Chapter 11: Installing and Bracing Trusses

Most Common Mistakes:

1. Installing interior ganged wood trusses at a height other than truss top chord top at eave height on bearing column outside edge.
2. Using bottom chord continuous lateral restraint other than what is specified on building plans.
3. Failing to confirm distance from end truss outside to opposite end truss outside matches overall building length at all points along end trusses.
4. Attaching roof truss bottom chords to tops of interior walls,

Due to differential expansion and contraction, roof trusses should never be attached permanently directly to interior walls. Interior walls should be framed so as top of wall is ½" below truss bottom and secured together by use of Simpson Strongtie STC truss clips. These keep trusses in alignment, while allowing for roof truss vertical movement. Use drywall clips to attach drywall edges and hold first drywall screw back from gypsum wallboard edges to allow sheetrock to flex and minimize possibilities of cracking drywall joints.

How to Lift

If available, use column cap winch boxes. Otherwise use a Genie lift, crane, boom truck, front-end loader, forklift, or other similar equipment. Small span trusses can be installed by hand labor. Helicopters have also been used to erect trusses!

Above two Genie Superlifts are used to raise a truss pair.

Below a crane picks up an entire bay with all purlins and ceiling joists installed.

Use equipment capable of installing trusses without risk to equipment operator and erectors. Connect any lifting devices to truss top chords with a closed loop attachment long enough to carry truss. *Avoid lifting trusses greater than 30 foot span by peak!*

Below is an example of **WRONG WAY** to lift trusses:

Long-span trusses present special erection challenges. Prevent any truss, when lifted off ground to be positioned on building, from flexing excessively. Place truss into position as straight and as plumb as possible. There is an inherent danger in attempting to hold a straight position without adequate bracing. This lessens when ganged wood truss installation is used for excessively long spans.

Interior trusses, in Hansen Buildings, are designed specifically to be installed joined face-to-face in pairs.

CAUTION Avoid, under any circumstances, installing trusses spaced apart with blocking between!

Following are two **incorrectly** installed truss examples.

Any installation method OTHER than what is specified on building plans can critically reduce load-carrying capacity and building's roof system performance. To do so may result in building failure causing damage to contents and potential injury or fatalities to persons in or near structure!

Installation

Start at one gable end using erection equipment to hold truss (with all hangers attached) in alignment while attaching one end into corner column notch. This is done while holding truss eave edge flush to corner column outside edge.

After installation, truss top at corner column is at **eave mark** and *outside truss edge* is **flush** with *outside column edge*.

Verify building width at column tops and, when accurate, nail end truss to opposite corner column.

Before nailing truss to other endwall columns, verify column spacings at end truss bottom chord level.

Nail trusses to columns according to plan. Good practice is to nail end trusses to each endwall column, as specified on endwall truss to corner column detail, but in any case, use 6-10d common nails minimum.

Before going further - Make certain to fasten all trusses properly and (prior to fully recessed purlin installation) braced appropriately. Winds can arise with little or no warning and many un-braced or poorly-fastened trusses have been damaged as a result.

Many construction injuries occur as due to improper truss handling, placement and bracing. Use appropriate temporary bracing at all times. Assure trusses are structurally undamaged during erection and maintain in proper alignment before, during and after installation.

Prior to raising trusses, fully recessed purlins for each bay can be cut to length by distance between trusses measure.

Remember, due to truss plate thickness, a truss pair is often thicker than three inches!


Strongly encouraged: If equipment is available to lift more than a single truss pair at a time, install all framing members between truss pairs and lift at same time. More work able to done on ground, faster *and safer* building project will be. First pair of truss notches closest to each endwall have been oriented towards endwalls in order to aid in ease of lifting bays closest to each building end.

Raise first truss pair closest to previously installed end truss into place and attach at one end. After verifying building width, fasten into place, according to building plans, using Strong-Drive® SDWS TIMBER Screws or bolts and nails, as specified on engineer sealed building plans.

Two truss pairs being "cranked" into place with winch boxes

CAUTION **This is an unsafe construction practice example!**

Interior Trusses to Columns (with Strong-Drive® SDWS TIMBER Screws)

In most cases Strong-Drive® SDWS TIMBER Screws are used in interior ganged wood truss to column connection. In most instances, fastener will be driven through column into trusses. **See Figure 11-1**

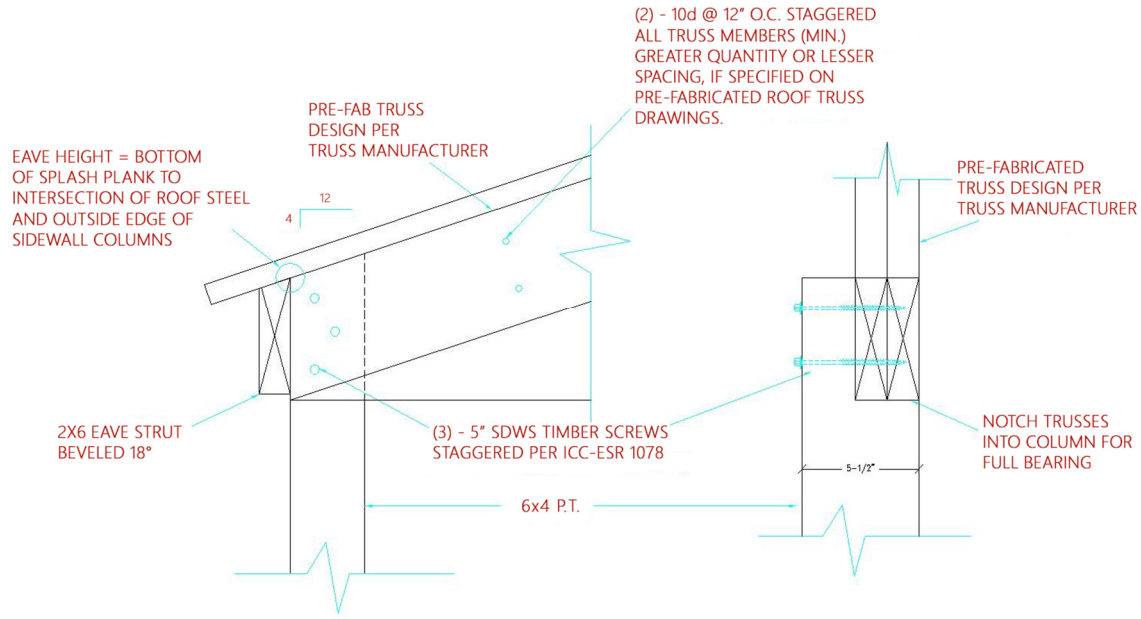

Figure 11-1 Strong-Drive® SDWS TIMBER Screws

Install Strong-Drive® SDWS TIMBER Screws through columns, with tip into trusses, using a high torque, ½" variable speed drill. Bring washer flush to side member – avoid countersinking. To avoid splitting during fabrication (or if steel truss connector plates cannot be avoided) , drill a 9/64" diameter lead hole 5" deep for each fastener. Then drill a 7/32" clearance hole for shank no greater than 2" deep.

Interior Trusses to Columns (with HST brackets)

High wind applications may require Simpson HST bracket use to resist uplift forces. In these instances, roof trusses will most typically be designed with a "raised" heel to provide an adequate surface area to drill through and bolt to. HST bracket installs on truss side of column vertically centered on bottom edge of truss. A single washer is provided for each bolt. Place washer on column side of assembly (opposite trusses). **See Figure 11-2**

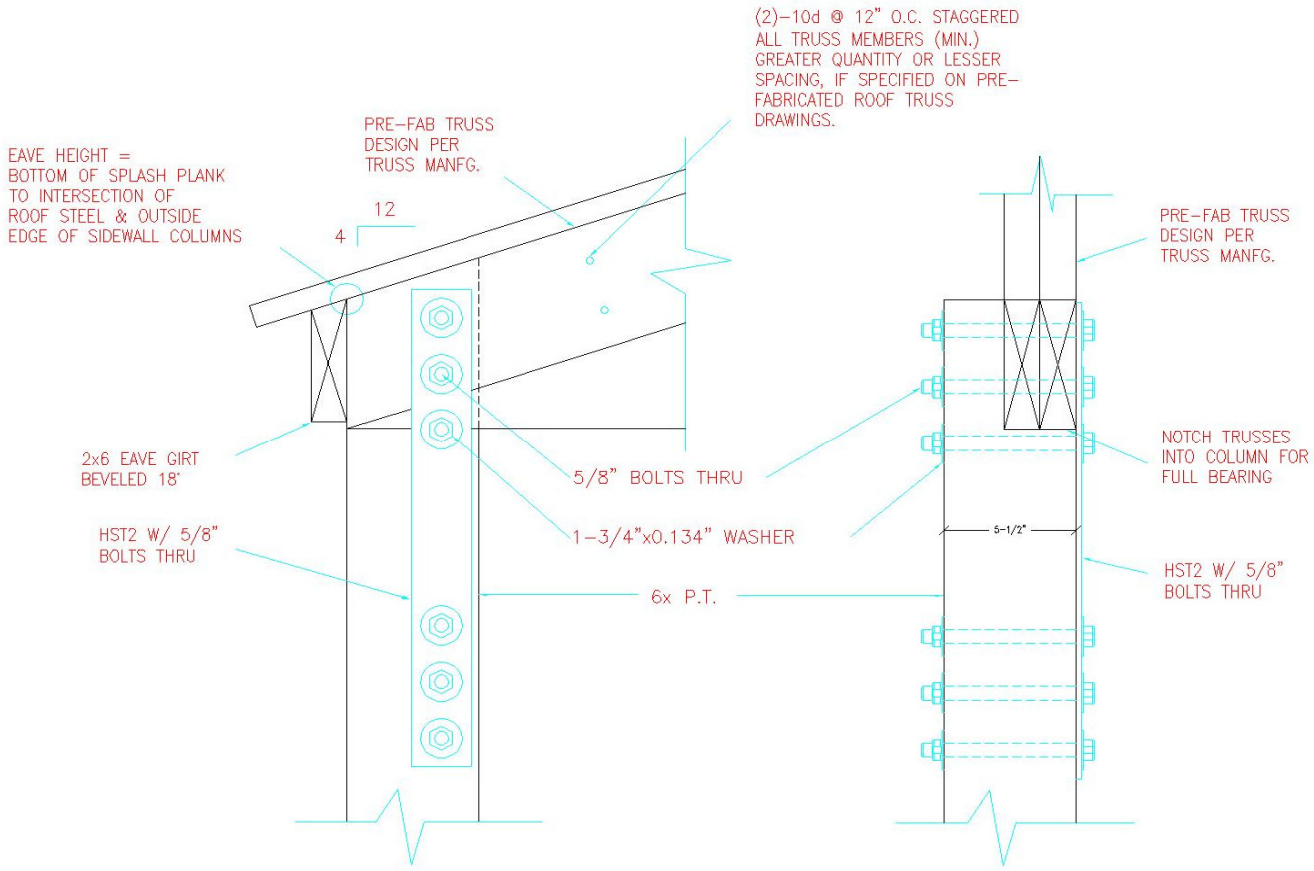

Figure 11-2 HST brackets

Fully recessed purlins

Install previously cut fully recessed purlins into hangers between endwall truss and first truss pair. All fully recessed purlins are installed with “crown” or “bow” up. Insure purlin ends are tight to truss face at each end.

Ridge fully recessed purlins are installed first.

On **40-foot or longer trusses**, install a fully recessed purlin half-way between eave and ridge next.

Then install rest of fully recessed purlins in this bay, working from eave to ridge.
Repeat this process until all trusses and fully recessed purlins have been installed.

PRIOR to installing fully recessed purlins between last truss pair and opposite endwall from where framing started, check overall building length as measured across roof.

Distance from *end truss outside face* to *end truss outside face* is **identical to building length**. If necessary, fully recessed purlin lengths in last bay can be adjusted in order to keep this overall length correct.

Purlins 2x10 or greater in dimension, spanning eight feet or more, require mid-span blocking. Please refer to your third-party engineered building plans.

Permanent Truss Bracing

Again, from **National Design Standards 2001 (NDS):**

> *The theory of bracing metal connected wood trusses, and indeed any structural element, is to apply sufficient support at right angles to the plane of the truss to hold every member in the position assumed for it in the design. Trusses are designed as planar members supporting loads applied within their plane (Figure 4.2.1). Loads applied perpendicular to the plane of the truss (Figure 4.2.2) must be resisted by bracing, which in turn must also transfer these loads safely to the diaphragms, shear walls or other lateral load resisting elements of the building. Lateral loads can be caused by buckling forces in compression members and/or environmental loads such as wind and seismic events.*
>
> *The thin dimension of the nominal 2-inch thick lumber used in a truss results in a structure notably subject to bending, bowing and buckling in the plane perpendicular to the trusses, especially during the installation process. The trusses must have lateral support of the truss members to prevent sideways movement during and after erection.*
>
> *Acceptable lifetime performance of trusses depends upon careful handling during delivery, proper temporary bracing during delivery, proper temporary bracing during installation, proper overall permanent building bracing, and care and maintenance of the building after being inhabited. Temporary bracing is required to temporarily stabilize the trusses until the permanent bracing can be applied. With some planning, portions of the temporary bracing can be left in place and will function as permanent bracing.*

Permanent lateral bracing system (roof fully recessed purlins and bottom chord continuous lateral restraint) meet ANSI/TPI 1-2014 requirements as providing for permanent truss bracing to resist wind, seismic and other lateral forces (see GENERAL NOTES on building plans Sheet S-0). If a request is made to ADD to top or bottom chord continuous lateral restraint, beyond what is specified on building plans, reference should be made to this GENERAL NOTE as well as to refer to MiTek,Inc. and/or ITW Building Components/Truswal Systems letters on following pages.

MiTek®

MiTek, Industries Inc.
14515 North Outer Forty
Suite 300
Chesterfield, MO 63017
Telephone 314/434-1200
Fax 314/434/5343

18 September, 2008

To Whom It May Concern:

MiTek Industries, Inc. is a manufacturer of metal truss connector plates and provides truss design software and engineering services.

The typical engineering services provided by MiTek are limited to the design of individual truss components. The applicability of the design parameters and the proper incorporation of the components into the overall building design are the responsibility of the building designer/project engineer.

The MiTek component designs are based solely on the parameters we are provided, and these are clearly indicated on the engineering design drawings.

We are not responsible for, and in fact have no knowledge of, the overall building design, which includes, but is not limited to, foundation design, support system member design, permanent building bracing systems and special site condition considerations.

The following language from the Truss Plate Institute's *National Design Standard for Metal Plate Connected Wood Truss Construction, ANSI/TPI 1-2002,* helps to clarify our position and current industry practice. In Chapter 2, RESPONSIBILITY IN THE DESIGN PROCESS INVOLVING METAL PLATE CONNECTED WOOD TRUSSES, the standard lists the responsibilities for the Building Designer in section 2.2. As part of these responsibilities, Section 2.2.2.4 states, "Permanent bracing for the building, including bracing to resist wind, seismic, or other lateral forces, and permanent bracing for all structural elements. The permanent bracing design shall incorporate the individual structural element bracing, including the continuous lateral bracing specified for trusses by the Truss Designer as set forth in Section 2.1.2.12. The permanent bracing design shall accomplish the proper transfer of design loads and individual member buckling forces to the building's shear walls, portal frames, bearing walls, columns, beams, or other structural elements to achieve total structural integrity."

Special design requirements, such as wind bracing, portal bracing, seismic bracing, diaphragms, shear walls, or other load transfer elements and their connections to the wood trusses must be considered separately by the building designer. The building designer shall determine size, location, and method of connections for diagonal bracing as needed to resist these forces. Diagonal or cross bracing is recommended in the plane of the top chord, in the plane of the bottom chord, and perpendicular to the truss web member, as needed for the

overall stability of the entire structure. Truss bracing and connection details should be shown or the building designers' framing plan as part of the design drawings. Bracing materials are not usually furnished as part of the wood truss package, and should be provided by the building or erection contractor.

Through special arrangement, MiTek's Engineering Services Group may be contracted to supply the roof bracing system for a structure.

MiTek recommends reviewing the *BCSI, Guide to Good Practice for Handling, Installing and Bracing of Metal Plate Connected Wood Trusses* (published jointly by the Wood Truss Council of America and the Truss Plate Institute) for recommended truss bracing guidelines.

MiTek takes full responsibility for the truss design drawings we provide to our clients, but permanent and temporary bracing design are the responsibility of other parties.

Sincerely,

David C Wert, P.E.
Director of Technical Development

ITW Building Components Group, Inc.
4445 NORTHPARK DRIVE, SUITE 102
COLORADO SPRINGS, CO 80907
(800) 322-4045 FAX (719) 598-8463

4/22/09

To whom it may concern:

Lateral bracing of individual truss members is specified on each Truswal engineering drawing, indicating the need for that member to be laterally braced, and implying that the member is not adequate unless braced to resist compression buckling. Sometimes there exists bracing for the overall design of the building that Truswal is not aware of at the time of the truss design, and this bracing may satisfy the needs of the truss without the requirement of additional lateral bracing. Regardless, this "building bracing" is the responsibility of the building designer, as stated in this excerpt from ANSI/TPI 1-2002:

> *2.2.2. The Building Designer shall prepare the structural design documents to include the following:*
>
> *2.2.2.4. Permanent bracing design for the building, including bracing to resist wind, seismic, or other lateral forces, and permanent bracing for all structural elements. The permanent bracing design shall incorporate the individual structural element bracing, including the continuous lateral bracing specified by the Truss Designer as set forth in Section 2.1.2.12. The permanent bracing design shall accomplish the proper transfer of design loads and individual member buckling forces to the building's shear walls, portal frames, bearing walls, columns, beams, or other structural elements to achieve total structural integrity;*

Therefore, any system that is acceptable to the building designer in satisfying the bracing requirements as specified by the truss designer is the responsibility of that building designer. Again, the truss designer specifies the *need* for lateral bracing, but the design of that bracing is the responsibility of the building designer.

I hope that this letter will resolve any issues that might exist concerning the bracing responsibilities of engineered wood trusses. If there are any remaining questions, please do not hesitate to contact Truswal at your convenience.

Sincerely,
Larry L. Messamer, P.E.
Chief Engineer, ITW-BCG

Permanent Truss Bottom chord continuous lateral restraint

Install permanent truss bottom chord continuous lateral restraint next. Begin with bay closest to each endwall. Bracing will attach to each endwall column, over 7' from corner. Nail 2x4, on edge, to column side, directly behind endwall truss bottom chord. Extend, parallel to fully recessed purlins, to top chord of first pair of trusses. Angle cut upper end to fit tight to truss top chord. Attach using LSTA 12 bracket. NOTE: Brace upper end may be shifted slightly to avoid fully recessed purlins as well as lowered 7/16" on double truss end to account for OSB roof sheathing (when required only) in bay closest to one or more endwalls only.
See Figure 11-3

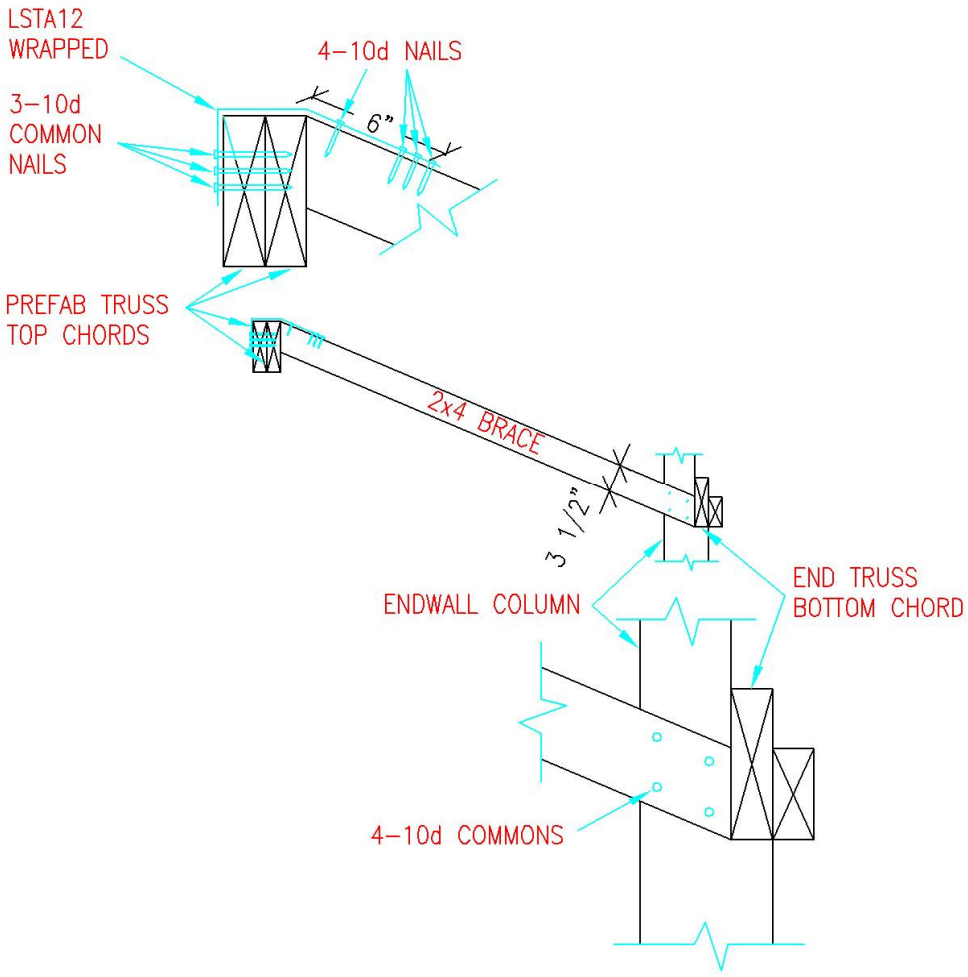

Figure 11-3: Permanent Truss Bottom chord continuous lateral restraint

HELPFUL HINT: Note where permanent truss bottom chord continuous lateral restraint attaches to endwall column. Attach to column on side away from an overhead door opening. If no other choice exists, attach HIGH enough to avoid any conflicts with overhead door tracks.

Attach 2x4, flat (3-1/2”) to sky (rotated 90 degrees from prior vertical 2x4), to endwall truss top chord and bottom chord of first pair of trusses, using LSTA12s. Angle cut both ends to fit tight to trusses. Connect at mid-point to previously installed vertical 2x4 with two 20d threaded hardened nails. Pre-drill 20d nail holes to avoid splitting. **See Figure 11-4**

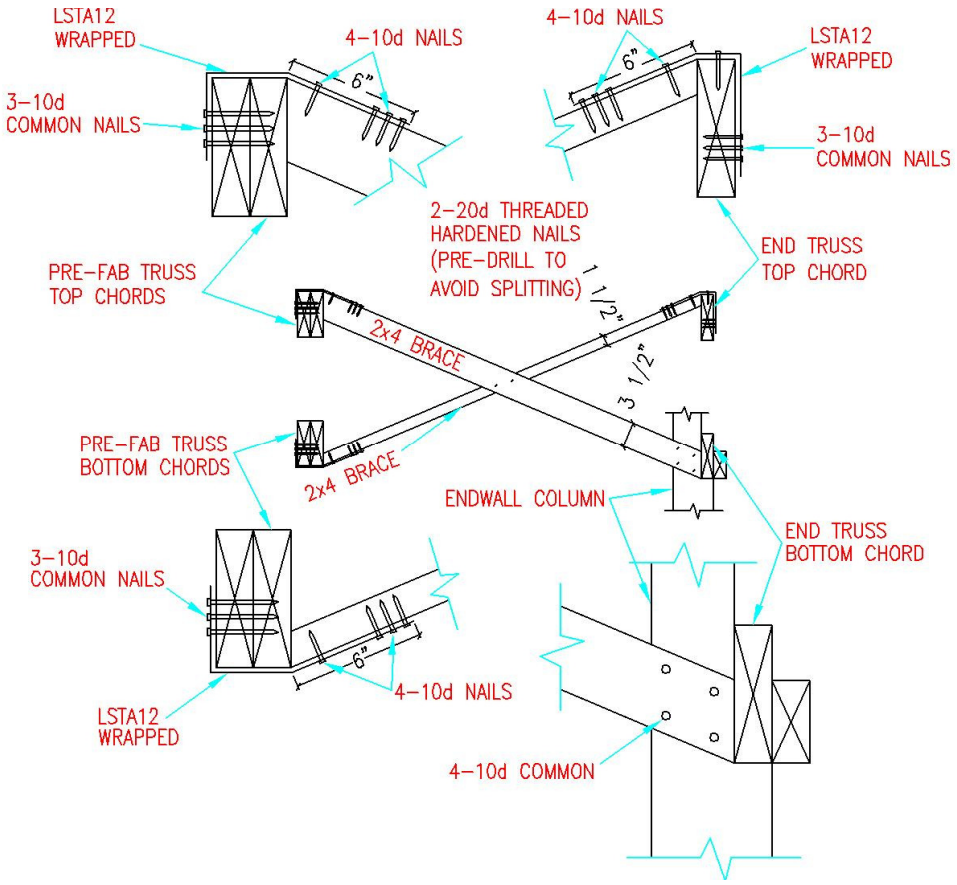

Figure 11-4: Permanent Truss X bracing

Install bracing between ganged wood truss bottom chords. 10’ or lesser spans between truss pairs usually are done with a single 2x4. Cut to fit tight between chords and attach with LU24 hangers. Hangers may be located to avoid truss plates, as long as distance across building between wall and brace (or adjacent braces) is 20 feet or less. **See Figure 11-5**

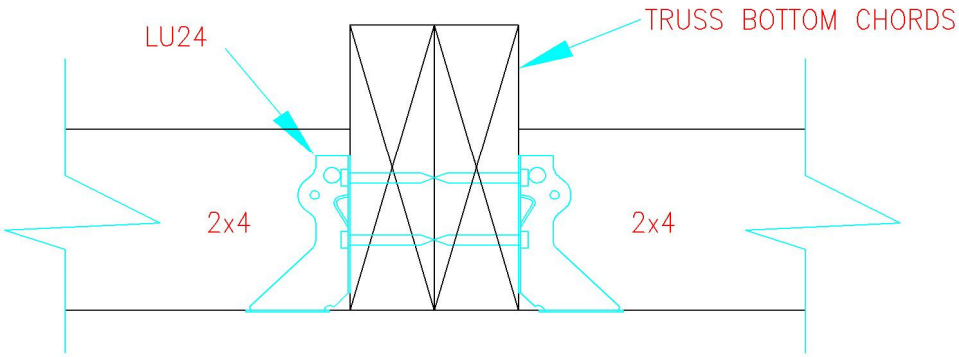

Figure 11-5: Single Bottom chord continuous lateral restraint

Trusses spaced over 10' between require a "T" bottom chord brace. Nail "T" brace members together with 10d commons at 8" on center.
See Figure 11-6

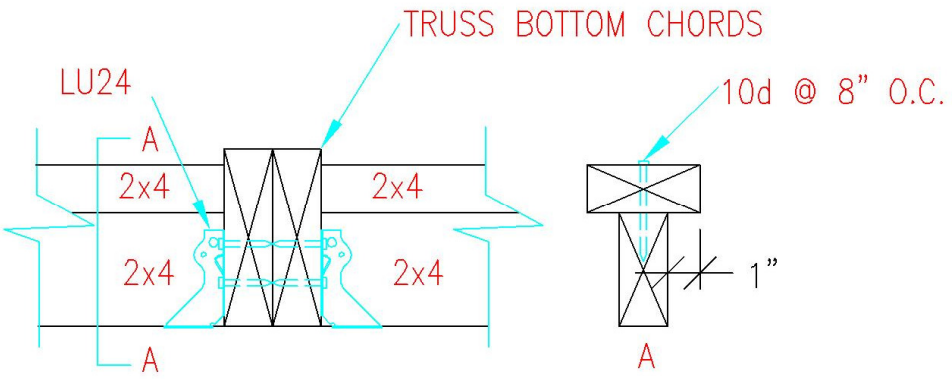

Figure 11-6: T Bottom chord continuous lateral restraint

Permanent truss chord bracing provided with building kit is appropriate to meet design requirements as specified by building designer or E.O.R.. Actual building system field performance may require additional unforeseen bracing. This additional bracing may be a resultant of any one of numerous factors – truss storage, handling, installation, weight distributions, climactic conditions or a myriad of other reasons.

Insufficient, inadequate, or totally neglecting installing permanent truss bracing can significantly increase chances of future building performance problems. Members can buckle out of plane causing deformations leading to "cracks" in drywall, wall racking, or other issues. Fixing these problems after building is up is seldom an easy or economical proposition. All bracing is far easier installed during normal construction procedures.

In some circumstances a building official may require, request or demand bracing to be added *beyond* what is specified by E.O.R..

Adding extra bracing (other than knee bracing) will NOT hurt building, nor reduce its overall ability to perform adequately. However, providing materials for and cost of *any* and *all* extra permanent truss bracing added beyond building plan requirements, will be borne by building owner or contractor hired to do building installation.

In simple terms – extra bracing above and beyond what appears on building plans may be ADDED– but cost is **YOURS**.

CAUTION Below is a knee brace photo. Do not, under any circumstances permanently add them. Knee braces induce loads into roof trusses beyond their design. Under critical conditions, this could result in roof system failure.