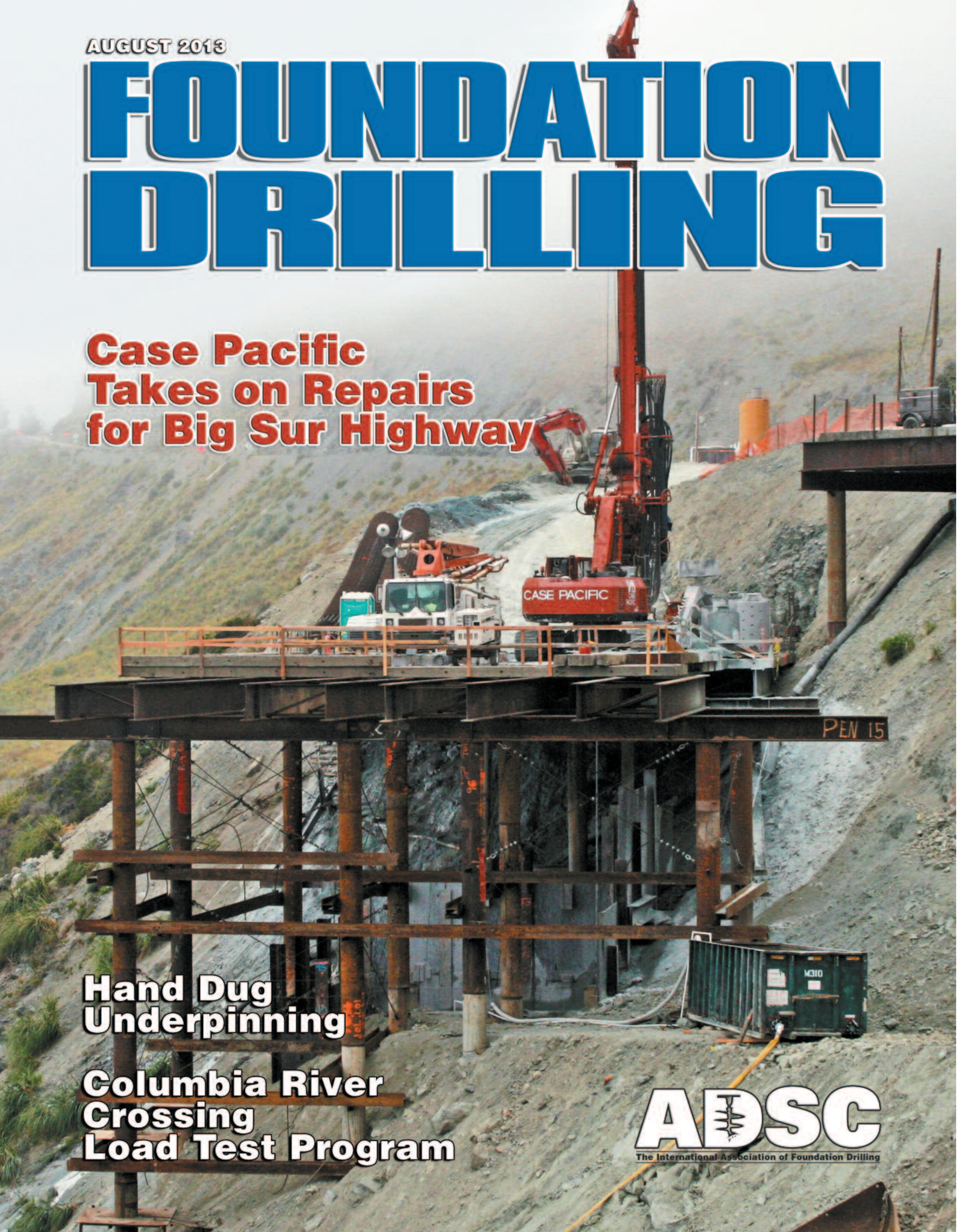
AUGUST 2013

FOUNDATION DRILLING

Case Pacific Takes on Repairs for Big Sur Highway

Hand Dug Underpinning

Columbia River Crossing Load Test Program



ADSC
The International Association of Foundation Drilling

Cover Feature

CASE PACIFIC TAKES ON PITKINS CURVE:

Reparing Scenic California Highway After a Landslide

By Will Gehrke, Case Pacific, Paso Robles, California

Introduction

After over 30 years of my involvement with the ADSC and specifically the incredible work that its members undertake, one might think that I would have become blasé about reviewing projects for possible publication in **Foundation Drilling** *magazine. As they say in French "au contraire" (roughly translated, "uh uh"). The following article by Will Gehrke, Project Manager, ADSC Contractor Member, Case Pacific, Paso Robles, California, is another one of those, "how in the world did they do that?" kind of projects. When looking at some of the photos I found myself literally gasping… So here you have it fine readers. With thanks to Will and all of those at Case Pacific involved in this project. (Editor)*

The stretch of coastline from Southern California to Northern California running along Highway 1 is one of the most scenic routes in the world. Starting in Orange County traveling north on Highway 1 along the great Pacific Ocean, you will see some of most beautiful sites including the Big Sur coastline, the Golden Gate Bridge and eventually ending in the enchanting Redwood Forest of Mendocino County. Highway 1, the coastline and the Pacific Ocean are well known for their rugged beauty.

Taken June 2005 Pitkins Curve and Rain Rocks before construction.

Highway 1 is located in a geologically complex, active and unstable area, especially along the 90 mile stretch from San Luis Obispo County to Monterey County known as the *Big Sur Coastline*. The Big Sur section from San Luis Obispo to Carmel is an official National Scenic Byway. Highway 1, along the Big Sur Coastline was officially opened to the public in 1937. Today an estimated three million tourists visit this part of the coastline every year. The highway winds along the rugged mountains with elevations from near sea level to 1,000 foot sheer cliffs.

Highway 1 Scene of Thousands of Construction Projects

Bent 3 Pitkins Curve Bridge Case Pacific Company drilling 60 inch diameter rock sockets, looking south towards Bent 2 column pour and Rain Rocks Shed.

The existing ground conditions and slopes include extremely hard rock to broken, weak and friable rock covered in years of eroded soils. Groundwater, intense rain storms, erosion, and water infiltrating the rock formations result in landslides that are in constant need of repairs and maintenance. Since the public opening in 1937, due to the constant variable conditions and movement of the ground, this stretch of Highway 1 has been the site of thousands of construction projects.

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The Caltrans (California Department of Transportation) project is known as "*Pitkins Curve Bridge and Rain Rocks Shed*." Since the 1990's at this one location landslides and falling rocks have created a constant public hazard and inconvenience. A bridge was proposed to permanently solve traffic problems caused by the slope instabilities. The state's solution was to build a 620 feet long three-span box girder structure. The main span of the bridge will

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cross over the slide path, allowing slide debris to freely pass under the bridge.

The project is located near Lucia, California on Highway 1. It is approximately 40 miles south of Carmel, and

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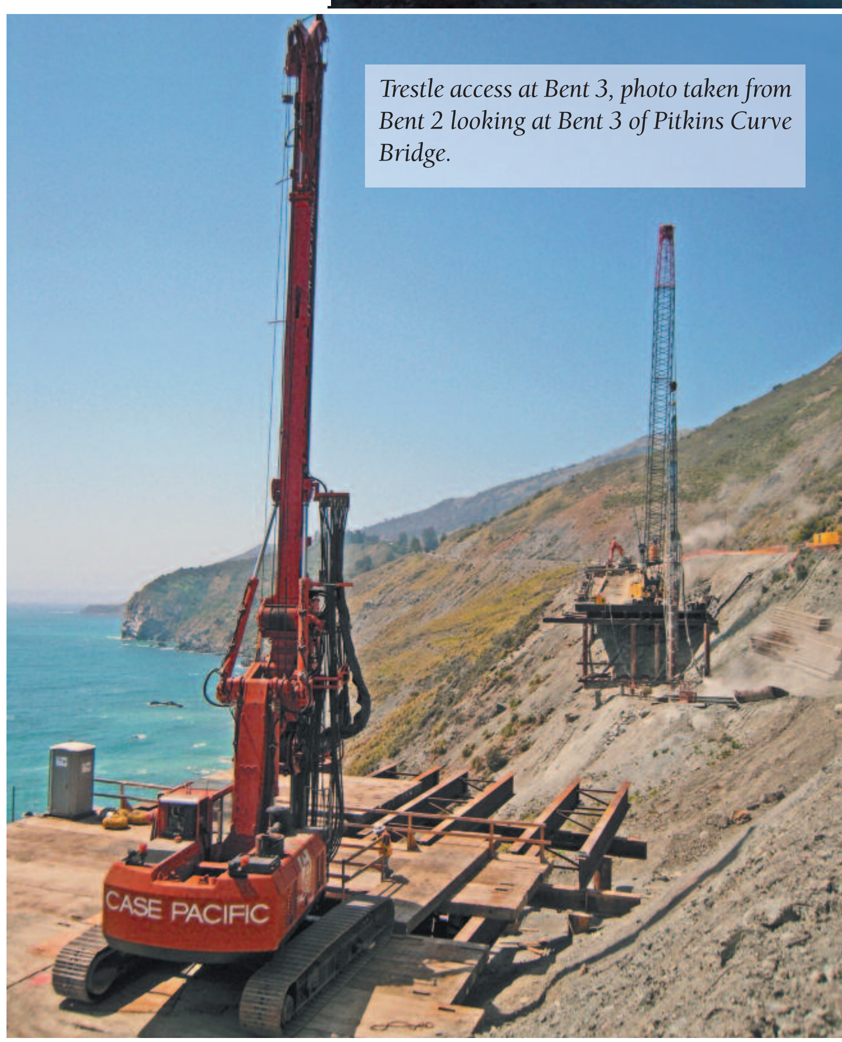
40 miles North of Cambria. The project start date was December 9, 2009 with an estimated completion date of October 2, 2013. The project was awarded to Golden State Bridge, Inc. based in Martinez, California as a $29.4 million contract. Case Pacific Company, Paso Robles, California was listed as the subcontractor to install the Cast-In-Drilled-Hole Concrete Pilings (CIDH) for both the bridge and the Rock Shed foundations for an initial subcontract amount of $1.6 million. The subcontract amount included drilling, and setting and pouring the concrete pilings. Rebar, steel casings and concrete were furnished by Golden State Bridge.

Massive landslide blocked Highway 1 fifteen miles south of the project for a couple of months.



Trestle access at Bent 3, photo taken from Bent 2 looking at Bent 3 of Pitkins Curve Bridge.

During the design phase by Caltrans engineers, the complexity of this project became apparent. Caltrans contacted the ADSC's West Coast Chapter (WCC) during their preliminary design phase to discuss the feasibility of their initial design. In 2007, a meeting was held at the project location with the Caltrans design team and members of the ADSC West Coast Chapter. Caltrans initial design for the Pitkins Curve Bridge consisted of one large diameter (8 foot to 14 foot) pile at the center span of the bridge. The problems with access, size of equipment necessary and safety concerns were all discussed during this meeting. It was decided that a single large diameter shaft would not be constructible at the bridge location.

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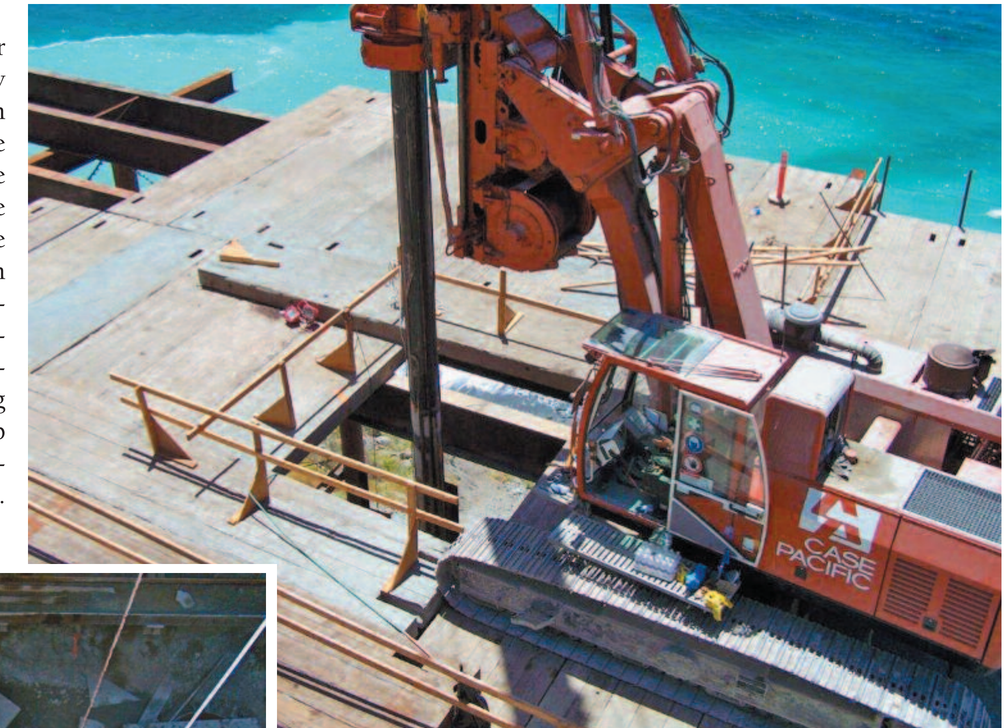
In April of 2007, a 42 inch diameter x 37 foot deep test shaft was drilled by ADSC Contractor Member, Condon Johnson and Associates. The test pile construction was announced to the ADSC and the interested parties were invited to the site to observe the drilling operations. In May of 2007, an Osterberg Load Test that was conducted on this test shaft. Caltrans engineers determined from their discussion with the ADSC WCC, and testing conducted, that a bridge with a group of 60 inch diameter piles with two supports was a more constructible design.



Bauer BG 20 on trestle working platform Bent 3.

Looking down the cofferdam from the bent working platform at Bent 3.

The final foundation design consisted of:

Pitkins Curve Bridge

➤ Two piles at each abutment – 60 inch diameter x 40 foot deep rock sockets

➤ Bent 2 – Four each 60 inch diameter x 50 foot deep rock sockets with 18.50 foot deep 66 inch permanent casings

➤ Bent 3 – Four each 60 inch diameter x 60 foot deep rock sockets with 35.25 foot deep 66 inch permanent casings

Rain Rocks Shed

➤ Six each exterior bent piles – 48 inch diameter x 40 foot deep rock sockets with 18 foot deep 54 inch permanent casings and 18 foot deep 60 inch isolation casings

➤ Eighteen each exterior retaining wall piles – 24 inch diameter 25 foot deep rock sockets with 18 foot deep of 30 inch diameter permanent casings and 36 inch diameter isolation casings

➤ Six each interior bent piles – 48 inch diameter x 30 foot deep rock sockets with 18 foot deep 54 inch permanent casings and 18 foot deep 60 inch isolation casings

➤ Eighteen each interior retaining wall piles – 24 inch diameter 25 foot deep rock sockets with 18 foot deep of 30 inch diameter permanent casings and 36 inch diameter isolation casings

Subsurface Conditions & Geology

The Pitkins Curve landslide site is located adjacent to the coastline within the Santa Lucia Mountain Range and lies in the Franciscan Formation. The Franciscan Formation is very complex. It includes altered mafic volcanic rocks, deep-sea cherts, greywacke sandstones, limestones, serpentines, shales and high-pressure metamorphic rocks all faulted and mixed in a very chaotic manner.

The project site is covered by fill and slide debris. The fill and slide debris consisted of loose to medium dense, gravelly sand and clayey silt with an abundant amount of gravels, cobbles and boulders. Bedrock was encountered at various depths below the slide debris. The bedrock was described by Caltrans as predominately intensely fractured, fresh, and hard to very hard, meta-basalt, and schist/phyllite, with shear zones, and with variable degrees of serpentine rock. Groundwater seepage was encountered in the borings. Seepage and/or spring water varied in amount and location during construction.

Scope of Work

Case Pacific Company's (CP) scope of work included oversize

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Rebar cage for the Bent piles at Pitkins Curve Bridge showing the congestion and tiedown anchor.

drilling for permanent/isolation casings, setting the permanent/isolation casings and grouting them in place. On completion of the casing installations, the rock sockets were drilled to depth, the reinforcement cages set and the concrete placed (rebar, casings and concrete were supplied by the General Contractor.)

CP had two drill rigs onsite for the majority of the job. These included a Delmag RH26 and a Bauer BG 20* which drilled on average 16 hours per day. CP personnel included **Brandon Christensen**, **Robert Tanguileg** and **Randy Virdell** as onsite Superintendents and **Will Gehrke** as Project Manager. All of the foundation work was performed with two shifts working around the clock. The CIDH Concrete Pilings were completed beginning in May of 2010 and through June of 2011.

Difficulties and Methods

The location of this project created many hardships and complexities for CP. Communication from field personnel to the office personnel was difficult and at times, almost nonexistent. There

Due to the lack of reliable communication, mechanical breakdowns, material deliveries and constructability problems that occurred, delayed the project by hours if not days.

was no cell phone service at the project location. The closest cell phone reception was a 20 minute drive north of the project site. Due to the lack of reliable communication, mechanical breakdowns, material deliveries and constructability problems that occurred, delayed the project by hours if not days.

Whether it was for deliveries of equipment, materials or everyday field personnel, just getting to the project was difficult. The Big Sur Coastline does not make it easy. Delays getting to the project during the summer months are caused by the millions of tourists that visit the area, while delays in the winter can be caused by landslides and slope failures that often happen all along the highway.

Soon after the start of the project a slide occurred to the north of the site sending the southbound lane into the ocean. This blocked access from the north for the majority of the foundation portion of the project. All equipment, material deliveries, and field personnel had to be rerouted to the project from the south.

During the last few months of work a massive landslide occurred 15 miles south of the project. This completely blocked the highway for months. During that time no oversized deliveries and no equipment could be moved to and from the project. To get to the site field personnel had to drive on a windy dirt road over the Santa Lucia Mountain Range, thus adding a treacherous two hours to the trip.

Once getting equipment to the jobsite, Golden State Bridge (GSB) and CP had to figure out how to access the Bent piles for the bridge as well as all of the complex logistics of the project. GSB designed and installed a trestle bridge on each side to function as a working platform for the CIDH installation. They would later use this as the platform for their false work supports. GSB used a Symmetrix 24 inch SE 610 ring system with an Atlas Copco* Secoroc QL 200 down-the-hole-hammer to install the pipe pile to support the working platform. In order to provide CP with a safe working area at pile cut-off elevation a cofferdam was installed to the bottom of the bent pile caps.

CP used conventional drilling techniques to install the piles at Bent 2, and at both abutments of the Pitkins Curve Bridge. Core barrels, rock augers and belling buckets were used to drill the slide debris material and the bed rock. The ground conditions varied from very hard rock to very loose slide debris with occasional water seepage. When drilling down CP encountered caving material and/or water seepage. A belling bucket was used to enlarge the shaft, and then backfill the caving lenses with sand slurry. The shaft was then re-drilled. A four to six cement sac sand slurry mix was used to control caving conditions and water seepage. An accelerator admixture was used so that the concrete could harden and be drilled within a few hours after placement.

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Concrete flowablity testing apparatus used to test the mix.

A precarious looking operation.

This process was effective in control of the caving conditions and the water seepage, but was very time consuming. Due to the configuration of the working trestle and pile-to-pile spacing requirements, only one pile could be accessed at a time. Once the pile was installed to depth the rebar cage was set and the shaft was poured using the dry method of concrete placement. The four piles at Bent 2 were drilled and poured using the dry method. The use of this method meant that integrity testing (Gamma Gamma) was not required by Caltrans specifications.

Installing 4 inch grout columns at the exterior Bents and retaining wall piles.

The dry method of concrete placement was a crucial element of the CIDH installation due to the congested rebar cages. If concrete had to be placed under wet methods, thus requiring Gamma Gamma testing, it would have added an additional degree of difficulty in construction. The rebar cages for the Bents at Pitkins Curve Bridge included installing a tiedown anchor down the center. It was then stressed to a load and locked-off to the pile cap under tension. Given these conditions, the wet method of concrete placement was nearly impossible to imagine. With the congested rebar in mind, CP Project Manager Will Gehrke, along with Mike Chernetsky of concrete ready-mix supplier Graniterock, performed extensive testing on the CIDH concrete mix. This step was taken in order to ensure that the flowabilty of the concrete would perform as needed.

After the installation of the permanent casings at Bent 3, CP encountered a substantial amount of water infiltrating the shafts. The belling of the shafts, placing concrete backfill and re-drilling proved unsuccessful in controlling the water. CP attempted to install multiple piles multiple times to seal off the water with the method that was successfully used at Bent 2. At this point, CP filed a “Differing Site Conditions Notice” with Caltrans. Discussions began as to how to solve the water issue. After many meetings and discussions with Caltrans, CP decided that under these ground conditions mineral slurry (bentonite) would work best. Mineral slurry was chosen due to the variable subsurface materials, and the length of time it was necessary for the shafts to be left “open.” CP successfully installed all four Bent 3 piles with the use of mineral slurry, which effectively controlled caving conditions. When piles are poured using the wet method of placement, Caltrans specifications require integrity testing. These test methods included Gamma Gamma testing and the use of a down-hole Shaft Inspection Device (SID), to verify the cleanliness of the bottom of the shaft. All piles were tested and accepted without any remedial work being necessary.

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This photo captures the magnitude of the project.

Difficulties on the Rain Rocks Shed Piles

The interior Bents and retaining walls piles of the Rock Shed were installed in solid rock ranging in hardness from moderately hard to very hard rock. CP installed the casings and rock sockets with core barrels and rock augers, with little-to-no slide debris, caving conditions and or water intrusion. However, within the slide debris on top of the bedrock, the exterior Bents and retaining wall piles encountered excessive caving conditions. The solution was to install grout columns around the circumference of each shaft. For this CP used a 4 inch down-the-hole-hammer attached to an Interoc Anchor Drill model AN 109B*. The grout column held the caving material and the permanent casing were installed in a dry open shaft. The Rain Rock Shed piles were installed using the dry method of concrete placement.

Photo taken on May 2013 Pitkins Curve Bridge and Rain Rocks Shed after construction.

Conclusion

CP has completed many successful projects on Highway 1 in San Luis Obispo County and Monterey County. This has provided company personnel with an understanding of the difficulties and

This project demonstrates how a strong relationship with the DOT's and the ADSC can benefit states, contractors and the general public.

complexities in completing successful projects under the unique circumstances presented by working on this scenic, yet, vulnerable highway. After overcoming the logistics, and the location and the variable rock conditions, the foundations were constructed successfully and the owner was most pleased by the result. This project demonstrates how a strong relationship with the DOT's and the ADSC can benefit states, contractors and the general public.

Case Pacific Company, established in 1968, is widely acknowledged as an industry leader in the design and construction of drilled foundations, earth-retention systems, slide repair, pin piles, soil nailing, underpinning, and related sub-structure construction in the western states.

**Indicates ADSC members.*

ADSC

Project Team

Owner:	Caltrans (California Department of Transportation)
General Contractor:	Golden Gate Bridge, Inc.
Specialty Contractor:	Case Pacific Company

ADSC