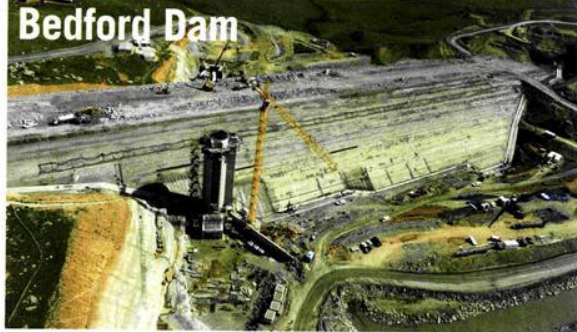


WINNER Projects with a value greater than R250 million



Bedford Dam is a 49m-high concrete-faced rockfill dam (CFRD) with an 810 m crest length, and forms the upper reservoir of the Ingula Pumped Storage Scheme (IPSS).

THE DESIGN of the dam was divided into three phases. Phase 1 was the basic design, in which detailed geotechnical investigations were conducted, a dam type selection study was performed and the dam layout was optimised and finalised. Phase 2 comprised the tender and construction designs, and phase 3, construction supervision. The Braamhoek Consultants Joint Venture (BCJV) was successful in its bid for phase 1 and a contract was signed in May 2004. The BCJV was later also awarded the remaining phases 2 and 3 of the project.

The construction of the CFRD was

undertaken using state-of-the art techniques developed worldwide for this type of dam.

A fairly new and innovative kerb system was used. This entailed placing a kerb using a modified road kerb machine. Once the kerb concrete had achieved initial set, filter/transition material layers were placed behind it and these were compacted with a smooth-drum vibrating roller. The kerb concrete also provided a much stronger surface to erect face slab formwork and reinforcement mats than the mortar skin method used previously.

The concrete face slab was slip formed. As the face slab acts as a relatively thin concrete

membrane (only 300 mm thick), it is essential that good-quality concrete is produced. Other factors that were taken into account when the face concrete mix was designed included the sub-zero ambient temperatures experienced in winter, strong winds of up to 120 km/h that could easily result in concrete drying shrinkage cracks and harsh crushed concrete sand.

Workability of the concrete is of the utmost importance as concrete that is too dry will block the discharge chutes down the face and concrete that is too wet will result in sagging behind the slip form screed and potentially weak concrete.

Concrete that is too wet will also result in a wavy surface finish and potential large financial losses by the contractor as they compensate on the theoretical design quantity. An extensive programme was therefore followed to optimise the mix design.

Optimisation measures included the following (per cubic metre of concrete):

- Water was reduced from 160 to 137 ℓ, resulting in the w/c ratio dropping from 0.5 to 0.43.
- The total cementitious content was 320 kg, with 70% cement and 30% fly ash.
- 38 mm aggregate was reduced from 615 to 550 kg.
- 19 mm aggregate was increased from 615 to 734 kg.
- The sand portion was reduced from 925 to 807 kg.
- A super plasticiser was introduced and the quantity added was increased from 1.1 to 3.5 ℓ/m³.
- The air entrainer was decreased from 1.6 to 0.35 ℓ.

Of particular importance is the addition of an air entraining agent. Entrained air, unlike entrapped air, is not removed from concrete by vibration.

In fresh concrete, entrained air reduces internal friction and increases the workability of the mix. This increased workability allows for a reduction in water content for a given slump.

The project was exceptionally well planned and executed. Close co-operation between client, consultant and contractor, combined with the high expertise and professional attitude of the contractor, resulted in Bedford Dam basically being completed on time and well within budget. **35**



Representatives of the Braamhoek Consultants Joint Venture (GIBB, SSI Engineers and Environmental Consultants and Knight Piesold) receive their award from CESA president, Zulch Lötter

