Chapter C12
SEISMIC DESIGN REQUIREMENTS FOR BUILDING STRUCTURES

C12.3.3.3 Elements Supporting Discontinuous Walls or Frames. The purpose of the special load combinations is to protect the gravity load-carrying system against possible overloads caused by overstrength of the lateral-force-resisting system. Either columns or beams may be subject to such failure, therefore, both should include this design requirement. Beams may be subject to failure due to overloads in either the downward or upward directions of force. Examples include reinforced concrete beams, the weaker top laminations of glulam beams, or unbraced flanges of steel beams or trusses. Hence, the provision has not been limited simply to downward force, but instead to the larger context of "vertical load." A remaining issue that has not been fully addressed in this edition is clarification of the appropriate load case for the design of the connections between the discontinuous walls or frames and the supporting elements.

The connection between the discontinuous element and the supporting member must be adequate to transmit the forces for which the discontinuous element was designed. For example, where the discontinuous element is required to comply with the special loads specified in Section 12.4.3, as is the case for steel columns in braced and steel moment frames, its connection to the supporting member will also be required to be designed to transmit the same forces. These same special seismic loads are not required for shear wall systems and, as such, the connection between the shear wall and the supporting member would only need to be designed to transmit the loads associated with the shear wall and not the special seismic loads.

C12.3.4 Redundancy. This standard introduces a revised redundancy factor for structures in Seismic Design Categories D, E, and F to quantify redundancy. The value of this factor is either 1.0 or 1.3. This factor has an effect of reducing the R factor for less redundant structures thereby increasing the seismic demand. The factor is specified in recognition of the need to address the issue of redundancy in the design. The National Earthquake Hazards Reduction Program (NEHRP) Commentary Section 5.2.4 explains that this new revised requirement is "intended to quantify the importance of redundancy." The NEHRP Commentary points out that "many non-redundant structures have been designed in the past using values of R that were intended for use in designing structures with higher levels of redundancy." In other words, the use of the R factor in the design has led to slant in design in the wrong direction. The NEHRP Commentary indicates that the source of the revised factor is Technical Subcommittee 2 of the NEHRP Provisions.

C12.4.3 Seismic Load Effect Including Overstrength Factor. Some elements of properly detailed structures are not capable of safely resisting ground-shaking demands through inelastic behavior. To assure safety, these elements must be designed with sufficient strength to remain elastic. The Ω_0 coefficient approximates the inherent overstrength in typical structures having different seismic force–resisting systems. The special seismic loads, factored by the Ω_0 coefficient, are an approximation of the maximum force these elements are ever likely to experience. This standard permits the special seismic loads to be taken as less than the amount computed by applying the Ω_0 coefficient to the design seismic forces when it can be shown that yielding of other elements in the structure will limit the amount of load that can be delivered to the element. As an example, the axial load in a column of a moment-resisting frame will derive from the shear forces in the beams that connect to this column. The axial loads due to lateral seismic action need never be taken greater than sum of the shears in these beams at the development of a full structural mechanism, considering the probable strength of the materials and strain hardening effects (for frames controlled by beam hinge-type mechanisms this would typically be $2M_p/L$, where for steel frames M_p is the expected plastic moment capacity of the beam as defined in the AISC Seismic Specification and for concrete frames, M_p would be the probable flexural strength of the beam, where L is the clear span length). In other words, as used in this section, the term "capacity" means the expected or median anticipated strength of the element, considering potential variation in material yield strength and strain-hardening effects. When calculating the capacity of elements for this purpose, material strengths should not be reduced by capacity or resistance factors.

C12.8.4.1 Inherent Torsion. Where earthquake forces are applied concurrently in two orthogonal directions the 5 percent displacement of the center of mass should be applied along a single orthogonal axis chosen to produce the greatest effect, but need not be applied simultaneously along two axis (i.e., in a diagonal direction).

Most diaphragms of light-frame construction are somewhere between rigid and flexible for analysis purposes, that is, semi-rigid. Such diaphragm behavior is difficult to analyze when considering torsion of the structure. As a result, it is believed that consideration of the amplification of the torsional moment is a refinement that is not warranted for light-frame construction.

Historically, the intent of the A_x, term was not to amplify the natural torsion component, only the accidental torsion component. There does not appear reason to further increase design forces by amplifying both components together.

C12.11.2.1 Anchorage of Concrete or Masonry Structural Walls to Flexible Diaphragms. Where roof framing is not perpendicular to anchored walls, provision needs to be made to transfer both the tension and sliding components of the anchorage force into the roof diaphragm.