ITAIPU DAM

General Information

Ambient Conditions
Yearly average temperature 21 C
Maximum Temperature 40 C
Mimimum Temperature -4 C

Volume of materials
Concrete 12.3 million m^3
Earth moving 23.6 million m^3
Rock excavation 32.0 m^3
Embankments 31.7 million m^3

River Basin
Area 820,000 km2
Average annual precipitation 1,400 mm
Average discharge at Itaipu 9,700 m^3/s

Reservoir
Area at the maximum normal level 1,350 km^2
Volume at the maximum normal level 29 billion m^3
Length 170 km

Dam
Maximum height 196 m
Total length 7,760 m

Penstocks
Length 142 m
Penstock internal diameter 10.50 m
Nominal discharge 690 m^3/s

Power house
Length 968 m
Width 99 m
Maximum height 100m

Generating Units
Quantity 18
Capacity 700 MW
Intake 645 m^3/s

Diversion of the Paraná river was achieved by the construction of a channel 2 km long, 150 m wide, and 90 m deep on the left river bank. A diversion structure aligned with the main dam was built in the channel before the diversion of the river. Two arch dams were built to protect the channel structures from floods. The diversion structure used mass concrete and had 12 temporary diversion openings that were designed to pass a maximum flood of 30,000 m^3/s without overtopping the upstream and downstream cofferdams. Later, the diversion structure was converted into intake structure for the power house. (Photograph courtesy of Itaipu Binacional)

Once the structures of in the diversion channel were finished, the two arch dams built to protect the structures from flood were simultaneously exploded in just 3 seconds. This was an important stage for the diversion of the river (Photograph courtesy of Itaipu Binacional)

The foundation of the dam consisted of Mesozoic igneous rock consisting of basalt and basaltic breccia. Geologically eight flows were identified as important for design. A concern was the discontinuities of the layers between these flows because of their low friction angle.

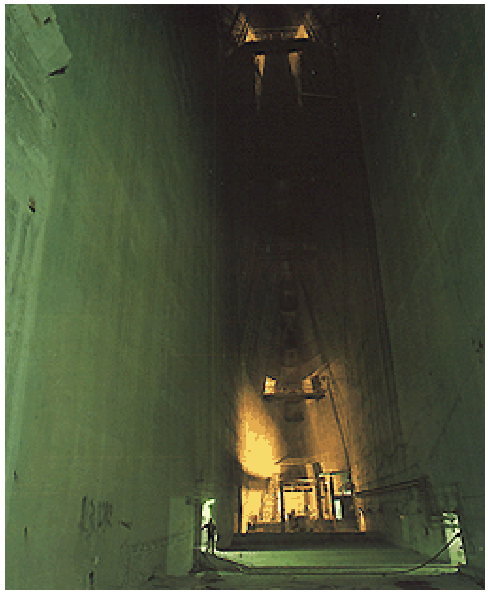
The main dam was instrumented to analyse its performance during construction and operation. The instrumentation included foundation piezometers, extensometers, stress meters, clinometer, direct and inverted pendulums, thermometers, and joint meters. (Photograph courtesy of Itaipu Binacional)

Seven aerial cables with an span of 1300 m were used for transporting concrete in 8 m^3 buckets. In November of 1979, a monthly production of 340,000 m^3 was achieved. In 1980, the yearly production was 3 million cubic meter.

Three major classes for mass concrete were used in the main dam. In the zones of high compressive stress of 6 MPa, concrete with compressive strength of 28 MPa at year was specified. In less stressed zones, concrete with compressive strength of 21 and 14 MPa at year were used. (Photograph courtesy of Itaipu Binacional)

The concrete blocks were built monoliths separated by inclined contraction joint. The joints were afterwards keyed and grouted. Concrete was placed in 2.5-m thick lifts. (Photograph courtesy of Itaipu Binacional)

The blocks of the intake dam were built with upstream and downstream slopes of 0.58 H:1.00 V and 0.46 H:1.00V, repectively. Fourteen blocks, 34 m wide, each with two butresses of varying width were built in the intake dam. (Photograph courtesy of Itaipu Binacional)



To reduce the amount of concrete in the dam, the center of the block is hollow. (Photograph courtesy of Itaipu Binacional)

The spillway, with a length of 483 m, was designed for a maximum discharge capacity of 62,220 m3/s. Fourteen gates 21m high and 20 m wide were used. (Photograph courtesy of Itaipu Binacional)