LGSEA

TECHNICAL NOTE

On Cold-Formed Steel Construction

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DESIGN GUIDE FOR PERMANENT BRACING OF COLD-FORMED STEEL TRUSSES

Summary: Prefabricated and site fabricated cold-formed steel trusses have proven to be efficient and structurally-sound roof structures. While roof trusses are the major component of the structural roof system, permanent bracing is also required to complete the system and ensure that it performs as designed. In this *Tech Note*, the basic requirements and design parameters for permanent bracing of cold-formed steel roof systems will be reviewed.

Introduction

Roof trusses are the major component of structural roof systems which utilize trusses. However, the roof system design is not complete until all of the the bracing members, their connection and anchorage are designed and detailed. In the publication "Design Guide for Cold-Formed Steel Trusses", the America Iron and Steel Institute (AISI) assigns the responsibility for design of permanent bracing to the building designer. Unfortunately, this aspect of the design system is often overlooked.

The design procedures and technical requirements discussed in this publication may be applied to pitched roof systems where truss spacing of up to 24 inches on-center is specified. The design recommendations and details shown are based on the collective experience of the author and other leading design professionals in the cold-formed steel framing industry, and are meant to serve only as a guide to the qualified engineer, architect, or building designer.

Section 1: General Design Procedure

The following suggested guidelines should be considered as the minimum requirements:

1. Review the truss design to determine the location of all required permanent braces.

2. Review all load cases used in the truss design to determine the maximum axial force in each truss member that requires permanent bracing.

3. Determine the design force required for each line of lateral bracing. The design force should be equal to a minimum of 2 percent of the member axial force.

4. Design the top chord lateral and diagonal bracing. The diagonal braces shall be designed to transfer the cumulative force from the lateral braces to the exterior walls, or other load resisting element.

5. Design of top chord lateral and diagonal bracing, connections to truss and anchorage. Anchorage shall be to the roof or ceiling diaphrams or anchored at the ends to a solid wall or member.

6. Design the bottom chord lateral and diagonal bracing in a manner similar to the top chord bracing system.

7. Design the web lateral bracing, connections to truss and anchorage. Anchorage shall be to the roof or ceiling diaphragm or anchored at the ends to a solid wall or other member.

Note: Construction bracing installed at the time the trusses were erected may be used for permanent truss bracing as applicable. All members and connections must be capable of resisting the permanent design loads.

Abbreviations

BC = bottom chord	ga. = gauge	DB-f = diagonal brace force
TC = top chord	lbs = pounds	LB-f = lateral brace force
o.c. = on center	psf = pounds per square foot	sds = self-drilling screw

Section 2: Design Example

PROJECT DATA

Truss span: 42 feet (*Figure 1*)
Truss Chord Forces (from full design loads = 37 psf)

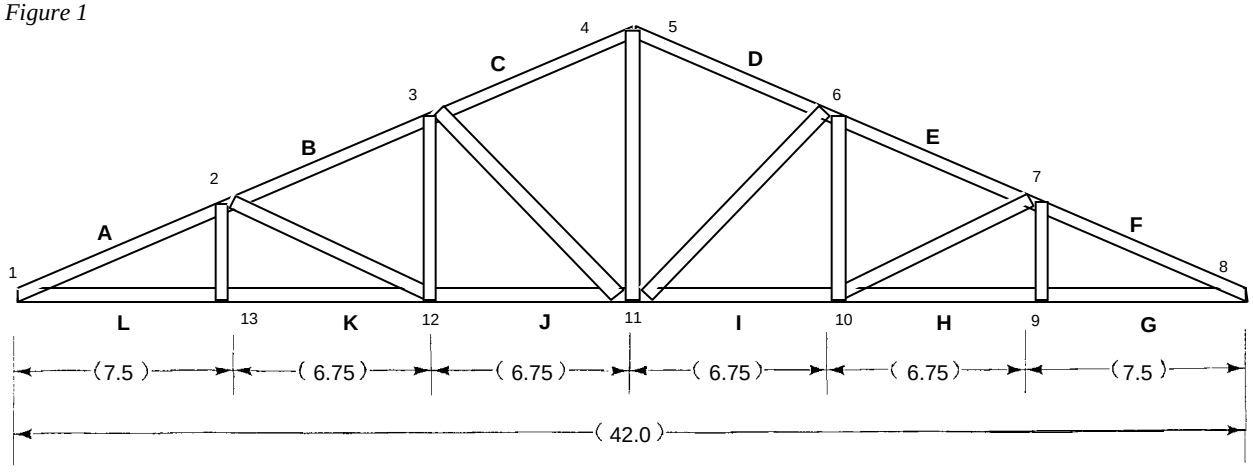
Member A:	4,120 lbs. compression
Member B:	3,340 lbs. compression
Member C:	2,535 lbs. compression
Member G:	3,885 lbs. tension
Member H:	3,885 lbs. tension
Member I:	3,170 lbs. tension

Truss Web Forces

Web 2-13:	105 lbs. tension
Web 2-12:	775 lbs. compression
Web 3-12:	370 lbs. tension
Web 3-11:	935 lbs. compression
Web 4-11:	1,185 lbs. tension

All truss members are "C" sections.
No uplift occurs on truss top chord.
Capacity of #10/16 x 3/4" sds =276 lbs. each (33 mils to 25 mils)

Figure 1



TOP CHORD LATERAL BRACING

This design will use 1/2 inch plywood roof sheathing attached to the truss top chord with sds at 12 inches o.c. The roof sheathing will provide adequate lateral support to the top chord, eliminating the need to install lateral bracing.

If roof sheathing is not installed (or is not adequate to provide lateral support to the top chord), then the top chord lateral and diagonal bracing can be designed using the basic procedures demonstrated in the Technical Note *"Design Guide for Construction Bracing of Cold-Formed Steel Trusses"* published by the LGSEA, (hereafter referred to as TN-551d). The design must be performed using a minimum of 2 percent of the full member axial forces and not the reduced forces used in TN-551d.

BOTTOM CHORD LATERAL BRACING

This design example will use 1/2 inch gypsum board sheathing attached to the bottom chord with sds at 12 inched o.c. The gypsum board sheathing will provide adequate lateral support to the bottom flange of the bottom chord. The top flange of the bottom chord may need lateral and diagonal bracing depending on the loading, the size of the bottom chords, and other conditions such as interior bearing which create compression in the top flange of the bottom chord. Design of the bracing should use the basic procedures discussed above. The design should be performed using a minimum of 2 percent of the full member axial forces. As a minimum lateral bracing on the top flange of the bottom chord should follow the recommendations of TN-551d (lateral bracing at a maximum of 10 feet o.c., diagonal bracing at 30 feet o.c. maximum).

Restraint (i.e., blocking) should be provided to prevent rotation of the truss members at the exterior walls and other points of bearing.

WEB LATERAL AND DIAGONAL BRACING

(*Figure 2*)

In this example, the truss designer specified that webs 3-11 and 6-11 need lateral support at the midpoint.

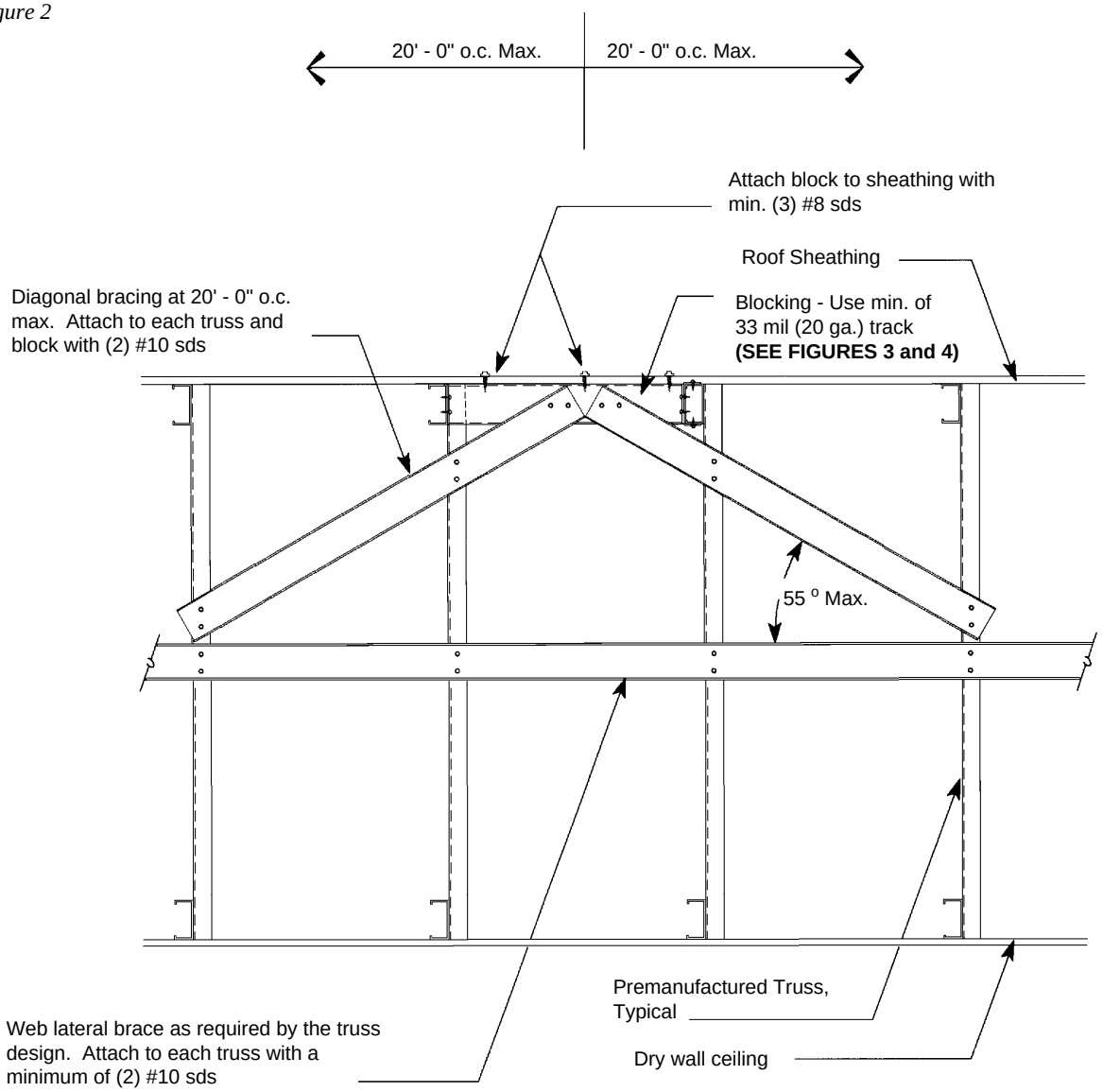
Lateral brace force per truss:

LB-f = 935 lbs. x 0.02 = 19 lbs.

Try spacing diagonal braces at 20 feet o.c. (every 10 trusses).

WEB LATERAL AND DIAGONAL BRACING

Figure 2



Diagonal brace force:

DB-f = 19 lbs. x 10 / 0.7071 = 270 lbs.

(Assumed diagonal brace installed at 45 degrees).

Design lateral brace for 190 lbs. axial force and 24 inch unsupported length with K=1.0 For this example, the use of a small hat channel or "C" stud section for brace members is recommended. Attach to each truss as determined below. Lap all braces a minimum of 2 trusses and attach to each truss as determined below.

Design diagonal brace for 270 lbs. axial force and 24 / 0.7071 = 34 inch unsupported length with K = 1.0. Install braces on the truss web as near the lateral brace as possible. For this example, the use of a "C" section stud is recommended. Splicing diagonal brace members is not recommended. Attach to each truss with a minimum of 2 - #10x 3/4" sds and at the ends as determined below.

Quantity of screws required to attach lateral braces to each truss:

190 lbs. / 276 = 1

Use minimum of 2 - #10 x 3/4" sds

Quantity of screws required to attach diagonal brace to blocking at roof sheathing:

270 lbs. / 276 lbs. = 1

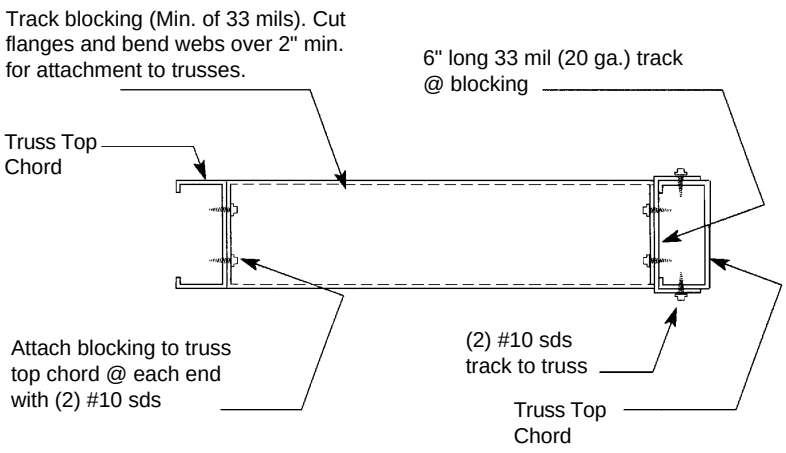
Use minimum of 2 - #10 x 3/4" sds

Design connection at each end of block for force perpendicular to roof sheathing created by diagonal bracing:

270 lbs. x 0.7071 = 190 lbs.

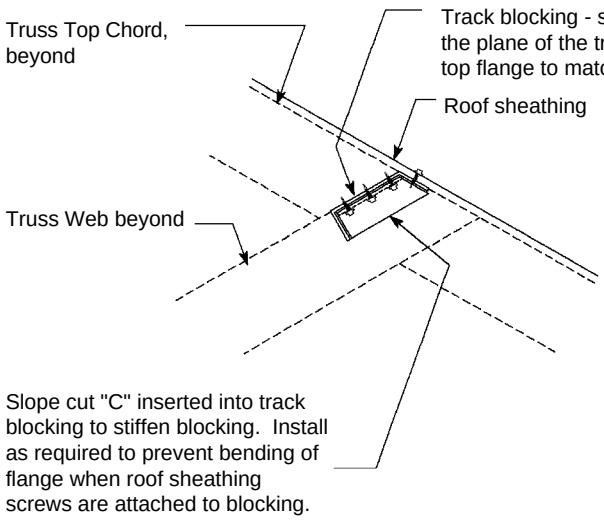
Use minimum of 2 - #10 x 3/4" sds at each end of block to truss

Figure 3



See Figure 4 for Additional Requirements

Figure 4



Design connection of blocking to roof plywood:

270 lbs. x 0.7071 = 190 lbs.
Appropriate capacity of #8 sds = 85 lbs. each (1/2inch sheathing to 33 mils)
Use minimum of 3 - #8 sds
Specify #8 sds at 6 inches o.c., with length as required for proper attachment of roof sheathing.

Summary

Providing adequate permanent bracing will ensure that the truss system will function as an integral part of the overall structure. The lateral load should always be small compared to the truss member forces as long a the truss deflections are limited and the trusses are installed in plane and plumb. Attention to detail is important and the use of clear details will help ensure that the bracing is correctly installed.

References

1. American Iron & Steel Institute, "Design Guide for Cold-Formed Steel Trusses", Publications\ RG-95-18, December 1995.
2. American Iron & Steel Institute, "Cold-Formed Steel Design Manual", 1986 with 1989 addendum.
3. Light Gauge Steel Engineers Association, "Design Guide for Construction Bracing of Cold-Formed Steel Trusses", Technical Note 551d.

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Section 2. Design Example

Project Data

References