Precast Concrete in Remote Locations

by S. H. Rizkalla and R. D. Keeler

The potential and capabilities of precast concrete were fully tested in building a large concentrate loading facility in northern Manitoba, Canada, where conditions are far from ideal and construction material not readily available. The efficiency and quality control achieved by plant-produced items and assembly on-site were the main reasons that erection was successfully completed in 60 hours.

The structure was designed to provide a facility for concentrates for Sherritt Gordon Mines, Ltd., with a storage capacity of approximately 90,000 ft³ covering an approximate area of 6,000 ft². The main elements of the structure were precast footings, precast retaining walls, and precast, prestressed channel-shaped girders, as shown in Fig. 1.

End-blockings of Dywidag high-tensile strength deformed reinforcing bars were embedded in the footing and protruded for coupling and extension into the retaining wall to provide structural continuity as shown in Fig. 2. Two types of retaining walls were used in the structure.

Main walls were designed to support the floor deck and the side wall to resist backfill. Due to limitations imposed by shipping and erecting procedures, all walls were divided horizontally into two panels of approximately equal weight. The main retaining walls were crowned at the top, as shown in Fig. 3, to provide sufficient bearing area to support the channel-shaped girders of the floor deck. The Dywidag bars were oriented in staggered locations to resist the possible reversed applied moment.

At the bottom of each panel, pockets were provided to facilitate placement of the couplers used to extend the Dywidag bars through the wall (Fig. 2). The holes in the main wall were formed using steel pipes which were removed the second day after casting. These holes were designed to match another set of holes in the channel girders, through which continuity would be provided by steel bars, Fig. 4.

Precast channel-shaped girders were used for the deck. The outside edge girders were provided with steel grids to facilitate cleaning of the floor deck during unloading operations.
Cross-diaphragms were provided at the midspan and both ends of each girder for lateral post-tensioning of the girders. Apart from the floor deck, a separate line of girders was provided to support a cat-walk and provide horizontal restraint for the retaining wall.

**Construction sequence**

The soil was compacted, levelled with a ½ in. sand base before placement of the foundations. The main retaining walls were erected by placing the lower panel as shown in Fig. 5. Each panel was supported temporarily by steel braces.

A Dywidag bar was threaded into the holes at each extreme end of each lower panel and coupled with the bars which protruded from the foundation at the same locations. These bars were extended upwards to a sufficient height to tie into the upper panels of each retaining wall. (Fig. 6.) Shims were used between the lower and upper panels to facilitate levelling of the panels and to provide space for dry-packing.

Following the dry packing, all Dywidag bars were coupled with the matching protrusions from the footing and then post-tensioned from the top to the specified forces, using hydraulic jacks. Erection of the side retaining walls followed the same procedure. The connections between the two sets of walls were designed to accommodate temperature changes and lateral movements.

After completion of the construction of the retaining walls, the floor girders were positioned and the holes at each end of each girder were matched with the holes provided in the retaining wall crown. (Fig. 7.)

Reinforcing bars were provided to achieve continuity between the girders and the retaining walls and the holes were grouted. The girders were post-tensioned laterally at each end and midspan. Part of the completed structure is shown in Fig. 8.

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**Fig. 3** — Upper panel of the main wall. (All dimensions in brackets are in mm.)

**Fig. 4** — Typical channel girder fixing.

**Fig. 5** — Lower panels of the retaining walls.

**Fig. 6** — Erection of the top panels.

**Fig. 7** — Placement of the floor girders.

**Fig. 8** — Loading facilities after construction.

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