

NONLINEAR SEISMIC EVALUATION OF PERRIS DAM OUTLET TOWER

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ABSTRACT

Outlet Tower at Perris Dam in Southern California is a critical feature of an emergency outlet works to drain the reservoir to avert potential uncontrolled release of water should a dam emergency occur. The tower is a 105-foot-high tubular reinforced concrete structure with an inside diameter of 26 feet and outside diameter of 31 feet and is accessed by a bridge. Previous linear-elastic seismic evaluations of the tower with pre-NGA ground motions indicated significant damage, and results with NGA ground motions were inconclusive. This paper presents the most recent seismic assessments of the tower using two different three-dimensional (3D) nonlinear models for prediction and validation of the level of damage to determine whether the tower would remain stable, functional, and accessible to safeguard dam safety following a postulated maximum credible earthquake (MCE).

One model employed layered shells comprised of nonlinear concrete and nonlinear steel layers to allow concrete cracking and steel yielding. The second more advanced model used 3D nonlinear solid elements to predict concrete cracking in three orthogonal directions and steel yielding/rupturing in individual vertical and horizontal reinforcements. Both models included the access bridge and allowed the bridge to slide on rollers at the tower support. The nonlinear models were analyzed for three sets of three-component rock acceleration time histories applied along the principal axes of the tower. The results indicate that the tower would perform satisfactorily and remain operational when subjected to the postulated MCE. It would suffer only minor damage in the form of microcracks in the bottom third with no yielding of the vertical and horizontal steel. The access bridge would be accessible to foot traffic but may not be safe for vehicle crossing.

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