

U.S.A. MUD MOUNTAIN DAM

OWNER	U.S. ARMY CORPS OF ENGINEERS, SEATTLE
ENGINEER	U.S. CORPS, SEATTLE, WASHINGTON STATE
TYPE OF STRUCTURE	EARTH DAM - 128 m
WORKS CARRIED OUT	HYDROFRAISE CUT-OFF & ANCILLARY WORKS
TYPE OF CONTRACT	SPECIALTY CONTRACTOR
1988 - 1990	REHABILITATION WORKS



BACKGROUND

MUD MOUNTAIN dam was built in 1941 on the WHITE RIVER near ENUMCLAW in the state of WASHINGTON, principally for flood control. It is an earth dam, 128 m high and 213 m long at the crest, in a steep-sided canyon of very hard (1400 kg/cm² compressive strength) blocky andesite cemented with volcanic ash and tuff.

In 1980, the monitoring piezometers detected leakage through the core accompanied by fines entrainment. The risk of retrogressive erosion and piping made repairs urgent.



LOCATION MAP

REPAIR PROJECT

The rehabilitation plan called for a 0,61 m-thick conventional concrete slurry trench cutoff through the core and 4,5 m into the bedrock.

SOLETANCHE, awarded the contract in 1988, proposed an alternative diaphragm wall, 0,85 m thick at the abutments and 1,00 m in the central portion of the dam. The hydrofraise was the only process capable of meeting the specification requirements on precision, depth and quality control in this very hard rock.

PRELIMINARY WORKS - GROUTING

Drilling mud was lost as soon as the first shallow drillings commenced for the panels. Work proceeded with difficulty until several vertical cracks appeared parallel to the crest when the deeper panels were being cut.

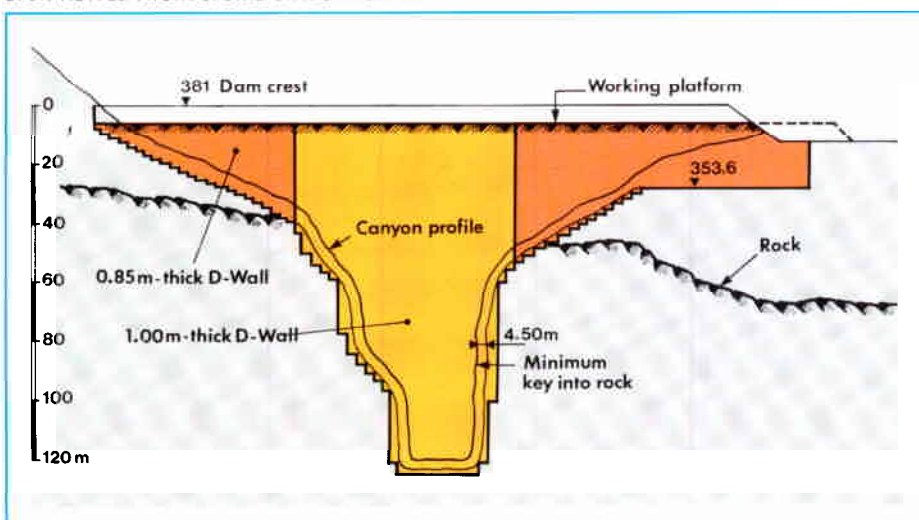
It was clear that very low compressive stress levels in the core were causing hydraulic fracture in the material and that the situation was becoming very dangerous.

The procedure for preliminary repairs to re-establish good compression in the core was a two-stage approach :

- A single row of holes was drilled on the cutoff centreline and grout poured in to fill the larger cracks and voids.
- A row of flanking holes was drilled on either side for high pressure sleeve claquage grouting of the diaphragm zone



DAM VIEWED FROM UPSTREAM RIGHT BANK



CUTOFF PROFILE - CONSTRUCTION DETAILS

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over a width of 7,3 m. Hole spacing was 1,80 m, with sleeve valves 0,60 m apart. The grout was a stabilized bentonite cement mix.

The ENPASOL digital drilling parameter recording system, used while drilling the first, upstream row, detected decompressed layers in the core, especially over the top 60 m and at a low level at the left bank rock core interface.

The ultimate grout take represented nearly ten per cent of the soil volume treated.

CUTOFF CONSTRUCTION

After these preliminary repairs had been completed, the deeper panels were drilled safely at a steady rate, although it was decided to limit panel width to 2,80 m (the width of the hydrofraise tool) and increase panel overlap to 0,36 m as an added safety measure.

Fifteen panels reached depths in excess of 100 m, the deepest at 122,5 m. Two panels cut into the steeply-sloping abutment andesite over a depth of 50 m.

HYDROFRAISE FEATURES

A type 12 000 Hydrofraise was used for the work. It generates three times more torque than the standard model and incorporates a trajectory correction system. Features of the Hydrofraise 12 000 machine are :

- guide frame 24 m high,
- toolhead swivels,
- reaction pads on frame sides bear against walls to prevent deviation by subvertical formations,
- continuous electronic monitoring and storage of drilling parameters and tool position,
- independent cutter speed control for sideways steering.

Control measurements showed longitudinal deviations not more than 10 cm (less than 1 per thousand) and relative lateral deviations not more than 20 cm (less than 2 per thousand at 120 m depth) ; mean deviation was of the order of 7 cm.



DAM VIEWED FROM RIGHT BANK



HYDROFRAISE CONTROL PANEL FOR DRILLING OPERATIONS

WORKS QUANTITIES

- INVESTIGATIONS
ENPASOL boreholes : 3,000 lm
- COMPRESSION GROUTING
Number of grout holes : 65
Aggregate hole length 6,000 lm
Calculated treated volume : 9,1 %
Total grout take : 3,500 m³
- HYDROFRAISE DIAPHRAGM WALL CUT-OFF
Max depth : 122,5 m
Thickness : 0,85 m & 1,00 m
Number of panels : 55
Area drilled : 13,300 m²
- ANCILLARY WORK
Earthmoving : 15,000 m³