Seismic Behavior and Design of Segmental Precast Post-Tensioned Concrete Piers

Description

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Abstract :

Segmental precast column construction is an economic environmental friendly solution to accelerate bridge construction in the United States. Also, concrete-filled fiber reinforced polymer tubes (CFFT) represents a potential economic solution for durability issues in bridge industry. Combining the segmental precast and CFFT will result in rapid durable construction system. The proposed research will build on recent work by the PI where he experimentally investigated the seismic behavior of tens single-column and two-column bents constructed using precast post-tensioned CFFT. The columns were constructed by stacking precast CFFT segments one on top of the other and then post-tensioned using unbonded tendons. Two specimens had external energy dissipation devices and another twospecimens had neoprene in the joints between the CFFT segments. The neoprene significantly reduced the seismic displacement demand. The columns re-centered upon the conclusion of the test resulting in minimal residual displacement which represents, in the case of a real strong earthquake, a huge advantage since the post-earthquake repair measures will be minimal. A 3-D finite element models were developed by the PI to predict the performance of the single-column under monotonic lateral loads. The main objective of this proposal is to improve and expand the capabilities of these finite element models to produce design recommendations. In particular, the models will be expanded to include dynamic loading, two-column bents, and the neoprene in the joints. Includingdynamic loading in the model is essential to quantify the energy dissipation due to rocking of the columns segments. The outputof this research will be recommendations on the optimum construction characteristics of the system including the segment height/column diameter ratio, neoprene thickness and hardness, external energydissipater requirements, and post-tensioning force level. The proposed research will develop a durable environmental friendly rapid construction bridge system, which has low life-cycle costs, construction waste, noise, traffic disruption, and initialconstruction cost. In addition, the developed system will has high work zone safety, efficient use of construction material, a short construction time, and improved constructability. The proposed construction system will not have a leakage of wet concrete into waterways leading to pollution of water and harm migrating fish. Finally, when the proposed construction system fully developed and implemented in construction, it will reduce the expense of bridge replacement, repair, and continuous operation interruption after earthquakes.

Subject : Piers

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