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Knowledge Is Power

Developing a Strategy for Long Span Truss Installation by Tony Piek & Kirk Grundahl, P.E.

A truss collapse can be devasting—to the jobsite and to the installers' confidence. Training a crew in proper bracing techniques in a way that gets them past the negative experience requires more than a little thinking outside the box.

Installing 80-foot clearspan roof trusses on a 108-foot long salt storage building is a challenging task under normal circumstances. It is even more challenging when the walls are 30 feet high and the installers have had the trusses fall over twice due to lack of proper bracing. The first time the installer got 17 trusses up; the second time 34 trusses up, so they were moving in the right direction, yet still only used metal spacers at 20-feet on-center as the top chord bracing in both instances. In the second case, they used lumber stiffeners to keep the trusses straight

CLICK ON IMAGES BELOW FOR LARGER VIEW

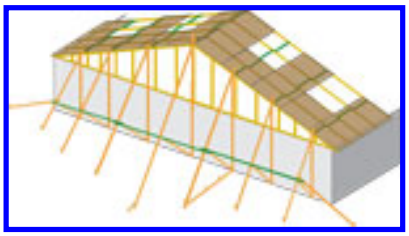

FIGURE 1. THE B2 SUMMARY SHEET INCLUDES THIS SHEATHING PATTERN, WHICH WAS USED AS A PART OF THE TRUSS ERECTION PLAN FOR THIS PROJECT. [SOURCE: WTCA-B2*]

DIAGONAL/LATERAL WEB BRACING ON FIRST FIVE SYSTEM WHERE SPECIFIED.

GROUND BRACING ON FIRST FIVE AFTER BEARING TIMBERS ARE LEVELED.

HOISTING FIRST FIVE SYSTEM, LINING UP TO EXTERIOR WALLS.

during the hoisting process, which also stiffened the trusses enough to get to 34 prior to top chord buckling. When one thinks about the complete lack of top chord bracing over the 34 trusses, one realizes quickly that truss stability is not a well understood science at all, as most theorists would say that these trusses should have buckled long before they actually did. On the third try, Qualtim staff was asked to oversee the truss installation at the jobsite and played a key role in developing a strategy to ensure the effective and safe installation. This was a perfect way to implement the BCSI concepts with which WTCA has been so intimately involved.

BACKGROUND ON THIS SUCCESS STORY

Given the jobsite experience, there were two significant needs:

SHEATHING ON FIRST FIVE, ALTERNATING 4X4 AND 4X8 SHEETS.

NEW LIFTING DEVICE EASED INSTALLATION.

LIFTING DEVICE KEPT TRUSS RIGID IN AIR AND THROUGHOUT INSTALLATION.

LIFTING DEVICE MADE SETUP AND TAKEAWAY EXTREMELY EFFICIENT.

LIFTING FIRST FIVE SYSTEM—NOTE THE THREE PICK POINTS.

LIFTING DEVICE MADE PICK-UP FAST, SAFE AND EASY.

PERMANENT BRACING—SHEATHING AS TRUSSES WERE INSTALLED MADE ENTIRE SYSTEM RIGID.

INSIDE OF COMPLETED SALT STORAGE FACILITY.

1. We had to instill confidence in the installers that the trusses were not the problem.

2. We had to change the approach that was used to hoist and erect the trusses. The goal was to overcome the perception that the trusses were going to collapse no matter how the installation was done. Because of past experiences, we could not use the same conceptual approach that the installers used previously and expect them to believe it would work.

Given all this, our process began by inspecting the trusses to provide the installers with the assurance that the trusses met the ANSI/TPI 1 quality standard. All plate sizes and lumber were checked to make sure they were as specified, along with plate rotation, embedment, and any wood damage due to the

EACH TRUSS TOOK ABOUT 15-20 MINUTES TO INSTALL AND BRACE.

INSTALLATION COMPLETE; TOP CHORD SHEATHED.

unloading process. Six trusses had to be repaired based on our inspections.

Next, we tackled the more significant hoisting and installing challenge. Given that safety and stability was absolutely mandatory, we used the “First Five” concept outlined in WTCA-B2*. But rather than set the first five trusses on top of 30-foot walls, we decided to set the first five trusses on the ground and use a sheathing pattern identical to the one shown in B2 as follows, only the trusses were all built on a 12-foot foundation versus a wall as shown in Figure 1:

First, the bearing timbers were leveled. Then the crane was used to position the first truss onto the bearing. The truss was plumbed and ground braced at the peak and two other top chord panel points. As the next four trusses were

positioned, 2-foot 2x4 lumber spacer pieces were attached to the top chord of the trusses with 2-16 penny nails every six feet to hold the trusses plumb and properly spaced. As soon as we could, we installed the 5/8-inch plywood sheathing. We began at the peak of the trusses by installing a 4x8 sheet on each side of the peak and then alternated with 4x4 and 4x8 sheets all the way down to the heel of the truss. The six webs that required permanent lateral bracing for buckling were laterally and diagonally braced, and the bottom chord was permanently laterally braced by each panel point or approximately every ten feet. The bottom chord diagonal bracing was also permanently installed, again following B2. This first set of five trusses then became our "superstructure," providing the plumb, square and stable foundation

we needed to easily install each additional 80-foot truss.

Pick points were designed to be placed, one at the peak and two symmetrically along both sloping top chords at the same panel point locations, to properly spread the assembly load out over multiple trusses. We then hoisted our superstructure onto the 30-foot high walls and lined it up accurately onto the exterior walls using a string line to designate the proper location for each truss.

From there our goal was to install the trusses as quickly and safely as possible. A newly engineered hoisting device was used to lift each truss into place. It consisted of a spreader bar with thick gauged wires that looped around the top chord. Additional wires from the spreader bar came down and attached to a thick steel bar spanning about 60 feet to

keep the 80-foot trusses from snaking out of plane during the hoisting process. The device was extremely effective in keeping long span trusses planar (see photos at right). From picking up the truss, lifting it above the roof, and setting it in place, the total installation time was well under ten minutes.

One of the keys to safe truss installation came in the form of using the plywood sheathing as temporary bracing and, ultimately, as permanent bracing, all at the same time. Our approach was as follows:

1. We hoisted the sixth truss up into position two feet away from our superstructure.

2. We installed the plywood in all the locations that needed four feet of plywood connecting the plywood to the two unsheathed trusses in the superstructure and to the sixth truss

that was just hoisted in place. The plywood was completely nailed off per code.

3. This left the plywood with a 2-foot cantilever section.

4. The seventh truss was then hoisted into place and the plywood was attached to the top chord.

5. Then we started the entire process over with each succeeding truss, each time using the plywood as our both our temporary and permanent bracing method.

6. At the same time, the crew was installing the permanent web member and bottom chord bracing.

7. We essentially found a way to install the trusses so that the temporary bracing was really the permanent bracing. This method actually saved time in the overall installation process.

8. The time it took to install and brace each truss was approximately 15-20 minutes.

9. We began this process at 8:30 a. m. on Tuesday and finished installing all the trusses—permanently sheathed and braced—on Thursday at 3:30 p. m., a total of about 22 hours to fully frame the 108-foot roof structure with learning curve.

We installed permanent diagonal bracing to create another "superstructure" and added the needed stability/ rigidity to the roof structure. In three days, 55 trusses had been set and the fear of installing long span trusses had turned into a positive sense of accomplishment. This truss installation project was now a wonderful success!

This was a valuable learning opportunity on a very efficient, effective and extremely safe

method for
installing long span
trusses.

Key Tips to Installing Long Span Trusses

Inspect Before Installing.
Inspecting each truss thoroughly before lifting was an important safeguard as we could take care of any damage prior to hoisting, where that damage could have caused a bigger problem once the truss was in the air.

Maintain Truss Straightness During Hoisting.
It was very evident during the hoisting process that long span trusses like to snake. It is very important to provide support so the trusses flex as little as possible if installation is going to be smooth. The hoisting device that was used on this project was a real time saver.

A Good Crane Operator Is Helpful.
Our crane operator had installed long span trusses before and was very helpful in determining the best approach for hoisting our superstructure and developing the plan to efficiently and safely hoist the remaining trusses.

Build the First Five on the Ground.
It was very important to ensure that the bearing points were level. Building the first five on the ground made the assembly process much easier, and the assembly could then be built precisely and safely. This provided the plumb and square foundation we needed to attach the remaining trusses. As we added trusses to this first five set, the assembly became increasingly rigid.

Sheath Top Chord as You Install Trusses.
An extremely effective method of developing much needed rigidity to the installation process, with that added bonus of saving significant time by applying permanent top chord bracing immediately. This process is also much safer as all the work is being done from a plywood deck.

Install All Permanent Bracing Immediately.
Once the installation crew got the system down, the web member and bottom chord bracing could also be installed in the time it took to release the hoist and pick up and set the next truss. This was very efficient. One was also able to install all the permanent diagonal bottom chord and web member bracing in the proper locations.

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*Webmaster's Note: WTCA-B2 document has been discontinued. The information is now part of the BCSI 1-03 Guide to Good Practice for Handling, Installation & Bracing of Metal Plate Connected

Wood Trusses.

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