



Case study No.1: Malaysian Dam Spillway

Physical model study for the determination of the flow patterns downstream of the spillway

The Dam

The dam will be a 62m high concrete gravity dam approximately 240m wide across, located in Malaysia. The dam will increase reliable raw water supply to the Water Treatment Plant that supplies Kuching City. Model testing was required to determine the flow patterns downstream of the spillway and to suggest improvements.

The Work Programme

The model was to investigate the effectiveness of the draft design in effective energy dissipation and containment of the hydraulic jump on the spillway under various flow and tail water conditions. Design improvements were also needed to the stilling basin and modelling was to determine elevations for chute blocks and baffle piers.

A 1:35 scale physical model was constructed and tests were undertaken at different flow rates to assess the hydraulic conditions within the spillway arrangement. Flows representative of various return periods of up to 1 in 1000 years were used (150 to 1950 m³/s).

During the initial tests, a detachment of the flow from the initial steps was observed downstream of the bridge for the five spillway openings. High velocities were measured on one side of the riverbank due to the non-symmetrical design of the spillway. At the higher flow rates, a significant proportion of the flow was overtopping the sidewalls.

Modifications to the physical model were made in three stages; flow detachment was reduced through a series of tests with various block arrangements on the spillway steps; blocks were added to the stilling basin for the containment of the hydraulic jump; the southernmost spillway opening was closed to observe the effects on the upstream levels and amount of water on the sidewalls. Finally, lips were added to the sidewalls to deflect the flow back onto the spillway.



The Result

As a result of the physical model testing, specific recommendations were made to optimise the initial outline design to improve the energy dissipation of the spillway and to ensure that the hydraulic jump was contained on the stilling basin at the design flow rate.



Case Study No.2: Treig Dam

Mobile Bed Study for Halcrow Water

The Dam

Treig Dam is a rockfill embankment dam approximately 12m in height. The spillway is located on the embankment with the spillway crest formed by the top of the core wall. The flow passes down the spillway over concrete slabs cast directly on the rockfill, which forms the sloping downstream face. The width of the spillway decreases from 100m at the crest to 45m at the roller bucket along the toe. Side training walls and baffle walls are used to guide the flow down the spillway.



The Concerns

- Original design flood peak outflow 215m³/s but recent estimates indicated PMF 624m³/s
- Flood Stability Assessment Report raised concerns that high flood flows could cause excessive erosion at the toe of the spillway resulting in:
 - failure of protective sheet pile wall beneath the toe of the dam
 - loss of embankment fill from beneath the concrete slabs
 - endangering the structural integrity of the dam

The Work Programme

The model testing was required to assess the performance of the spillway under the revised potential flood flows to ensure that the spillway was capable of safely passing the PMF and to investigate the problem of erosion immediately downstream of the toe.

A 1:30 scale model of the dam was constructed to assess the performance of the spillway at a range of discharges up to the equivalent to the 1 in 10,000 year peak flood and the Probable Maximum Flood (PMF). The installation of a mobile bed section enabled the extent and magnitude of the erosion of the downstream terrain to be investigated.

A rockfill apron positioned immediately downstream of the roller bucket was found to prevent severe erosion of the bed material local to the spillway at discharges up to the PMF. This ensured that a sheet-piling wall previously installed along the toe of the spillway would be protected. Structural modifications were recommended to contain the flow within the confines of the spillway.

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