PORT COLBORNE HARBOR WORKS.*

By J. M. Hogan, S. Can. Soc. C.E.* (Concluded.)

Concrete Blocks.

These blocks, 4-ft. by $4\frac{1}{2}$ -ft. by 7-ft., were moulded in timber forms made of 2-in. dressed pine, tongued and grooved. A piece nailed to side of mould gave required joggle to block. The moulds were tied across by two $\frac{1}{2}$ -in. round rods with nuts, threaded both ends. The lower rod passed through the partition forming end mould of block.

Sides were held in position by the shoulder formed by lapping on 3-in. by 4-in. upright. To remove moulds, nuts are slacked and uprights taken down, when the sides will remove in one piece and may be utilized again. These moulds were filled with concrete in layers and allowed to set for 48 hours before removal of moulds. After five days these blocks were sufficiently set to be removed by derrick.

In top of the block is seen a basin-like depression, while in the side a slot or joggle is moulded. When blocks are placed side by side, the mass concrete of wall filling up joggles, etc., forms



a strong joint between each block and between top of block and wall above, and prevents any lateral displacement of blocks relative to the wall which might be caused by impact of the heavy seas or vessels.

The joggle also allows of the simple method of handling the blocks, shown in Figure 4.

Much difficulty was experienced in setting these blocks level and close jointed, especially the latter. This was due to the uneven character of the bed left by the dumping in of stone filling and the difficulty of levelling same in 2-ft. and 3-ft. of water. As an aid to obtaining close joints the blocks are now made with a batter of 2-in. from face to rear of block which allows of the front face being brought closer to the neighboring block.

Moulds for concrete wall are of similar material to block moulds and similarly fastened, except the lower rod, which



rests on the block and supports outside upright which overhangs the face of wall. This rod remains in the wall. The rear upright is wedged into the joggle. Moulds were erected in sections of 60 to 75 feet, a day's work. The next day's work began at finishing point of previous day, which allowed sufficient expansion. Canvas nailed to inside face of mould and allowed

*This paper was awarded the prize offered by the publishers of the Canadian Engineer for the best student's paper read before the Canadian Society of Civil Engineers in 1904. to drape over the block, was extensively used to prevent washing out of concrete by seas before thoroughly set at the level of block.

Concrete.

Concrete was I. 2. 4. mixture. Owing to the large area covered by the works, it was impossible to set up a permanent plant anywhere. The convenient approaches to most of the work being by water, the plan of utilizing a floating plant was adopted with good results.

A large deck scow was equipped with a derrick, mixer, and crusher, and storage provided for cement and sand. The lay out was so arranged that the derrick, having a 68-ft. boom, controlled all the operations. Materials for the day's work were loaded each morning, and the scow towed to the site. The stone for crushing was obtained directly from the back filling of the cribs and hoisted to the crusher platform in tubs, where two men fed it continually to the crusher. This stone, being dredged from the bottom of the lake, was clean and excellent for concrete. The stone thus crushed runs out below into another skip or tub. When 3-in. or 4-in. have accumulated the spout door is closed and a wheelbarrow of sand from the pile close at hand is dumped in and spread, followed by two or three bags of cement. This alternate process is con-



tinued until the box is filled, when it is hoisted up and dumped into the incline bin of the mixer, and thus runs in a continuous stream through the mixer itself and into moulds below. Besides being continuous, this system is compact. Where stone was not available from filling it was brought alongside in scows and used as wanted.

The mixer used consists essentially of a sheet of iron spout having small iron rods placed perpendicular to line of flow to give a tumbling or turning over motion to the concrete. A perforated pipe, controlled by a valve sprays water over the dry mixture as it passes. A door at the bottom of spout is operated by a man, who also controls the water. The door is kept closed till the lower chamber of the spout is filled when concrete is released and door closed for another batch, or about two shovelfuls.

A large boiler on the scow provided steam for hoist, crusher and engine, and small pump, which fed water to mixer.

An average day's work consisted of 65 to 75 yards for a gang of 18 Italians, foreman and hoistman, or about 50 cents per yard for labor. Cement used (at least 40,000 barrels to date), was Rathbun "Star," made in Deseronto, Ontario, and the results obtained have been excellent.

The mixer moved on tracks, and both could be lifted off and set up on a wall within radius of boom, and the concrete process go on as before. Such a method was used in laying concrete slab covering of docks.