

Omo River (Ethiopia)

GILGEL GIBE III HYDRO POWER PROJECT

THE DAM WITH THE TALLEST ROLLER-COMPACTED CONCRETE WALL IN THE WORLD WAS COMPLETED WITH MAPEI PRODUCTS

The largest hydroelectric power plant in Africa is located in Ethiopia – to the south-west of the capital, Addis Ababa, on the banks of the Omo River – and is powered by the Gilgel Gibe III dam, a 250 m tall colossus with a 630 m long crest.

Inaugurated in 2016, the dam was constructed by Webuild Group. Along with Gibe I, Gibe II and the Grand Ethiopian Renaissance Dam (GERD, see *Realtà Mapei International* no. 75), it is part of the country's drive to exploit its enormous reserves of water. In fact, the Blue Nile has its source in the Ethiopian mountains and the country is also known as "The water tower of Africa". The aim of the 1.5-billion-dollar Gilgel Gibe III project was to double the country's electrical power generating capacity and to modernise the economy.

The figures for the project give an idea of its sheer size: it took 6.2 million m³ of concrete to build the dam, a volume equivalent to 2.5 Giza Pyramids in Egypt, and the ten Francis turbines installed in the plant have an installed power of 1,870 MW, the equivalent of two nuclear power stations. The dam wall, made from Roller-Compacted Concrete (RCC), is the tallest of its kind in the world.

The large spillway is incorporated in the central part of the dam body. It includes an overflow crest divided into seven bays, controlled by radial gates, and flip buckets on the chute. Two middle outlets are embedded



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1. The spillway embedded in the dam body was built by using concrete admixed with DYNAMON SR3 and MAPEPLAST SF.

2. The waterproofing system used at the foot of the dam wall included the use of PURTOP 1000 pure polyurea membrane.

in the dam body, being designed to allow the control of the reservoir impounding and are sized to cope with wet season floods release, according to the recommendations of the ESIA (Environmental and Social Impact Assessment) studies. Two 11 m power tunnels, each long over 1 km, form the waterways of the hydropower project. The outdoor powerhouse is located on the left bank and houses the 10 Francis turbines.

Mapei's contribution: concrete admixtures and waterproofing products

Mapei participated in the construction of Gilgel Gibe III dam by supplying products for the construction of the main body and spillway of the dam, the protection system for the lake-side face of the dam wall and to create the vertical waterproof joints. For the construction of the main body of the dam and the spillway, Mapei supplied the following admixtures:

- MAPETARD CBS1 liquid set-re-

tarder to prevent the formation of cold joints between layers of roller-compacted concrete applied at different times and guarantee extended workability times;

- DYNAMON SR3 and DYNAMON EW super-plasticisers and MAPEPLAST SF mineral addition based on densified silica-fume were used to maintain the right degree of workability during the high temperatures encountered on site and to increase the durability of the concrete used for the spillway, particularly with regards to erosion and cavitation phenomena. This mix was designed in the Mapei R&D labs to ensure it would meet challenging technical requirements (resistance to abrasion, low consistency, excellent control of setting times);
- DYNAMON SR3 and MAPEFLUID N280 were used for all the side buildings of the dam (power house, diversion tunnels) which were made using conventional vibrated concrete (CVC).



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GILGEL GIBE III DAM

1.5 billion US dollars cost of the dam

250 m height

630 m length of the crest

6.2 million m³ concrete used

1,870 MW installed power (equivalent of 2 nuclear power stations)

Waterproofing solutions

The client also asked for a waterproofing system to be supplied for the facing band at the foot of the dam wall to prevent the build-up of uplift pressures.

The product chosen was PURTOP 1000, a pure polyurea membrane spray-applied on site. The product was subjected to tests to withstand hydraulic pressure of up to 25 bar, pressure-resistance tests, and puncture-resistance tests to guarantee impermeability in extreme conditions. Adhesion tests were also carried out at different curing stages of the substrate and after thermal cycles to make sure the membrane

would maintain a tough, firm grip to the wet roller-compacted concrete substrate. The substrate was simulated in the laboratory to reproduce similar conditions to those found on site in Ethiopia.

The priming cycle chosen for this application included BIBLOCK two-component epoxy primer and TRIBLOCK P three-component epoxy-cementitious primer.

To protect and maintain the continuity of the waterproofing system, including around the joints in the dam wall, MAPEBAND FLEX ROLL elastic TPE tape was used, which was bonded to the substrate with ADESILEX PG4 epoxy adhesive.

PURTOP 1000

Two-component, solvent-free pure polyurea membrane applied by spray to form waterproof coatings for hydraulic works, roofs and bridge decks directly on site.

FIND OUT MORE



TECHNICAL DATA
Gilgel Gibe III hydropower project, Omo River (Ethiopia)
Period of construction: 2006-2016
Period of the Mapei intervention: 2011-2015
Intervention by Mapei:

supplying admixtures for concrete and products for waterproofing joints and concrete surfaces
Owner: Ethiopian Electric Power Company
Design: Studio Pietrangeli
Main contractor: Webuild Group

Mapei coordinators: Pasquale Zaffaroni and Roberto Saccone, Mapei SpA (Italy)
MAPEI PRODUCTS
Admixtures for concrete: Mapetard CBS1, Dynamon SR3, Mapeplast SF,

Dynamon EW, Mapefluid N280
Waterproofing: Triblock P, Biblock, Purtop 1000, Mapeband Flex Roll, Adesilex PG4

For further information on products visit mapei.com