

Renovation of an underground hydroelectric dam gallery using high wear-resistant UHPFRC screed

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Hydraulic civil engineering renovation
Wear resistant UHPFRC screed

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Extended Abstract

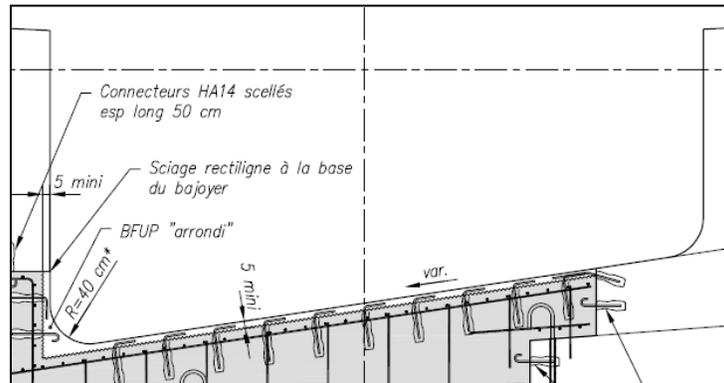
The “bottom valve gallery”, located on the right bank of the river Rhone, is an underground tunnel that was dug during the construction in 1948 of the Génissiat (Ain, France) hydroelectric dam. This underground gallery, whose primary function was the diversion of the river to allow the dam construction, is now used once a year as a giant flush to drain all kind of waste carried by the river. When opening the bottom valve, the gallery has to deal with considerable hydraulic stresses, intense cavitation phenomena, high abrasion of the sidings and multiple shocks.

Regarding this very demanding environment, the dam concession holder (Compagnie Nationale du Rhône - CNR) set up a renovation program of the gallery to enhance its level of service and durability. Renovation program mainly consisted in extending the thick metallic armoring of the valve and setting up of a new high wear-resistant layer of Ultra-High Performance Fiber Reinforced Concrete (UHPFRC) on all other surfaces subjected to high hydraulic stresses. Objectives assigned to this UHPFRC screed were to reproduce the projected geometry of the gallery with a very neat surface finish, to resist to the aggressions related to the annual flush (cavitation, shocks, abrasion, etc.) and to be able to delay the spread of a potential disorder or localized degradation whatever the cause.

After roughening by hydro demolition of the surfaces, a 5 to 7 cm thick UHPFRC (SMART^{UP} [STRUCTURE] Gris FM – VICAT Groupe) screed was casted on a 70 meters length on all the half-bottom edges of the gallery. UHPFRC layer was linked with concrete foundations by means of 8 metallic

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connectors per m² to reduce the risk of potential tearing of big pieces of screed under the effects of cavitation.



Typical cross section of the gallery

To avoid any cavitation or abrasion initiation, the main challenge of the project was to realize this screed with a very soft surface finish and minimum geometrical defects (bubbles, voids, joints or anchor points...) that would represent weakness areas. For this reasons UHPFRC has been casted with success under formwork following the complex slopes of the gallery. UHPFRC was injected at the bottom of each mold with a simple screw spindle concrete pump. To get rid of any anchor points, massive formworks with heavy counterweight were used.

UHPC used meets French NF P 18-470 standard specifications, offering characteristic compressive strengths greater than 150 MPa and characteristic tensile elastic strength greater than 8.5 MPa. Durability being a key performance of the project, UHPFRC used also provided very low porosity, chloride penetration and gas permeability. This material also proved its very high performance in terms of shock and abrasion, being tested with the concession holder specific protocol.

