

Project:

Penstock reinforced by carbon fiber

Location:

Le Bois (France)

Project completed:

2018

Owner/s:

EDF

Applicator/Contractor:

Donelli

Market sector:

Water Management Industry

Products used:

MasterBrace PRE

MasterBrace FIB 300/50 CFS

MasterBrace SAT 4500

MasterBrace ADH 4000

EDF La Coche

Carbon fiber reinforcement of the penstock



Reinforced penstock at EDF La Coche (Le Bois – France)

The background

The EDF La Coche hydropower plant, located at the entrance of the Tarentaise valley in Savoy (France), was commissioned in 1976. Its innovative concept is based on two reversible turbines that can both generate electric power and pump water from a lower-elevation reservoir to a higher elevation to store energy which can then be released in periods of higher demand.

The average annual production of the La Coche hydropower plant is approx. 550 GWh, which is equivalent to the consumption of approx. 225.000 inhabitants (about half of the population of Savoy).

The challenge

Thickness reduction frequently occurs in penstocks as a result of. Friction and corrosion. This leads to higher stress and deformation.

In the most common case, it is only necessary to reduce the stress caused by internal pressure by applying external reinforcement.

In this case, three different zones were identified: Linear and constant degradation at the level of the slab, a zone with corrosion around it and the remaining section without visible damage.

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EDF La Coche

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Application of MasterBrace carbon fiber to a penstock at EDF La Coche

Our solution

Our proposal for reinforcement included the following steps:

1. Emptying the installation to ensure the application of the fiber without water load.
2. Substrate preparation, removing all corrosion and any adhesion impairing elements as well as obtaining a rough surface to improve adhesion.
3. Application of MasterBrace ADH 4000 as a levelling coat where necessary.
4. Application of MasterBrace FIB 300/50 CFS with MasterBrace SAT 4500 adhesive.
5. Installation of pre-formed MasterBrace PRE (consisting of a layer of MasterBrace NET GA 240 as non-conductive layer plus four layers of MasterBrace 300/50 CFS) in the longitudinal direction with MasterBrace SAT 4500 adhesive.

A containment installation including a dehumidifier and a heat generator was installed in order to lower the value of RH below 50% and ensure a minimum temperature of +15 °C (the limits set by the resins in the composite system).

Benefits to the customer

Preliminary design work for the solution required was carried out in cooperation between the owner, the University of Padua and the project engineer; this included the adhesion test to evaluate surface preparation.

The reinforcement was designed in accordance with ISO 24817. Structural design calculations were carried out by finite element analysis to establish the safety factor required to withstand water pressure.

Finite element analysis was also carried out to verify the increase in strength obtained using the composite.

Projects facts at a glance

- Penstock length 2 km, surface area about 17,000 m².
- Damaged area approx. 200 m².

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