Large-Scale Cement Grouting for Forrest Kerr Cofferdam Construction

Location: **Forrest Kerr, British Columbia**

Sector: **Dams**

Case Description

Forrest Kerr is a 195 MW run-of-river hydroelectric power plant in northern British Columbia, situated in a geologically complex location at the junction of Iskut River and Forrest Kerr Creek. The power plant headworks was constructed in a narrow river valley that was bisected by the Forrest Kerr geological fault.

A feature of all rivers in northern British Columbia is that summer water levels resulting from melting snow in the mountains are much higher than during the winter low-flow river water levels.

As project construction was underway, AltaGas, owner of Forrest Kerr hydro project, became concerned that complex geological conditions underlying the headworks sheet pile cofferdam could lead to flooding during high water level conditions and jeopardize construction of the de-sanding basin and associated headworks structures.

Porous rock formation beneath cofferdam

Drilling grout holes adjacent to cofferdam

Solution

AltaGas requested Peter White to direct cement grouting operations on an urgent basis to consolidate porous foundation conditions beneath a sheet pile cofferdam prior to seasonal flooding of the Iskut River and Forrest Kerr Creek.

Cofferdam construction was already underway and the limited construction footprint was congested with ongoing heavy civil work, equipment and materials.

A local drilling contractor was retained to provide crews and Davey Kent DK725 duplex drilling equipment to install steel casing into the porous foundation rocks beneath the sheet pile cofferdam.

Drilling commenced along the cofferdam alignment with widely spaced primary holes, drilled to shallow depths of a few meters. Drilling stopped and cement grouting commenced whenever difficult ground conditions were encountered or when drillers would lose circulation through underground fissures or cavities.

Upper stages of drilling and grouting were undertaken above existing river water elevation. Deeper stages of drilling and grouting were undertaken under similar geological conditions but below the river water elevation.

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Drilling of secondary holes was undertaken by split-spacing between primary holes. Secondary holes were typically able to achieve deeper penetration before losing circulation, followed by cement grouting.

Over a cofferdam alignment of approximately 260 m, within a span of 8 weeks, more than 130 holes were drilled utilizing down-stage methods to ultimate depths exceeding 20 m and approximately 3,000 cubic meters of cement grout was consumed.

Small portable concrete pumps were provided for undertaking cement grouting operations. The contractor provided both Reed B20 and Mayco LS30 concrete pumps with 2-inch diameter concrete hose.

Mayco B20 concrete pump in operation

Arrangements were made with the on-site batch plant to provide ready-mix trucks with 4 cubic meter loads of high-density cement-flyash grout mixtures.

Typical high-density grout mixture required the following ingredients (for one cubic meter):

- 553 liters water
- 553 kg Type GU cement
- 553 kg Flyash
- 44 kg Accelerator admixture

Ready-mix truck fleet availability was dependent upon higher priority project requirements for concrete placement scheduled at other locations but typically 3 or 4 trucks were used to support cofferdam foundation grouting operations.

Drilling and grouting operations at each drill hole stage were monitored to assess ground conditions encountered and to adapt appropriate grout volumes and pressures for each stage.

Locations for drilling and grouting work were coordinated on a daily basis in conjunction with ongoing cofferdam installation operations, to minimize delays and to allow sufficient time for grout curing before drilling deeper stages or adjacent secondary holes.

Cofferdam grouting work was undertaken during the months of February to April and encountered the expected challenges associated with cold weather operations.

The completed cofferdam was successful in holding back high river water flows during the summer months, enabling headworks construction to be completed as scheduled.

Iskut River during summer high water flood stage

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The following winter, similar grouting techniques were implemented to consolidate broken ground conditions beneath the Stage 2 cofferdam to facilitate construction of downstream diversion gates across the river bottom adjacent to the original cofferdam.

This work involved more than 30 holes sequentially drilled and grouted using down-stage methods to ultimate depths exceeding 12 m and consumed approximately 300 cubic meters of cement grout over a span of 2 weeks.

For Stage 2 cofferdam grouting work, a concrete boom pump was utilized to facilitate placement of cement grout into drilled holes.

Drilling and grouting at Stage 2 cofferdam

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Peter White, P. Eng., is a senior engineer and grouting specialist with over 25 years of experience working on many different types of pressure grouting operations at hundreds of project locations around the world.