Seismic Performance of Self-Centering Frames composed of Precast, Post-Tension Concrete encased FRP Tubes

Description

Meta Fields
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Abstract :

This research studied the performance of continuous and segmented precast post-tensioned concrete columns confined by fiber reinforced polymer (FRP) tubes used to construct moment resisting frames that were 60 in. high and 82 in. wide. Four unbonded post-tensioned frames constructed using precast members were designed to re-center in the direction of the original position after lateral loading. The columns were 8 in. in diameter and 45 in. in clear height. The FRP columns were composed of either continuous 45 in. long segments or by stacking three 15 in. long segments on top of each other. A monolithic reinforced concrete moment resisting frame with similar dimensions of the FRP specimens designed according to the provisions of the American Concrete Institute Building Code Requirements for Structural Concrete was constructed as a control specimen. Key parameters were analyzed and compared such as hysteresis, damage, drift, and energy dissipation. SAP2000 was used to construct pushover models of the reinforced concrete specimen and one FRP specimen to predict load-drift response, which were about 95% accurate.Three FRP specimens were constructed from segmented columns while one was constructed from continuous columns. Neoprene layers were added to the column-beam and column-base interfaces of one segmented FRP specimen to dissipate energy, reduce damage to the structural members, and to lengthen the period of the frame. External sacrificial energy dissipating devices in the form of modified steel angles were attached to another segmented FRP specimen to dissipate energy when deforming plastically while allowing them to be replaced after testing.The reinforced concrete specimen was the most damaged in the form of plastic hinge formation, cover spalling, core crushing, as well as rebar fracture. The FRP specimens suffered minor damage with the specimen with neoprene layers the least damaged. The FRP specimen with sacrificial energy dissipaters had the highest amount of energy dissipated followed by the reinforced concrete specimen. The FRP specimen with segmented columns dissipated more energy than the one with continuous columns, while the specimen with neoprene layers dissipated the least amount of energy. Post-tensioning bar yielding only occurred in the specimen with sacrificial energy dissipaters.

Subject : Columns
Group : Seismic
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