

Owner / Client:

County of Santa Cruz
Department of Public Works

Timeline:

1999 - 2009

Services provided:

- ◆ Geotechnical investigation
- ◆ Geologic evaluation
- ◆ Structural analysis & design
- ◆ Preparation of plans, specifications & estimates

Key personnel:

Steven H. Sanders
Drew G. Kennedy
William L. Millhone
Darren A. Mack
Adam C. DesJardins
Travis W. Koch
T. Nathan Manley



For decades the County of Santa Cruz has been battling bluff erosion along East Cliff Drive at Pleasure Point, one of the most used and valued sections of coastline in the region. East Cliff Drive is designated as a County scenic roadway, and provides public access to the beaches along Pleasure Point as well as the world-renowned offshore surfing areas. As bluff erosion continues, there is an increasing danger that the majority of East Cliff Drive (already reduced to a single lane of traffic), and the primary utilities that run below it, will be lost.

In 1999, the County required emergency stabilization of three failing crib walls on the bluff along East Cliff Drive between 33rd and 36th Avenues. The walls were up to 18 feet tall, 30 feet long and exhibited severe structural distress. Imminent failure of these walls posed a significant risk to the roadway, underground utilities, and public safety.



Before



After stabilization and application of sculpted and stained shotcrete facing

SAGE provided structural design, plans, and specifications for emergency repair measures to provide immediate, local crib wall stability. To minimize construction impacts to the sensitive coastal bluff and ocean environment, we recommended that the crib walls be stabilized in place using soil nail walls. Specifically, our design included installation of “injection anchor” type soil nails extending approximately 20 feet behind the face of the crib walls, followed by application of a reinforced shotcrete facing over the crib wall facings and flanks. Injection anchors were selected to minimize cuttings and dust common to standard soil nail installation. Key design considerations included impact loading from wave-borne debris and outflanking of the soil nail walls.

To address aesthetic considerations along the scenic corridor, SAGE researched specialty contractors skilled in sculpting and staining of shotcrete to replicate the surrounding bluff materials. Research included interviews and field trips with County personnel to view finished walls. SAGE also provided full-time observation during construction to confirm that field conditions were consistent with our design assumptions and help to verify contractor conformance to the plans and specifications.

While the emergency repairs successfully addressed the failing crib walls, continued erosion of unprotected sections of the bluff has resulted in the deterioration and partial collapse of the guardrail and shoulder along portions of East Cliff Drive. In order to address safety and stability concerns and to improve and enhance public access to Pleasure Point, the County has planned a parkway for pedestrians and cyclists, scenic overlooks, new beach stairways, a new restroom structure, and parking. As part of this project, the County plans to stabilize and protect the coastal bluff adjacent to the parkway by building approximately 1,100 linear feet of soil nail wall between 33rd and 36th Avenues ("Pleasure Point") and at the end of 41st Avenue ("The Hook"). SAGE has been working with the County as its primary structural consultant providing geotechnical engineering services during the planning and permitting process.



In support of the Coastal Development Permit (CDP) application submitted to the California Coastal Commission (CCC), SAGE prepared preliminary structural design plans for soil nail walls and performed a coastal bluff evaluation to more precisely define the degree of threat to East Cliff Drive and critical underground utilities with respect to ongoing coastal erosion. Our geologists documented existing bluff conditions and estimated maximum episodic bluff failure size and frequency using historic aerial photographs and maps. SAGE also performed slope stability analyses to estimate the largest potential episodic bluff failure and factors of safety against bluff failure for static and seismic conditions. Based on the results of the coastal bluff evaluation and the slope stability analyses, we estimated the degree of threat to the existing improvements and assigned specific sections of the roadway to one of three numerical threat zones. In light of these threat estimates and after reviewing our preliminary structural design plans for soil nail wall stabilization measures, the CCC approved the County's CDP application in December 2007.



SAGE recently completed the final geotechnical investigation report, and final structural design plans, specifications, and estimates for construction of the soil nail walls. Project challenges included design of integrated stairways at three locations, and mechanically stabilized earth (MSE) build-out areas to create scenic overlooks and/or to rebuild areas where the existing roadway has been lost to erosion. Our engineers have worked closely with the County to locate beach access staircases, scenic overlooks, and escape routes for surfers stranded at the base of the bluff during high tides. Construction of the project commenced in May 2009.