two chord pieces join together to form a single member. J1 shows the location, J2 the corresponding connector plate.

K Heel
The point of the truss where the top and bottom chord intersect, generally at a bearing point.

L Span
The nominal span based on out-to-out dimensions of the supports or the bottom chord length, whichever is greater.

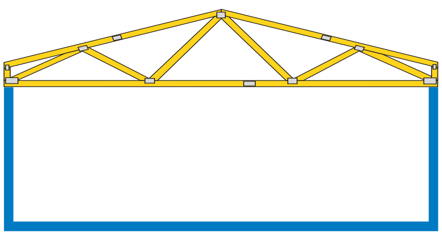
M General Notes
Notes that apply to all Alpine design drawings.

N Special Notes
Notes that apply only to this specific design drawing.

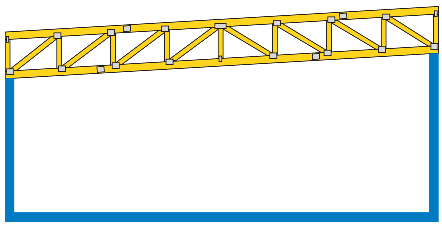
Trusses are reliable and versatile structural building components when used with certain considerations. Following are some of the more frequently overlooked considerations.

Drainage of Low-Sloping, Flat or Parapet Roofs

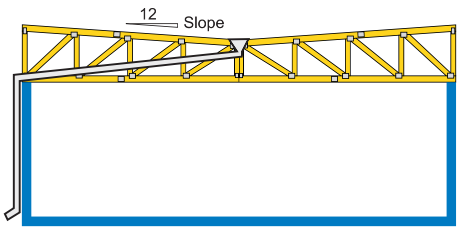
Wood trusses, when used as the structural element on flat or relatively flat roofs must have provisions for adequate drainage so as to avoid ponding. Some suggested methods of preventing ponding are illustrated below.



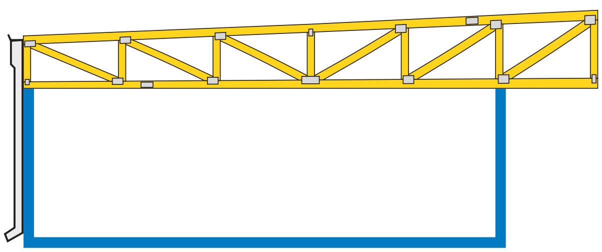
Sloped Top Chord



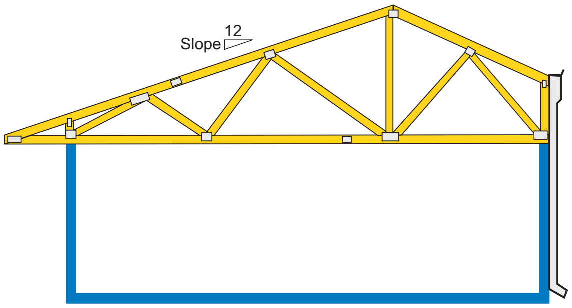
Elevated Bearing



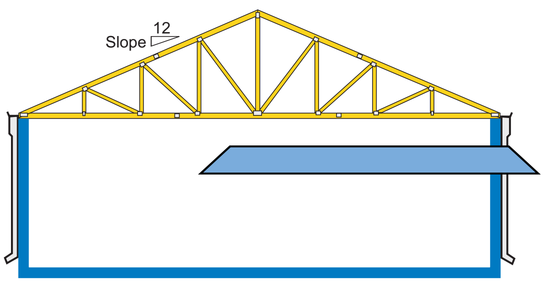
Internal Drain



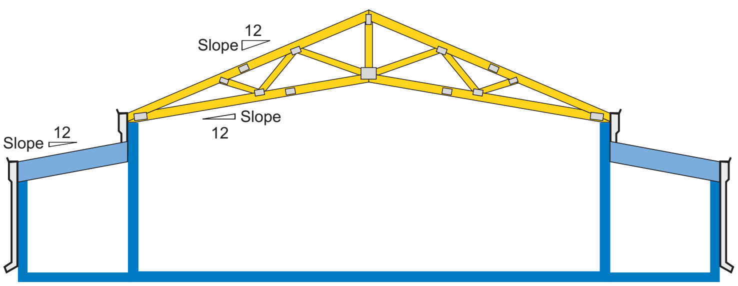
Sloping top chord cantilevered



Dual slope top chord cantilevered



Peaked top chord combined with flat mansard



Scissors trusses combined with low slope

Positive Ventilation

Trusses used in humid or corrosive atmospheres may require additional ventilation and protection. When fire resistant wood is required to be used in the trusses, additional ventilation may also be necessary. Any of these conditions may require additional methods to protect the light gauge metal connector plates consult the truss designer.

Builder's And Contractor's Reference Section

Responsibility

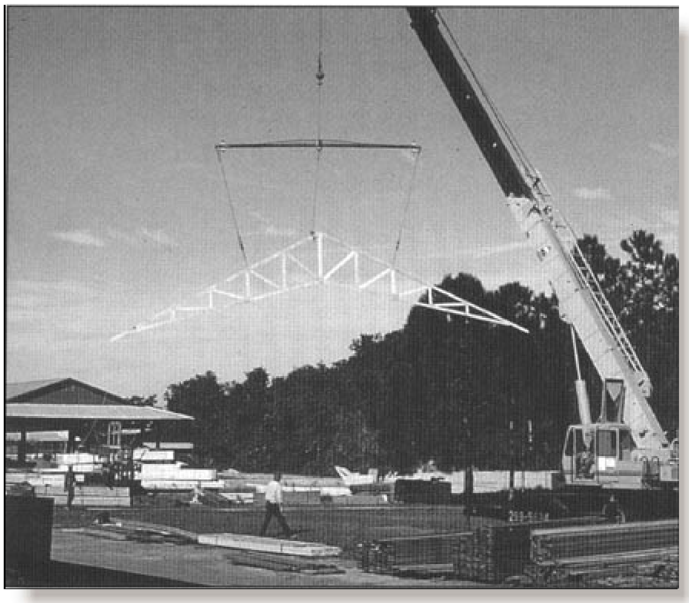
According to the publication *Standard Responsibilities in the Design Process Involving Metal Plate Connected Wood Trusses (WTCA 1-1995)*, published jointly by the Wood Truss Council of America (WTCA) and the Truss Plate Institute (TPI), responsibility for wood trusses is divided among the owner, building designer, the contractor or builder (installer) and the truss manufacturer.

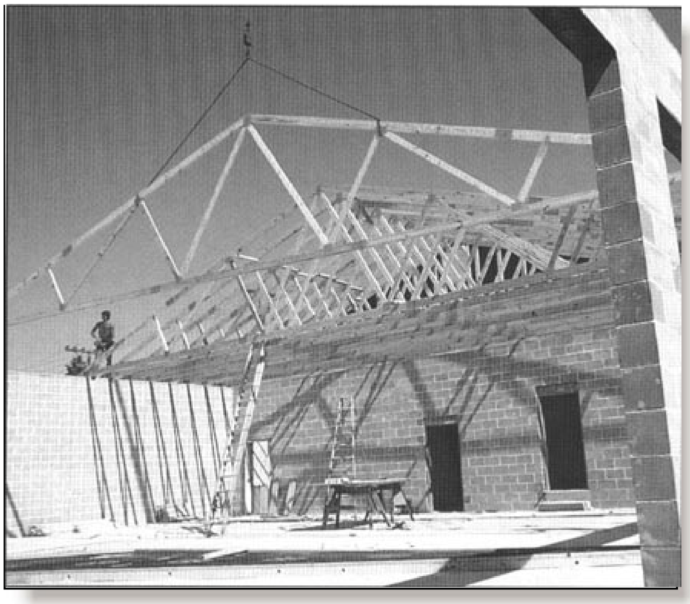
The truss installer is responsible for safe handling, installation and both temporary and permanent bracing of the trusses after they reach the jobsite.

A good guide for these areas of responsibility is *Handling, Installing and Bracing Metal Plate Connected Wood Trusses - HIB-91* published by the Truss Plate Institute (TPI). The publication is also available in a six page fold-out summary form for use as a jobsite reference. It is recommended that all persons associated with the installation process read and adhere to the recommendations of this publication to help prevent injury to themselves, other workers and property.

A good publication for guidance in the design of a temporary bracing system is the publication *Temporary Bracing of Metal Plate Connected Wood Trusses, DSB-89*, published by the Truss Plate Institute (TPI).

WARNING:
Do not cut or notch any truss member without permission of the truss designer.
Do not use or repair damaged trusses without professional consultation with the Architect, Engineer or Truss Designer.





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Your truss manufacturer produces quality trusses using standards recommended by Alpine and the Truss Plate Institute (TPI). These standards include provisions for tight joints, accurate dimensions, proper plate placement and material storage. Similar provisions to protect the quality should be continued through delivery, storage, handling, erection and bracing in order to maintain the structural reliability and strength of the trusses.

Finished trusses are usually banded with steel strapping in convenient size bundles. The strapping helps maintain truss alignment and the bundle strength minimizes damage during storage and delivery.

Your manufacturer will normally store trusses vertically in racks or horizontally with blocking to prevent lateral bending. Throughout all phases of construction, care must be taken to avoid excessive lateral bending of the trusses which can cause joint and lumber damage.

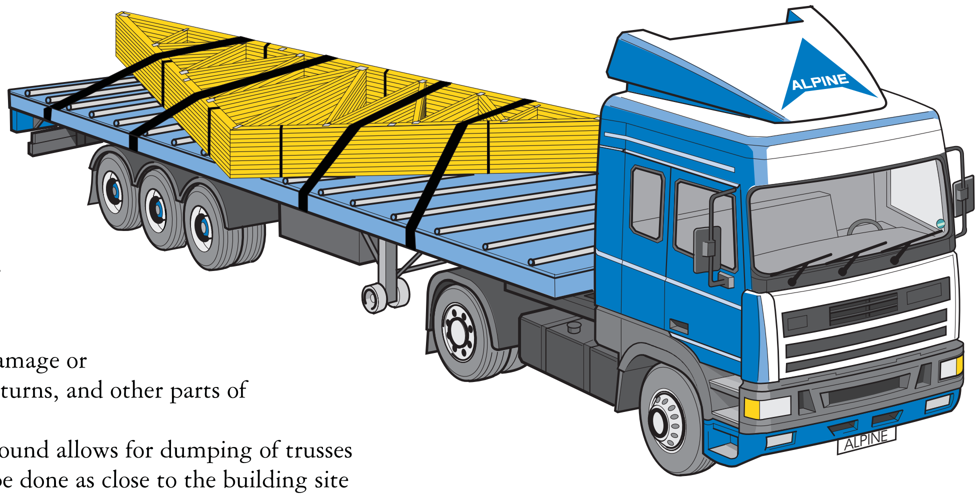
WARNING: Exercise care in removing steel strapping to prevent injury.

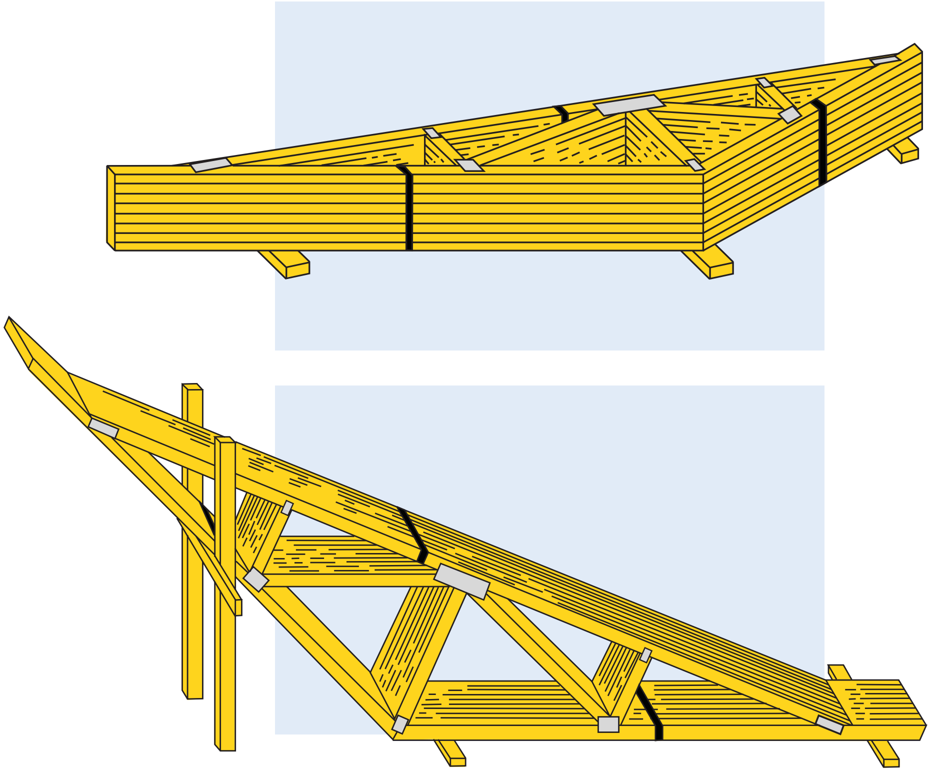
Banded trusses for delivery are transported to the jobsite on flatbed trailers with a roller deck or on special "pole-type" trailers.

If possible, trusses should be unloaded on relatively smooth ground. They should not be unloaded on rough terrain that would cause undue lateral strain resulting in distortion of the truss joints.

Rough terrain can also cause damage or breaking of overhangs, soffit returns, and other parts of the truss.

Proper banding and smooth ground allows for dumping of trusses without damage. This should be done as close to the building site as possible to minimize handling.





If trusses are not to be immediately installed, several provisions should be made.

Truss bundles may be unloaded and stored in the horizontal or vertical position. If the trusses are horizontal, they should be blocked above ground to protect them from ground water and termites.

Blocking should be on eight to ten foot centers to prevent lateral bending. Be sure the blocking is solid in order to prevent toppling or sliding.

If trusses are in the vertical position they should be staked on both sides of the bundle to prevent toppling and personal injury.

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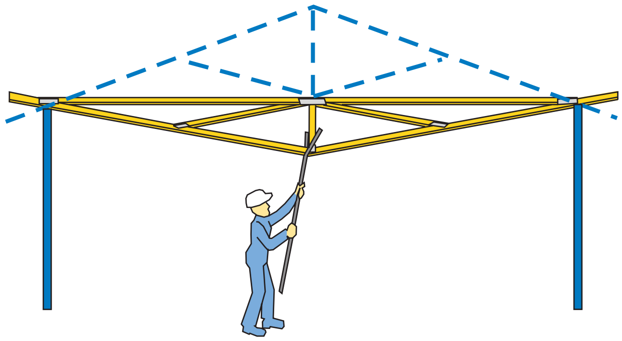
Trusses may be installed manually, by crane, or by forklift, depending on truss size, wall height and job conditions. Individual trusses should always be carried vertically to avoid lateral strain and damage to joints and members.

Trusses installed manually are slid into position over the sidewall and rotated into place using poles. The longer the span, the more workers needed to avoid excessive lateral strain on the trusses. Trusses should be supported at joints and the peak while being raised.

Large trusses should be installed by a crane or forklift employing chokers, slings, spreader bars and strong-backs to prevent lateral bending. Trusses may be lifted singly, in banded groups, or preassembled in groups.

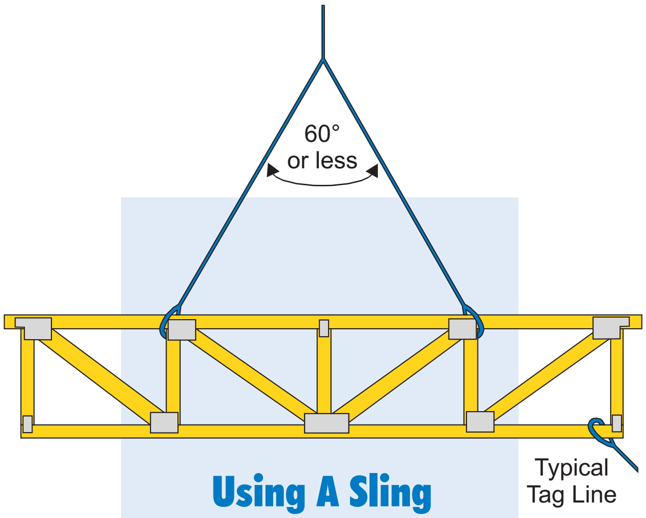
Tag lines should always be used to control movement of trusses during lifting and placement.

Refer to *Handling, Installing and Bracing Metal Plate Connected Wood Trusses (HIB-91)* by the Truss Plate Institute, or *Wood Truss Erection* poster by the Wood Truss Council of America for proper methods of installation.

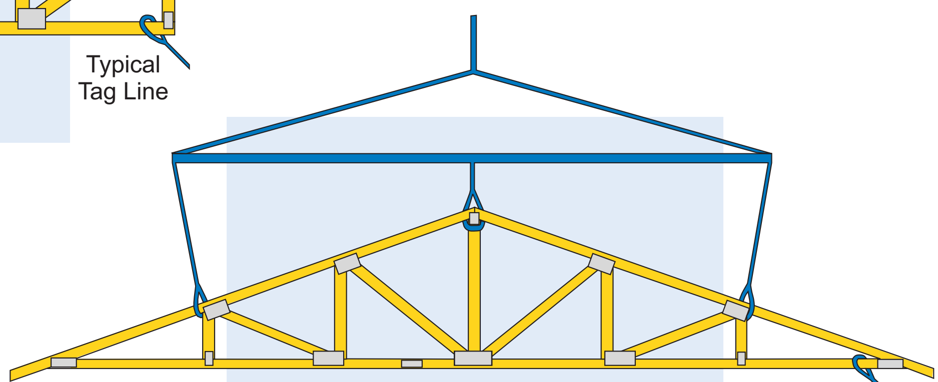


Manual Installation

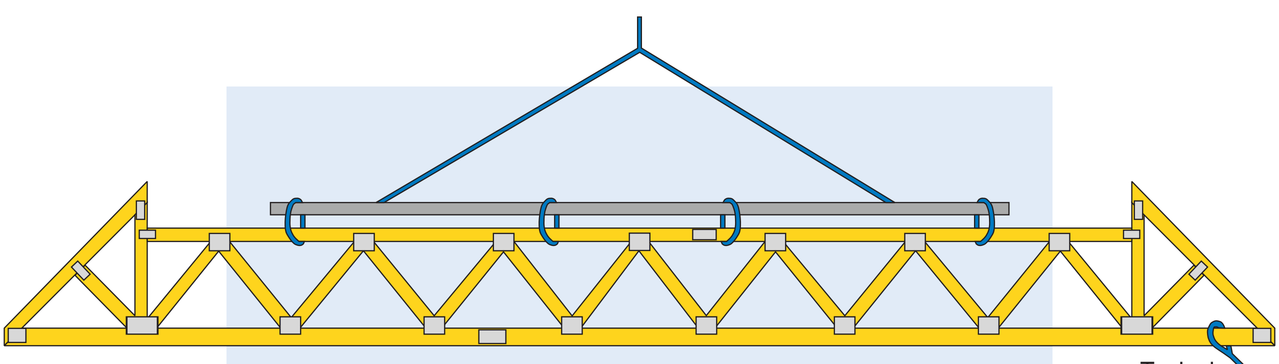
Installation procedures are the responsibility of the installer. Job conditions and procedures vary considerably. These are only guidelines and may not be proper under all conditions.



Using A Sling

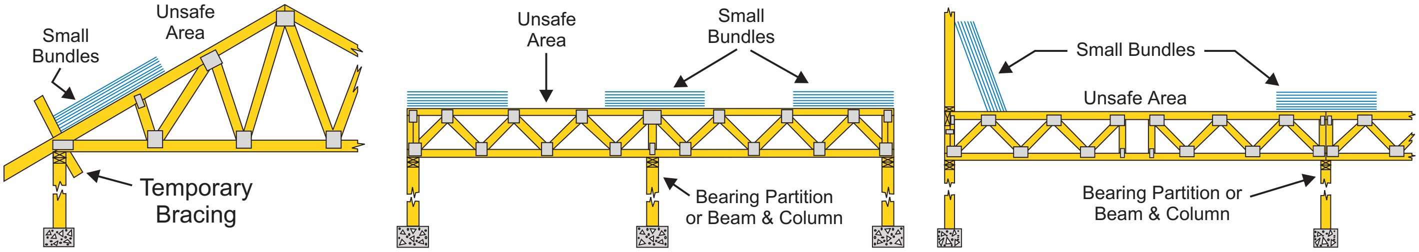


Using A Spreader Bar



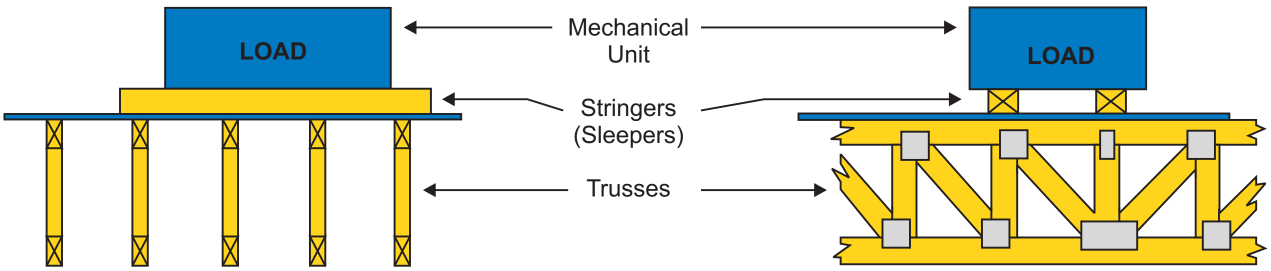
Using A Strong-Back

Storage of Materials During Installation



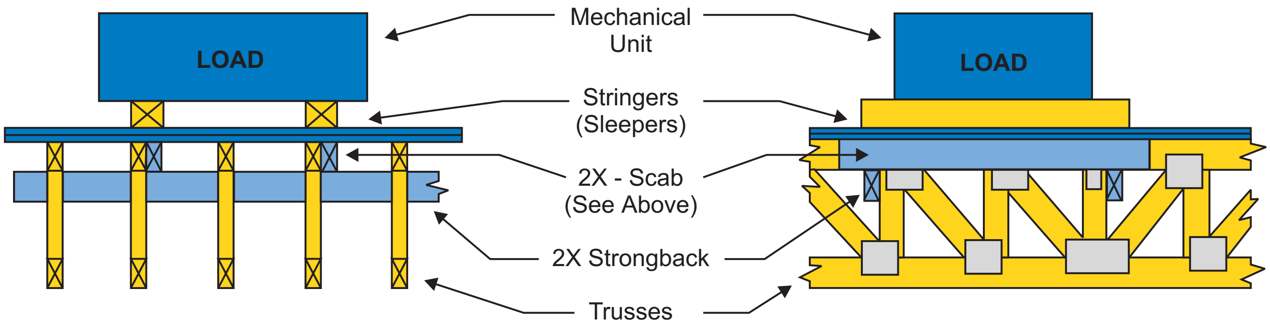
Mechanical Equipment

Platform Stringers Perpendicular To Trusses

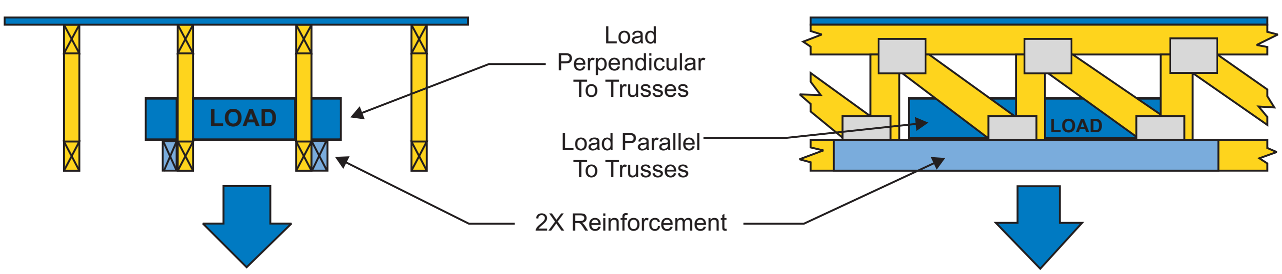


Trusses under mechanical units must be specifically designed and may be doubled. Stringers (sleepers) shall be placed directly over truss joints or a scab of the same size, grade and species of lumber as the top chord shall be nailed to the top chord @ 6" o.c. Scab shall cover joints on each side adjacent to the stringers (sleepers). If building designer is relying on the sheathing to support the mechanical load or other heavy load, it is important that the building designer verify the sheathing thickness and capability.

Platform Stringers Parallel To Trusses



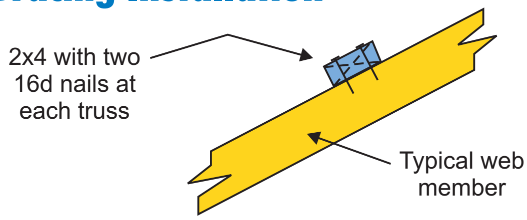
Loads Suspended From Bottom Chords

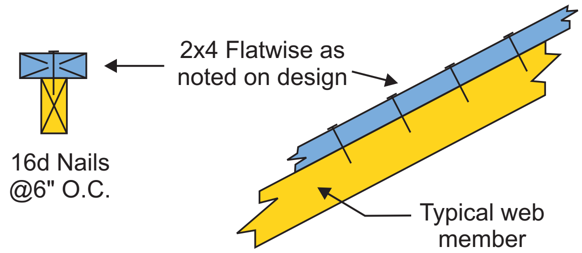


When the load is perpendicular to trusses, reinforcement of bottom chord as well as other parts of truss may be necessary. When the load is parallel to trusses, reinforcement of bottom chord may be necessary.

NOTE: Mechanical loads may produce sufficient vibration to be considered in the truss design. Such loads may require additional trusses or custom design.

Web Bracing Installation





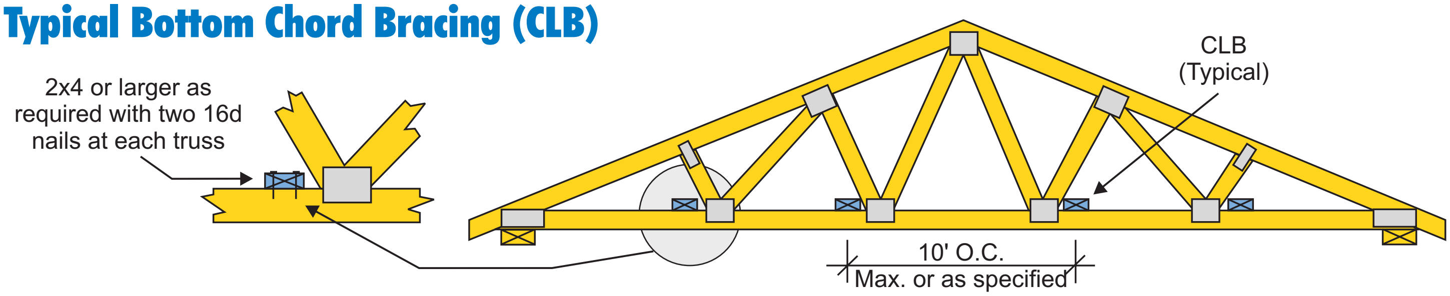
Continuous Lateral Bracing

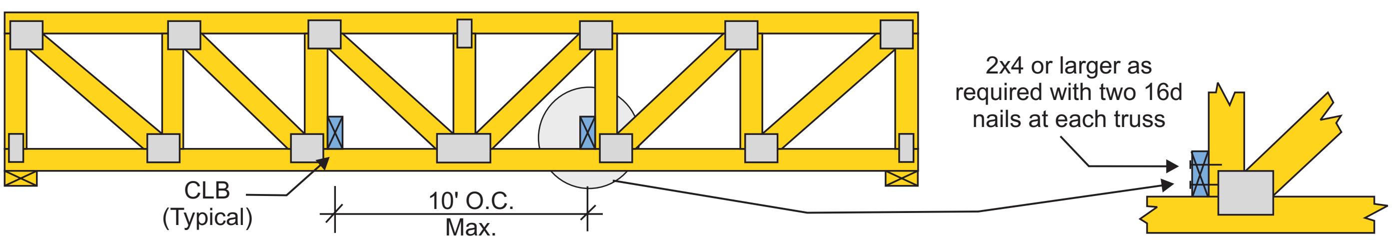
When continuous lateral bracing (CLB) is specified on the design drawing, the CLB shall be installed and connected to each end of the building and cross-braced at intervals determined by the building designer.

T-Brace

The T-Brace is typically used with hip trusses.

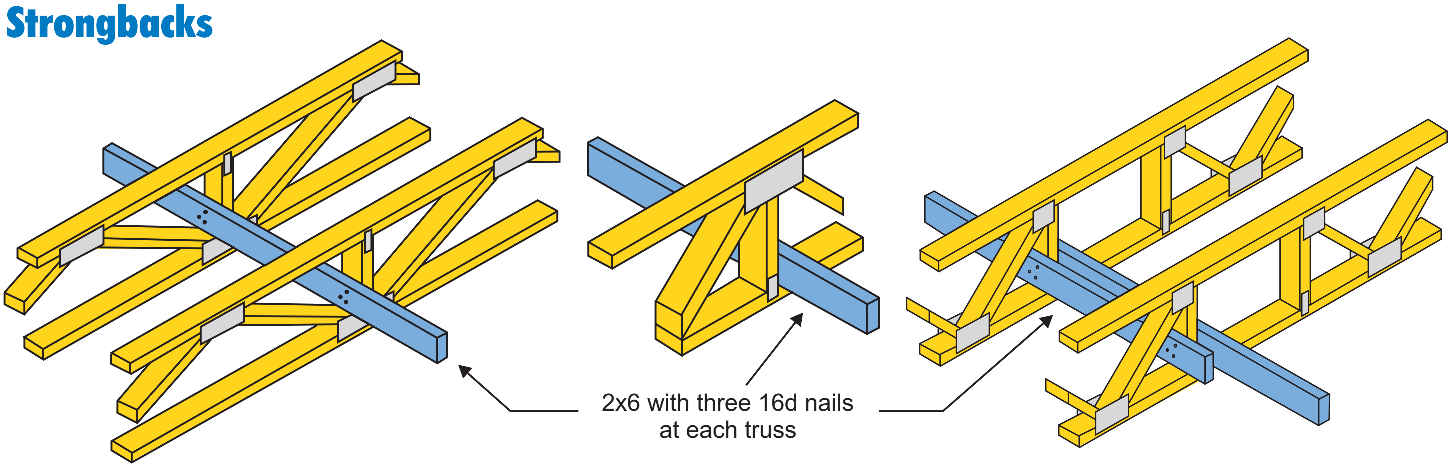
Typical Bottom Chord Bracing (CLB)





Where the building design does not provide for a ceiling diaphragm or other means of continuous lateral bracing of the bottom chord of the truss, the truss design will specify the spacing of the continuous lateral bracing of the bottom chord. NOTE: The building designer is responsible for the design of the roof, floor and building bracing.

Strongbacks



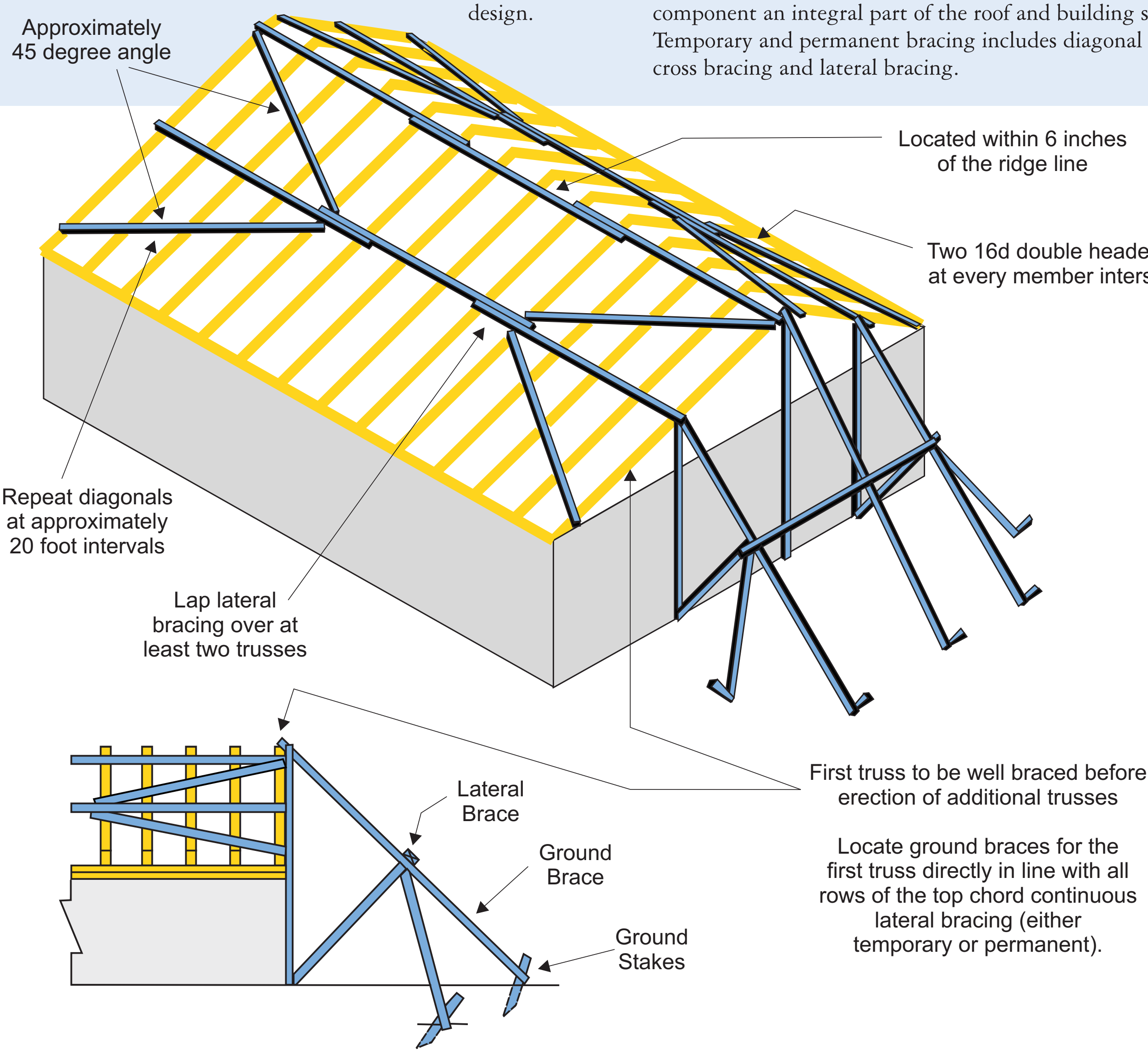
Strongbacks, 2x6 minimum, should be secured to a vertical member with 3-16d nails on floor trusses. For spans less than 20 feet, one row of strongbacking at the centerline is sufficient. For spans greater than 20 feet and less than 30 feet, use two rows of strongbacking equally spaced. In general, use one strongback row for each 10 feet of truss span. Blocking behind the vertical is recommended while nailing the strongback in place. Strongback lumber should be at least 14 feet in length and lapped two feet at their ends over two adjacent trusses.

Guidelines For Installation Of Bracing From HIB-91[1]

All trusses must be securely braced, both during erection and after permanent installation. Individual wood trusses are designed only as structural components. Responsibility for proper bracing always lies with the building designer and contractor for they are familiar with local and job-site conditions and overall building design.

All trusses should be installed straight, plumb and aligned at the specified spacing. Trusses should also be inspected for structural damage.

There are two types of bracing. Temporary bracing is used during erection to hold the trusses until permanent bracing, sheathing and ceilings are in place. Permanent bracing makes the truss component an integral part of the roof and building structure. Temporary and permanent bracing includes diagonal bracing, cross bracing and lateral bracing.



Lateral bracing, as may be required by truss design to reduce the buckling length of individual truss members, is part of the wood truss design and is the only bracing specified on the design drawing. This bracing must be sufficiently anchored or restrained by diagonal bracing to prevent its movement. Most truss designs assume continuos top and bottom chord lateral support from sheathing and ceilings. Extra lateral and diagonal bracing is required if this is not the case.

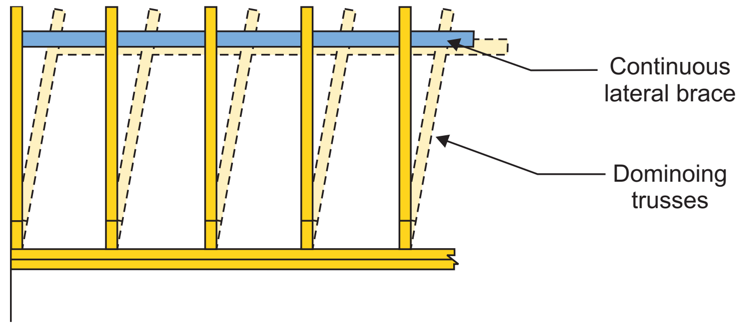
Bracing members should be 2x4 nailed with two 16d nails at each cross member unless specified otherwise on the design drawing. Lateral braces should be at least 8 feet long. Cross and diagonal braces should run on an approximate 45 degree angle.

It is important to temporarily brace the first truss at the end of the building. One method calls for the top chord to be braced by ground braces that are secured by stakes driven in the ground, preferably outside and inside. The bottom chord is to be securely anchored to the end wall.

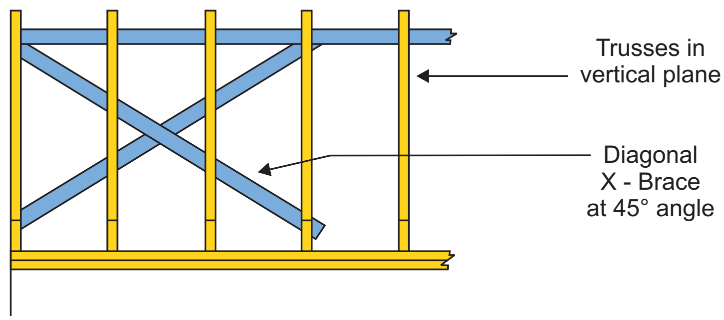
Adjacent trusses are now set connecting each to continuos lateral bracing on the top chord. These are typically spaced at 8 to 10 feet on centers along the length of the truss. Refer to HIB-91 for diagonal spacing. Bracing on the top chords is also required. This top chord bracing will be removed as the sheathing is applied after the other bracing is completed.

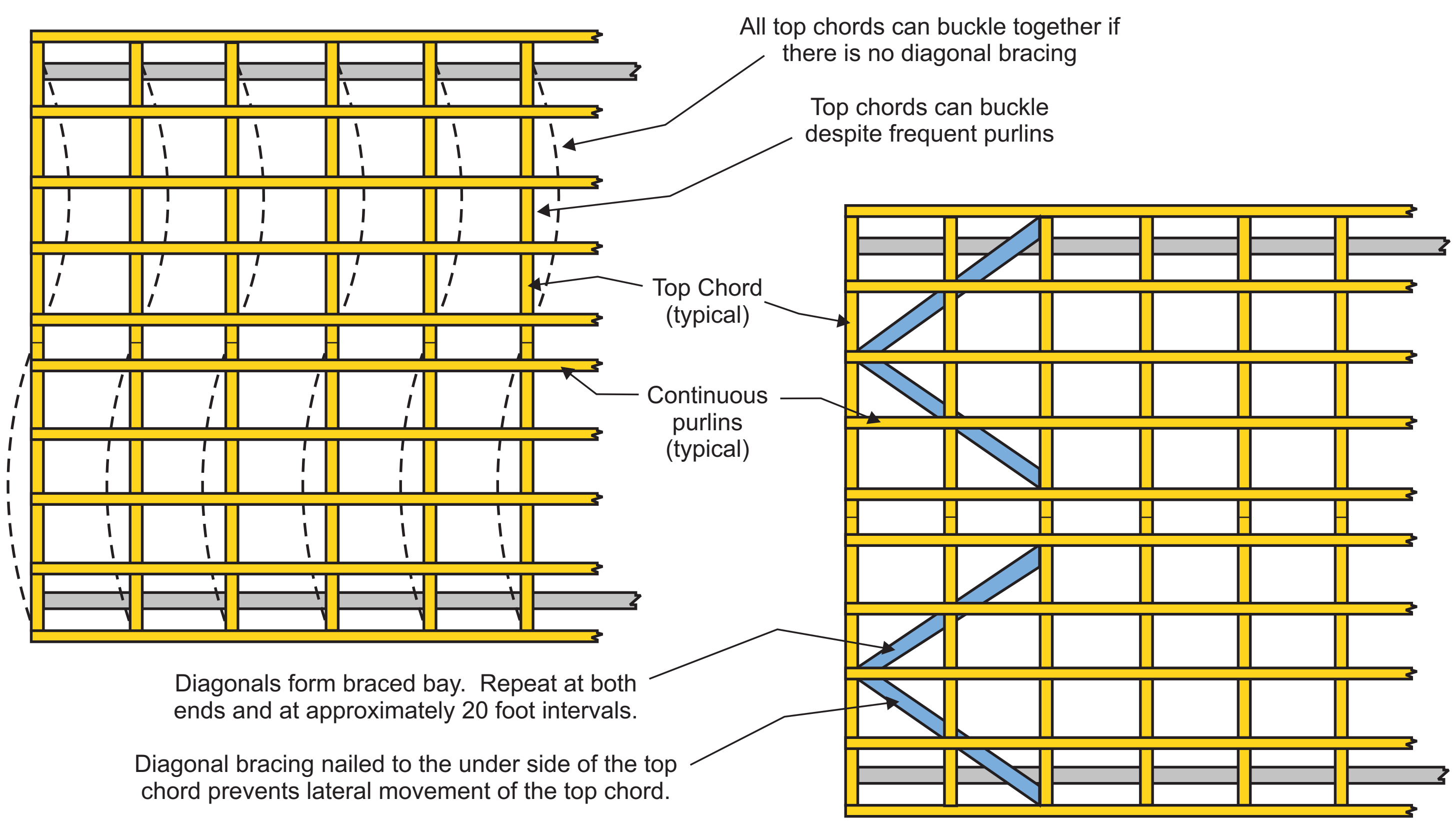
1) See Appendix B - Truss Plate Institute (TPI)

Temporary bracing should be 2x4 dimension lumber or larger and should be 8 feet minimum in length. The use of short spacer pieces of lumber between adjacent trusses is not recommended. Continuous lateral bracing maintains spacing, but without cross bracing, permits trusses to move laterally. See HIB-91.



To prevent domnioning, cross bracing should be installed in the plane of the webs as the trusses are installed. See HIB-91.

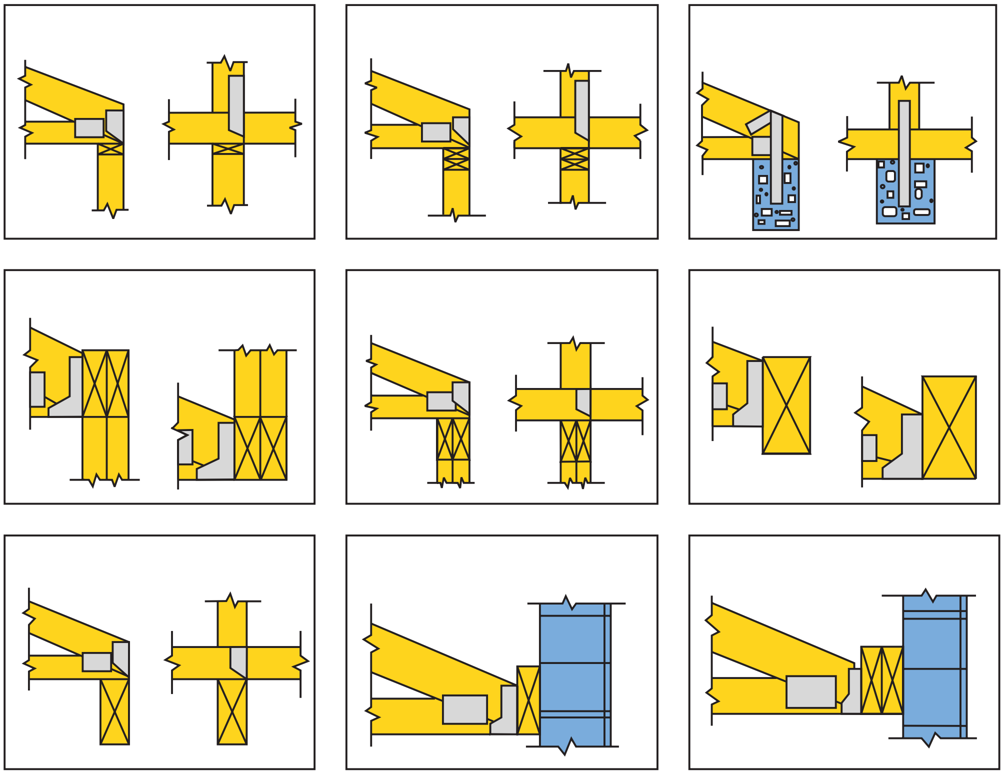


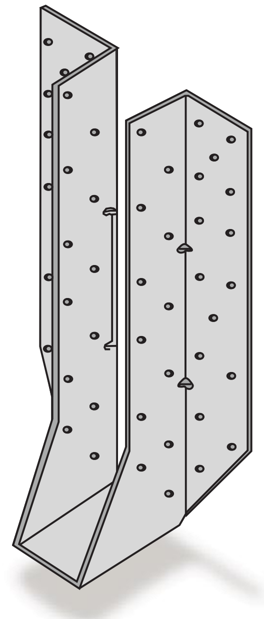


Full bundles of sheathing should not be placed on the trusses. They should be limited to 8 sheets to a pair of trusses. Likewise, other heavy concentrated loads should be evenly distributed. Inadequate bracing is the reason for most wood truss installation failures. Proper installation is a vital step for a safe and quality roof structure.

These recommendations are offered only as a guide. Refer to *Recommended Design Specifications for Temporary Bracing of Metal Plate Connected Wood Trusses (DSB-89)* by the Truss Plate Institute (TPI), or *Handling, Installing and Bracing (HIB-91)* by TPI.

Alpine Construction Hardware - A Complete Solution For Truss Installations





Installation Notes:

1. All specified fasteners must be installed according to the instructions in the catalog. Incorrect fastener quantity, size, type, or material may cause the connector to perform poorly or even fail.

2. All nails shown in the tables are to be common nails unless noted otherwise. Box nails or sinkers of the same nominal size (length) are not to be used unless an appropriate reduction in the hanger capacity has been made in accordance with the 1991 edition of the *National Design Specification (NDS)* published by the American Forest and Paper Association.

3. When special short nails are indicated in the tables, use only nails that have the same diameter as the listed common nail size.
   - An 8d x 1 1/2 nail is 0.131 inch in diameter and 1 1/2" long.
   - A 10d x 1 1/2 nail is 0.148 inch in diameter and 1 1/2" long.

4. Do not use any other nails than those shown in the design load tables. If a smaller diameter nail or a shorter nail is used, the listed design load may have to be reduced in accordance with the 1991 NDS.

5. The proper installation of structural hangers is dependent on the wood being sound and virtually unchecked in a continuously dry environment. If the wood splits during nailing, it will not support the listed load safely. The wood member should be replaced.

6. Unless specified by a professional engineer, lag bolts should not be used with any product listed in the product guide.

7. Bolt holes shall be a minimum of 1/32" and a maximum of 1/16" larger than the bolt diameter, per the 1991 NDS.

8. When attaching a product to concrete or masonry, the product should be installed plumb, square and true. If necessary, temporarily brace the product in place while the concrete is poured and cured.

9. If power or pneumatic nail drivers are used, the nail should be driven through the pre-punched holes only. Use the correct quantity and size of fasteners. The pneumatically driven nails shall conform to the nail sizes shown on the schedules. When using powder actuated or pneumatic nail drivers, always follow the specific written instructions for the equipment and wear safety glasses. Improper use of the nail driving equipment may cause injury to others.

10. When prefabricated structural wood is framed into a hanger or other product, follow the manufacturer's written instructions regarding nailing, minimum and maximum nail size, nail locations and the use of blocking or web stiffeners, if required.

11. Welding galvanized steel may produce harmful fumes. Please follow proper welding procedures.

Do Not Use Roofing Nails Or Shingle Nails In Hangers At Any Time.

Use The Exact Nails Specified For The Hanger.

For additional information about Alpine Construction Hardware, visit our web site on the internet:
http://www.alpeng.com

Structures perform only as well as the connectors that join its various members. Alpine makes available through its network of truss manufacturers a full line of construction hardware.

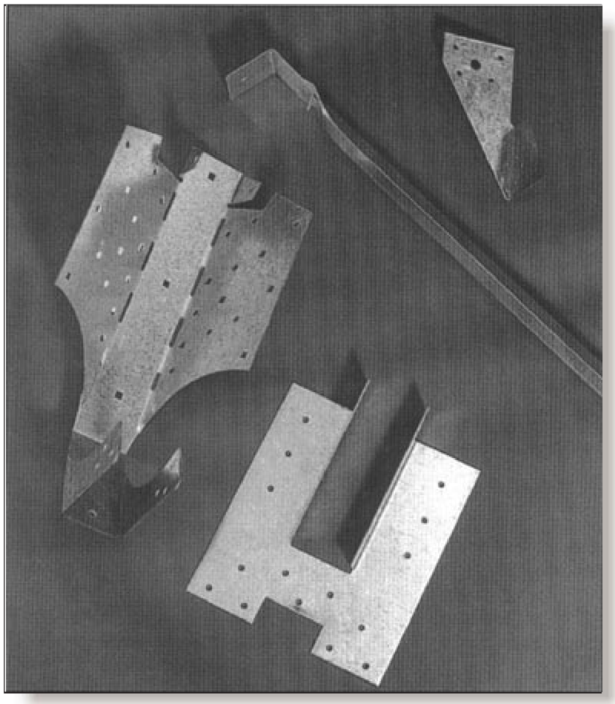
Designed to speed construction and meet the demanding and ever changing building codes, the line includes hangers, framing anchors, tie-downs, and hundreds of other specialty products.

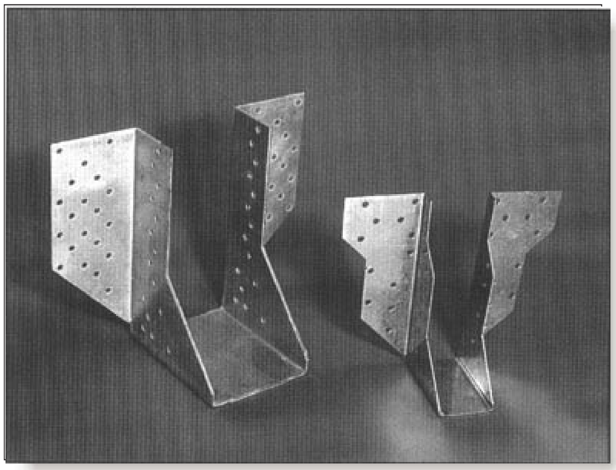
Alpine truss manufacturers can provide the truss-to-truss, truss-to-wall and wall-to-foundation connections for wood, masonry and light gauge steel framing systems.

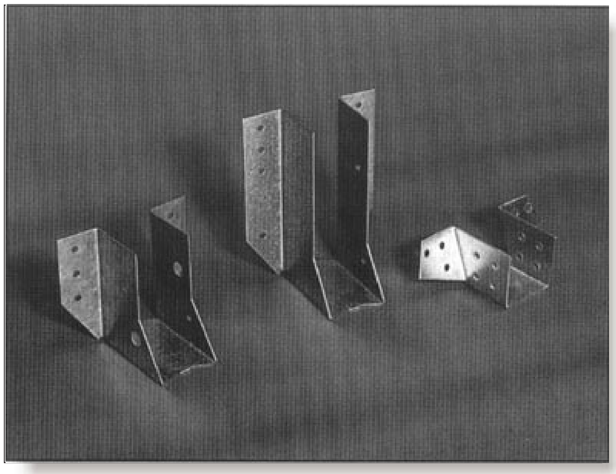
Alpine truss manufacturers use proprietary, engineered software to specify the exact hanger or connector for the trusses they produce right on the truss design sheet.

Every item of construction hardware produced by Alpine is backed by the same staff of professional engineers that design your trusses. You can be confident every detail of the truss design has been considered before structural hardware is specified.

Use of the correct hardware specified is important. Substitution should not be made without consulting your truss designer. Install all hangers specified.







ALPINE CONSTRUCTION HARDWARE

Order your construction hardware when you order your trusses to be sure they are on the jobsite when you need them.

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Revolutionary Steel Truss Technology

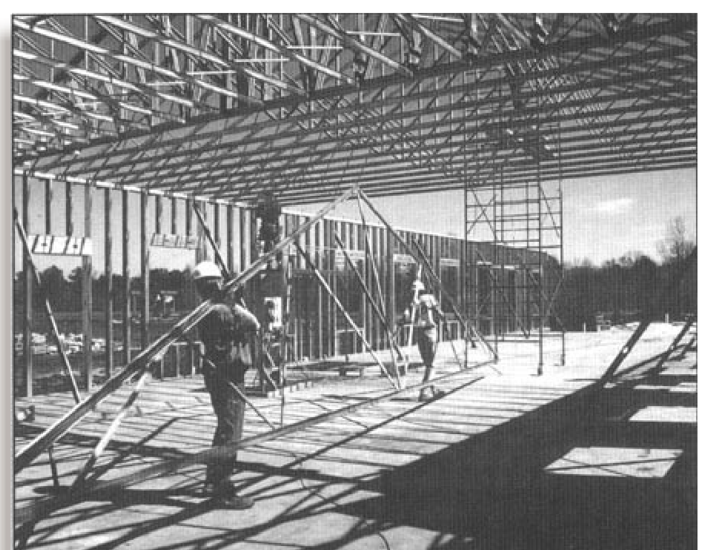
Alpine Engineered Products, the nation's leading wood truss design company, has introduced an innovative steel truss component system for the residential and commercial construction markets. TrusSteel light gauge steel trusses offer the architect, engineer, contractor and owner all of the flexibility and design advantages of wood trusses plus the versatility of an alternative material. That versatility can provide several advantages over traditional wood framing in residential applications — relative price stability, moisture and insect resistance, increased strength to weight ratio, and increased uniformity of material strength from member to member. When utilized in commercial application, TrusSteel light gauge steel trusses augment traditional steel framing to achieve fully non-combustible structures where fire codes require.

An alliance formed between Alpine Engineered Products, Inc. and Unimast, Inc., combined truss engineering and design technology with steel roll forming and construction technology to develop a unique, proprietary light gauge steel chord section. Results from extensive full scale testing have been used to develop a dedicated steel truss design and engineering software package that gives the designer the speed and flexibility of existing wood truss software packages.

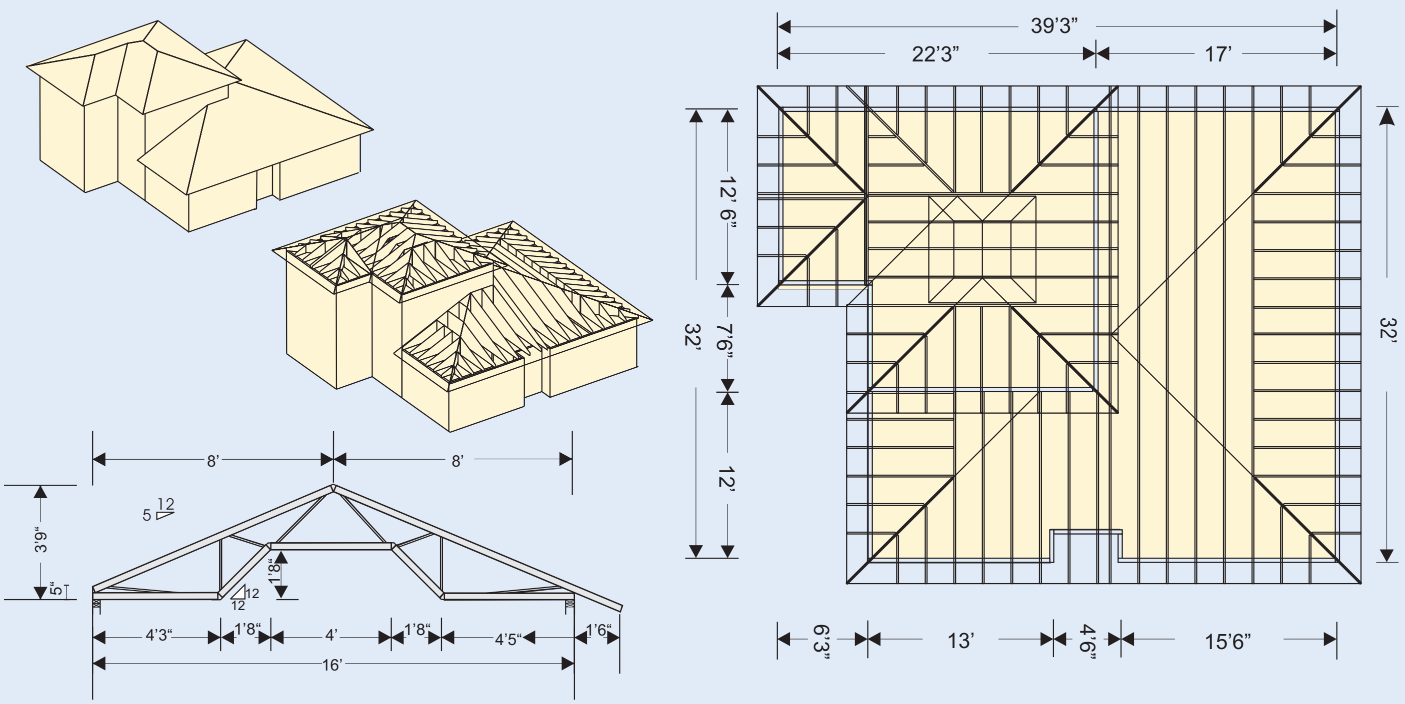
TrusSteel light gauge steel trusses offer the architect and project engineer the same quality and reliability that has been synonymous with the Alpine name for more than 30 years. By offering two chord profiles, 1½" x 2¾" and 2½" x 4" formed in 22 to 16 gauge galvanized steel, the TrusSteel components provide the designer and the engineer with solutions from the shortest jacks to 80-foot clear span trusses.

In the truss plant, TrusSteel products are intended to be laid out, fabricated, and handled like wood trusses, except that they are built using screw guns rather than traditional plated methods. The trusses can be fabricated on existing truss tables or with inexpensive steel truss jigging that is available from Alpine. The engineering software automatically provides callouts for layout stops on any of Alpine's automated setup equipment. On the job site, the high strength to weight ratio of TrusSteel trusses makes them easier to deliver, handle, and install. One man can typically lift and carry a 35-foot TrusSteel truss by himself, because of its light weight and handling stability. The lateral stability created by the unique chord design and tight chord to web joint connection achieved with double shear screw technology provides handling capabilities uncommon to other steel truss designs. The 1½" section can be installed using many existing wood truss hardware applications.

For the owner, TrusSteel trusses provide solutions to insect damage, material deterioration and shrinkage, drywall nail pops, and fire code non-combustible materials requirements. Steel construction in general will provide straighter, tighter, more true framing and an overall structure that will require less maintenance than fiber products.



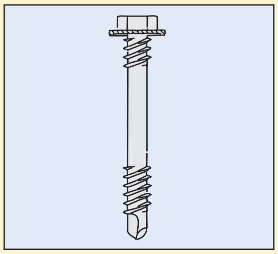
TrusSteel Layout, Design, and Engineering Software



The CAD-based design software used by Alpine truss manufacturers generates traditional plan view layouts, and 3-D graphics that give an accurate picture of a roof from virtually any perspective by showing every truss in place.

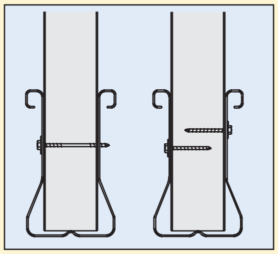
TrusSteel Fabrication and Construction Details

DOUBLE SHEAR SCREW



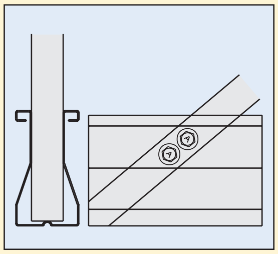
Proprietary double shear screw technology - Patent Pending

TECHNOLOGY COMPARISON



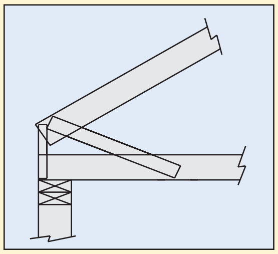
Typical single shear screw requirement vs. double shear screw technology

TYPICAL SCREW REPLACEMENT



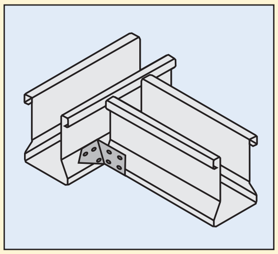
Typical screw placement within the TrusSteel chord section

TYPICAL HEEL



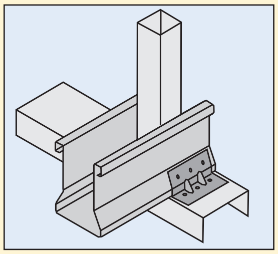
Typical raised heel detail for flat bottom chord trusses using TrusSteel components

SCISSORS HEEL DETAIL



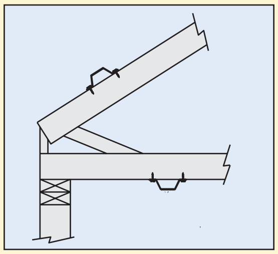
Uplift clip detail for screw and pin attachment to stud, masonry, or I-beam bearing. Welded detail available.

WOOD OVERHANG DETAIL



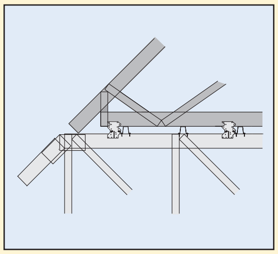
Bottom chord bearing jack to girder connection detail.

CHORD BRACE CONNECTION



Hat channel connection for temporary or permanent bracing

PIGGYBACK



Typical connection detail for high pitch trusses requiring multiple sections

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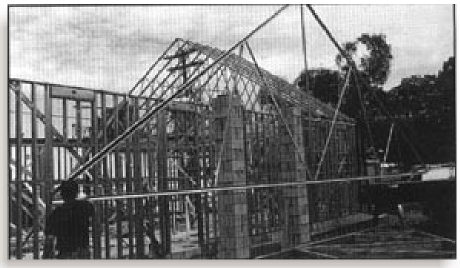
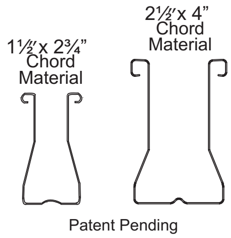
Unique Features of the TrusSteel System

- exceptional truss strength to weight ratios
- multiple chord and web options to assure design versatility
- nearly equal chord member moment capacity in both “in-plane” bending directions
- superior chord member bending strength in “out-of-plane” directions
- labor-saving single-side fabrication technology
- rapid setup steel truss fabrication jigging
- unique chord shape lies flat for easier fabrication and shipping
- square end cutting eliminates angle cuts and coping
- color coded screws assure quality and easy inspection
- exceptional handling stability compared to other steel truss systems
- reduced exposed edges for safe handling
- fast and flexible truss design software
- rapid quotations based on design inputs
- 48 hour turnaround for engineering seals on completed drawings
- evaluated for use in BOCA, ICBO and SBCCI areas in NER-529

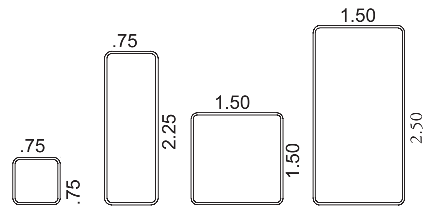


Technical Data

All load bearing members shall be Alpine TrusSteel components having mechancial properties determined by testing that conform to ASTM A370 - “Standard Test Methods and Definitions for Mechanical Testing of Steel Products.” The members shall be cold formed to indicated sizes, profiles, and thickness of steel conforming to ASTM 653, minimum G60 coating, and ASTM A500 with minimum yield and material thickness as shown in the table below.



TrusSteel Chord Material			TrusSteel Web Material		
22 GA	55 KSI	.0284 IN	20 GA	45 KSI	.0330 IN
20 GA	55 KSI	.0329 IN	18 GA	45 KSI	.0470 IN
18 GA	55 KSI	.0428 IN	16 GA	45 KSI	.0630 IN
16 GA	55 KSI	.0538 IN			



The calculation of the structural properties for TrusSteel truss chords and webs is in compliance with the standards set forth in the American Iron and Steel Institute (AISI) "Specification for the Design of Cold Formed Steel Structural Members,” dated August 19, 1986, with December 11, 1989 Addendum.

ARCHITECTURAL / ENGINEERING SUGGESTED SPECIFICATIONS FOR STEEL TRUSSES

GENERAL -- Light gauge steel trusses shall be fabricated by an authorized Alpine Truss Fabricator in accordance with designs prepared by Alpine Engineered Products, Inc. Engineering drawings conforming with the design load and deflection criteria contained in these specifications shall be submitted for approval before fabrication. Final engineering drawings shall bear the seal of a Registered Professional Engineer.

DESIGN STANDARDS -- Design standards shall conform with the applicable provisions of the AISI "Specification for the Design of Cold Formed Steel Structural Members," dated August 19, 1986, with December 11, 1989 Addendum.

TRUSS COMPONENTS -- All load bearing members shall be Alpine TrusSteel components having mechanical properties determined by testing that conforms to ASTM A370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products. The members shall be cold formed to indicated sizes, profiles, and thickness of steel conforming to ASTM 653, minimum G60 coating, and ASTM A500 with minimum yield and material thickness as shown in the table above.

QUALITY CONTROL

1. Shop fabricate from cold formed steel components in accordance with shop drawings, using jigging systems to ensure consistent component placement and alignment of components.
2. Field fabrication of trusses is strictly prohibited unless performed by authorized TrusSteel Fabricator using the Fabricator's shop assemblers and proper jigging systems.
3. Truss components shall be fastened with Alpine screws only, as shown on the shop drawings.

INSTALLATION

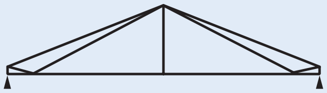
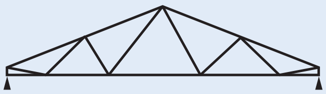
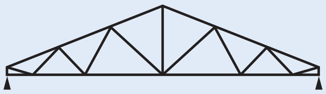
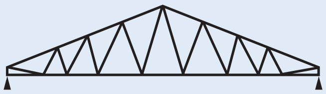
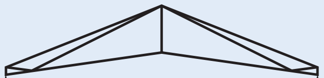
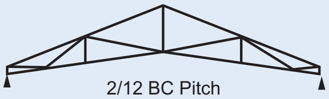
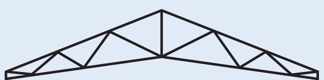
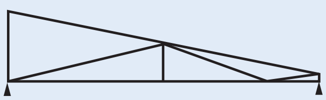
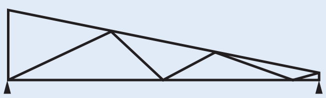
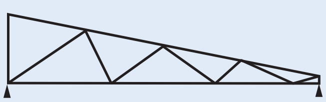
1. Handle and store trusses per Alpine TrusSteel published recommendations.
2. Install trusses per Alpine TrusSteel details and the Truss Fabricator's shop drawings.
3. Install **required permanent bracing and bridging** as indicated by the drawings and notes of the Architect or Engineer-of-Record before the application of any loads.
4. The field removal, cutting or alteration of any truss chord and web members is not allowed without prior written approval of the Architect or Engineer-of-Record and the Truss Designer.
5. Damaged chords, webs, and complete trusses shall be repaired or replaced as directed and approved in writing by the Architect / Engineer-of-Record and the Truss Designer prior to installation or application of the repair or replacement.

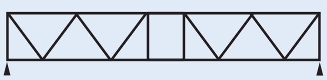
BRACING --All trusses must be securely braced both **during erection and after permanent installation**. Erection bracing shall hold trusses straight and plumb and in safe condition until decking and permanent truss bracing has been fastened forming a structurally sound roof framing system. All erection and permanent bracing shall be installed and all trusses permanently fastened before application of any loads. Permanent structural cross-bracing to ensure overall rigidity of the roof system shall be in accordance with the architectural/engineering plans for the building structure. See truss design drawings for any additional special bracing requirements. Materials used in bracing are to be furnished by the erection contractor unless otherwise noted in these specifications.

COMPLETE GUIDE SPECIFICATION

For a copy of our complete TrusSteel Guide Specification, contact Alpine or visit our web site at **http://www.alpeng.com.**

Maximum Design Spans

Truss Type Roof Trusses	TC pitch /12	2-3/4" Chord Material 24" o.c. Spacing	2-3/4" Chord Material 48" o.c. Spacing	4" Chord Material 24" o.c. Spacing	4" Chord Material 48" o.c. Spacing
	3 4 5 6	14'11" 14' 3" 13' 0" 12' 7"	11' 3" 10' 8" 10' 3" 10' 0"	29' 8" 29' 5" 29' 1" 28' 9"	21' 1" 21' 4" 21' 5" 21' 6"
	3 4 5 6	32' 0" 32'11" 33' 1" 32'10"	17' 4" 18' 8" 19' 8" 20' 6"	47' 0" 47' 4" 47' 6" 47' 6"	34' 7" 35' 1" 35' 6" 35' 6"
	3 4 5 6	38' 8" 42' 3" 44'10" 44'11" *	19' 8" 22' 9" 24' 5" 25'10"	58'11" 62' 6" 65' 1" 68' 1"	45' 8" 48' 6" 49'10" 50' 2"
	3 4 5	42' 4" 48' 0" * 52' 1" *	19' 7" 23' 0" 26' 3"	78'10" 81' 8" -- --	49' 9" 52' 5" -- --
 2/12 BC Pitch	4 5 6	14' 5" 13' 1" 12' 6"	10'11" 10' 5" 10' 2"	28' 0" 29' 0" 28' 8"	20'10" 20'11" 21' 1"
 2/12 BC Pitch	4 5 6	27' 9" 29' 4" 30'10"	15'11" 17' 5" 18' 6"	39' 8" 42' 6" 44'10"	34' 0" 36' 0" 36' 6"
 2/12 BC Pitch	4 5 6	30'11" 34' 3" 35' 6"	14'11" 18' 5" 21'11"	49' 7" 55' 4" 58' 0"	37' 6" 44' 9" 46' 6"
	3 4 5 6	13' 9" 14' 5" 16' 1" 17' 9"	11' 1" 11' 7" 11'11" 12' 3"	24' 9" 26' 2" 26' 3" 26' 1"	20' 0" 20' 1" 19' 8" 19' 6"
	3 4 5 6	19' 1" 19'10" 21'10" 22' 4"	15' 3" 15' 4" 15' 2" 14' 9"	34' 9" 35' 2" 34' 8" 33' 8"	27'10" 28' 0" 27' 7" 26' 9"
	3 4 5 6	22' 5" 22' 4" 23' 5" 23' 9"	17'10" 17' 1" 16' 3" 15' 2"	40'11" 39' 3" 37' 1" 34'10"	32' 7" 31' 2" 29' 5" 27' 6"

Floor Trusses	Depth	2 3/4" Chord - 16" o.c. Spacing	2 3/4" Chord - 24" o.c. Spacing
	12" 14" 16"	18' 6" 22' 6" 26' 4"	18' 2" 20' 6" 22' 9"

Roof Truss Design Notes:

1) Design Loads - 20-10-0-10
2) Designs may include multiple gauge in top and bottom chords as selected by Alpine's TrusCalc engineering software.
3) * Top chord plumb cut at each end.
4) 2 3/4" chord sections have top and bottom chords laterally braced with roof and ceiling sheathing when trusses are spaced at 24" o.c. When truses are spaced at 48" o.c., the top and bottom chords are laterally braced with purlins at 24" o.c. spacing.
5) 4" chord section having top and bottom chord laterally braced with purlins at 24" o.c. spacing.
6) Trusses designed with ASCE7-93 Wind
   - 80 m.p.h. - exposure C
   - residential building - 15 ft. mean roof height
   - 100 miles from ocean line - interior zone
7) Spans exceeding those indicated above can be obtained using different chord / web combinations.

Trusses are designed and tested according to the: DESIGN GUIDE FOR COLD-FORMED STEEL TRUSSES PUBLICATION RG-9518 AMERICAN IRON AND STEEL INSTITUTE.

Floor Truss Design Notes:

1) Design Loads - 40-10-0-5
2) 2 3/4" chord section having top and bottom chord laterally braced with floor and ceiling sheathing
3) Deflection Limits: Live Load - L/480 Total Load - L/360
4) Chase located in center of span, maximum chase width allowed - 24 inches

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Evolution of Metal Plate Connected Wood Trusses

The highly engineered metal plate connected wood truss as we know it today is the evolution from a principle known to building designers for centuries. Architectural trussing was a late Roman invention, although it didn't really become popular until the early Gothic period in Northern France around 1100. Church construction began to feature pointed arches and vaults, and an overall feeling of height. The latter was not always just an impression - some ceilings towered 150 feet above the faithful.

By the 15th century, Leonardo Da Vinci's notebooks contained numerous drawings and comments about the strengths of framing members arranged in triangular configurations.

The practice of binding, or connecting, structural members in triangular configurations results in a product known as a truss. Prior to the 1940's most trusses in the building industry were constructed of heavy steel. The use of wood as members was primarily limited to timbers with bolted connections in large buildings and bridges.

The early days of World War II created a demand for the hurried construction of a large amount of military housing. To satisfy this demand, engineers in many cases chose dimensional lumber, connected with glued and nailed plywood gussets, or simply nailed joints, to form "wood trusses" to speed the jobsite time for framing roofs.

Alpine's Wave Connector Plate

This practice was continued following the end of the war to fulfill a pent-up demand for single family housing.

To shorten the labor intensive process of cutting the plywood gussets and glue/nailing them to the dimensional lumber, a light gauge metal plate was devised. The early plates were predrilled to receive nails - still somewhat labor intensive, but an improvement.

Looking to reduce the labor and increase truss production, Carol Sanford invented a light gauge metal plate with "teeth" punched from the base metal. These plates could then be imbedded into the lumber by a mechanical device. His metal connector became a forerunner of today's modern, highly engineered and tested quality connector.

Lumber used in manufacturing trusses has also changed drastically. In the early days, ordinary construction lumber was used. Much of the lumber now used in trusses is machine stress rated or visually graded lumber whose stress rating is based on rules established by years of testing. The reliability of lumber today is more predictable.

Adding to these improvements are the methods used to cut and assemble the wooden members of the truss. Widespread use of saws with computer controlled angle and length settings assure more accurate fitting of pieces and joints than with older hand set saws. Computer aided controls are also used to set the jigging points during the truss assembly and manufacturing process, further assuring more accurate fit of members and joints.

The wood truss is now a highly engineered product utilizing two excellent materials; wood, an energy efficient, renewable resource and steel, a recyclable resource.

The Industry

The metal plate connected wood truss industry is represented by two trade associations. In the U.S.A., connector plate manufacturers are organized in an association known as the Truss Plate Institute (TPI), and the truss manufacturers association is named the Wood Truss Council of America (WTCA). Both organizations are located in Madison, Wisconsin.

TPI is responsible for developing and publishing the design and testing methodology for wood trusses and is accredited by the American National Standards Institute (ANSI) as a consensus based standards writing organization. A listing of the standards and recommended practices of TPI is contained in Appendix B. WTCA, is an association of wood truss manufacturers, and works closely with TPI on many projects. WTCA promotes high standards in the manufacture and delivery of trusses by its member firms and is active in the marketing of and education about trusses. WTCA publishes the *Metal Plate Connected Wood Truss Handbook*, a complete guide to the design, manufacturing and use of wood trusses and other publications (see Appendix B). WTCA produces educational video presentations to train in the proper installation of trusses. WTCA and TPI is the voice of the industry in government and code matters.

In Canada, the metal plate connected wood truss industry is similarly represented by two trade associations. The Truss Plate of Canada (TPIC) and The Canadian Wood Truss Association (CWTA).

Wood Truss Handbook

For technical design and additional information about wood trusses, the Wood Truss Council of America (WTCA) publishes the *Metal Plate Connected Wood Truss Handbook*. The publication contains more than 300 pages of references regarding the truss manufacturing industry. It is considered the most comprehensive reference of its kind in the industry.

The Handbook covers the A-to-Z of information about wood trusses.

Contact:

Wood Truss Council of America, 5937 Meadowood Drive, Suite 14, Madison, WI 53711-4125
Phone: 608/274-4849,   Fax: 608/274-3329

Internet Web Site

Alpine maintains a site on the Internet's world wide web that provides additional reference material and links to hundreds of pages of useful information about trusses and other products. The entire Construction Hardware Division's catalog is there, as well as full specifications and information about FR-Systems Fire Resistance Assemblies. Please visit that site for additional information, parts of this publication, or just for browsing. You can find us at the following URL: http://www.alpeng.com

Video Training

Alpine makes available, through truss manufacturers who use their products and services, a number of video productions that are great for use in training new employees or in safety meetings.

Some of the subjects available are:

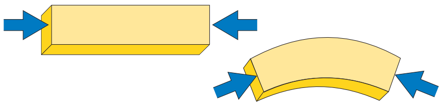
- ***Lifting Wood Trusses by Crane***
- ***Handling, Installing and Bracing of Metal Plate Connected Wood Trusses***

Your truss manufacturer also has available video presentations for loan that are produced by the Wood Truss Council of America.

- ***MPC Trusses: Fire Performance, Tactics and Strategy***
- ***Bracing and Erecting Wood Trusses***
- ***Building With Floor Trusses***

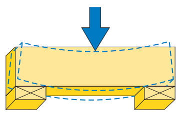
Contact your local truss manufacturer for additional information.

Types Of Stresses To Be Considered In The Design Of Trusses



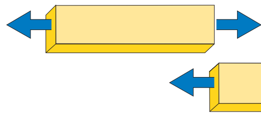
Compressive Stress Parallel To Grain

Truss top chords are generally in compression. When subjected to compressive stress, wood members can buckle. The longer and more slender the member is, the less compressive force it takes to buckle. In lumber, the compressive strength is measured by the F_c value.



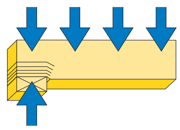
Bending

Bending occurs between supports when lumber is subjected to loads. Bending strength is measured by the F_b value of the lumber.



Tensile Stress

When subjected to tensile stress, wood members can elongate. Truss bottom chords are normally in tension. In lumber, tension strength is measured by the F_t value.

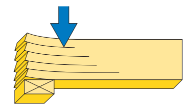


Compressive Stress Perpendicular To Grain

An example of compression perpendicular to grain is the bottom chord sitting on a support. It is necessary that the bottom chord lumber area be sufficient to prevent side grain crushing. Lumber's resistance to crushing is rated by the $F_{c\perp}$ value.

Horizontal Shear

Horizontal shear occurs along the grain, causing fibers to slide over each other. In lumber, horizontal shear strength is measured by the F_v value.

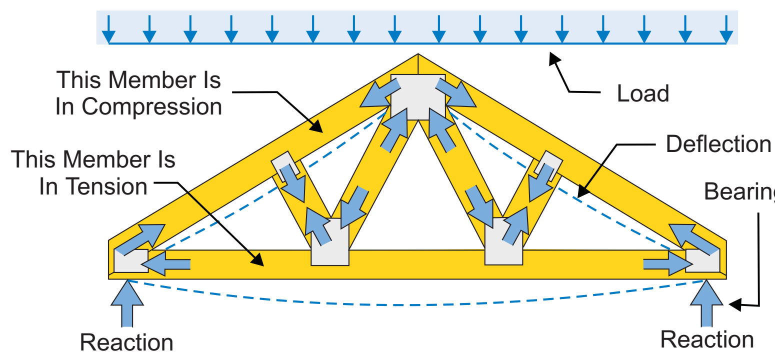


Vertical Shear

An example of vertical shear occurs at the inside of the truss support. Wood is stronger in vertical shear than horizontal shear. Since a vertical shearing force produces both vertical and horizontal shear stresses, wood will fail in horizontal shear instead of vertical shear.

Loads In Wood Trusses

This truss illustrates the action of the various stresses occurring along the wood members.
The applied loads induce stresses and movement in the truss members. A stable truss will resist these stresses.
The wood members are designed to resist the stress according to the allowable design values published in the National Design Specification For Wood Construction (NDS). NDS is published by the National Forest Products Association.
Forces at the member joints are resisted by metal connector plates that are held in place by "teeth" punched out of the base metal at right angles. The plates are rated for lateral resistance (tooth holding), shear, and tension and require review and approval by each of the model codes.



Short Term Loading

Wood has the ability of carrying a greater load for short durations than for long durations.

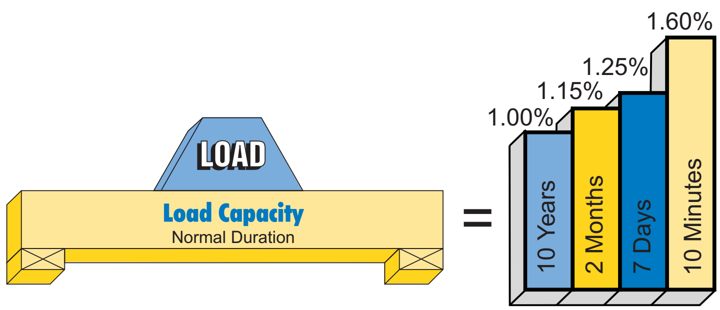
Duration Of Load Adjustment

The table shows the more common types of loads, their expected accumulated duration and the factor of adjustment in the allowable lumber stresses and the lateral resistance value (tooth holding) of the connector plate. Note: the factors do not apply to shear and tension in the connector plate. See NDS Section 2.3 for possible exceptions.

Load Type	Duration Of Load	Adjustment Factor
Dead Load	Permanent	.90
Floor Live - Normal	10 Years	1.00
Snow Load	2 Months	1.15
Construction	7 Days	1.25
Wind/Earthquake Load	10 Minutes	1.60
Impact	Impact	2.00

Other Adjustments

Other adjustments to design values may be necessary. Consult NDS Section 2.1. The value of lumber in extreme fiber bending "F_b" may be increased when there are three or more trusses spaced not more than 24 inches on center and are joined by load-distributing elements.
In special single-member applications where deflection may be a critical factor, or where deformation must be limited, reduction of modulus of elasticity (E) value may be appropriate.



Appendix A -- Weight Of Materials

All weights are pounds per square foot (psf) unless otherwise shown.

DECKING AND INSULATION

3/8 inch thick Plywood	1.1
1/2 inch thick Plywood	1.5
5/8 inch thick Plywood	1.8
3/4 inch thick plywood	2.2
5/4 inch thick plywood	3.3
1 inch nominal wood	2.3
2 inch nominal wood decking	4.3
16 ga. Corrugated Steel	2.5
22 ga. Corrugated Steel	1.5
28 ga. Corrugated Steel	1.0
29 ga. Corrugated Steel	0.9
Rigid Fiberglass - 1 inch thick	1.5
Styrofoam - 1 inch thick	0.2
Insulrock - 1 inch thick	2.7
Poured gypsum - 1 inch thick	6.5
Rock Wool - per 1 inch of thickness	6.5
Glass Wool - per 1 inch of thickness	0.2
Vermiculite - per 1 inch of thickness	2.6

WALLS AND PARTITIONS

Masonry, per 4 inches of thickness:

Brick	38.0
Concrete Block	30.0
Stucco - 7/8 inch thick	10.0
2x4 Framing @ 16" oc with ½ inch Thick gypsum each side	6.0
2x6 Framing @ 16" oc with ½ inch Thick gypsum each side	7.0

CEILINGS

1/2 inch thick Gypsum board	2.2
5/8 inch thick Gypsum board	2.8
5/8 inch thick Type X Gypsum bd	3.0
Acoustical Fiber Tile	1.0
Metal Grid Ceiling	0.8
Plaster - 1 inch thick	8.0
Plaster on Metal Lath	8.5

ROOFING

Asphalt Shingles - Minimum	2.5
Wood Shakes - 5/8 inch thick	3.0
3 Ply & Gravel	5.6
4 Ply & Gravel	6.0
5 Ply & Gravel	6.5

FLOORING

Hardwood - 1 inch nominal	4.0
Quarry Tile 3/4 inch thick	10.0
Linoleum or Soft Tile	1.5
Vinyl Tile - 1/8 inch thick	1.4
Concrete:	
Reinforced 1 ½ inch thick	17.5
Lightweight 1 ½ inch thick	12.5
Terrazzo 1 ½ inch thick	19.0

LUMBER (32 pcf)

Nominal Size:	@ 12" oc	@ 16" oc	@ 24" oc
2x4	1.4	1.1	0.7
2x6	2.2	1.7	1.1
2x8	2.9	2.2	1.5
2x10	3.7	2.8	1.9
2x12	4.4	3.3	2.2

WOOD TRUSSES - (APPROXIMATE)

Based on Southern Pine

Top Chord	Bottom Chord	PLF	24" oc.
2x4	2x4	5.2	2.6
2x6	2x4	6.1	3.1
2x6	2x6	6.9	3.5
2x8	2x6	7.8	3.9
2x8	2x8	8.5	4.3
2x10	2x8	9.3	4.7
2x10	2x10	10.1	5.2
2x12	2x10	10.9	5.5
2x12	2x12	11.6	5.8

We suggest the addition of 1.5 psf for misc. dead loads

FLOOR TRUSSES - (APPROXIMATE)

Based on Southern Pine

All members 2x4 - Weights are PLF

Depth in inches	Single Chord	Double Chord
12	5.0	
14	5.25	
16	5.5	8.4
18	5.75	8.6
20		8.9
24		9.4

SPRINKLER SYSTEMS

Pipe Size	Dry (PLF)	Wet (PLF)
1	1.7	2.1
1 1/4	2.3	3.0
1 ½	2.7	3.6
2	3.7	5.2
2 ½	5.8	7.9
3	7.6	10.8
3 ½	9.2	13.5
4	10.9	16.4
5	14.8	23.5
6	19.2	31.7
8	28.6	50.8

NOTE: The weight of wood and wood products will vary as the moisture content varies and as density of grain varies. Code of jurisdiction should be consulted for live load requirements. Weight of manufactured products should be verified with manufacturers.

Appendix B -- References

The materials listed below provide a good resource library for the design and use of wood trusses. Please contact the publisher/group directly for further information.

Alpine Engineered Products, Inc. 305/781-3333
P.O.Box 2225 • Pompano Beach, FL 33061 www.alpeng.com
- *System 42 With Tension Webs*
- *Good Connections Magazine*
- *Sweet's Insert*
- *FR-Systems Fire Resistance Rated Assemblies*
- *Quick Reference-Fire Rated Assemblies*

American Forest & Paper Association (AFPA) 202/463-2700
1111 19th St. NW, # 700 • Washington, DC 20036 www.afandpa.org
- *National Design Specification for Wood Construction (NDS)*
- *Wood Frame Construction Manual*

American National Standards Institute (ANSI) 212/642-4900
11 West 47th Street • New York, NY 10036 web.ansi.org
- *See TPI*

APA - The Engineered Wood Association 206/565-6600
1119 A Street • Tacoma, WA 98401 www.apa.wood.org
- *Use of Rated Sheathing in Roofs and Floors*
- *Fire Rated Systems*
- *Diaphragm Design*

American Society of Civil Engineers (ASCE) www.asce.org
345 East 47th Street • New York, NY 10017
- *Minimum Design Loads for Buildings And Other Structures, ASCE7*

American Society for Testing and Materials (ASTM) www.astm.org
1916 Rice Street • Philadelphia, PA 19103
- *Test Methods for Fire Tests for Building Construction and Materials, E-119*

Building Officials and Code 708/799-2300
Administrators International, Inc. (BOCA) www.bocaresearch.com
4051 W. Flossmoor Road • Country Club Hills, IL 60478
- *The BOCA National Building Code*

Council of American Building Officials (CABO) 703/931-4533
5203 Leesburg Pike, Suite 798 • Falls Church, VA 22041 www.cabo.org
- *One and Two Family Dwelling Code*

Forest Products Laboratory www.fpl.fs.fed.us
U.S. Department of Agriculture
One Gifford Pinchot Drive • Madison, WI 53705
- *Wood Handbook: Wood as an Engineered Material*

Gypsum Association 202/289-5440
810 First St. NE, # 510 • Washington, DC 20002 www.gypsum.org
- *Fire Resistance Design Manual, GA-600*

International Conference of Building Officials (ICBO) 213/699-0541
5360 S. Workman Mill Rd • Whittier, CA 90601 www.icbo.com
- *Uniform Building Code*
- *Uniform Fire Code*

National Frame Builders Association (NFBA) 913/843-2111
4980 W. 15th St., # 1000 • Lawrence, KS 66049 www.postframe.org
- *Post Frame Building Design*
- *Post Frame Comes of Age*
- *Recommended Practices-Post Frame Construction*

Southern Forest Products Association (SFPA) 504/443-4464
P. O. Box 641700 • Kenner, LA 70064 www.southernpine.com
- *Southern Pine Maximum Spans for Joists and Rafters*
- *Southern Pine Use Guide*

Southern Building Code Congress International, Inc. (SBCCI) 205/591-1853
www.sbcci.org
900 Montclair Road • Birmingham, AL 35213-1206
- *Standard Building Code*
- *Wind Design Standard, SSTD 10-93*

Truss Plate Institute (TPI) 608/833-5900
583 D'Onofrio Drive, Suite 200 • Madison, WI 53719
- *National Design Standard for Metal Plate Connected Wood Truss Construction, ANSI/TPI 1-1995*
- *Standard for Testing Metal Plate Connected Wood Trusses, ANSI/TPI 2-1995*
- *Recommended Design Specification for Temporary Bracing of MPC Wood Trusses, DSB-89*
- *Handling, Installation and Bracing Metal Plate Connected Wood Trusses, HIB-91*

Western Wood Products Association (WWPA) 503/224-3930
533 SW Fifth Ave. • Portland, OR 97204 www.wwpa.org
- *Western Lumber Product Use Manual*

Wood Truss Council of America 608/274-4849
One WTCA Center
6425 Normandy Ln. • Madison, WI 53719-1133
- *Metal Plate Connected Wood Truss Handbook*
- *Job-Site Bracing Poster*
- *Standard Responsibilities in the Design Process Involving Metal Plate Connected Wood Trusses WTCA 1-1995*

Canadian References

Alpine Systems Corporation 905/879-0700
70 Moyal Court • Concord, ON L4K 4R8 www.alpeng.com
- *Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses (Limit States Design), published by TPIC*

Canadian Wood Truss Association - L'Association Canadienne des Fabricants de Fermes de Bois 613/747-5544
www.cwc.ca
1400 Blair Place, Suite 210 • Ottawa, ON K1J 9B8
- *Wood Design Manual*

Canadian Standards Association 416/747-4044
178 Rexdale Boulevard • Rexdale, ON M9W 1R3 www.csa.ca
- *CSA 086.194 "Engineering Design in Wood (Limit States Design)"*
- *CSA S347-M1980 "Method of Test for Evaluation of Truss Plates Used in Lumber Joints"*

National Research Council of Canada 613/993-2463
Institute for Research in Construction www.nrc.ca/irc
1500 Montreal Road • Ottawa, ON K1A 9Z9
- *National Building Code of Canada (NBCC)*
- *National Farm Building Code of Canada (NFBCC)*

AXIAL FORCE - A push (compression) or pull (tension) acting along the length of a member. Usually measured in pounds (lbs).

AXIAL STRESS - The axial force acting along the length of a member, divided by the cross-sectional area of the member. Usually measured in pounds per square inch (psi).

BEARING - Structural support of a truss, usually walls, hangers or posts.

BENDING MOMENT - A measure of the bending effect on a member due to forces acting perpendicular to the length of the member. The bending moment at the given point along a member equals the sum of all perpendicular forces, either to the left or right of the point, times their corresponding distances from the point. Usually measured in inch-pounds.

BENDING STRESS - The force per square inch acting at a point along the length of a member, resulting from the bending moment applied at that point. Usually measured in pounds per square inch (psi).

BOTTOM CHORD - A horizontal or inclined (scissors truss) member that establishes the lower edge of a truss, usually carrying combined tension and bending stresses.

BUILT-UP BEAM - A single unit composed of two or more wood members having the same thickness but not necessarily the same depth, which provides a greater load carrying capacity as well as greater resistance to deflection.

BUTT - CUT - Slight vertical cut at outside end of truss bottom chord made to insure uniform nominal span and tight joints. Usually 1/4-inch.

CAMBER - An upward vertical displacement built into a truss, usually to offset deflection due to dead load.

CANTILEVER - The part of a structural member that extends beyond its support.

CLEAR SPAN - Horizontal distance between interior edges of supports.

COMBINED STRESS - The combination of axial and bending stresses acting on a member simultaneously, such as occurs in the top chord (compression + bending) or bottom chord (tension + bending) of a truss.

CONCENTRATED LOAD - An additional load centered at a given point. An example is a crane or hoist hanging from the bottom chord at a panel point or mechanical equipment supported by the top chord.

DEAD LOAD - Permanent loads that are constantly on the truss, ie: the weight of the truss itself, purlins, sheathing, roofing, ceiling, etc.

DEFLECTION - Downward or horizontal displacement of a truss due to loads.

DIAPHRAGM - A large, thin structural element that acts as a horizontal beam to resist lateral forces on a building.

DRAG STRUT - Typically a horizontal member, such as a truss or beam, that transfers shear from a diaphragm to a shearwall.

DURATION OF LOAD FACTOR - An adjustment in the allowable stress in a wood member, based on the duration of the load causing the stress. The shorter the time duration of the load, the higher the percentage increase in allowable stress.

HEEL - Point on a truss at which the top and bottom chord intersect at the end of a truss with a sloping top chord.

LATERAL BRACING - A member installed and connected at right angles to a chord or web member of a truss to resist lateral movement.

LEVEL RETURN - Lumber filler placed horizontally from the end of an overhang to the outside wall to form soffit framing.

LIVE LOAD - Any load which is not of permanent nature, such as snow, wind, seismic, movable concentrated loads, furniture, etc. Live loads are generally of short duration.

NOMINAL SPAN - Horizontal distance between outside edges of the outermost supports.

OVERHANG - The extension of the top chord (usually) or bottom chord of a truss beyond the support.

PANEL - The chord segment defined by two successive joints.

PANEL LENGTH - The centerline distance between joints measured along the chord.

PANEL POINT - The centerline of the point of intersection in a joint where a web(s) meets a chord.

PEAK - Point on a truss where the sloped top chords meet.

PLUMB CUT - Top chord cut that is plumb to the building floor line provided for vertical installation of a fascia.

PURLIN - A horizontal member in a roof perpendicular to the truss top chord used to support the decking.

REACTION - Forces acting on a truss through its supports that are equal but opposite to the sum of the dead and live loads.

SHEARWALL - A wall element that acts as a large vertical beam, cantilevered from the foundation to resist lateral forces on the building.

SLOPE (Pitch) - The inches of vertical rise in 12 inches of horizontal run for inclined members, generally expressed as 3/12, 4/12 etc.

SPLICE POINT (Top or Bottom Chord Splice) - The point at which two chord members are joined together to form a single member.

SQUARE CUT - A cut perpendicular to the slope of the member at its end.

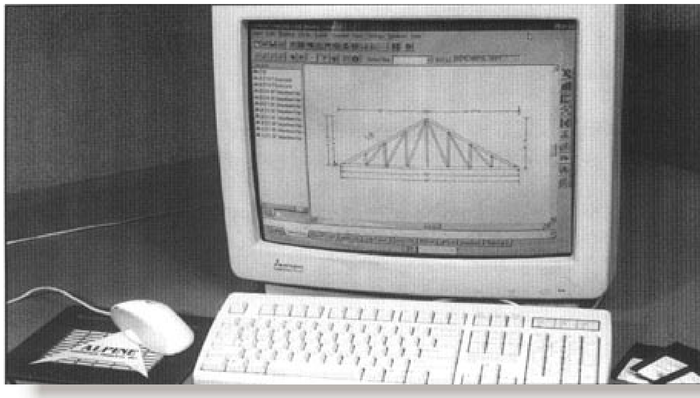
TOP CHORD - An inclined or horizontal member that establishes the upper edge of a truss, usually carrying combined compression and bending stresses.

TRUSS - A pre-built component that functions as a structural support member. A truss employs one or more triangles in its construction.

VIBRATION - The term associated with the serviceability of a floor. If the occupant feels the floor respond to walking or other input, it may be referred to as vibration or response to load.

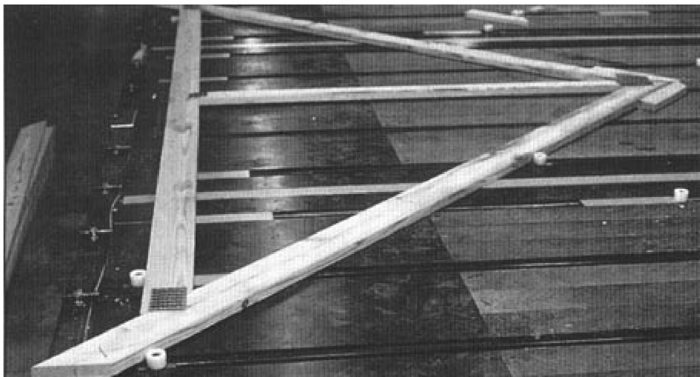
WEBS - Members that join the top and bottom chords to form the triangular patterns that give truss action, usually carrying tension or compression stresses (no bending).

Truss Production Sequence

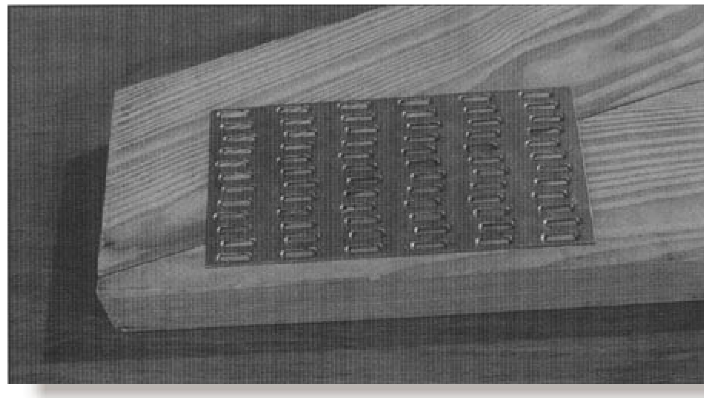


Computer Design Workstation

Automated Sawing



Computer Aided Jigging For Lumber

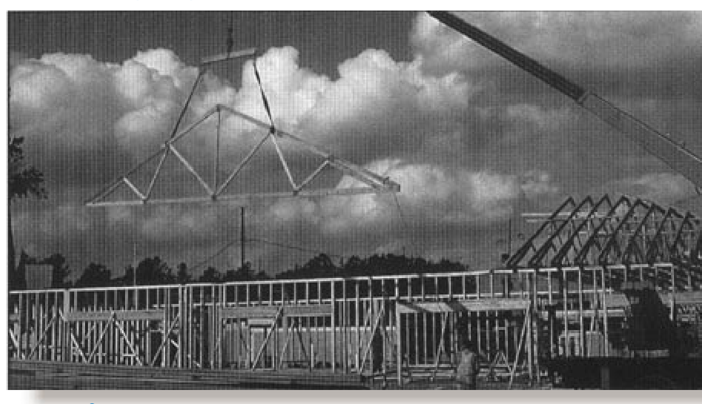


Connector Plate Placement

Truss Pressing

Job Staging

Delivery



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Missouri: 13389 Lakefront Drive • Earth City, MO 63045 • 314-344-9121
Illinois: 2440 Production Drive • St. Charles, IL 60174 • 630-584-7735
825 S. Industrial Drive • Litchfield, IL 62056 • 217-324-0303
Pennsylvania: 120 E. Ridge Road • Nottingham, PA 19362 • 610-932-0300
California: 8351 Rovana Circle • Sacramento, CA 95828 • 916-387-0116
Washington: 3700 Pacific Highway East #101 • Tacoma, WA 98424 • 253-926-8778

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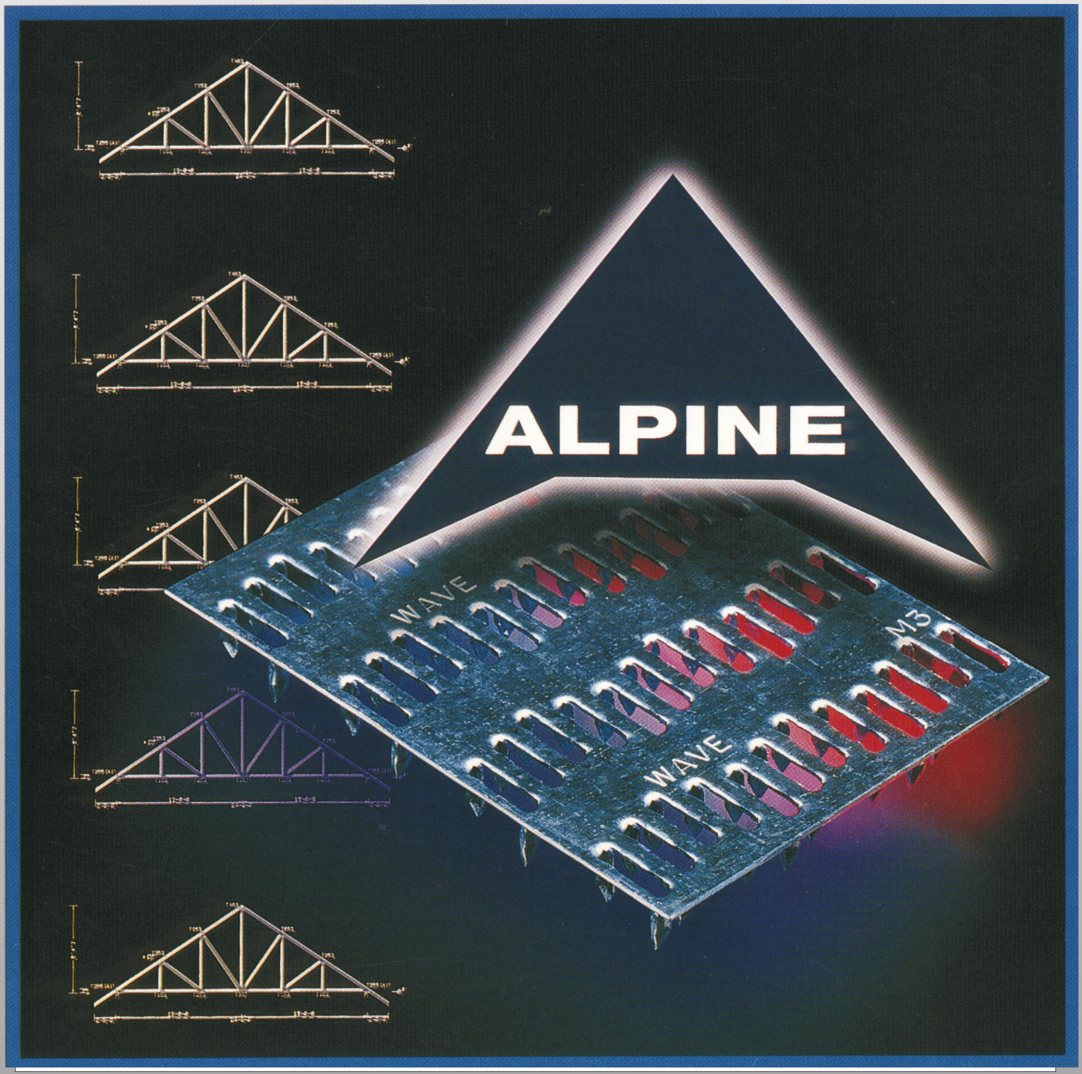
Québec: 2 Place de Commerce, Suite 207 • Brossard, PQ J4W 2T8 • 514-923-5555
British Columbia: 2922 Glen Drive, #204 • Coquitlam, BC V3B 2P5 • 604-944-4100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