APA

Technical Topics

TT-100H MAY 2020

A Portal Frame with Hold Downs for Engineered Applications

The APA portal-frame design, as shown in Figure 1, was envisioned primarily for use as bracing in conventional light-frame construction. However, it can also be used in engineered applications, as described in this technical topic. The portal frame is not actually a narrow shear wall because it transfers shear by means of a semi-rigid, moment-resisting frame. The extended header is integral in the function of the portal frame, thus, the effective frame width is more than just the wall segment, but includes the header length that extends beyond the wall segment. For this shear transfer mechanism, the wall aspect ratio requirements of the code do not apply to the wall segment of the APA portal frame.

FIGURE 1

CONSTRUCTION DETAILS FOR APA PORTAL-FRAME DESIGN WITH HOLD DOWNS

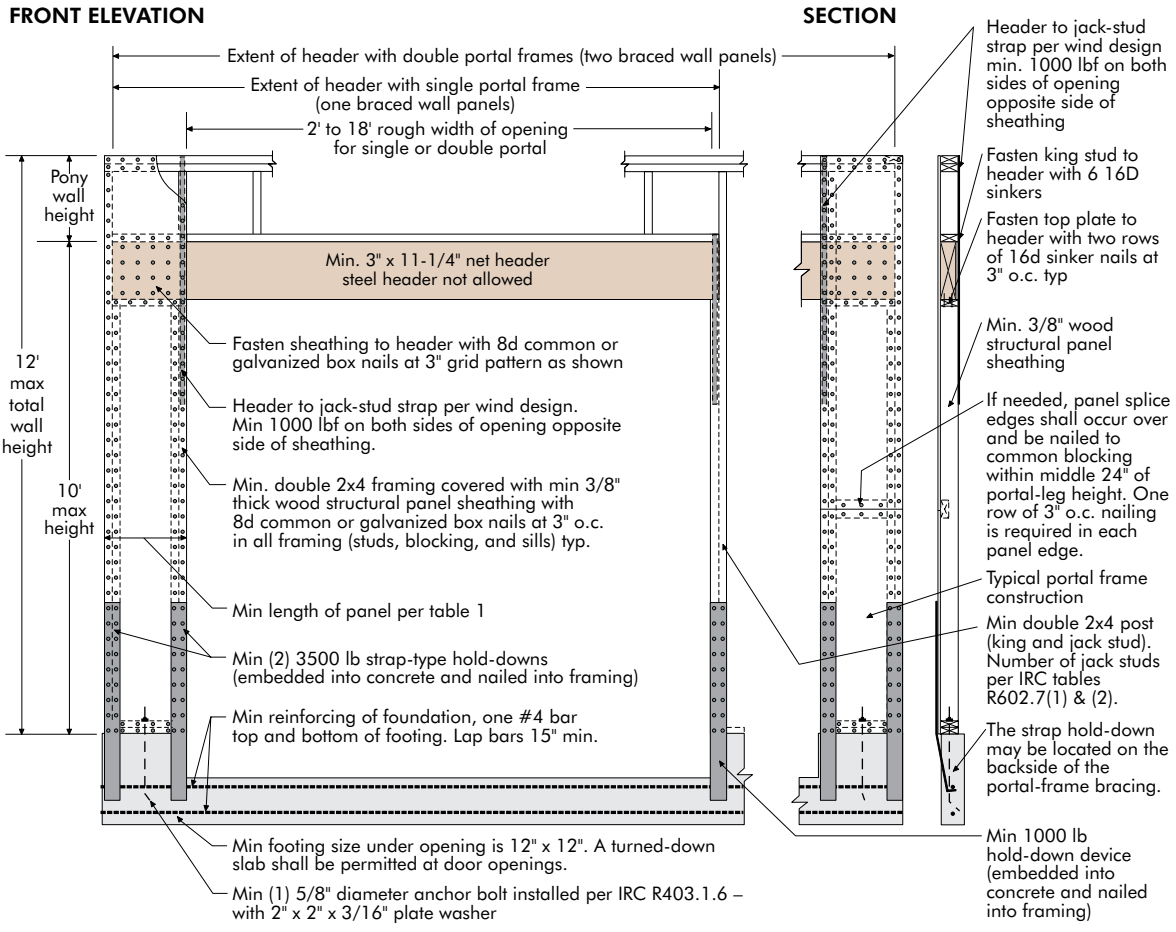

TABLE 1

RECOMMENDED ALLOWABLE DESIGN VALUES FOR A SINGLE LEG OF AN APA PORTAL FRAME USED ON A RIGID-BASE FOUNDATION FOR WIND OR SEISMIC LOADING[a,b,c,d]

Minimum Portal Width (in.)	Maximum Portal Height (ft)	Allowable Design (ASD) Values per Frame Segment		Load Factor
		Shear[e,f] (lbf)	Deflection (in.)	
16	8	850	0.33	3.09
	10	625	0.44	2.97
24	8	1,675	0.38	2.88
	10	1,125	0.51	3.42

a. Design values are based on the use of Douglas-fir or Southern pine framing. For other species of framing, multiply the above shear design value by the specific gravity adjustment factor = (1 – (0.5 – SG)), where SG = specific gravity of the actual framing. This adjustment shall not be greater than 1.0.

b. For construction as shown in Figure 1.

c. Values are for a single portal-frame segment (one vertical leg and a portion of the header). For multiple portal-frame segments, the allowable shear design values are permitted to be multiplied by the number of frame segments.

d. Interpolation of design values for heights between 8 and 10 feet, and for portal widths between 16 and 24 inches, is permitted.

e. The allowable shear design value is permitted to be multiplied by a factor of 1.4 for wind design.

f. If story drift is not a design consideration, the tabulated design shear values are permitted to be multiplied by a factor of 1.15. This factor is permitted to be used cumulatively with the wind-design adjustment factor in Footnote (e) above.

Recommended design values for engineered use of the portal frames are provided in Table 1 considering both strength and stiffness. The Table 1 values were developed using the CUREE cyclic test protocol (ASTM E2126) with a flexible load head to ensure that the code (IBC) drift limit, ductility and safety factor are maintained. For seismic design, APA recommends using the design coefficients and factors for light-frame (wood) walls sheathed with wood structural panels rated for shear resistance (Item 15 of Table 12.2-1 of ASCE 7-16). See APA Report T2004-59 for more details.

Since cyclic testing was conducted with the portal frame attached to a rigid test frame using embedded strap-type hold downs, design values provided in Table 1 of this document should be limited to portal frames constructed on similar rigid-base foundations, such as a concrete foundation, stem wall or slab, and using a similar embedded strap-type hold down.

References

APA. 2004. *Confirmation of Seismic Design Coefficients for the APA Portal Frame*. APA Report T2004-59. Tacoma, WA.

APA. 2012. *Effect of Hold-Down Capacity on IRC Bracing Method PFH and IBC Alternate Method*. APA Report T2012L-24. Tacoma, WA.

American Society of Civil Engineers. 2016. *Minimum Design Load and Associated Criteria for Buildings and Other Structures*. ASCE 7. Reston, VA.

ASTM International. 2001. *Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings*. ASTM E2126. West Conshohocken, PA.

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