Notes:

1. If Spruce-Pine-Fir (G=0.42) roof framing lumber is substituted, W' would be 54 lb and the required nail spacing would reduce to 4 inches on center in the roof sheathing panel interior. Thus, it is extremely important to carefully consider and verify the species of framing lumber when determining fastening requirements for roof sheathing.
2. The above analysis is based on a smooth shank nail. A ring shank nail may be used to provide greater withdrawal capacity that is also less susceptible to lumber moisture conditions at installation and related long-term effects on withdrawal capacity.
3. With the smaller tributary area, the roof sheathing edges that are supported on framing members may be fastened at the standard 6 inch on center fastener spacing. For simplicity, it may be easier to specify a 6 inch on center spacing for all roof sheathing fasteners, but give an allowance of 2 to 3 inches for a reasonable construction tolerance; refer to Section 7.3.6.
4. As an added measure given the extreme wind environment, the sheathing nail spacing along the gable end truss/framing should be specified at a closer spacing, say 4 inches on center. These fasteners are critical to the performance of light-frame gable roofs in extreme wind events; refer to the discussion on hurricanes in Chapter 1. NDS•12.3.8 provides an equation to determine nail lateral strength when subjected to a combined lateral and withdrawal load. This equation may be used to verify the 4 inch nail spacing recommendation at the gable end.

Conclusion

This example problem demonstrates a simple application of the nail withdrawal equation in the NDS. The withdrawal forces on connections in residential construction are usually of greatest concern in the roof sheathing attachment. In hurricane prone regions, it is common practice to use a 6-inch nail spacing on the interior of roof sheathing panels. In lower wind regions of the United States, a standard nail spacing applies (i.e., 6 inches on panel edges and 12 inches in the panel field); refer to Table 7.1.

EXAMPLE 7.2 *Roof-to-Wall Connections*

Given

- Design wind speed is 120 mph gust with an open coastal exposure
- One-story home with a hip roof (28 ft clear span trusses with 2 ft overhangs)
- Roof slope is 6:12
- Trusses are spaced at 24 in on center

Find

1. Uplift and transverse shear load at the roof-to-wall connection
2. Connection detail to resist the design loads

Solution

1. Determine the design loads on the connection (Chapter 3)

Dead load (Section 3.3)

Roof dead load = 15 psf (Table 3.2)
Dead load on wall = (15 psf)[0.5(28 ft) + 2 ft] = 240 plf

Wind load (Section 3.6)

Step 1: Basic velocity pressure = 18.8 psf (Table 3.7)
Step 2: Adjust for open exposure = 1.4(18.8 psf) = 26.3 psf
Step 3: Skip
Step 4: Roof uplift G_{cp} = -0.8
Overhang G_{cp} = +0.8
Step 5: Roof uplift pressure = -0.8(26.3 psf) = -21 psf
Overhang pressure = 0.8 (26.3 psf) = 21 psf

Determine the wind uplift load on the wall.

Design load on wall = $0.6D + W_u$ (Table 3.1)
= 0.6 (240 plf) + {(-21 psf)[0.5(28 ft) + 2 ft] – (21 psf)(2 ft)}
= - 234 plf (upward)

Design load per wall-to-truss connection = (2 ft)(-234 plf) = -468 lb (upward)

Determine the transverse shear (lateral) load on the roof-to-wall connection. The transverse load is associated with the role of the roof diaphragm in supporting and transferring lateral loads from direct wind pressure on the walls.

Design lateral load on the wall-to-truss connection
= 1/2 (wall height)(wall pressure)(truss spacing)

Adjusted velocity pressure = 26.3 psf
Wall GC_p = -1.2,+1.1*
Wind pressure = 1.1(26.3 psf) = 29 psf

*The 1.1 coefficient is used since the maximum uplift on the roof and roof overhang occurs on a windward side of the building (i.e., positive wall pressure).

= 1/2 (8 ft)(29 psf)(2 ft)
= 232 lb