WHARF STRUCTURE DESIGN CONSIDERATION OF PIER E REDEVELOPMENT PROJECT AT THE PORT OF LONG BEACH

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ABSTRACT

The Pier E Redevelopment Project at the Port of Long Beach (POLB) targets reconfiguring and combining two irregularly shaped adjacent container terminals to establish a more efficient and environmentally friendly facility. This project aims at replacing the existing wharf structures with modern structures over wharf slope areas stabilized by rock dike revetment or ground improvement. Also, the existing Pier E wharf will be rehabilitated and widened to accommodate a 120’ gauge crane, and eventually extended to the south to connect with the Pier F terminal.

The Pier E wharf is the first wharf at POLB that was designed to accommodate a crane with 120’ gauge. Pier E utilizes a wider gauge crane with a higher vertical load and translational elastic period of the mode with the maximum participating mass being about 1.3 to 1.5 seconds. The wharf seismic design considered the crane mass impact on the wharf displacement demand. The wharf layout consists of a 4,311-foot long berth composed of 8 wharf segments separated by transverse expansion joints. The design of the wharf considers variation in soil properties and proposed wharf slope stabilization solutions at the different wharf segments.

This presentation addresses the wharf structural design considerations. A performance-based approach was used for the seismic design of the wharf structure for inertia and kinematic loading. The design philosophy objective is to provide a ductile structure with plastic hinges forming in the piles to dissipate earthquake energy. A series of non-linear static pushover analyses that consider the nonlinear soil behavior were performed to evaluate the structure’s displacement capacity and shear demand. The substitute structure method was used to calculate the seismic displacement demands for three levels of ground motions. A non-Linear Time History Analysis was performed for the linked wharf units to verify the displacement demands and determine shear key forces.

Performance based design was employed for the seismic analysis and design of the wharf structure. This method results in cost-effective design and minimum impact on operations due to OLE and CLE events. The design satisfies the strain limits for three earthquake levels, as presented in POLB Wharf Design Criteria for inertia and kinematic loading.

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