

filled and finished off with a suitable working face. The dock forms a water-front structure, and is protected by wooden fender-piles.

Jacksonville.—In the construction of a semi-concrete dock at Jacksonville, the Braxten concrete pile was used, with very satisfactory results. In another case the Ripley concrete-encased wooden pile was adopted.

Key West.—A reinforced concrete quay wall dock, 1,589 ft. long, was completed at the U.S. Navy Yard at Key West in 1912. The main wall consists of a series of pre-moulded concrete pile bents capped by a concrete girder and a deck-slab 40 ft. wide on top. From the inner edge of the deck-slab a sloping concrete apron runs down to the top of a row of sheet-piles which forms a retaining wall for the reclaimed land. The piles are from 16½ to 20 in. square, and vary from 25 to 60 ft. in length. The bents are 10 ft. apart, with the same spacing for the piles, each bent having six piles. The face of the dock is protected by a system of creosoted fender-piles placed midway between each bent.

Port Arthur.—A reinforced concrete pile-bent dock, 1,050 ft. long and 25 ft. wide, was constructed at Port Arthur, Tex., in 1911-12. In general, the piles are 16 in. square, 44 ft. long, and 5½ ft. from centre to centre. The pile bents, of five piles each, are about 23 ft. apart, and are capped with a reinforced concrete girder. Five concrete beams, running from bent to bent, and a 4½-in. concrete slab, form the deck structure. The dock is tied back to the concrete trestle built for carrying the railroad tracks in the rear of the dock. No provision is made for any spring or other device to take up the impact forces on the fender system, as it is believed that the wooden fender-piles will afford sufficient elasticity to prevent any injury to the dock from this source.

Cuba.—Two reinforced concrete docks, 620 and 670 ft. in length, respectively, and 160 ft. wide, were built in 1911-12 at Havana, the depth of the water varying from 12 to 40 ft. Each consists of a concrete floor-slab resting directly on concrete caps placed on top of clusters of from four to eighteen reinforced concrete piles, the clusters being about 23 ft. from centre to centre in each direction. The concrete piles, 18 and 20 in. square, were designed for a load of 32 tons each. The design of the floor slab would indicate a cantilever effect longitudinally between each row of longitudinal piling.

One of the railroad companies of Cuba, also, has built a reinforced concrete dock at Havana, for coaling purposes. The structure, which is subjected to very heavy loading, rests on Chenoweth concrete piling, and was but recently finished.

Haiti.—In constructing a reinforced concrete dock at Port au Prince, during 1913, the Ripley type of concrete wrapped wooden pile was adopted. This dock has a total length of 2,326 ft., varying in width from 24 to 60 ft. The piles are 10 ft. from centre to centre, longitudinally and transversely, and are capped by heavy concrete girders of rectangular section for the inshore end of the dock, otherwise by arched girders. The deck system consists of a series of reinforced concrete beams supporting the concrete deck-slab, built with a crown, in order to shed water. The dock is protected by a creosoted fender-pile system.

Panama and Canal Zone.—The United Fruit Company in 1909 built a combined reinforced concrete and wooden pile dock at Bocas del Toro, for the docking of fairly large steamers. The wooden piling is surrounded by a 4-in. concrete shell up to about 1 ft. above the high-water line. The piles are extended up to the deck as reinforced columns, with a concrete beam and deck-slab

system. Up to the present time the dock is said to have given good results.

In the Canal Zone the U.S. Army Engineers have constructed a reinforced concrete dock, 706 ft. long and 55 ft. wide, for unloading timber. There are fifty-five concrete piers or columns, 8 ft. in diameter and about 80 ft. long arranged in two rows, 35 ft. from centre to centre across the dock, and 30 ft. from centre to centre longitudinally, and built in the form of hollow reinforced concrete sectional cylinders. After these cylinders had been sunk to bed-rock, they were filled with concrete, being reinforced vertically with eight rails. On top of the columns there is a concrete girder, deck-beam, slab system. The girders are about 5½ ft. deep, the beams about 4½ ft. deep, and the slab 6 in. thick. The railroad track runs over one row of columns. The floor system is designed for a load of 400 lb. per sq. ft., with a concentrated load of 105 tons over the track beams. The depth of water for a mean sea-level tide is 40 ft., the total fluctuation in the tide being 20 ft.

Two other concrete docks of extensive size are now in course of construction in the Canal Zone, with still more to follow.

Pacific Coast.

On the long stretch of our Pacific Coast, perhaps is found the greatest development of reinforced concrete dock construction in the United States. This section is making vast harbor improvements in anticipation of the opening of the Panama Canal.

San Diego.—At this most southern port on the California Coast an extensive reinforced concrete dock is now under construction. It consists of two parts, viz., the dock itself, 800 ft. long and 130 ft. wide, and a quay wall or bulkhead, 2,675 ft. long and 25 ft. wide. Wooden piles are driven into the soil and cut off "at any point between mean and low water and 18 ft. below city datum." Each of the 42-in. concrete columns encases one wooden pile and supports a system of structural deck-beams, a concrete slab covering the whole. The columns are 15 and 13 ft. 4 in. from centre to centre. The entire structure is protected by a wooden fender-pile system having the so-called San Francisco type of steel spring shock-absorbers.

San Pedro.—In connection with extensive port developments at San Pedro, a semi-reinforced concrete dock was recently completed in the outer harbor. It consists of pre-moulded concrete piles, 10 ft. from centre to centre in each bent, the bents being 16 ft. apart. The tops of these piles are corbeled out to support two 10 by 16-in. wooden caps, which in turn support the wooden floor joist and wooden decking. The piles are tied together with a wooden cross-bracing system above mean high tide. The structure is also stiffened against lateral blows on its face by inclined bracing piles. The wooden pile fender system has a car-spring to assist in taking up lateral forces. The dock is of the quay type, 48 ft. 6 in. in width, the total pier head frontage being 12,000 lin. ft. A railroad runs parallel to the inner edge on the inshore fill.

Redondo.—It is of interest to take note of the ocean pier at Redondo, Cal., though it is not a dock. It extends some 637 ft. out into the Pacific Ocean, and supports the intake pipe (for cooling purposes) of a power station. The pier consists of concrete pile bents, 20 ft. apart, each bent having four piles. As considerable surf runs at times under this pier, the outer bents have an extra outside pile driven with a batter of 2 in. per ft. The piles consist of a thin steel shell, 18 in. in diameter, closed at the lower end. After the steel cylinder had been driven to the