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Behavior of Common Philippine-Made Concrete Hollow Block Structures Subjected to Seismic Load Using Rigid Body Spring-Discrete Element Method

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Abstract : Concrete hollow blocks (CHB) are the most commonly used masonry block for walls in residential houses, school buildings and public buildings in the Philippines. During the recent 2013 Bohol earthquake (Mw 7.2), it has been proven that CHB walls are very vulnerable to severe external action like strong ground motion. In this paper, a numerical model of CHB structures is proposed, and seismic behavior of CHB houses is presented. In modeling, the Rigid Body Spring-Discrete Element method (RBS-DEM)) is used wherein masonry blocks are discretized into rigid elements and connected by nonlinear springs at preselected contact points. The shear and normal stiffness of springs are derived from the material properties of CHB unit incorporating the grout and mortar fillings through the volumetric transformation of the dimension using material ratio. Numerical models of reinforced and unreinforced walls are first subjected to linearly-increasing in plane loading to observe the different failure mechanisms. These wall models are then assembled to form typical model masonry houses and then subjected to the El Centro and Pacoima earthquake records. Numerical simulations show that the elastic, failure and collapse behavior of the model houses agree well with shaking table tests results. The effectiveness of the method in replicating failure patterns will serve as a basis for the improvement of the design and provides a good basis of strengthening the structure.

Keywords : concrete hollow blocks, discrete element method, earthquake, rigid body spring model
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