Precast Bunkers and Overland Conveyor Foundations at Shondoni Colliery

Surge bunkers of 15 000 t and 4 000 t storage capacity are serving as buffers in the coal transportation line from the mine to the Sasol Secunda process plant. Both bunkers have the same type of structure, though the 4 000 t bunker is shorter.

The 15 000 t bunker is a horizontal containment structure with 10 (3 for the 4000 t) discharge chutes at 7.5 m centres, 76 m length by 19.5 m width and 28 m height, on four rows of columns, with a discharge deck at 11.2 m elevation, supporting the chutes discharging into a reclaim conveyor at ground level.

A structural steel grid of beams on top of the bunker supports the feeding tripper conveyor and is tying the columns across.

Longitudinal side walls, are sloped at 50° from top of the deck up to the external columns. There is a loading slide chute 10m wide in the mine side end wall, while the far end wall is totally flat. Pre-stressed diaphragm walls 4.2 m high, are provided at each cross frame to contribute to full discharge and structural strength.

An emergency stockpile of 15 000 tons capacity is added beyond the bunker, by increasing the tripper conveyor run on an elevated steel gantry over a reclaim conveyor tunnel. Folded retaining wing walls, 24 m high, contain the stockpile around the bunker.

The modular highly repetitive geometry of the structure allowed for efficient use of large precast elements in combination with cast in-situ construction in an innovative integrated "composite" structural concept, based mainly on constructability and cost criteria. In-situ

TEAM

Location: Sasol, Mpumalanga
Categories Entered: Civil Engineering Structure over R100 million, Innovation in Concrete
Submitted by: Lyonell Fliss & Associates (LFA)
Client: Sasol Mining Coal Division
Principal Agent: Logiman and Lyonell Fliss & Associates – JV Consultants
Main Contractor: Stefanutti Stocks Civils
Sub-Contractor 1: AfriSam SA (Pty) Ltd
Sub-Contractor 2: Preform (Pty) Ltd
Sub-Contractor 3: High Safety Training Academy (Pty) Ltd

Judges' Citation

The coal bunkers at Shondoni are an excellent example of "hybrid" or "composite" reinforced concrete structures as the benefits of precast are combined with in-situ concrete. The design used resulted in significantly less scaffolding at working at height during construction. Animated 3D models and 3D printing were used to ensure accuracy of every connection between precast and precast and between precast and in-situ.

The number of precast elements was reduced in the design to reduce the number of costly moulds and the design of an innovative precast sleeper foundation for the conveyor resulted in increased efficiencies in the precast yard. The quality of both the precast and in-situ concrete were of a very high standard and these massive structures are worthy of a judges commendation.

construction was used for heavier than 20 tons or non-modular elements, such as foundations, columns, and end and diaphragm walls.

Precast construction was used for repetitive, modular elements lighter than 20 tons, such as horizontal and inclined beams and slabs, modular walls and permanent formwork. Connections of precast to cast in-situ or precast to precast, were cast in-situ. Pre-stressing was used to tie across the two lateral sides of the bunker through the diaphragm walls.

An original precast erection technique was developed, using the in-situ columns to support on top steel gantries for a remote controlled overhead crane, resulting in cost and time savings, safety and accuracy.

An innovative concept was developed for the 22 km overland conveyor which has over 7 000 modular, highly repetitive foundations.

It consists of using lightweight, precast sleepers and minipiles, which were connected together in composite frames. These use the ground shear resistance for stability as opposed to conventional gravity sleepers which gain stability through their mass of concrete.

This new concept resulted in substantial cost savings, speed of erection and increased stability (load tested on full scale prototypes), compared with conventional cast in-situ practice. ▲

commendation

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High strength concrete was used to ensure mould turnaround and high abrasion resistance. The precast and in-situ elements are structurally integrated though monolithic in-situ connections and prestressing.

An additional innovation was the design of the precast-sleeper-on-minipiles foundation for the 7000 conveyor frame supports. The precast sleepers added to the efficiency of the precast yard.

The innovation in both design and construction of the massive bunkers and the conveyor supports earn a commendation from the judges.

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