Chapter 11: Installing and Bracing Trusses

Most Common Mistakes:

1. Installing interior double trusses at a height other than truss top chord top at eave height on bearing column outside edge.
2. Using bottom chord bracing other than what is specified on building plans.
3. Not making sure distance from outside of end truss, to outside of end truss matches overall building length at all points along the end trusses.

How to Lift

If available, use post 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!

Here a pair of Genie Superlifts are used to raise a pair of trusses.

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 single trusses greater than 30 feet by peak!*

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. The inherent danger in attempting to hold a straight position with adequate bracing lessens when double 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.

Do NOT, under any circumstances, install trusses spaced apart with blocking between!

Following are two examples of trusses **incorrectly** installed.

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 in alignment while attaching one end. This is done while holding truss eave edge flush to corner column outside edge.

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

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

Before nailing truss to other endwall columns, verify post 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 column detail, but in any case, use 6-10d nails minimum.

STOP **Before going further -** Make certain to fasten all trusses properly and (prior to 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.

CAUTION *Many construction injuries occur as due to improper handling, placement and bracing of trusses. Use appropriate temporary bracing at all times. Assure trusses are not structurally damaged during erection and maintain in proper alignment before, during and after installation.*

Prior to raising trusses, 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!

If equipment is available to lift more than a single truss pair at a time, install all framing members between truss pair which will be lifted at same time. The more work which can be done on ground, the faster *and safer* the building project will be.

Raise first truss pair closest to endwall into place and attach at one end. After verifying building width, fasten into place, according to plan.

Two pairs of trusses being "cranked" into place with winch boxes

DANGER This is NOT an example of safe construction practice.

Interior Trusses to Columns (with LedgerLocks)

In most instances FastenMaster LedgerLocks are used in the interior double truss to column connection. Install using a high torque, ½" variable speed drill. Bring washer flush to side member – do not countersink. Install LedgerLoks through trusses, with tip into columns. To avoid splitting during fabrication, drill a 9/64" diameter lead hole 5" deep for each fastener. Then drill a 7/32" clearance hole for the shank no greater than 2" deep.

Purlins

Install pre-cut purlins between endwall truss and first truss pair. All purlins are installed with "crown" or "bow" up.

Ridge purlins are installed first.

On **40-foot or longer trusses**, install a purlin half-way between eave and ridge next. Then install purlin balance in this bay, working from eave to ridge. **Repeat this process until all trusses and purlins have been installed.**

PRIOR to installing 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, purlins in last bay can be shortened in order to keep this overall length correct.

Permanent Truss Bracing

Again, from the **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.*

The permanent lateral bracing system (roof purlins and bottom chord bracing) meet the requirements of ANSI/TPI 1-2007 as providing for permanent truss bracing to resist wind, seismic and other lateral forces (see GENERAL NOTES #11 on your building plans). In the event a request is made to ADD to the top or bottom chord bracing, beyond what is specified on building plans, reference should be made to note #11 as well as to refer to MiTek,Inc. and/or ITW Building Components/Truswal Systems letters on the following pages.

MiTek®

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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

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(800) 322-4045 FAX (719) 598-8463

4/22/09

To whom it may concern:

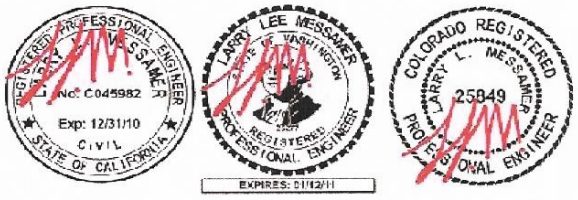
Lateral bracing of individual truss members is specified on each Truswal engineering drawing, indicating the need for that member to be laterally braced, and implying that the member is not adequate unless braced to resist compression buckling. Sometimes there exists bracing for the overall design of 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 Bracing

Install permanent truss bottom chord bracing next. Begin with bay closest to each endwall. Bracing will attach to each endwall column, over 7' from corner. Nail 2x4, on edge, to side of column, directly behind endwall truss bottom chord. Extend, parallel to roof 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 purlins. **See Figure 11-1**

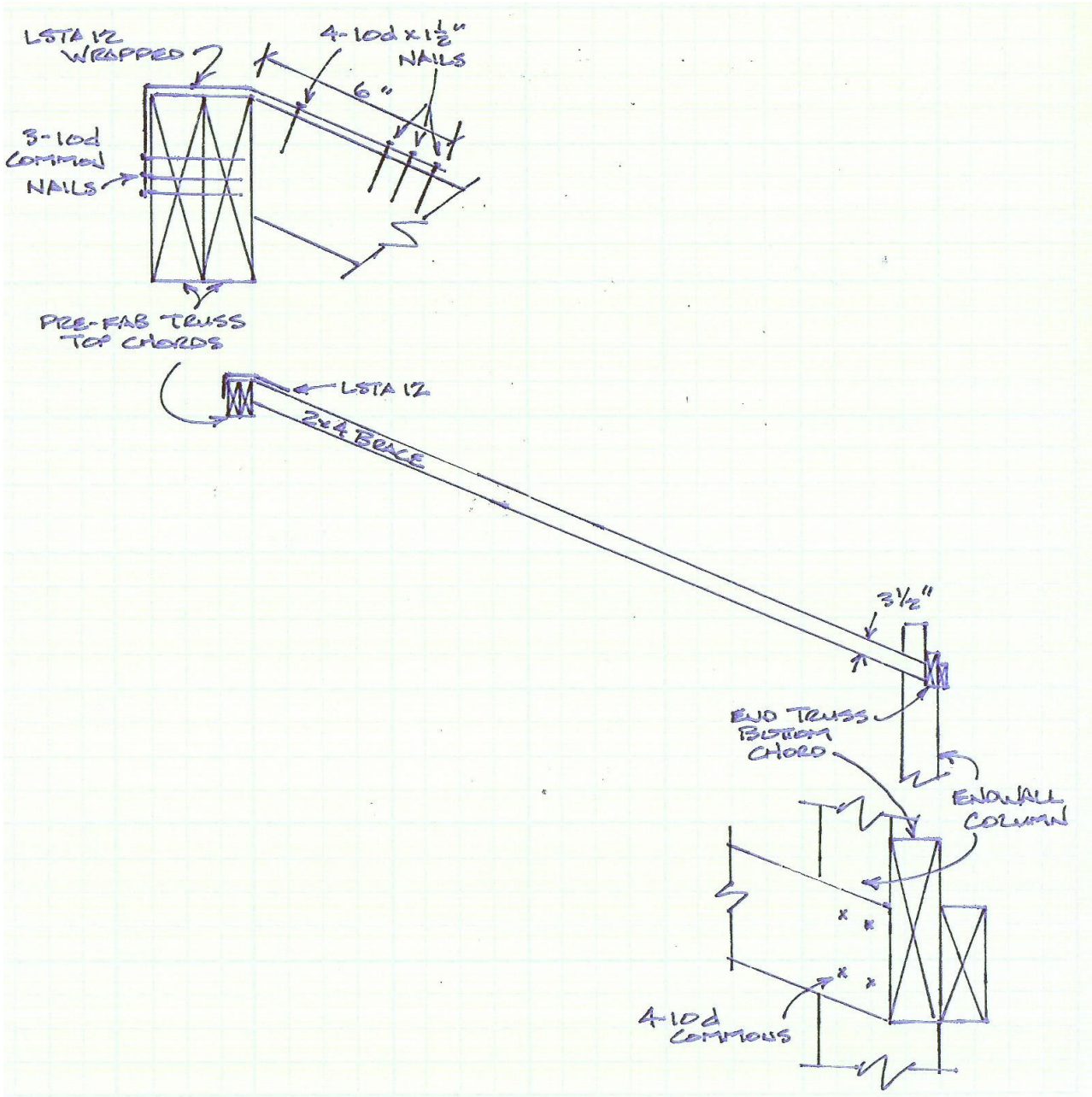


Figure 11-1

HELPFUL HINT: Note where permanent truss bottom chord bracing 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 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 11-2**

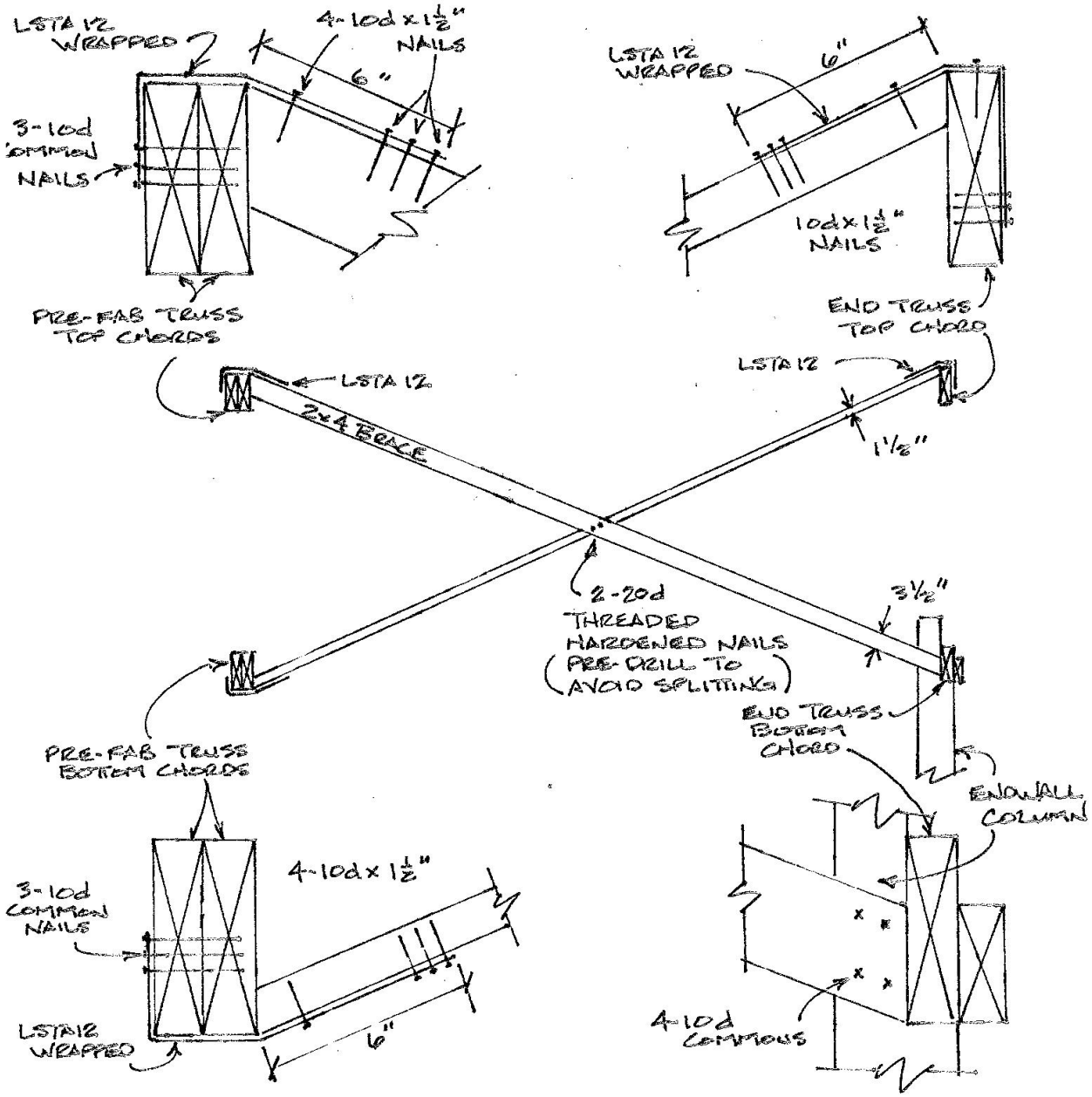


Figure 11-2

Install bracing between double truss bottom chords. Spans between pairs of trusses of 10' or less 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 not over 20'.

See Figure 11-3

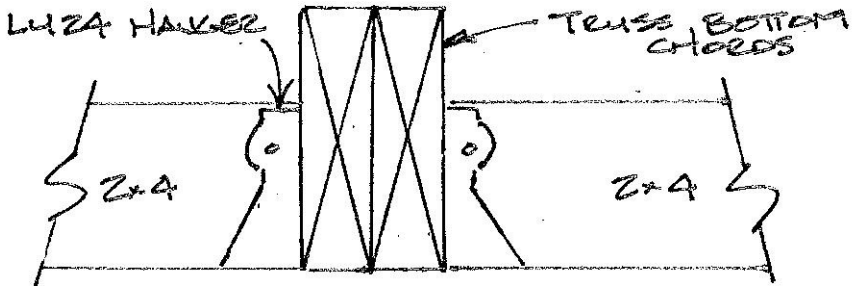


Figure 11-3

Trusses spaced over 10' between require a "T" bottom chord brace. Nail "T" or "L" brace members together with 10d at 8" on center. **See Figure 11-4.**

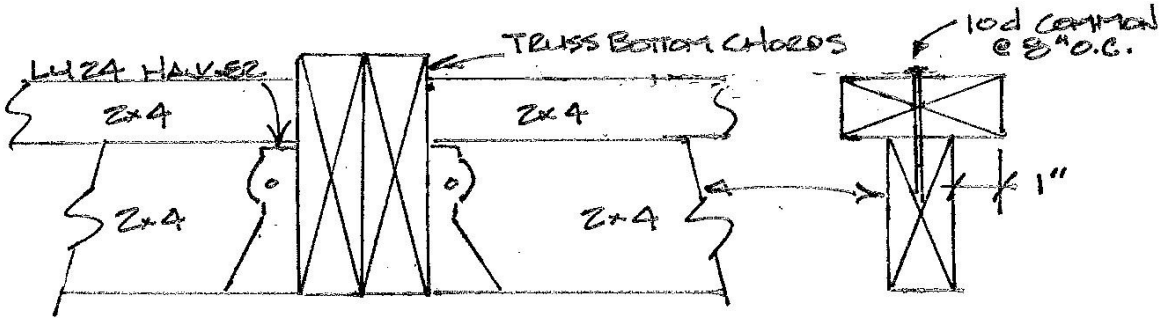


Figure 11-4

The permanent truss bracing provided with building kit is appropriate to meet design requirements as specified by building designer or engineer of record. Actual building system field performance may require additional bracing which could not have been foreseen. 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 total neglect of installing permanent truss bracing can significantly increase future building performance problem chances. Members can buckle out of plane causing deformations which lead 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 engineer of record.

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 the cost is **YOURS**.

Below is a photo of knee braces. Do not, under any circumstances add them. They induce loads into the roof trusses, which the trusses are not designed to take. Under extreme conditions, this could result in roof system failure.

Temporary Truss Bracing

Install end truss (with all hangers attached) into notches in end and corner columns. Nail to columns per plan.

Install 1st pair of trusses closest to previously installed end truss, using ledgerlocks or bolts and nails, per plan.

Install pre-cut purlins between endwall truss and first truss pair. All purlins are installed with “crown” or “bow” up.

Ridge purlins are installed first.

On 40-foot or longer trusses, install a purlin half-way between eave and ridge next. Then install purlin balance in this bay, working from eave to ridge. Repeat this process until all trusses and purlins have been installed.

PRIOR to installing 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, purlins in last bay can be shortened in order to keep this overall length correct.