

Seismic Rehabilitation of Extreme Soft-Story School Building with Friction Dampers Using the ASCE 41 Standard

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Abstract

This paper presents a case study of the seismic rehabilitation of an existing high school building in Southern California. The two-story 1968 building has extreme soft and weak story irregularities. Its second story concrete and masonry full perimeter shear walls sit on non-ductile reinforced concrete moment frames at the first story. The voluntary seismic rehabilitation falls under the jurisdiction of California's Division of the State Architect (DSA). The authors describe and compare a code-based elastic solution to an ASCE 41 nonlinear, displacement-based solution. The elastic solution involved adding steel concentric braced frames with sufficient stiffness to eliminate the first story irregularities. The nonlinear solution involved adding steel tube braces to provide additional initial stiffness, selectively cutting reinforcement to protect shear critical beams, and jacketing columns to increase deformation capacity. Friction dampers were included in the new tube braces to protect existing non-ductile elements from overload and provide desirable post-yield behavior of braces. The nonlinear approach dramatically reduced construction costs, by significantly decreasing the required structural steel tonnage of braces, easing the ability to connect braces to the existing structure, eliminating the need to strengthen diaphragm collectors, and eliminating the need to add drilled piers to existing pile groups.



Figure 1: Photo of Building

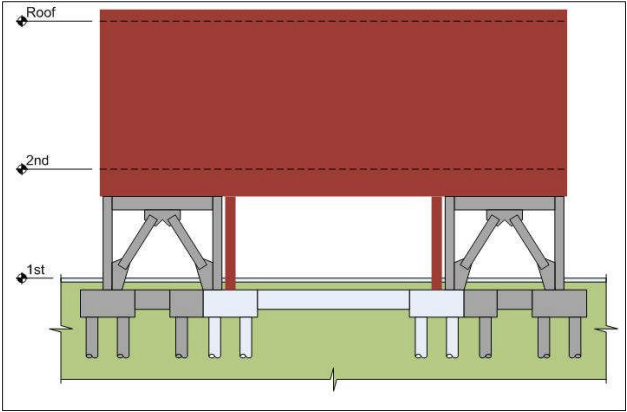


Figure 2: Elastic Solution

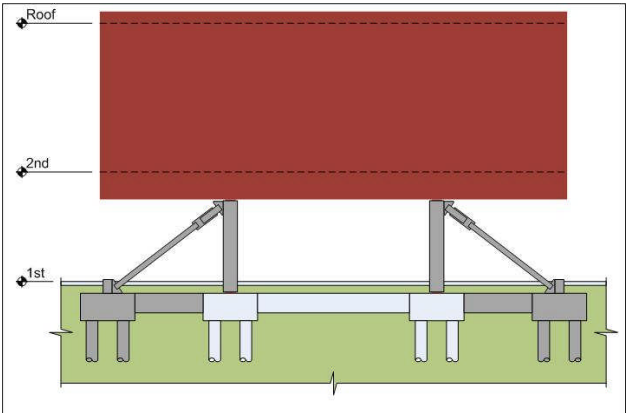


Figure 3: Nonlinear Solution