The Howard A. Hanson Dam

By Marcus H. von der Hofen

Howard A. Hanson
Courtesy U.S. Army Corps of Engineers

Howard A. Hanson Dam, 1990s
Courtesy U.S. Army Corps of Engineers

Flood in Kent Valley, part of the Green River Valley region, 1930s

The Howard A. Hanson Dam, located in the foothills of the Cascade Mountain Range, is one of many in the state of Washington. Dedicated in 1962, the dam brought necessary flood relief to the Green River Valley and opened the way for increased valley development. Named for Seattle Attorney and State Legislator Howard A. Hanson (deceased 1957), who campaigned long and hard for the project, the dam has changed South King County from flooded farmlands to a sea of warehouses, industrial plants, condominiums, and shopping centers.

Hanson, an early campaigner for flood control in the valley, was a member of the Washington State Legislature in 1907, and became the Chief Civil Deputy Prosecuting Attorney for King County in the 1920s. In the late 1920s, he became Chair of a Rivers and Harbors Subcommittee of the Seattle Chamber of Commerce.

Hanson felt that flood control in the valley would aid not only valley farmers, but also the economic development of both King and Pierce counties. Taking his campaign on the road, it was Hanson who turned the project into a regional, rather than localized, undertaking.

After World War II, Hanson organized efforts leading to contributions by the State and King County totaling $2 million. Unfortunately, the tireless advocate for Eagle Gorge Dam passed away on November 4, 1957, and was never able to see the fruits of his labors. In his honor, the name of the dam was changed in 1958 to the Howard A. Hanson Dam by an Act of Congress (www.HistoryLink.org).

On July 31, 2008, the general contractor was awarded a $5,888,250 contract for providing reaction plane strengthening at the Howard Hanson Dam additional water storage fish passage (Phase II). One of the components of this contract was the use of shotcrete in combination with rock anchors to create a slope stabilization structure to be installed concurrently with the excavation process. The "top down" installation process, combined with multiple ground conditions and a remote location, created a very challenging project.

One of the advantages to making this a successful project was the U.S. Army Corps of Engineers' prequalification of the construction team as part of the contracting process for Phase II. Understanding the critical sequencing and being able to provide solutions to changing conditions is critical to this type of project.

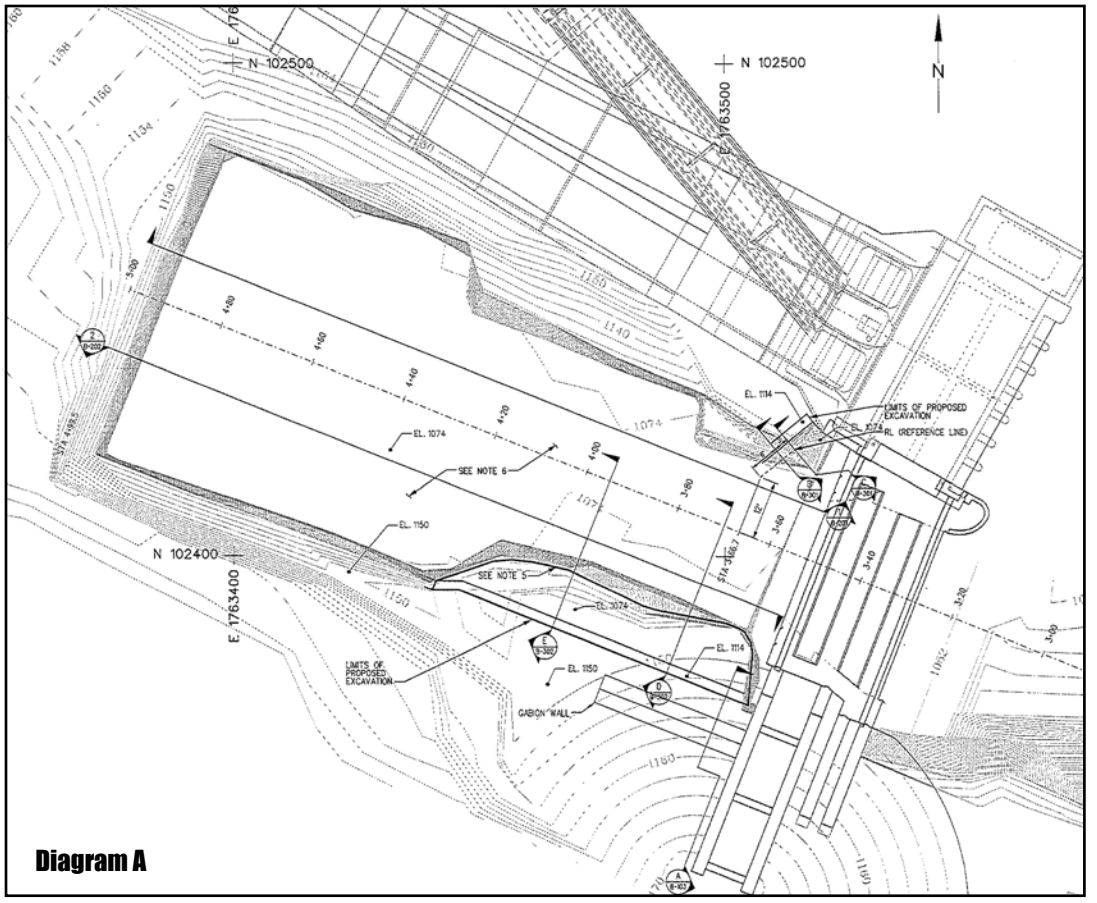

Diagram A

Blasting, excavation, drilling, reinforcing, and shotcreting with critical time frames, multiple ground conditions, and structural configurations is a challenging task for an expert team of contractors; there would be no time for a learning curve.

The scope of the project involved excavating and stabilizing a 67 ft (20.4 m) long, 76 ft (23.2 m) high section of the south slope of the structure, shown in Diagram A. The area would be broken into six levels (lifts) of excavation. Each level of excavation was divided into two sections of support type. Directly adjacent to the reaction plane would require a 6000 psi, 10 in. (41.4 MPa, 254 mm) minimum thickness shotcrete structure with continuous No. 9 Grade 75 bar reinforcing on all sides of the 40 ft (12.2 m) long rock dowels and 4 x 4 in. (101.6 x 101.6 mm) w4.0 x w4.0 welded wire fabric over the entirety. The second section was reinforced with similar rock bolts and a 6 in. (152.4 mm) minimum thickness steel fiber shotcrete (refer to Diagram B).

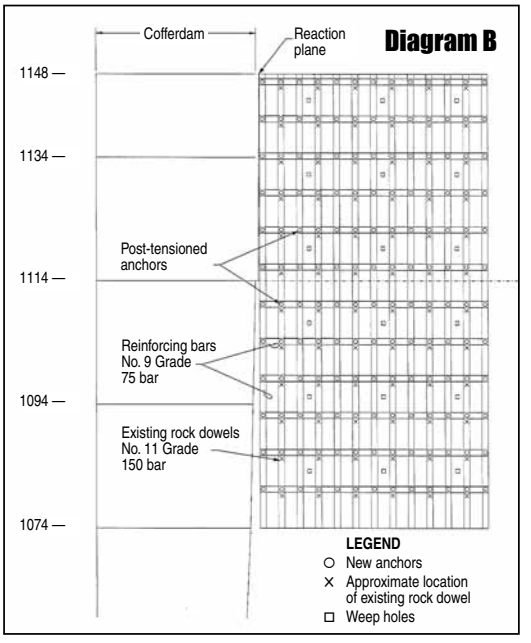

Diagram B

It wasn't that long ago that many engineers might not have thought shotcrete could be used on that size of reinforcing bar. The shotcrete industry has come a long way in its 100-plus years of existence and it is quite common for an experienced shotcrete contractor to shoot around large reinforcment.

All of the rock anchors, weep holes, and shotcrete were to be installed no later than 3 days after excavating a lift. Wet-mix shotcrete was the chosen method of placement. The shotcrete was supplied via a concrete truck. Because of the proximity of the project, additives were used to increase the loading-to-discharge time. The lack of radio contact onsite and long road time made staging of trucks especially critical for the project, yet delivery proved to be more economical than other possible methods.

A great deal of time is put into determining the ground conditions that are going to be encountered.

Soils reports, boring logs, and sample pits give crucial information to help predict what will be encountered but, unfortunately, they are not always accurate. The Puget Sound area is a beautiful region of abundant wildlife and pristine forests that comes with a price: rain—and of course more rain—and let's not forget rain mixed with snow. The conditions are often changing from moment to moment and require judgment from experience often not found in a book.

In this case, the general contractor and the shotcrete contractor's first task turned out to be mitigating poor rock and unforeseen soil veins. Shotcrete can be an exceptional tool for dealing with this problem. Flashing areas of instability with shotcrete provided enough ground support to make the drilling operation safe. This process is well known, but because of the irregular rock face in this case, it would require a creative guide wire setup to ensure the flashing did not encroach into the structural wall. Of course, this still takes time and because of the concerns of the proximity to the dam structure, additional time to complete a lift was not an option.

Immediately following the first hurdle was the rain and groundwater. Preemptive measures were taken during the first lift by creating a shotcrete gutter at the top that would channel runoff away from the wall. This step, while often left out, can be a job saver when a rain squall drops in during the middle of the operation. Water coming out of the face is the most difficult to deal with during placement and sometimes can be impossible to stop. An experienced shotcrete contractor should understand the principles and limitations of the products and procedures used to deal with the situation. A great deal of time and money can be spent with on-the-job learning—something this project did not afford.

The U.S. Army Corps of Engineers had a great deal of misconceptions about what quality shotcrete looked like and the right way to solve the issues, as they had gone through in Phase I of the project with a large contractor who convinced them that a certified nozzleman and some equipment is all you need to shotcrete. Phase I was plagued with problems and cost overruns that were avoided in Phase II.

Spillway at Howard A. Hanson dam, 1990s
Courtesy U.S. Army Corps of Engineers

Phase I and Phase II jobs combined, as the shotcrete contractor finishes the bottom lift under the heat tent during Phase II

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Owner
U.S. Army Corps of Engineers

Contractor
C.A. Carey Corporation
Issaquah, WA

Subcontractors
Jensen Drilling Company
Eugene, OR

SubTerra, Inc.
North Bend, WA

Johnson Western Gunite Company
San Leandro, CA

Shotcrete Supplier
CalPortland
Seattle, WA