Sg. Kinta Dam – The First Dam In Malaysia To Use Roller Compacted Concrete Technology

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The Sg. Kinta Dam located approximately 12 km north east of Ipoh which form part of the Greater Ipoh Water Supply Scheme Phase 2 is expected to be completed in March 2006. The dam at a height of 85m will be the first Roller Compacted Concrete (RCC) dam constructed in Malaysia. The dam will create an impounding reservoir of 29.9 million m^3 to supply 227mld of raw water to a new treatment plant and 85 mld to the existing Ulu Kinta treatment plant. The construction cost of the dam is about RM160 million.

RCC technology was adopted for the construction of the dam. High speed construction and a no-slump consistency that allows the concrete mixture to be compacted by large vibratory rollers is an unique feature of RCC technology. Fly ash is introduced as cement replacement in order to save material cost, to reduce the heat of hydration and to increase the workability as well as the long-term strength development.

Design Features of the Sg. Kinta RCC Dam

The dam is a straight axis gravity structure about 760m long with a vertical upstream face and a uniform downstream face sloping at 0.75h:1.0v from the crest. It contains about 0.97 million m^3 of RCC. The spillway with an uncontrolled ogee crest and stepped chute is incorporated on the dam structure close to its central axis and terminates at a roller bucket.

Figure 1 shows a typical section of the RCC Dam designed. The dam includes three near horizontal drainage galleries set within the RCC dam body.

The dam structure is divided into 39 monoliths by full length transverse contraction joints spaced typically at 20m centres. A 500mm wide coffer waterstop and 500 wide Hypalon waterstop provide the seal for the transverse joints between adjacent monoliths. A 100mm diameter formed drain is positioned downstream of the first waterstop and connects to the drainage gallery system.

Sg. Kinta Dam under construction. View towards the left abutment.

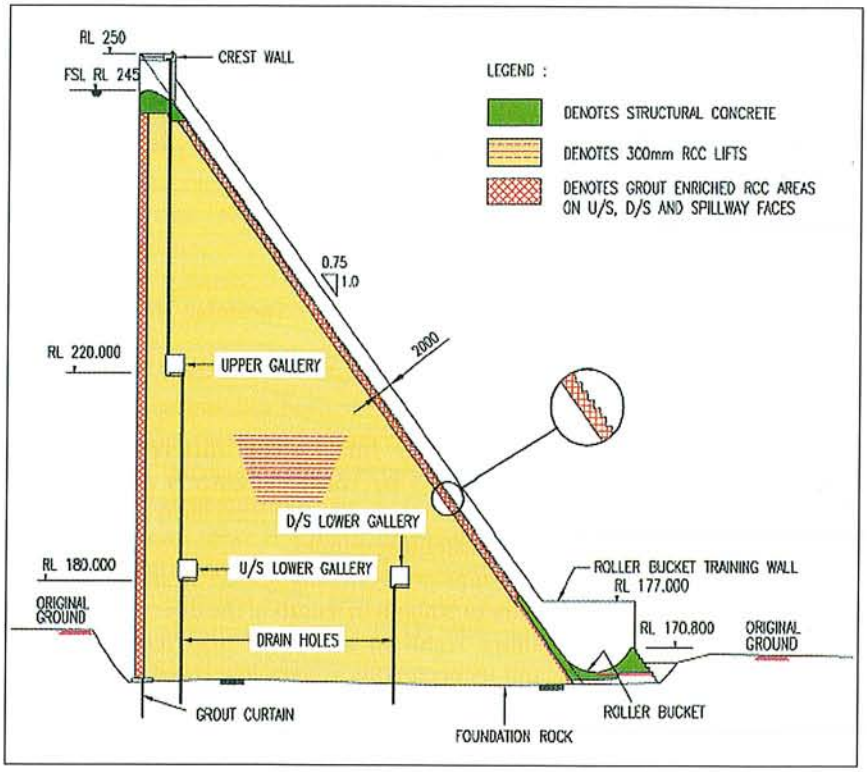

Figure 1 : Typical Cross Section of Sg. Kinta Dam

The RCC used a fully crushed granite aggregates with a maximum size of 62mm and with about 8% finer than 75 micron. All aggregate are sourced from a quarry developed upstream of the dam. The mix contains 100kg of a portland cement and 100kg of fly ash per cubic metre of RCC.

Grout Enriched RCC (GERCC) are used for the full upstream and downstream faces, including the 100m wide stepped spillway, the abutment contact and the transverse joint waterstop encasement. The ogee crest, spillway side walls, roller bucket, diversion conduit/outlet works and foundation leveling/ dental concreting works are constructed with conventional concrete.

Advantages of RCC Dam Option

The RCC dam with a crest level at RL250 provides the most cost effective dam construction option.

The RCC option has eliminated the need for:-

- Separate chute spillway. The spillway is incorporated over the crest of the RCC dam.
- A diversion tunnel. Flood water during construction was passed through a conduit built into the RCC dam. Extreme floods could be passed over the partly constructed dam without incurring significant delays or damages.
- Separate intake tower and access bridge. This is incorporated into the upstream face of the dam.

By providing a wider spillway crest length, a lower flood rise is achieved and the height of dam is reduced.

The foot print of the 85m high RCC dam is only about 70m wide and the volume of dam for RCC is relatively small compared with other dam types. With a much smaller construction material required for RCC dam, the size of quarry and quantity of material for disposal is much reduced. The environmental impact associated with the earthworks and quarry operation is significantly reduced.

The other advantages of RCC dam include the following:-

- Lower construction risk associated with damage due to over topping by floods.
- Better durability of the concrete gravity structure and hence lower maintenance cost.
- Lower operation risk as the concrete structure is not erodible in the event that it is overtopped by flood.
- Less dependent on weather conditions compared with filled embankment dams for construction.

The Sg. Kinta dam consumed about 100,000 tons of fly ash which is a scheduled waste from a coal fired power plant at Manjong, Perak. The utilization of fly ash in the Sg. Kinta RCC dam construction has lessen the environmental problem related to disposal of the waste product from the power plant.

The viability of RCC technology for dam construction compared with other type of dam designs is dependent on a number of key factors as follow:-

- Foundation condition of dam and the depth of stripping required to achieve a moderately to fresh rock condition.
- Availability of suitable rock for concrete aggregates and cost of quarry development.
- Cost of transportation of fly ash, cement and other construction materials to the damsite.
- Expertise available for RCC dam construction from local construction companies.

The experience from the Sg. Kinta Dam Project shows that local contractors experience in dam construction can readily master the skill required for RCC construction. The construction workers overall took about three months to pick-up the skill required for RCC construction and quality control.

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