

Retrofitting of Boundary Dam in Canada



PRODUCTS

*DYWIDAG Strand Anchors
DYNA Force® Sensor*

UNIT

*DSI Canada Ltd., Western
Division, Surrey, Canada*

LOCATION

Canada

TIMELINE

2007-11-30

SCOPE

Supply

OWNER

*SaskPower, Regina,
Canada*

CONTRACTOR

*DSI Canada Ltd.,
Western Division, Surrey,
Canada Subcontractor
for anchor installation
Beck Drilling and
Environmental Services
Ltd., Calgary, Canada*

ENGINEERS

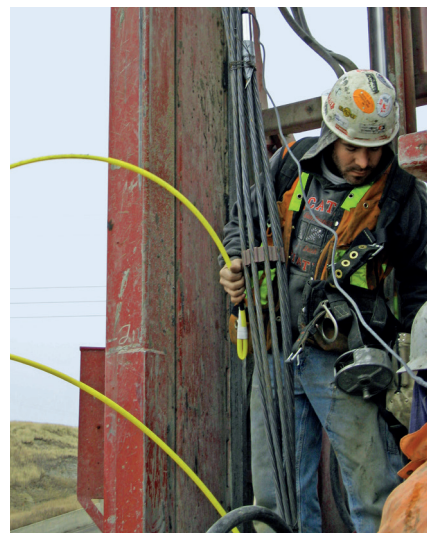
*SaskPower, Regina,
Canada*

The Boundary Dam was built in 1957 and started to show signs of frost heaving. It was also not meeting today's probable maximum flood requirements established by the Canadian Dam Association. A retrofitting of the dam was necessary.

Context

The Boundary dam is located near Estevan in the Canadian province of Saskatchewan. The dam has a spillway that protects it from flooding and ensures that floodwater cannot run over the top of the dam and damage the structure.

The dam owner, SaskPower, has just started retrofitting the spillway because the 50 year old structure showed signs of frost heaving. Furthermore, an investigation in 2006 found that inadequate joint design and a drainage malfunction had led to undermining and to slab movements in the spillway.



Solution

Work is made particularly difficult because construction may neither compromise the functioning of the spillway during high-water periods nor interrupt the cooling water supply to a nearby power station.



The retrofitting of the dam will be carried out in phases and involves installing Post-Tensioned Strand Anchors in the spillway chute and the stilling basin to enhance slope stability and resist uplift forces during eventual high water flow. The new spillway also needs to resist a potential swelling of the rock strata underneath both the chute and the stilling basin.

DYWIDAG executed a test program during the first phase of the retrofit program in order to determine the length and capacity of the resulting anchors. The test anchors were installed in the western side of the spillway. Ten DYWIDAG Strand Anchors with 9 strands (ASTM A416) and single corrosion protection were used as test anchors. The design load per anchor was 910kN and the ultimate load was 2400kN. The anchor bond lengths were post-grouted because the soil consists of mudstone and siltstone.

Two of the test anchors with intentionally long bond lengths of 18m and unbonded lengths of 20m and 24m were equipped with three DYNA Force® Sensors placed on the bonded length of the anchors. The sensors were attached to the anchors at various depths measured from the top of the bonded length at 0.2m, 6.2m and 12.2m.

The main purpose of the DYNA Force® Sensors was to determine how stress is distributed throughout the anchor bond zone in these specific soil conditions. The tests also needed to determine whether there was any potential benefit to shortening the bonded length below the limits recommended in the specifications.

Readings during testing to 80% of the ultimate load showed that the sensor at the top of the bond zone matched the tensioning force, the middle sensor indicated significant load reduction and the bottom sensor indicated zero loads.

Consequently, the results of the sensor measurements confirmed that the entire 1900kN load was transferred to the soil in less than the first half of the bonded length, resulting in anchor lengths designed with a shorter bond length. This is due to the fact that the shear strength of rock strata can be mobilized to sustain the entire test load, provided that the post grouting method is carried out and that the hole size and drilling methods are consistent with those employed during the testing program.

Because of this test program, the owner is saving material, drilling and labor costs and will be able to carry out construction work much faster as a result of the shorter bond lengths.