

## Panel Anchorage Requirements

Panels must be securely anchored to roof and floor diaphragms to prevent tearing loose in the event of an earthquake. This had been a major problem in seismically active areas until more stringent requirements were imposed after lessons learned from earthquakes.

IBC 2003 requires this anchorage force to be:

For anchorage to flexible diaphragms:  $F_p = 0.8I_E S_{DS} W_p$ , where the notations are described previously, and the anchorage force based upon tributary area to the point of lateral support.

For anchorage to non-flexible diaphragms, use ASCE-7, Section 9.6.1.3, with  $a_p = 1.0$  and  $R_p = 2.5$ .

Per UBC '97, in seismic zones 3 and 4 the minimum anchorage force is 420 plf (equivalent to service level force of  $420/1.4=300$  plf), however, the following formula, as described above for use for panel design, must also be checked and will usually control:

$$F_p = \left[ \frac{a_p C_a I_p}{R_p} \right] \left[ 1 + 3 \left( \frac{h_x}{h_r} \right) \right], \text{ where for anchorage, } a_p = 1.5 \text{ and } R_p = 3.0.$$

For a one-story building, assuming  $I_p = 1.0$ , this reduces to:

$$F_p = 2C_a. \text{ Thus, in zone 4 for } C_a = 0.40, F_p \text{ would equal } 0.80,$$

and the total anchorage force would be  $0.80 \times W_{trib}$ . (strength level)

UBC requires for design of steel components of anchorage, this force must be increased by 40% for strength design. For wood components (nails, bolts, and checking wood stresses) the strength-level force can be reduced 15%, and the customary one-third stress increase allowed. Wood members used must be at least 1½ in. thick.

For transfer of the anchorage forces into the diaphragm by way of sub-diaphragms, if a plywood diaphragm is used, the strength level forces may be reduced by 1.4 to convert to service level, then use diaphragm values in UBC Table 23-II-H.

When pilasters are used (this also applies to stiffened walls - reinforced on each face - such as when supporting concentrated loads) the anchorage force at the top of the pilaster must be calculated assuming the adjacent panel(s) are supported on four sides (in other words, one-fourth the tributary panel lateral forces).

Where embedded steel straps are used for anchorage, they shall be hooked around the reinforcing steel or otherwise terminated to transfer the anchorage force to the reinforcing.