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NONLINEAR SEISMIC ANALYSIS OF REINFORCED CONCRETE STRUCTURES USING POD REDUCED ORDER METHOD

N. Ayoub, W. Larbi, J-F. Deü
Structural mechanics and coupled systems laboratory (LMSSC)
Conservatoire National des Arts et Métiers
292 rue Saint-Martin 75003 Paris cedex 3 France
naim.ayoub@lecnam.net, walid.larbi@lecnam.net, jean-francois.deu@cnam.fr

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This works concerns the development of reduced order models [1, 2] for dynamic analysis of reinforced concrete structures with material nonlinearities and subjected to seismic excitations. Model reduction is achieved by extending the application of the Proper Orthogonal Decomposition (POD) [3] to dynamic models of reinforced concrete structures with material nonlinearities originating from steel reinforcement plasticity and concrete damaging. This reduction technique is tested first on a reinforced concrete multistory frame structure where material nonlinearity is modeled by the multifiber [4] section approach. In the case of a single earthquake, a full model nonlinear time-history analysis is conducted on a portion of the seismic base excitation. Then, proper orthogonal decomposition modes are extracted and used to reduce the dynamic analysis of the remaining excitation portion, thus reducing the computational cost. For multiple earthquake scenarios, a full model nonlinear time-history analysis is conducted on a portion of only one selected seismic base excitation. Then, proper orthogonal decomposition modes are extracted and used to reduce the dynamic analysis of the other base excitations while saving a large part of the computational cost. Similar testing is made on a multistory planar reinforced concrete shear wall with material nonlinearities introduced via the layered membrane approach. To evaluate the efficiency and accuracy of this reduction technique, a comparison is made between the reduced order models and the full order ones. This comparison covers the computational cost, the structural displacement in function of time and the hysteretic behavior of steel and concrete materials.

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