San Francisco - Oakland Bay Bridge Geofill Project

Location: Oakland Bay Bridge, San Francisco, CA
Product: Nilex MD-88 Wick Drains and Nilex Earthquake Drains
Engineer: Caltrans
Contractor: Gordon N. Ball, Inc.

Figure 1

Figure 2

The Challenge:

As part of a seismic upgrade to the San Francisco - Oakland Bay Bridge, it was necessary to widen the roadway connecting the Skyway section of the existing freeway lanes west of the Bay Bridge Toll Plaza. This roadway, the Oakland Touchdown, was built on top of a "Geofill" area that contained mole fill material overlaying soft bay mud.
Engineering calculations indicated excessive consolidation settlement would occur in the bay mud under the added load created by roadway widening. Additional calculations indicated existing mole material would liquefy under shaking caused by an 8.1 magnitude design earthquake.

The Solution:

The schematic (Fig. 3) which addresses both problems, was adopted by Caltrans engineering to utilize both wick and earthquake drains.

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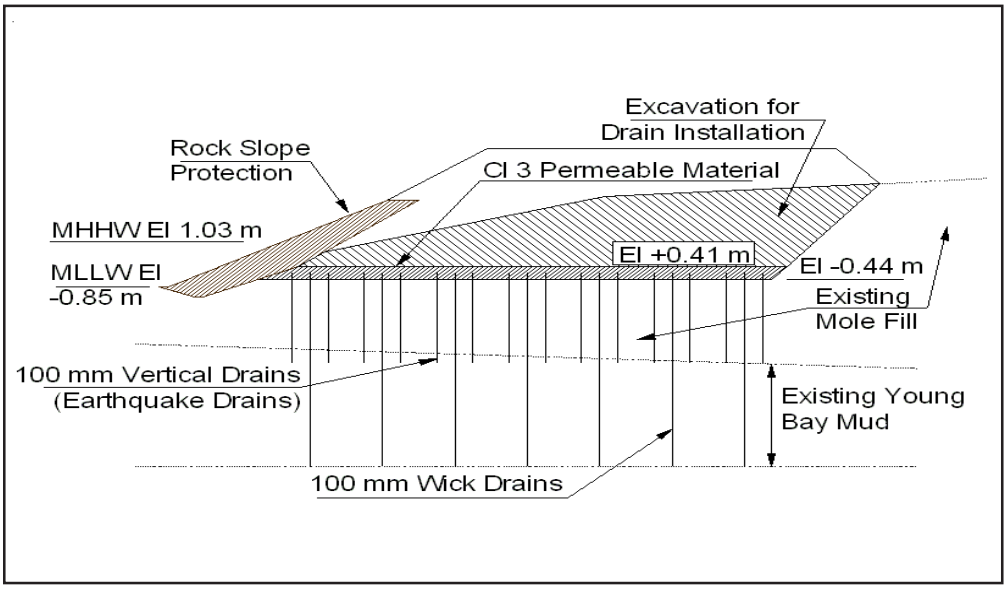

Figure 3

Figure 4

Installation:

1. The first step was to excavate to an approximate elevation of -0.44m (Fig. 1).
2. Secondly, 0.47m of class 3 permeable aggregate was placed over geotextile to bring surface elevation to +0.03m.
3. Six thousand wick drains were installed through the class 3 aggregate to depths ranging from 10 to 25m. Wick drains were placed at a triangular spacing of 1.8m and were cut off at the surface of the aggregate. (NOTE: Due to low elevation of the working surface, installation was performed during low tide (Fig. 1).
4. Seventeen thousand 100 mm diameter earthquake drains were installed at traingular spacing of 0.9m, through the aggregate to the bottom of the original mole fill, at depths ranging from 3.5 to 6.5m. (Earthquake drains were also installed during low tide as indicated in Fig. 2.) Drains were installed within a vibrating mandrel to achieve densification of the mole fill simultaneously with installation. Three symmetrically spaced fins attached to the mandrel assisted in transmitting vibration to the soil. (Fig. 2). Approximately 0.6m of settlement occurred during installation of the 6.5m earthquake drains.
5. Drain tops were trimmed close to the top of the aggregate layer and elbows were placed on top of each drain. An additional 0.38m of stone was bladed over the drains (Fig. 4). The stone was bladed over the drains from the closed side of the elbows to avoid falling into drains. After placing geotextile over the stone, the rock slope protection and embankment were built. A surcharge load was added and would remain in place for nine months.

Performance:

A number of ground improvement techniques were evaluated for this project. The wick/earthquake drain combination using multiple geosynthetic layers was determined the most cost-effective. The installation took place in Spring of 2003; consolidation is complete and settlement rates occured as expected. The surcharge will remain in place until Caltrans is ready to begin bridge construction. Replacement of the East Span and completion of the San Francisco - Oakland Bay Bridge Project is projected for 2007.

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