

Seismology Opinion

Issue: Use of cantilever steel columns in residential buildings in lieu of shear walls.

Opinion: In Type V (light frame) construction it is acceptable to use steel columns in cantilever action with out applying the lower R value to the remaining portion of the structure providing the following items are met:

1. The deflection of the column under service loads is limited to the lesser of $0.005H$ or the approximate deflection of the adjacent shear walls in the same orthogonal direction.
2. The column flexural stress shall be based on loads factored up by the ratio of larger R / lower R. (i.e.: $5.5/2.2=2.5$)
3. The column axial stress ratio shall based on a $K=2.1$ and shall not exceed the stress ratio of $f_a/F_a \leq 0.10$
4. The cantilever height of the column shall not exceed 24'-0"
5. The total shear in all columns combined shall be less than 15% of the story shear based on tributary area.
6. A minimum of two (2) columns shall be provided at each independent line of resistance.
7. A grade beam shall join the columns together with sufficient stiffness to provide fixity at the column base. Flag pole footings are not permitted.

Commentary:

Chapter 1630.4.4 requires that where different lateral force resisting systems act in the same direction, the forces shall be based on the lateral system with the lowest R-value.

The type of structure addressed in this issue will normally have several lines of sheathed walls meeting the requirements for an $R=5.5$. To factor up the force (250%) to the entire building in the same direction as the cantilevered columns would be counter productive in terms of the increased connections. The increased force will generate larger foundations, holdowns with large bolts, floor to floor ties with excessive nailing, drag and chord connections with large bolt and/or excessive nailing and shear walls with heavy nailing requirements that would normally not be required. The additional connectors could have the potential to cause splitting of the wood members under cyclic loading.

Cantilever Column

Page 2

6/16/00

The primary objective in designing the Cantilever Column lateral force resisting system is to achieve deformation compatibility with the adjacent force resisting elements and provide sufficient factors of safety for the structure to perform adequately during seismic events.

The provisions above will yield a structural solution that will allow the building to perform without penalizing the remaining shear walls. By limiting the deflection of the cantilever columns with respect to the shear walls, uniform diaphragm displacement will occur.

Respectfully submitted,

William M. Nelson
SEAOSC Wood Sub-Committee Chairman