The Construction of the Port Arthur Dry Dock.

Canadian Railway and Marine World for March contained a description by A. V. Powell, M. Am. Soc. C.E., of the dry dock which has been built at Port Arthur, Ont. Following are particulars as to the construction methods, plant, etc.

The dock is constructed of concrete and steel and rests upon a foundation of solid rock. A large amount of excavation was necessary, 90,000 cubic yards of earth and rock being removed. A 70-ton Marion shovel, with a 2½ yd. dipper fitted with Panama teeth was used. Digging began at the shore end in April, 1910, and trains and dump cars hauled by locomotives transported the excavated material to form an earth fill on either side, making new ground beyond the original shore line. To cut off

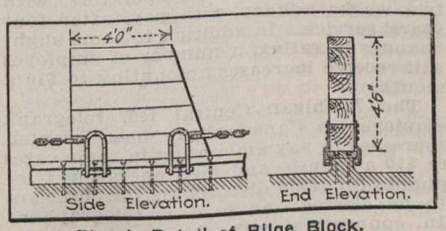

Fig. 1. Detail of Bilge Block.

the water during construction a cofferdam 900 ft. long was built in the shape of a horseshoe surrounding the site on three sides, as shown in fig. 2.

Two pile drivers, working in opposite directions from the portal end, drove round piles in two parallel rows, 900 ft. long, forming an enclosure around the entrance end 300 ft. wide. These piles, spaced 3 ft. centres, formed an outer and inner fence for the 6 by 10 in. and 2 by 10 in. sheet piling which was afterwards driven to rock. Waling strips 8 by 12 ins. were used for the sheet piling and round pile wales were used for the outside. Steel tie rods were placed across the cofferdam every 3 ft. On top of the round piling and sheet piling a framing was constructed of 8 by 12 in. timbers on which a temporary track was laid. As fast as the sheet piling was driven, earth filling was carried out by means of trains of dump cars operated by small locomotives. The resulting cofferdam was a very stable structure. To pump out and keep dry the dock excavation, and the enclosure formed by the cofferdam, three pumps were installed. The cofferdam completed, excavation was carried to rock throughout, enough shale and igneous rock being removed to level the basin. Six Canadian Rand drills and a 5 in. well boring machine comprised the drilling outfit.

The speed with which the concrete work was done was due to the organization of the working forces and the efficient arrangement of the plant. Placing concrete was so simplified that from the dredging to the final pouring the work was continuous. The arrangement of the construction plant is shown in fig. 2. Scows of 1,000 yards capacity, fitted with derricks and clam shell buckets, dredged sand and gravel from Lake Superior, at 60 miles from the site, and unloaded it at the portal face upon the cofferdam on either side of a travelling whirley; two hoppers placed over a 24-in. conveyor belt, electrically driven, received the materials from the whirley and alternately fed the belt which led to the mixer tower. Here were two receiving hoppers for sand and gravel, and below were two charging hoppers. The latter received the proper quantities of sand, gravel and cement for separate batches of concrete, and the whole charge was run into one of the two mixers below. A new charge was immediately prepared and this in turn was run into the second mixer. In this way it was possible to have the plant working to its full capacity without intermission. The concrete, after being mixed, was elevated by a bucket hoist, to V-shaped steel dump cars, of one yard capacity, on a truck running along the top of the forms for the dock wall. From the cars the concrete was poured directly into the forms. The tracks were laid in a number of loops crossing the dock excavation on trestles, so that there was no confusion in returning empty cars to the mixers. (Fig. 2.) By this system as much as 1,000 yards of concrete was placed by two shifts in one 24-hour day.

The forms for the side walls were made in small sections, for convenience in handling. Each section was 5 ft. wide and extended the full height of the wall. Seven of these were placed together and bulkheads were attached at each end. In this way a section of the wall 36 ft. long could be poured, making a huge monolithic block. Alternate 36 ft. lengths were first built, and when the concrete had finally set the intermediate sections were poured. An expansion joint was formed for every 36 ft. of length, and so cracking was obviated.

The dock proper is 85 ft. 4 ins. wide at the floor level and 98 ft. 8 ins. at the top of the walls. It is 700 ft. long, and a further length of 28½ ft. within the portal or entrance may be utilized. Spaced every 18 ft. in the side walls are three altar steps designed to hold lateral bracing to support vessels in the dock.

The floor is solid concrete from 2 to 4 ft. thick, sloping towards a central drain which terminates in a rudder well at the portal end. From the rudder well a drain protected by an iron grating gives access to the pumping well situated in the west portal pier. With a view to future extension this drain was duplicated on the opposite side of the pumping well so that when a second dry dock is built parallel to the present basin, the pumping outfit will serve for both docks.

The portal walls are solid masses of concrete, faced with concrete of a 1-3-5 mixture, which is used also in the side walls. The outside corners are curved and are protected from injury by steel plates firmly attached by means of steel angle anchors embedded in the concrete. The portal jambs and sills are faced with steel. Angles 6 by 6 by ¾ ins., firmly fastened to the concrete floor by 3 by 3 by ½-in. angles, 4 ft. long, spaced 2 ft. apart, form a connection for the 16 by ¾ in. plate against which the heavy steel gate and caisson rests. Strong lateral anchors embedded in the portal piers hold the jambs in position. Great care was exercised in placing this steel framework to obtain a truly vertical and longitudinal alignment.

A feature of interest is the construction and arrangement of the bilge and keel blocks with their attachments. The slides upon which the bilge blocks move are spaced 12 ft. apart on each side of the dock, and are made of 3 by 14 in. white oak timbers bolted every 2 ft. Split anchor bolts, ¾ by 18 ins., fasten them securely to a concrete base and the nuts are countersunk, leaving a smooth upper surface on which the bilge blocks slide. These blocks are 4½ ft. in height, made of 12 by 12 in. Oregon fir timbers. They are drift bolted together at the ends and are furnished with slide irons and wooden slide blocks clamping them to the slides.

Two hauling chains are attached to each block by means of U bolts, and two fair leaders are attached to the dock wall, one at the lower angle and the other near the top. The keel blocks, constructed of 12 by 12 in. white oak timbers, fastened together with 1 by 20 lag screws, rest on a 12 by 14 in. white oak timber set in the concrete floor and fastened thereto with 24 in. expansion bolts. These are spaced 6 ft. apart and extend from the rudder well to within 12 ft. of the shore end of the dock.

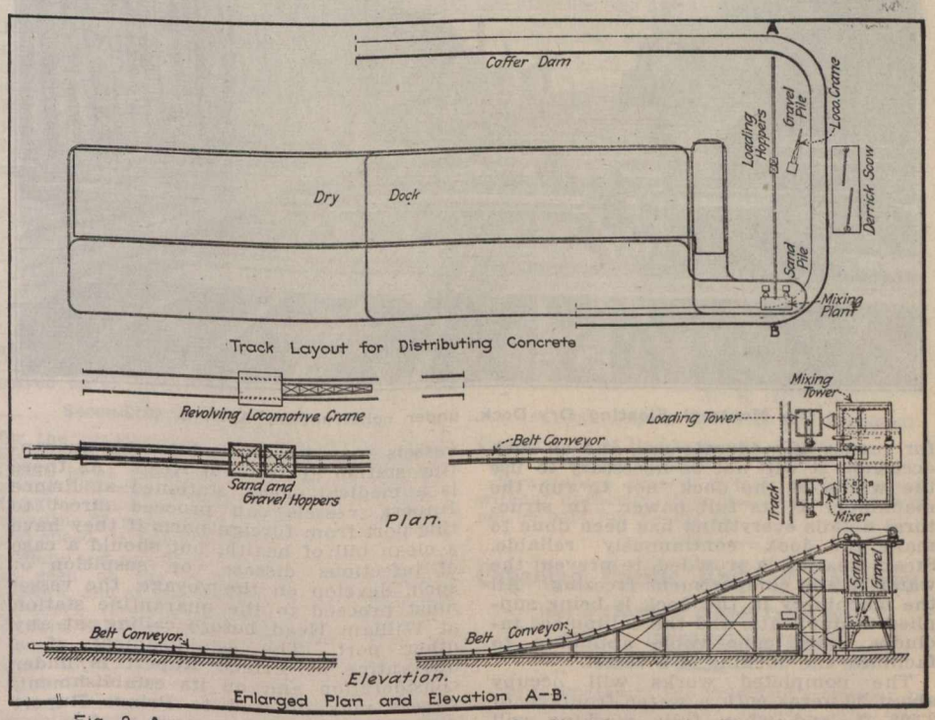

Fig. 2. Arrangement of Construction Plant for Mixing and Handling Concrete.

Concrete sidewalks 5 ft. wide run the full length at each side, and four reinforced concrete stairways lead from their ends to the top of the dock walls. The dock was begun April, 1910, and completed by the end of November of the same year. The work was carried out under the direction of W. R. Sinks, Manager, and R. H. Folwell, Engineer for the contractors, Canadian Stewart Co., Ltd.