Heel Blocking Requirements and Capacity Analysis

Design Guide

Revised 3/22/2017

SBCA

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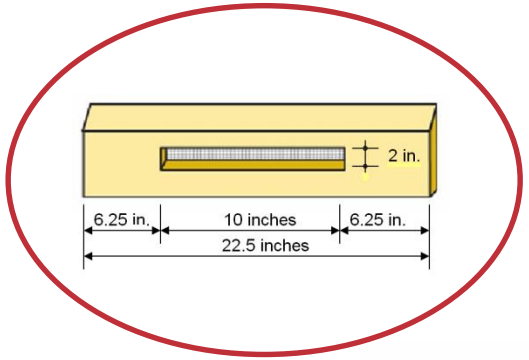
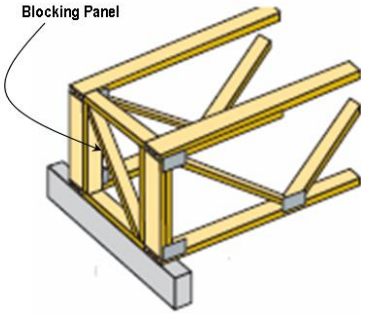
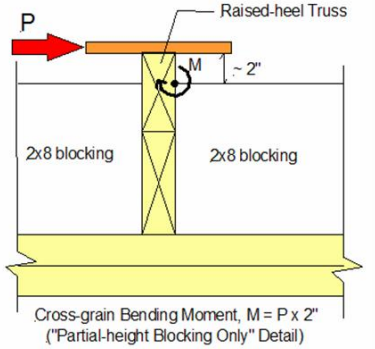
Introduction

- Heel blocking (also known as bird blocking) is one of several methods for transferring lateral loads from the roof diaphragm to the shear walls.

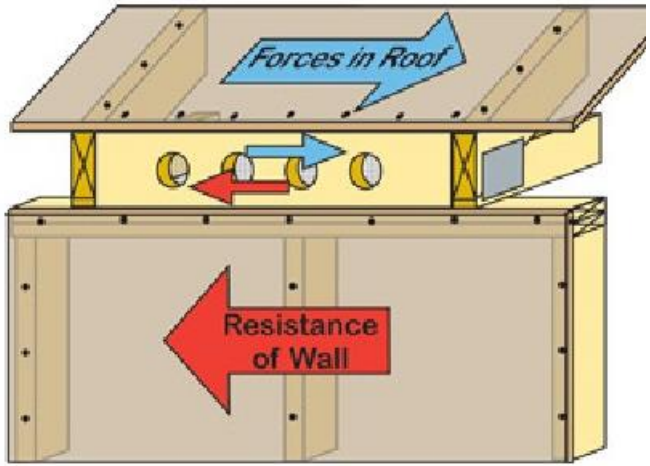






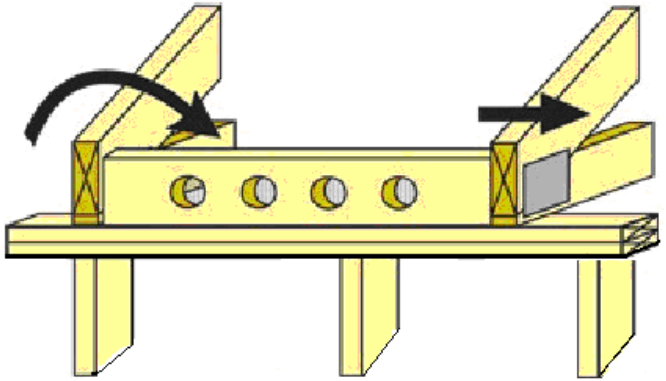
Introduction

- The heel blocking is installed between roof truss heels at the top of the exterior wall.
- This guide will assist the designer in choosing appropriate heel blocking options



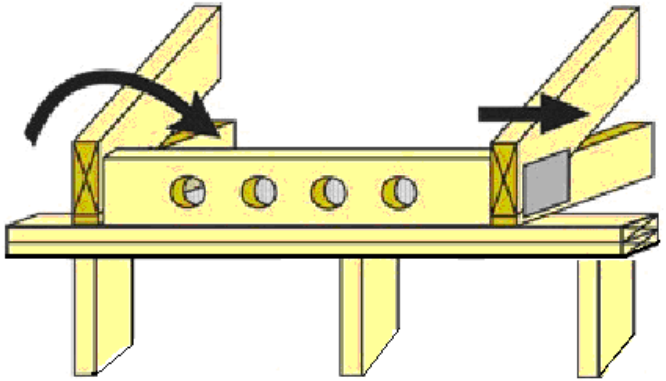
Step 1 – Vented or Unvented?

- Attics or roofs can be designed and constructed to be either vented or un-vented in any climate



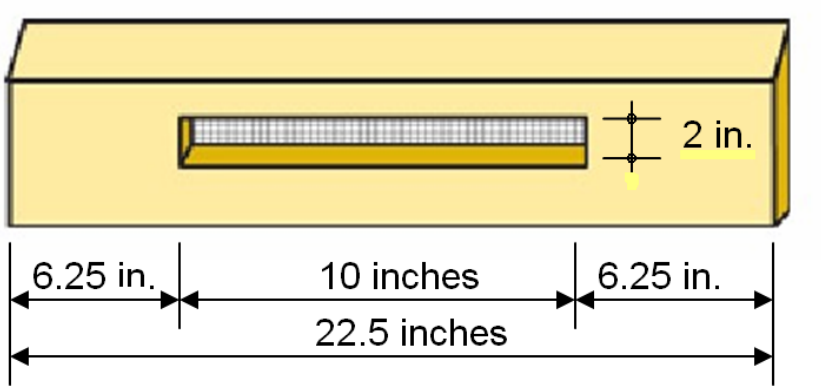
Step 1 – Vented or Unvented?

- When vents are added to heel blocking, the structural capacity is reduced
- Heel Blocking must be designed to account for removed material



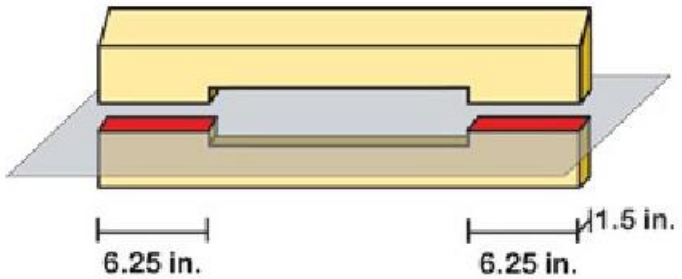
Step 2 – Bird Block Design Example A: Slot

- The truss manufacturer uses 2x6 beveled blocks
- The block has a 2″x10″ letterbox type ventilation hole as shown



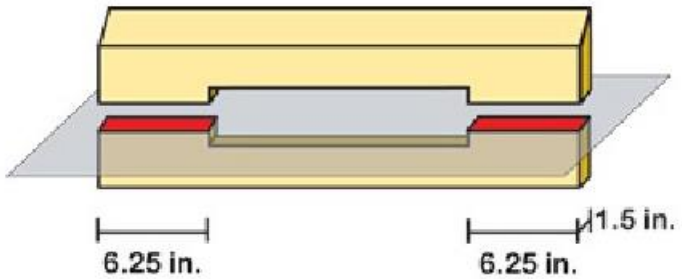
Step 2 – Bird Block Design Example A: Slot

- Imagine a horizontal plane cutting through the block at the location with the least material.
- Calculate the area of the remaining material along that plane.
- In this case it’s a total of 18.75 sq. in.



Step 2 – Bird Block Design Example A: Slot

- This is the area of block left to resist the shear forces being transferred from the roof diaphragm to the wall below.
- To be conservative, we will use a value of F_v = 110 psi, which is for "Northern Species" lumber



Step 2 – Bird Block Design Example A: Slot

- The only adjustment factor to consider is load duration factor (Table 2.3.2 of the *NDS*).
- We will use 1.6, since these forces are either caused by wind or seismic events.

Table 2.3.2 Frequently Used Load Duration Factors, C_D[1]

Load Duration	C_D	Typical Design Loads
Permanent	0.9	Dead Load
Ten years	1.0	Occupancy Live Load
Two months	1.15	Snow Load
Seven days	1.25	Construction Load
Ten minutes	1.6	Wind/Earthquake Load
Impact[2]	2.0	Impact Load

1. Load duration factors shall not apply to modulus of elasticity, E, nor to compression perpendicular to grain design values, $F_{c\perp}$, based on a deformation limit.
2. Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with water-borne preservatives (see Reference 30), or fire retardant chemicals. The impact load duration factor shall not apply to connections.

Step 2 – Bird Block Design Example A: Slot

- Shear Capacity of the block = F_v' x Area

$$= 110\ psi\ * 1.6\ * 18.75\ sq.in. = 3300\ lb$$

- A 22.5" block with 3300 lb of shear capacity would have the following shear load in pounds per linear foot (plf)

$$3300\ lbs\ /\ (22.5\ in\ * \frac{1\ ft}{12\ in}) = 1760\ plf$$

Step 3 – Bird Block Design Example B: Holes

- Bird blocks can also be designed with holes instead of a slot.
- The effective area is given by:

$$\text{Area} = (L * B) - (n * d * B)$$

where:
L = Length of block
B = Breadth of the block (thickness)
d = Diameter of the hole
n = Number of holes

Step 2 – Bird Block Design Example B: Holes

- A 22.5″ long block with (3) 3″ diameter holes, has the following effective area:

$$(22.5" * 1.5") - (3 * 3" * 1.5") = 20.25 \text{ sq. in.}$$

- Total shear capacity will be:

$$110\ psi\ * 1.6\ * 20.25\ sq.in. = 3564\ lb$$

- Shear capacity in plf:

$$3564\ lbs\ /\ (22.5\ in\ * \frac{1\ ft}{12\ in}) = 1901\ plf$$

Step 2 – Bird Block Design

- According to the APA's *Introduction to Lateral Design,* the highest recommended load listed is 820 plf for roof diaphragms and 870 plf for shear walls.
- Therefore, even a low grade bird block with a large horizontal ventilation opening or ventilation holes is adequate, provided the building designer properly details the roof-to-block and the block-to-wall connections.

SHEAR WALLS: RECOMMENDED SHEAR (POUNDS PER FOOT) FOR APA PANEL SHEAR WALLS WITH FRAMING OF DOUGLAS-FIR, LARCH, OR SOUTHERN PINE[e] FOR WIND OR SEISMIC LOADING[b]

Panel Grade	Minimum Nominal Panel Thickness (in.)	Minimum Nail Penetration in Framing[h] (in.)	Panels Applied Direct to Framing: Nail Size (common or galvanized box)	Panels Applied Direct to Framing: Nail Spacing at Panel Edges (in.) 6	4	3	2[e]	Panels Applied Over 1/2" or 5/8" Gypsum Sheathing: Nail Size (common or galvanized box)	Panels Applied Over 1/2" or 5/8" Gypsum Sheathing: Nail Spacing at Panel Edges (in.) 6	4	3	2[e]
APA STRUCTURAL I grades	5/16	1-1/4	6d	200	300	390	510	8d	200	300	390	510
	3/8	1-1/2	8d	230[d]	360[d]	460[d]	610[d]	10d[f]	280	430	550	730
	7/16			255[d]	395[d]	505[d]	670[d]					
	15/32			280	430	550	730					
	15/32	1-5/8	10d[f]	340	510	665	870	—	—	—	—	—
APA RATED SHEATHING; APA RATED SIDING[g] and other APA grades except species Group 5	5/16 or 1/4[c]	1-1/4	6d	180	270	350	450	8d	180	270	350	450
	3/8			200	300	390	510		200	300	390	510
	3/8	1-1/2	8d	220[d]	320[d]	410[d]	530[d]	10d[f]	260	380	490	640
	7/16			240[d]	350[d]	450[d]	585[d]					
	15/32			260	380	490	640					
	15/32	1-5/8	10d[f]	310	460	600	770	—	—	—	—	—
	19/32			340	510	665	870	—	—	—	—	—
			Nail Size (galvanized casing)					**Nail Size (galvanized casing)**				
APA RATED SIDING 303[g] and other APA grades except species Group 5	5/16[c]	1-1/4	6d	140	210	275	360	8d	140	210	275	360
	3/8	1-1/2	8d	160	240	310	410	10d[f]	160	240	310	410

Step 3: Protect Attic Space

- Blocks with ventilation holes typically have wire mesh on one side to prevent animals from entering the attic space.