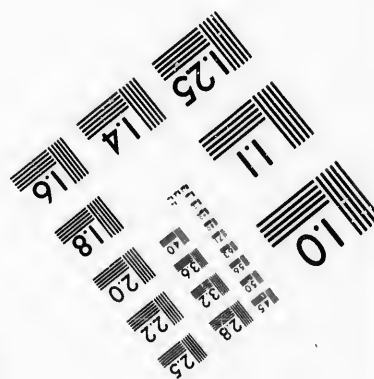
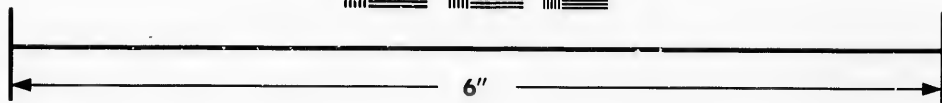
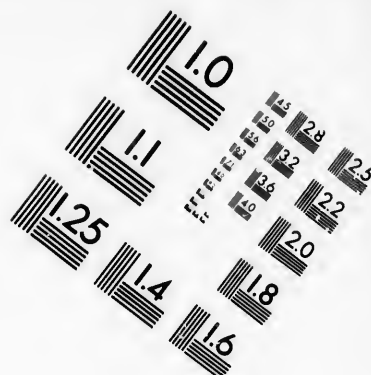




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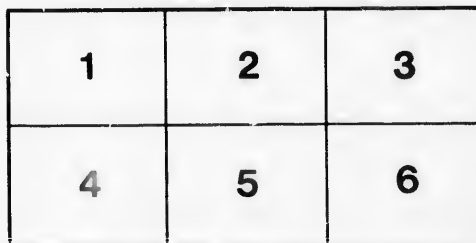
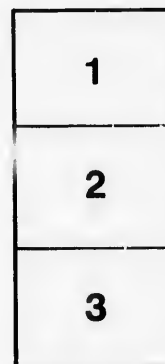
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THE COLONIAL GOVERNMENT DRY DOCK, ST. JOHN'S, NEWFOUNDLAND.

By H. C. BURCHELL, M. Can. Soc. E. C.

To be read on *Monday, March 28th or April 11th.*

The Dry Dock, which is the subject of this Paper, is situated at the Riverhead or Western end of the harbour of St. John's.

It is built of wood and concrete. The form is illustrated by accompanying drawings, and the following are the principal dimensions:—

Length upon top from inside of head to gate when at outer sill.....	600 ft.
Length upon the line of keel blocking.....	553 "
Width upon top at head.....	78 " 6 inch
" " " " body.....	132 " 6 "
" " " " abutments.....	84 " 9 "
Bottom width from inner end of abutment to angles near head.....	49 " 10 "
Bottom width at abutments.....	52 " 9 "
Depth of water over gate sill (H.W. Spring Tides)	25 "

The floor is founded on a bed of Portland cement concrete, laid on exceedingly hard cemented gravel (glacial drift) immediately overlying the bed rock. Bedded in the concrete and held down by frequent anchor straps of 2½ in. x ½ in. iron is a system of longitudinal pitch pine timbers 12 in. square. Immediately under the keel track four of these are laid close together, each anchored to the concrete and all bound together by through bolts. Two on each side of the keel track timbers are one foot apart, and the remainder of the longitudinals from this to the edge of the floor are set with three feet spaces. The anchor straps are bolted alternately to opposite sides of the timbers, and are held in the concrete by a simple right angle bend.

Cross floor timbers of pitch pine 14 in. x 16 in. and 4 ft. from centre to centre are laid on and securely fastened to the longitudinals. Their ends are boxed down to receive a stringer piece 12 in. x 14 in. which runs around the sides and head, and receives part of the thrust from the main braces.

The concrete extends beyond the floors, and is carried three feet up the sides and head behind the altars. Within the floor area it fills the spaces between cross floor timbers at their ends, and slopes thence gradually to shallow drains formed between the longitudinals, one on each side of the keel track. The entire lower system of floor timbers is completely embedded in and covered by concrete.

The working floor is of 3 in. plank, spiked to the cross timbers with ample opening left at the joints.

In order to lessen the possibility of water courses, the longitudinal

timbers are omitted in the abutment, and under the gate platform and apron; but here the concrete, instead of being as at the head $2\frac{1}{2}$ ft. average depth, is 6 ft. deep with anchor straps for the cross floor timbers extending to the bottom.

No indications of springs were observed during construction. It was thought best, however, in view of possible developments of either spring water or under leakage, to insert in the concrete 2 in. vertical iron tubes, 20 ft. apart, alternating on opposite sides of the keel track throughout the length of the dock. The lower ends, extending into the gravel below the concrete, were left open, and the upper ends, protruding above the concrete, were fitted with valves (light dead weights) opening upwards. There has been no flow from these tubes.

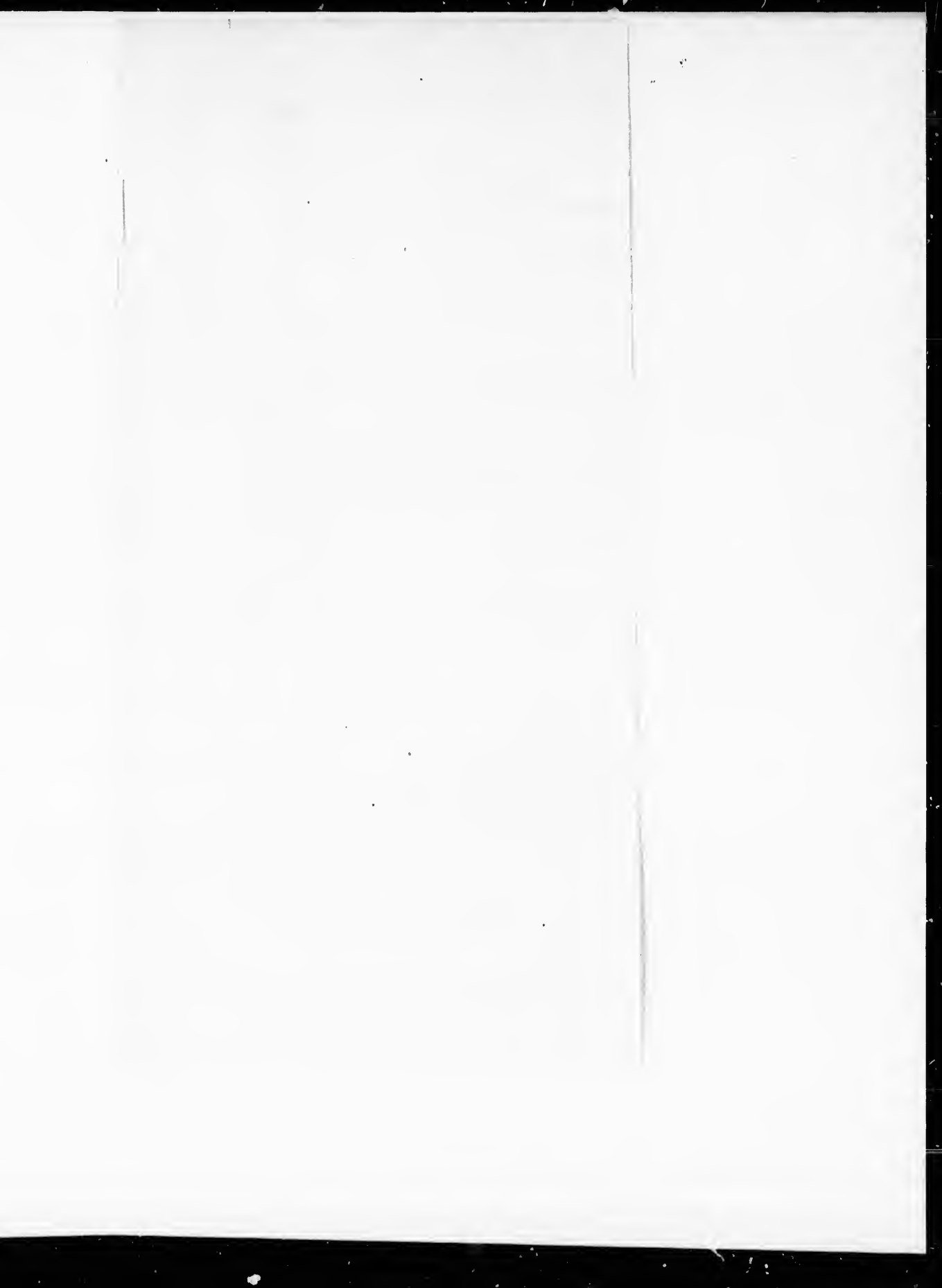
A line of sheet piling surrounds the entire structure at a distance of 26 ft. from the coping. The sides of the dock are supported by transverse frames 4 ft. apart from centre to centre, extending from the floor to the line of sheet piling, and made up as follows:—A heavy pitch pine main brace or rafter abutting at its lower end on the cross floor timber and stringer already described, and at its upper end on the coping; a cap of 12 in. square pitch pine running horizontally from coping to sheet piling; brace and cap resting on 12 in. spruce piles 5 ft. apart, all three parts of the system being bound together by a diagonal tie of pitch pine, firmly bolted to them, and acting, to use another roof term, like an ordinary collar beam.

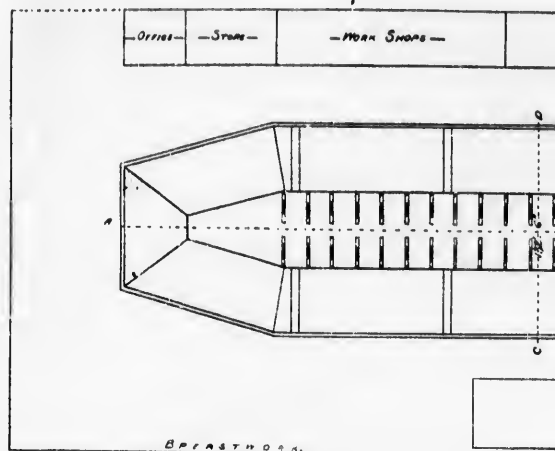
These transverse frames are connected on top by the coping, which is built up of three heavy pieces of pitch pine, and are farther stiffened laterally by the altars. The altars are of pitch pine. Two are sawn from a stick 11 in. x 14 in., by ripping obliquely, not from corner to corner, but cutting each 14 in. side 3 in. back from the corner. These are bolted with an oblique face resting on the main braces, an 11 in. side uppermost and horizontal, and a 3 in. side looking towards the coping, and covering by that much the next altar above. A series of continuous steps, ascending from floor to coping with 8 in. rise and 11 in. tread, is thus formed around the entire body and head of the dock, admitting of convenient access at any point.

The entrance works differ somewhat in detail of construction from the body. Six lines of transverse sheet piling on each side run from the floors to the main outer line before referred to, one at the end of the apron, two at each sill, and one at the inner end of the inner abutment. The concrete foundation is carried 5 feet beyond the floors, and the sides or walls are backed by concrete 5 feet thick at the bottom and 2 feet thick at coping. The cross floor timbers and main braces are covered by two thicknesses of 6 in. timber breaking joint. Each course is thoroughly caulked with dry pine wedges.

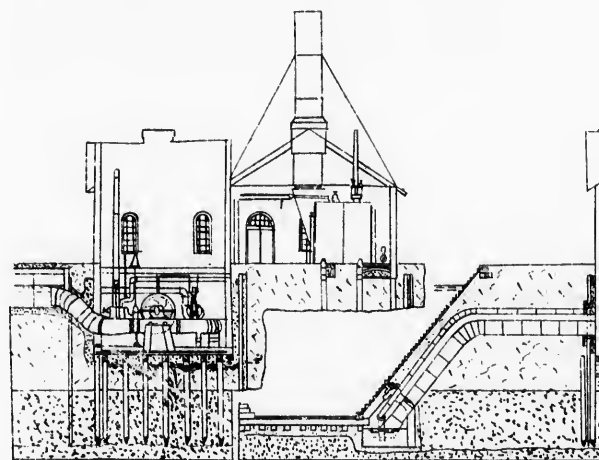
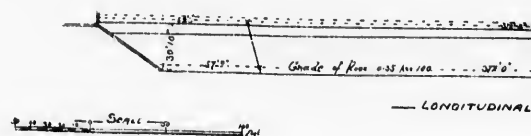
The transverse floor timbers in the inner abutment are 10 in. higher than the corresponding body floor timbers. The rise from the main floor is formed by six large oak timbers, rabbetted and bolted together, and backed up by heavy oak knees, running back over and framed into the main floor timbers.

There are two positions for the gate 20 feet apart. At each sill four heavy pieces of oak rabbetted and securely fastened together form a step or offset, that runs across the floor and up the sides, and receives the weight and thrust of the gate when in position. The top courses of 6 in. timber are rabbetted into and are flush with the sill timber. There are no grooves, and the chances of troublesome obstructions are consequently much lessened. The offsets are fitted with stout rubber gaskets, against which the gate bears and forms a water-tight joint.

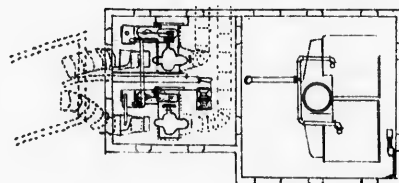




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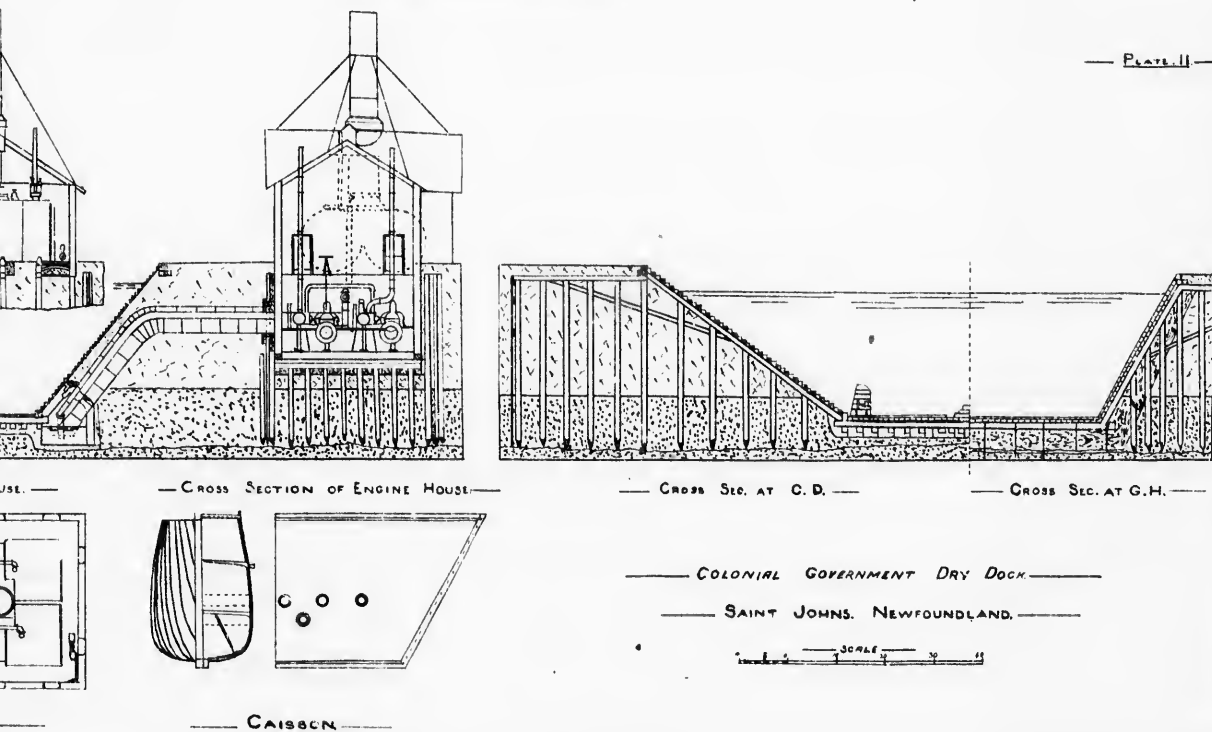
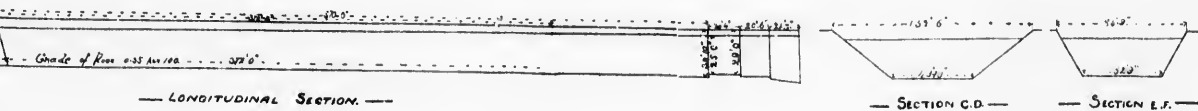
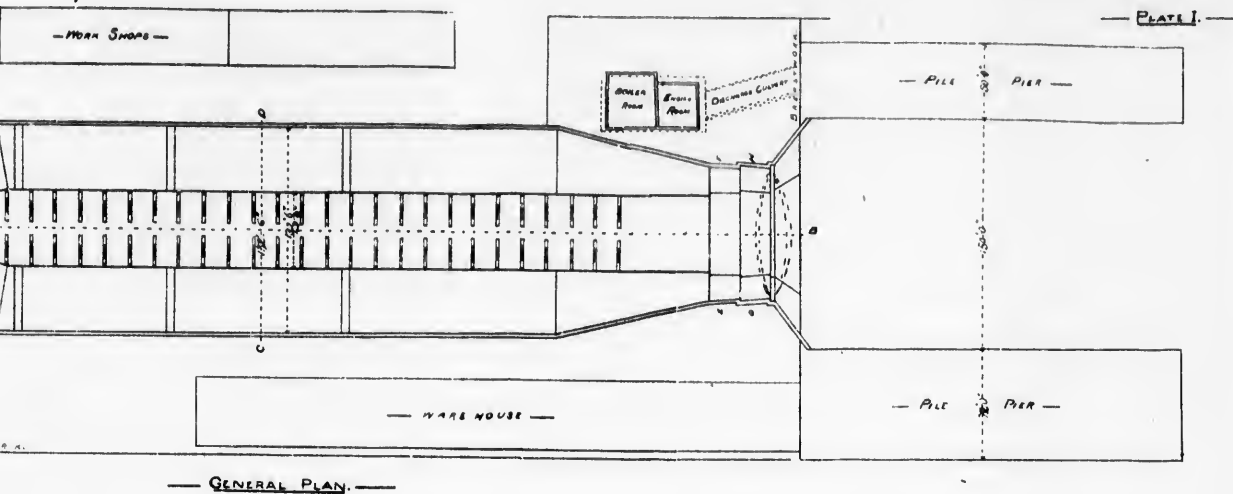


— CROSS SECTION —



House. —

— CA —



timbers are omitted in the abutment, and under the apron; but here the concrete, instead of being as average depth, is 6 ft. deep with anchor straps for beams extending to the bottom.

No indications of springs were observed during construction, but it was thought best, however, in view of possible spring water or under leakage, to insert in the iron tubes, 20 ft. apart, alternating on opposite sides throughout the length of the dock. The low side of the gravel below the concrete, were left open, and the tubes, running above the concrete, were fitted with valves opening upwards. There has been no flow of water.

A line of sheet piling surrounds the entire dock, 26 ft. from the coping. The sides of the dock are framed 4 ft. apart from centre to centre to the line of sheet piling, and made up of pine main brace or rafter abutting at its ends to the timber and stringer already described, and the coping; a cap of 12 in. square pitch pine coping to sheet piling; brace and cap run parallel apart, all three parts of the system being made of pitch pine, firmly bolted to them together, like an ordinary collar beam.

These transverse frames are connected together laterally by the altars. The altars are made from a stick 11 in. x 14 in., by rigging the corner, but cutting each 14 in. side square, and are bolted with an oblique brace on the side uppermost and horizontal, at the coping, and covering by that same stick continuous steps, ascending from the coping, 11 in. tread, is thus formed around the dock, admitting of convenient access.

The entrance works differ from those of the body. Six lines of transverse frames from the floors to the main enter the apron, two at each sill, and the sides or walls are built up of concrete 2 feet thick at coping and 2 feet thick at the bottom. The coping are covered by two thick courses of concrete, the bottom course is thoroughly caulked.

The transverse floor timbers are stronger than the corresponding floor is formed by six lines of timber and backed up by heavy timbers.

There are two posts on each side of the dock, four heavy pieces of oak rabbetted into the floor and up to the top of the gate, forming a step or offset, that runs across the floor and up to the top of the gate, the weight and thrust of the gate when in position. The top of the gate is made of 6 in. timber are rabbetted into and are flush with the sill timber. There are no grooves, and the chances of troublesome obstructions are consequently much lessened. The offsets are fitted with stout rubber gaskets, against which the gate bears and forms a water-tight joint.

The apron is constructed on a concrete foundation in similar manner to the floors of the gate platforms, the timber being covered with an extra layer or facing of concrete. The apron proper extends 21 feet beyond the outer sill with a concrete toe carried 13 feet further.

Sheet piles are of spruce fitted with dry pine tongues or keys. Bearing piles are of the same timber. All are driven to the hard gravel on which the concrete foundations of the floors rest, so that the whole structure has a perfectly uniform bearing.

The excavation of the dock basin was made after most of the piles had been driven. The material excavated was alluvium, having but a small proportion of gravel, and was found to be impervious to water; hence no more was disturbed than was necessary for the setting of main braces and ties. As the altars were put on, all existing spaces were filled with suitable material taken from the excavation, and thoroughly rammed. Very slight indications of leakage appeared at several points in the plane, dividing the more recent from the glacial drift. This was doubtless caused by the same plane having been cut in dredging a wet slip on the South side of the dock.

The area around the dock was filled with earth carted from the neighbouring hills, and was graded level with the top of the coping timber. Cross-caps and sheet-piles are thus covered by about two feet of ground.

The cofferdam was formed by driving three parallel rows of sheet piling about 5 feet apart, each row being re-inforced by round piles and braces. The intervening spaces were filled with earth.

In plan its form was three sides of a rectangle, the two parallel sides being under the piers at each side of the dock entrance, and the third connecting them just outside the toe of the apron.

The dock is fitted with sliding bilge blocks, 28 on each side, operated from the coping by endless chains.

Keel blocks are placed on each cross-floor timber. They are thus 4 ft. apart from centre to centre.

Materials are sent to the working floor by means of six slides conveniently situated, three on each side of the dock.

The gate is a floating iron caisson. It is provided with a steam capstan, a 10 in. direct acting centrifugal ballast pump, and a boiler. The capstan stands on the upper or flush deck. The engines that operate it and all the other fittings are on a lower deck.

Eight pipes, or filling culverts 22 in. diameter, that pass athwart-ship through the gate, afford a means of filling the dock. They are fitted with valves controlled by hand-wheels on the lower deck.

The gate is moved into and out of position by the steam capstan and suitable warps. Raising and lowering are effected by the ballast pump and inlet valves.

The pumping installation is placed in a brick building a little back of the abutment on the north side. The pumps and engines were made by W. H. Allan & Co., of London, Eng. There are two thirty inch centrifugal pumps, each driven by an independent single engine. The discs are 5 ft. 6 in. in diameter, with curved arms similar to the appold. The suction expands from 30 in. to 36 in. the size of the wrought iron suction pipe. The discharge expands from 30 in. to 48 in., at which size it delivers into a brick culvert 14 ft. 6 in. wide, 5 ft. 8 in. deep, and 60 ft. long. The suction is divided into two passages at the periphery of the pump, and water is drawn into the disc chamber from both sides at the centre. Each pump is fitted with a steam ejector for

The engines are single, horizontal variable cut-off, directly connected to the pump shafts. Cylinders are 21 in. diameter; stroke, 22 in.

The drainage and leakage are removed by a 10 in. Heald and Cisco centrifugal, driven by a pair of vertical engines directly connected.

The engine pit is enclosed by sheet piling. For a foundation round piles were driven $3\frac{1}{2}$ ft. apart, all soft material was excavated to a depth of 2 ft. below floor level, and a quantity of loose stone thrown in. The piles were capped, and concrete laid on the loose stone was rammed round them and brought up level with the caps. A double floor of caulked 3 in. spruce was then laid, and another thickness of concrete placed on it. The pumps and engines were bedded on this foundation in concrete faced with brick. The walls of the engine house start from the same platform, the space between walls and sheet piling being filled to the surface with concrete.

There are two boilers of the marine type built of Siemens-Marten steel. They are 12 ft. 9 in. diameter and 11 ft. 6 in. long. Each has three furnaces 3 ft. inside diameter, 8 ft. 3 in. long, each furnace opening into a separate combustion chamber.

The contract stipulated that there should be pumping capacity sufficient to empty the dock when occupied by a 2,000 ton ship in two hours and a half. At an official trial under direction of the writer, the dock was emptied without a ship in it in two hours and twenty minutes. At every six inches fall of the water observations were taken of the steam pressure in boilers, and speed of engines. The speed of the engines, though slightly increasing, was comparatively uniform. It so happened also that the depth of water was reduced at a uniform rate, that is to say, very nearly the same time elapsed between the observations, from which it will appear that the ship resulting from the increased depth of suction varies approximately as the contents of a layer or stratum of a given depth at varying depths in the dock.

On the south side of the dock is a wooden freight shed 400 ft. x 40 ft., conveniently situated for a storage of cargo, either from ships in the channel dredged directly alongside or from ships in the dock.

On the opposite or north side a brick building 400 ft. x 35 ft. affords ample space for convenient office accommodation, stores and work-shops. The shops are furnished with electric light plant, punch shears, rolls, and other machinery suitable for repairs of wood and iron ships and a stationary engine giving the necessary motive power.

Among the most prominent features in this dock are the entire absence on the working floor of discomfort or inconvenience from drainage; the abundance of light and ventilation for workmen, resulting from the great top width; the readiness with which shores may be adjusted, owing to the small and numerous altars; and the facilities for expedition construction.

The materials used were the very best of their respective kinds, and the workmanship most thorough throughout.

The only casualty that occurred during construction was a slight movement of the material on the south side of the entrance works, before the frames or concrete were put in. It was promptly stopped by a system of struts to the opposite side, and gave no further trouble.

The work of construction was commenced on 28th May, 1883, and was suspended for four months during the winter of 1883-4. On the 10th Dec., 1884, the dock was formally opened, and H. M. S. "Tenedos" was successfully docked.

