EXAMPLE 7.9 *Wood King and Jamb Stud to Floor or Foundation Connection*

Given

- From Example 7.2, the net design uplift load at the roof-to-wall connection was determined to be 234 plf for a 120 mph gust, open exposure wind condition.
- Assume that the uplift loads at the top of the wall are adequately transferred through interconnection of wall framing members (i.e. top plates, sheathing, studs, headers to king and jamb studs, etc.) to the base of the upper story wall.
- The framing lumber is Hem-Fir

Find

1. The net uplift load at the base of the king and jamb studs adjacent to a 6 ft wide wall opening
2. An adequate connection detail to transfer the uplift load

Solution

1. Determine the net design uplift load at the base of the king and jamb studs supporting the 6 ft header using the ASD load combinations in Chapter 3.

Tributary load
= (1/2 header span + 1/2 stud spacing)[uplift load – 0.6(wall dead load)]
= [0.5(6 ft) + 0.5(1.33 ft)][234 plf – 0.6(64 plf)]
= 717 lb (uplift)

2. Determine the number of 8d common nails in each end of an 18g (0.043 inch minimum thickness) steel strap

$Z' = ZC_D$ (Section 7.3.2)

$Z = 82$ lb (NDS Table 12.3F)
$C_D = 1.6$ (wind load duration)

$Z' = (82 \text{ lb})(1.6) = 131$ lb

The number of nails required in each end of the strap is determined as follows:

(717 lb)/(131 lb/nail) = 6 nails

Note: As an option to the above solution, the same strap used on the layout studs may be used on the jamb and king stud connection by using multiple straps. The uplift strap on the layout studs would be required to resist 234 plf (1.33 ft) = 311 lb. Therefore, two or three of these straps could be used at wall opening location and attached to the jamb and king studs. If the single strap is used as calculated in the example problem, the jamb and king studs should be adequately interconnected (i.e., face nailed) to transfer shear load from one to the other. For example, if the header is strapped down to the top of the jamb stud and the king stud is strapped at its base, then the two members must be adequately fastened together. To some degree, the sheathing connections and other conventional connections will assist in strengthening the overall load path and their contribution should be considered or enhanced as appropriate.

As another alternative design, the king/jamb stud uplift connection may serve a dual role as a wind uplift strap and a shear wall hold-down restraint if the wall segment adjacent to the opening is designed to be a part of the building's lateral force resisting system (i.e., shear wall segment). The method to calculate hold-down restraint forces for a shear wall is detailed in Chapter 6, Section 6.5.2.4. The uplift force due to wind would be simply added to the uplift force due to shear wall restraint to properly size a hold-down bracket or larger strap than required for wind uplift alone.

Regardless of whether or not the wall segment is intended to be a shear wall segment, the presence of wind uplift straps will provide overturning restraint to the wall such that it effectively resists shear load and creates overturning restraint forces in the uplift straps. This condition is practically unavoidable because the load paths are practically inseparable, even if the intention in the design analysis is to have separate load paths. For this reason, the opposite of the approach described in the paragraph above may be considered to be more efficient. In other words, the wind uplift strap capacity may be increased so that these multiple straps also provide multiple overturning restraints for perforated shear walls; refer to Chapter 6, Section 6.5.2.2. Thus, one type of strap or bracket can be used for the entire job to simplify construction detailing and reduce the potential for error in the field. This latter approach is applicable to seismic design (i.e., no wind uplift) and wind design conditions.

Conclusion

In this example, the transfer of wind uplift loads through wall framing adjacent to a wall opening is addressed. In addition, several alternate design approaches are noted that may optimize the design and improve construction efficiency – even in severe wind or seismic design conditions.