Rain Rocks Rock Shed

by Mike Van De Pol, California Department of Transportation

South portal of the Rain Rocks Rock Shed. All photos: California Department of Transportation.

The California Department of Transportation (Caltrans) is making improvements to Highway 1 along the Big Sur Coast in Monterey County. The Rain Rocks Rock Shed project will restore highway reliability, decrease maintenance expenditures, and improve safety.

Unstable geology and winter storms cause landslides and rock fall at the site, regularly creating significant hardship for travelers and the coastal communities. Caltrans evaluated structure types and met with other state agencies, local agencies, and local community representatives. Among the alternatives considered were a bypass structure, a tunnel, total Highway 1 relocation, and a rock shed. Multiple rock shed configurations were explored to meet functional needs and the significant aesthetic requirements. An aesthetics advisory committee established goals and guidelines for the structure relating to form, shape, proportions, surface textures, and colors.

The selected structure follows the existing highway alignment and covers the roadway. The roadway section is composed of two 12-ft-wide lanes, 4-ft-wide shoulders, concrete barriers, and steel pipe hand railing. The rock shed is 239.5 ft long and 54.5 ft wide.

The substructure is composed of two, five-span, cast-in-place, post-tensioned concrete arched bent spans. The bent spans are supported on tapered rectangular concrete columns. The columns are founded on steel-case, cast-in-drilled-hole piles with deep rock sockets.

The roof, or superstructure, is composed of precast, prestressed arched, voided rectangular concrete girder sections, which rest on the bent caps. Concrete roof panels are joined together with post-tensioning in the direction of the roadway and are affixed to the bent caps with vertically oriented post-tensioning. The array of roof panels has a cast-in-place concrete overlay.

Internal and external retaining walls span between, and are affixed to, the bent span columns. On each end of the structure, there are variable height headwalls, intended for backfill/cover containment, structure hillside conformance, and visual relief. Tieback anchors are employed between the structure and the hillside and between the headwalls. To absorb rock fall impact loads, a combination of materials is employed on top of the roof panels. The roof cover is composed of sand, expanded polystyrene, coarse aggregate, and a grid system. The grid system is comprised of a continuous layer of welded-wire reinforcement (WWR) with a criss-cross grid of concrete bands that are cast around the WWR in a specific, normal pattern.

For structural design, a geologic history of rock fall was obtained. Employing site contours and computer simulations, rock fall parameters were developed. Structure impact zones were established with impact/force equations to develop rock impact loads on the roof cover. The impact loads were distributed through the roof matrix for structural component design. Multiple staged loadings were evaluated, including temporary static and construction equipment live loads. A

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Interior view of the rock shed with roof panels in place, looking south.