

Simplified Geometric Nonlinear Analysis:

Conventional design practice in steel uses the exterior frames to carry lateral loads, while the rest of the framing carries the gravity loads only. Although the gravity frames have limited lateral elastic stiffness, they can play a significant role when second order effects are considered, because their elements are generally lighter than those in the lateral load resisting system and they carry a significant amount of the gravity loads. Hence, they can supply a significant geometric stiffness. One way to include the second order effects of the gravity framing is through what is called a “leaning” or “lean-on” column. In this approach, the area of all the columns in the gravity system is lumped in one column and the total gravity load of the story is applied at each level to it. The horizontal displacements of the nodes of the leaning column are slaved to the horizontal displacements of the lateral load resisting system at each level, to simulate the effect of the slab or rigid diaphragm. A schematic of this approach is shown in Fig. 1.

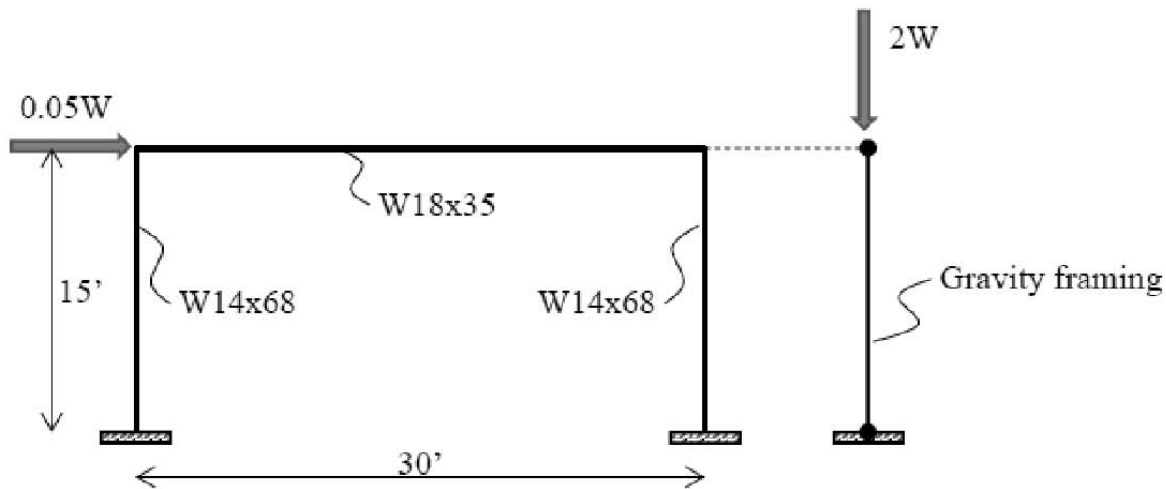


Fig. 3. One-story MRF design

This model can be further simplified by considering that the frame only provides lateral stiffness, as shown in Fig. 2.

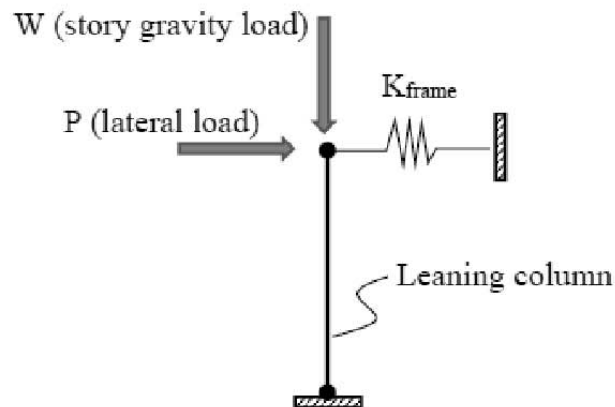


Fig. 2. Simplified model of a one story MRF structure