



wassara

**STRAIGHT
FORWARD
DRILLING**



WATER-POWERED DRILLING CHANGUINOLA I RCC DAM

The Wassara technology was used for drilling the foundation drainage and grouting holes and was chosen as it has delivered successful results at a number of similar dam projects around the world. The drilling at the Changuinola I dam in Panamá was finished more than three months ahead of schedule, in May 2011.

Project needs

During the construction process, delays were out of the question. Therefore when it came to the drilling of grout and drainage holes, Wassara technology was the only feasible drilling choice. This is a well-proven fact, established by the key stakeholders Golder Associates and the Changuinola Civil Works consortium.

Drilling description and plan

In brief, the project required around 400 unique holes measuring \varnothing 95 mm (3.5"), to be drilled vertically downwards (+/- 20 degrees to the vertical) and depths 20 - 75 m (66 - 246 ft.) along the 595 m (1 952 ft.) dam crest, for grout curtain and drainage. This was done from the two cross-section galleries of the concrete dam.

The mission set for Wassara technology was to drill the grout and drainage holes for the new dam without incident. In total, ~30 000 m (~100 000 ft.) was drilled. The body of the dam itself consisted of hard concrete (80% of drillings), whereas the formation beneath the dam was very soft volcanic and abrasive sedimentary rock (20% of drillings).

Grouting procedure requirements

For the construction of the grout curtain, the main requirement was to ensure the holes were drilled as straight and parallel as possible, allowing a deviation < 2%. Additionally, the grout hole wall finishing was very important. It had to be up to standard throughout the entire length of the holes for the high quality of the grout curtain.



Drilling in action in one of the galleries

Monitoring installation requirements

Also, the holes needed to be straight so that pendulum-monitoring instruments could be inserted; these instruments detect deformation behaviour due to seismic activities – if any – of the dam. The straightness was important since the pendulum cannot function properly if it comes into contact with the borehole wall.

Project results

The drilling project was considered a complete success. The borehole and grouting results were as hoped for and the costs of drilling was much lower compared to what alternative core drilling methods would have cost. In addition, the drilling phase was finalised well in advance of schedule – three months ahead to be exact. With alternative methods, such as air powered or rotary drilling, the project would have taken at least three months longer than the original proposed schedule and the labour costs would have been considerably higher.

Drilling results

Drilling resulted in a ROP of 0.5 m/min (1.64 ft./min) at the slowest rate and sometimes as fast as 0.8 m/min (2.6 ft./min). The hole wall finishing was also to customer's satisfaction, particularly as the water-pressure Lugeon tests were successful.

Project costs – Evaluation

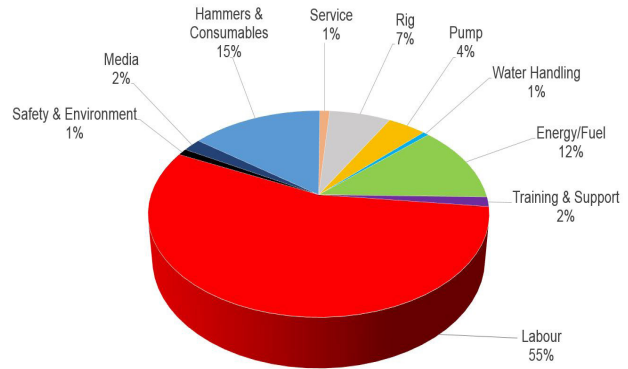
The project costs for the ~30 000 m (~100 000 ft.) drilling of grout and drainage hole activities was kEUR 822, i. e., EUR 27/m (kEUR 1.4 per hole).

Conclusions

Wassaras water-powered drilling technology has once again proved to be the optimal choice for this kind of projects. In the main, this was thanks to in-depth knowledge and extensive understanding of the technology, as well expert technical support in the planning, start-up and drilling stages of the process by the key stakeholders.

Hammer	Wassara W80
Bit	Ø 95 mm (3.75")
Pump	Uraca RS3-45-E/250 (electric)
Drilling fluid	Clean Water from river
Drill rods	Wassara, 1 000 - 2 000 mm, OD 76 mm
Borehole length	20 - 75 m(66 - 246 ft.)
Scope of drilling	~30 000 m (~100 000 ft.)
Rig	Comacchio MC 600
Formation	80% hard concrete and 20% volcanic and sedimentary rock, abrasive basalt

Or, as project's Supervising consultant rock reinforcement, Technology Dr. Lars Hässler, at Golder Associates, states it: "The water-powered technology from Wassara was chosen for the Changuinola I Hydroelectric Project in Bocas del Toro, Panamá, since it was evaluated to be the most feasible drilling method to solve the drilling within the given time and quality frames"



The distribution of main cost categories with Wassara (%)
Total cost: kEUR 822

