

Design of cut-and-cover tunnel in seismically-active urban area: Presidio Parkway Replacement Project

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Summary

Positioned alongside the north shoreline of San Francisco, the Battery Tunnel is one of the structures of Presidio Parkway which will connect the city streets through Presidio of San Francisco National Park to the iconic Golden Gate Bridge. The site is seismically active area and surrounded by the National Cemetery and historic battery structures. The design team came up with unique geometry to accommodate geometric constraints and numerous utilities. The soldier piles were selected as the temporary shoring system during construction to protect the marsh lands from interruption of ground water. As a “recovery route” designated by the California Department of Transportation, accurate evaluation of seismic performance of the tunnel was warranted. To that end, nonlinear soil-structure interaction analysis as well as linear analysis was performed. The analyses not only confirmed that the structural design of the tunnel satisfies seismic design criteria for both temporary and permanent condition, but also showed the differences between linear and nonlinear analysis.

Keywords: cut-and-cover tunnel, geometric constraints, soil-structure interaction analysis, seismic design, nonlinear finite element analysis

1. Introduction

The existing south access to the Golden Gate Bridge, known to many as Doyle Drive or U.S. Route 101, was built in 1936 and has reached the end of its useful life. Most of the existing structures within this segment of the roadway are structurally and seismically deficient and in the process of being replaced.

To preserve the natural beauty of this area and its numerous historic landmarks, Doyle Drive has been re-envisioned as the Presidio Parkway – a roadway tucked into the natural contours of the Presidio of San Francisco and the Golden Gate National Recreation Area, one of the largest urban parks in the U.S.

The Presidio Parkway Project called for the complete replacement of a 1.6-mile-long 6 lanes highway including the construction of three tunnels, five bridges, one depressed section, many retaining walls and other miscellaneous structures. Two of the tunnels will put the current at-grade traffic underground to restore the land above for pedestrian and bicyclist use (See Figure 1).

As one of the major components of the project, the Battery Tunnel was proposed to replace the existing at-grade roadway in approximately the same location, between the San Francisco National Cemetery and the three historic battery structures. The tunnel site is located on a bluff that