

duced in section for 41 ft. at the centre to a vertical wall 18 ft. thick, thus forming pilasters at the ends, through which the anchor wells are built.

Owing to the importance of the work, the contractor spared no effort or expense to provide a plant up-to-date in every respect.

On the north side a large wooden trestle was built around the four sides of the caissons, all supported on piles and cribs. As the current here reaches 7 miles per hour and there is an average tide of 16 ft. and a maximum of 20 ft. it was necessary to have this trestle very strongly built. Platforms extended to the shore from the up- and down-stream ends of the pier carrying standard gauge double tracks which formed loops around the caisson and connected with the concrete plant 600 ft. inshore and located at the foot of the cliff.

The power plant, dining-room for "sand-hogs," and two-story bunk house were also located at the water's edge—just upstream from the pier. All supplies and material required were received by rail or team at the top of the cliff, some 160 ft. above high-water level and were delivered by gravity to the concrete plant and service tracks at the foot. A service elevator was operated by cable and hoisting engine at the top of the cliff which was an angle of about 45° at this point connected the tracks at the top with those at the bottom. A stairway provided means for the men to reach the upper and lower levels. The board of engineers' office was located at the top of the cliff.

At the foot of the cliff were situated the mechanical plants which furnished the power for the various operations. To supply compressed air, five Ingersoll-Sargeant compressors were employed. Four had a capacity of 1,250 cu. ft. and one 2,500 cu. ft. per min. These compressors discharged into a 12-in. main from which 7-in. branches led into the two caissons. Each branch was fitted with a gate valve so that the air could be cut out of either caisson at will. The main pipe was carried in a sluice of running water about 400 ft. long, which kept the temperature of the air down to about 75° F. As a consequence, the temperature of the working chamber rarely exceeded 90° F., although the service shaft, on account of the heat generated by the setting of the concrete around it, generally exceeded 100° F. For this same reason the temperature of the working chamber reached as high as 110° F. when being finally filled with concrete.

The compressors were at first supplied with power from six 100-h.p. horizontal boilers. As the work proceeded it was found that the demand on the compressors was greater than was anticipated. As a consequence, an extra 100-h.p. boiler was installed, together with one 500-h.p., one 75-h.p. and one 250-h.p. boilers, making a battery of 10 boilers, aggregating 1,075 h.p. These boilers were all coupled up, and in addition to the compressor plant, supplied power to the power-house, rock crusher and concrete mixing plant. There were also one 100-h.p. vertical and two 50-h.p. horizontal boilers on the platform near the caissons, and were used to furnish power to six 15-ton stiff-leg derricks which were used for handling stone, concrete, etc., during the sinking operations. They also furnished power to one 8-in. high-pressure pump used for washing material in the working chamber and to two 4-in. pumps which supplied water to the high-level tank on the top of the hill, thus furnishing the water supply for the whole plant.

The plant was supplied with electric light from its own power set situated near the boiler-house. It was equipped with a 30-kw. C.G.E. generator, capable of operating 16 arc lights and 100 incandescent lights

(16 c.p.). There was also a blacksmith and machine shop in connection, so that all minor repairs to plant and equipment could be made on the job.

The concrete mixing plant was placed just at the foot of the cliff. Half-way up the slope was the rock crushing plant. The rock used for the concrete was obtained from an adjoining cut and was brought to the brow of the hill in cars which dumped into a chute leading to the crusher plant. The stone was fed into 2 gyratory crushers which were capable of dealing with about 500 cu. yd. in 12 hours. After passing through the crushers the stone was led over an inclined screen of 2-in. mesh, and thence into a storage hopper bin of about 200 yds. capacity. These chutes led from this to the concrete mixing platform below, the mouth of each chute being directly over a mixer. From this platform the sand, stone, cement and water, were fed in the proper proportions to the mixers underneath the platform, which in turn dumped into self-discharging buckets on trucks, which were hauled to the caissons by horses. Three Ransome mixers were used on the work, two having a capacity of  $\frac{2}{3}$  cu. yd. and the other 1  $\frac{1}{3}$  cu. yds. Owing to the conditions under which the work was carried on the mixers never had a chance to work to their full capacity; their best day's work being 450 cu. yds. for the 24 hours.

The sand used in the concrete was conveyed to the concrete mixing platform in the same manner as the stone, i.e., by means of a chute from the upper level, where it was unloaded from hopper bottom cars. The chute was 8 ft. wide by 6 ft. high and was kept practically full all the time, the sand being taken from the lower end as required. The coal for the boilers was also delivered from the upper level through a chute, which emptied into 2-yard side-dump cars at the boiler-house level. By means of a track these cars delivered the coal to each boiler-house as required. On the top of the coal chute was a double line of rails with balanced trucks, which conveyed the cement from cars at the upper level to the storage shed at the level of the concrete mixing platform. The cars could, therefore, be unloaded as they arrived and the cement placed where required for use with the minimum amount of handling.

For the convenience of the "sand hogs," who were compelled to work on shifts through the whole 24 hours, the contractor erected both sleeping and dining quarters for a large number of his men. On the lower level a bunk-house had been provided to accommodate about 100 men, and a dining room that would seat as many more. On the upper level was a similar house with bunks for about 60 men and dining quarters of about the same capacity. On the dock the contractor erected a number of buildings, which included an office and bath accommodation for the inspectors, a hospital with a doctor in continual attendance, where first aid might be administered in case of serious accidents, or regular treatment in case of minor troubles. There was also provided a coffee-house, kept at a high temperature, where the "sand hogs" could change their clothes and receive hot coffee at the end of their shift in the working chamber. In addition to the above were the usual stores, offices, etc., for the contractor's own use. In connection with the hospital arrangements there was also provided a steel hospital tank connected with the compressed air system, to which men suffering from the "bends" could be immediately transferred and treated.

For serving each caisson four 30-in. shafts for material and two 30-in. ladder shafts were employed. For ejecting the sand and smaller stones four 4-in. blow pipes were used. The larger boulders were broken up and