

Goronyo Dam Spillway

Physical Modelling

ATKINS GLOBAL, NIGERIA



The Nigerian Government Department for Dams and Reservoir Operations is currently engaged in a programme of construction and rehabilitation of 33 dam projects and 27 small earth dams including work on the Goronyo Dam, the emergency spillway of which was breached as a result of flooding in 2010.

BHR Group was appointed by Atkins Global to verify the performance of the Goronyo Dam spillway and to provide valuable information on the capacity of the spillway under extreme flood conditions to ensure that flows are contained.

The Goronyo Dam is a 21m high, 12.5km long structure that holds back the Rima River in the north of Nigeria. It has a storage capacity of 976 million cubic meters and is an important measure for the control of flooding and the controlled release of water for irrigation in the dry season.

“Working with the BHR Team has given us confidence in the design. The accurate modelling undertaken enabled the testing of scenarios that would have been difficult to replicate in the live environment”

Ian Mathieson

**CHIEF WATER RESOURCES CONSULTANT
ATKINS ENVIRONMENT & WATER MANAGEMENT**

With climatic events likely to increase in severity throughout the coming decades, a program to reduce the risk of failures has been undertaken by the Nigerian Federal Ministry of Water Resources. Its appointed design and technical contractors for the programme include Atkins Global based in England.



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A model of the Goronyo Dam overflow was built and tested in the BHR Group laboratory to accurately represent conditions in the real spillway. Physical modelling allowed engineers and designers to quickly and accurately prove that the existing design performs adequately under all flow scenarios. In particular, the test programme was designed to:

- Obtain the free discharge curve for the ogee weir.
- Assess the impact on discharge of drowning of the ogee weir crest.
- Evaluate the impact on discharge of fully closing one spillway.
- Review stilling basin performance.

“It’s been great working with the Atkins team and their clients on this high profile project for the Nigerian Government. Making a real difference at an international level is always very rewarding for the BHR engineers”

Sarah Fairhurst
OPERATIONS MANAGER,
WATER & WASTEWATER

BHR modelled the Goronyo Dam overflow with the following critical features:

GATED SPILLWAYS WITH OGEE WEIRS

The gated spillways enable controlled release of water from the dam under flood flow conditions. Ogee crested weirs are commonly used in spillways as they give a high discharge efficiency.

ENERGY DISSIPATING STILLING BASIN

The energy dissipators in the stilling basin are critical for reducing the kinetic energy at the base of the spillway, so that flow into the downstream river is at a reduced rate and the downstream bed and banks are protected from erosion.

The model was constructed to a geometric scale of 1:35 and operated at flow rates to maintain equality of Froude Number. Key features of the model included:

- Two gated spillways with ogee weirs.
- Stilling basin with energy dissipation blocks.
- Wide river channel downstream of the stilling basin.

A full set of tests were conducted under steady state conditions operating at the design flowrates and downstream water levels specified by the client. The tests looked at the flow characteristics of the dam with either of the single spillways in operation or with both spillways open concurrently. These tests showed that the reservoir level was almost identical irrespective of which single spillway was in operation.

The reservoir level was also identical for free discharge and raised tailwater level with both spillways in operation. These results were sufficient to give the client confidence that the design of the spillway can cope with maximum flowrate conditions and rising river levels downstream of the structure, without failure.