Commentary Chapter: Appendix D

BUILDINGS EXEMPTED FROM TORSIONAL WIND LOAD CASES

As discussed in Section C27.4.6, a building will experience torsional loads caused by nonuniform pressures on different faces of the building. Because of these torsional loads, the four load cases as defined in Fig. 27.4-8 must be investigated except for buildings with flexible diaphragms and for buildings with diaphragms that are not flexible meeting the requirements for spatial distribution and stiffness of the MWFRS.

The requirements for spatial distribution and stiffness of the MWFRS for the simple cases shown are necessary to ensure that wind torsion does not control the design. Presented in Appendix D are different requirements which, if met by a building's MWFRS, the torsional wind load cases need not be investigated. Many other configurations are also possible, but it becomes too complex to describe their limitations in a simple way.

In general, the designer should place and proportion the vertical elements of the MWFRS in each direction so that the center of pressure from wind forces at each story is located near the center of rigidity of the MWFRS, thereby minimizing the inherent torsion from wind on the building. A torsional eccentricity in buildings with rigid diaphragms larger than about 5% of the building width should be avoided to prevent large shear forces from wind torsion effects and to avoid torsional story drift that can damage interior walls and cladding.

The following information is provided to aid designers in determining whether the torsional wind loading case (Fig. 27.4-8, Load case 2) controls the design. Reference is made to Fig. CD-1. The equations shown in the figure for the general case of a square or rectangular building having inherent eccentricity e_1 or e_2 about principal axis 1 and 2, respectively, can be used to determine the required stiffness and location of the MWFRS in each principal axis direction.

Using the equations contained in Fig. CD-1, it can be shown that regular buildings (as defined in Chapter 12 Section 12.3.2), which at each story meet the requirements specified for the eccentricity between the center of mass (or alternatively, center of rigidity) and the geometric center with the specified ratio of seismic to wind design story shears can safely be exempted from the wind torsion load cases of Fig. 27.4-6. It is conservative to measure the eccentricity from the center of mass to the geometric center rather than from the center of rigidity to the geometric center. Buildings having an inherent eccentricity between the center of mass and center of rigidity and designed for code seismic forces will have a higher torsional resistance than if the center of mass and rigidity are coincident.

Using the equations contained in Fig. CD-1 and a building drift analysis to determine the maximum displacement at any story, it can be shown that buildings with diaphragms that are not flexible and that are defined as torsionally regular under wind load need not be designed for the torsional load cases of Figure 27.4.6. Furthermore, it is permissible to increase the basic wind load case proportionally so that the maximum displacement at any story is not less than the maximum displacement under the torsional load case. The building can then be designed for the increased basic loading case without the need for considering the torsional load cases.