RCC Placing Procedure and Slope Layer Method

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1. INTRODUCTION

The Sg. Kinta Dam is the first concrete dam constructed in Malaysia using RCC (Roller Compacted Concrete). For RCC construction the stiff concrete is laid in lifts of about 300mm and compacted by vibrating rollers. The treatment of the lift joints is determined by the time lapsed between subsequent lift of RCC and the setting time of the RCC or the lift joint maturity index. The Slope Layer Method is adopted for the construction of the Sg. Kinta Dam as this method of placement permits the rapid building up of the RCC lifts reducing the time interval between placements of subsequent lifts. This article briefly describes the RCC construction for the Sg. Kinta Dam Project and reviews the advantages and disadvantages of the Slope Layer Method for RCC construction.

2. RCC PLACING PROCEDURE

(1) RCC Mix and Production

The Sg. Kinta Dam RCC mix comprises of granite aggregates, quarry and natural sand fines, cementitious content of 200kg with 50% of cement replaced by flyash and approximately 150kg of water. The aggregates are produced by a 350t/hr dry crushing plant, with a vertical shaft impact crusher to produce the high percentage of 75 microns aggregate fines required in the RCC mix design. The mixing plant used is a continuous mixer plant of 400m^3/h capacity[1].

(2) Transportation System, GE-RCC and Roller Compaction

The width of construction access road is 6 to 8m, with a maximum gradient of 15%. RCC is transported by 30t articulated dump truck and dump on the placement area and spread by bulldozer to a thickness of 300mm. The RCC lift is spread using bulldozer with laser level sensor attached to the blade to ensure the correct lift thickness, level and grade is achieved. While the RCC lift is being spread, to reduce evaporation the fresh RCC surfaces are kept moist by water applied by a very fine mist like spray. The process of transporting, spreading and compaction of the layer of RCC is completed within 45 minutes after the RCC is mixed.

The RCC adjacent to the upstream and downstream forms are modified using the GE-RCC method[2], to enable the concrete to be consolidated by internal concrete vibrators. The RCC layer is compacted initially by a pass of the roller in non-vibratory mode, followed by 6 passes with vibration mode.

(3) Join Cutting and Other Works

The transverse joints are formed by inserting galvanized sheet as joint inducers, which are inserted using a blade as a guide fixed to a pneumatic hammer mounted on a hydraulic excavator. The taper edge of the slope layer is terminated by rolling over the edge of the lift. The end edge of the compacted RCC layer is called the feather edge; this edge is cut back to a 100mm thickness before a fresh layer is laid above the compacted RCC.

The upstream formwork of 3m height is erected using the lightweight form with truss system. The dam stepped downstream face is formed using precast concrete blocks. The RCC adjacent to the downstream face is grout enriched and the top surface is leveled manually to facilitate arrangement of the precast concrete blocks used for downstream face.

3. SLOPE LAYER METHOD

The Horizontal Layer Method is generally adopted for RCC construction. In this method RCC is laid continuously in horizontal layers of 300mm thickness and rolled. Whereas the Slope Layer Method involves the continuous placement and compacting of RCC in inclined layers of 300mm thickness to a 3m high lift. With a Slope Layer Method the overall

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surface of the placement area is reduced. The height of a lift is determined by the upstream formwork. The image and photographs of Slope Layer Method are shown in Fig- 1 and Fig- 2. The method was conceived in China 1996-99[3].

The slope layer method adopts enabled RCC placing to be executed continuously and subsequent lifts to be placed within the RCC initial setting time allowing the omission of bedding mortar for the lift joints. The criterion for the treatment of the lift joint is shown in Table- 1. The lift joint maturity index (*LJMI*) is defined by the formula below;

$$LJMI = \Sigma \text{ (average hourly temperature in } ℃ + 10) \quad (1)$$

The setting time is dependent on the quantity of retarder used in the RCC mix. Generally the mix setting time is retarded to about 5 hours by additives.

The gradient (1:*L*) is calculated by the RCC placing speed, setting time of RCC and the width of dam which is the length between upstream and downstream as shown in the equation below;

$$L = \left(\frac{Q \times (t - a)}{B \times 0.3} \right) \Big/ 3.0 \quad (2)$$

Where, *Q*: RCC placing speed (m^3/hr), *t*: initial setting time of RCC (hr), α : time to spare (hr), *B*: with of dam (m)

The advantages of the Slope Layer Method are;

1) Enhance the probability of achieving an impermeable and safe structure because of the less lift joints.
2) Savings in construction cost due to reduction in RCC surfaces to be cleaned, bedding mortar between lift joints and surfaces requiring curing.
3) Efficiency in the laying works as green cut and cleaning works can be executed in advance.
4) Sliding formworks is not critical in the schedule. The quantity of formworks required for a project may be reduced as the formwork is easy to be recycled.

Disadvantages are;

1) Difficulty in arrangement of formwork for construction of the downstream face.
2) The need for care to ensure that the feather edge is not disturbed by cutting and removal work.
3) Requires good survey control to ensure that layers are spread to the required thickness and gradients.

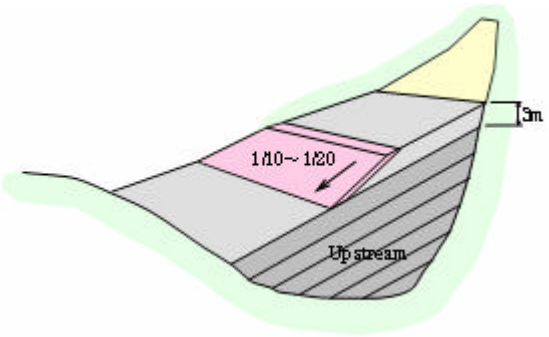

Fig- 1 Image of the Slope Layer Method

Fig- 2 Spreading and compacting RCC by SLM

Table -1 Lift joint treatment

Condition	Treatment
Each subsequent lift is placed prior to the initial set occurring in the previous lift. （less than about 5 hours）	No treatment
Initial set has occurred but *LJMI* is less than 1200. （about 5 ～30 hours）	Bedding mortar
LJMI is greater than 1200. （more than about 30hours）	Green cut and bedding mortar

【 References 】

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