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Commercial Advertiser.

ESTABLISHED JULY 2, 1856.

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HONOLULU, HAWAII TERRITORY, THURSDAY, FEBRUARY 3, 1910.

PLANS OF THE PEARL HARBOR DRYDOCK

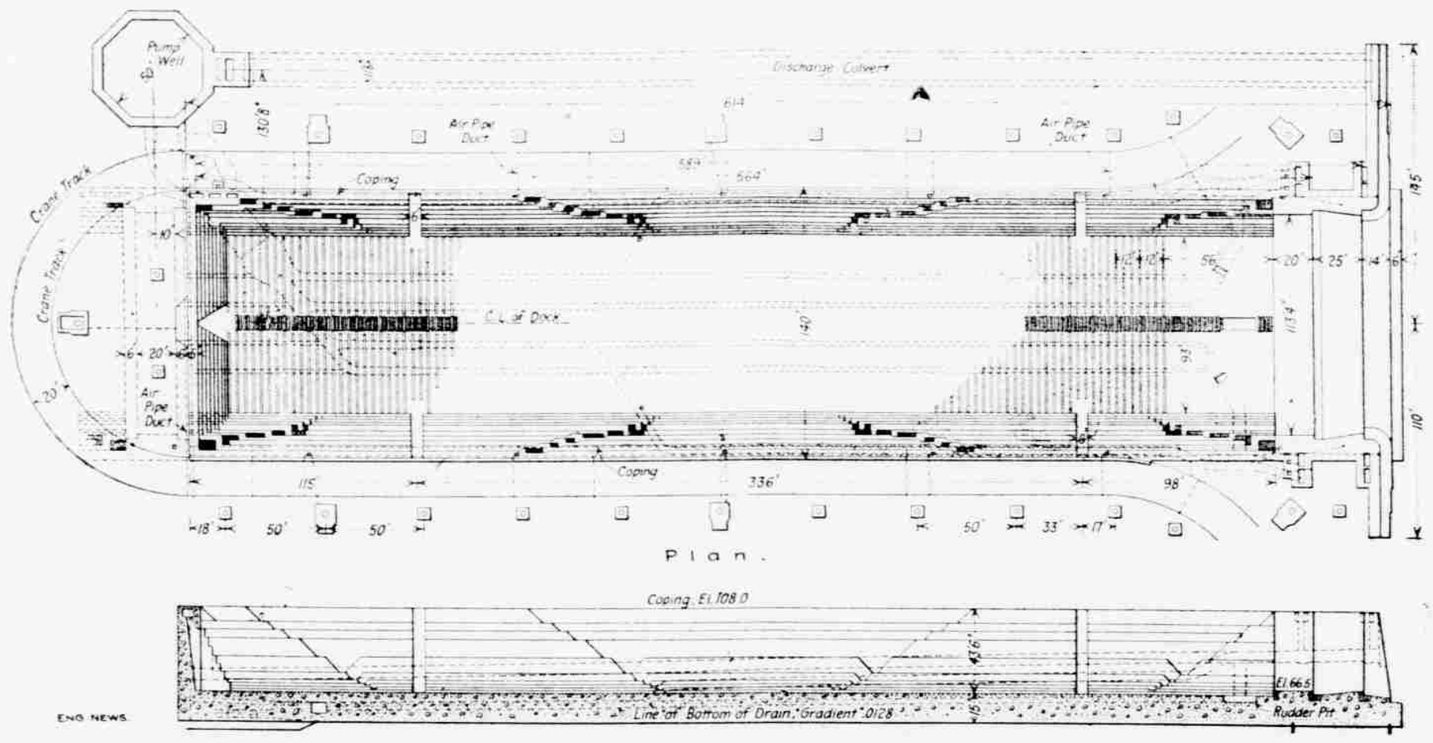

FIG. 1. GENERAL PLAN AND LONGITUDINAL SECTION OF PEARL HARBOR DRYDOCK (PRESENT CONTRACT).

(The broken lines at the left show the location of the intermediate gate seats which will form part of the extension to 1200 ft. See Fig. 3. The head wall of the 600-ft. dock now being built is to be removed after the extension work is all completed. The intermediate gate seats will accommodate a caisson gate like that at the entrance, and as the seats are double the inner and outer docks can be used separately or together.)

Description of What Is Being Done at the Lochs.

Engineering News contains an elaborate article on the Pearl Harbor drydock by R. E. Bakenhus, civil engineer, United States Navy, in charge of the design of the dock, the same being illustrated with cuts of the detailed plans giving cross-sections and the elevation of the entrance, the general plan of the dock, and the arrangement and detail of the keel-block slides and floor drains. The contractors are about ready to commence actual construction in the dredged excavation, and the construction equipment will arrive here in a short time from Mare Island navy yard.

Mr. Bakenhus' article, in part, is as follows:

The new concrete drydock now being built, for which plans and specifications were prepared by the bureau of yards and docks of the navy department, will be the nucleus of the station. The amount available for the dock is $2,000,000. Its general dimensions will be such that it will take the largest battleship now built or contemplated. It will be so arranged that the length may be increased at any time to accommodate longer ships, or two ships in tandem, provided congress authorizes the necessary expenditure. If the projected plans for lengthening are carried out it will be the largest dock in the world. The width and depth over the sill, which it is practically impossible to increase after the dock is built, will be great enough to cover all possible future demands, in the way of battleships. The present length will be 580 feet from outer seat to coping at head; the proposed increased length is 1,200 feet.

The site of the dock is in coral formation, which is of somewhat irregular character. The borings show that layers of hard coral rock, soft coral rock, so-called mud, and coral sand are distributed in an unsystematic manner. There is indication, however, of a layer of rather stiff mud extending under the entire site. If this layer is continuous it will probably prove fortunate as water would be more easily excluded from the excavation. The coral rock is likely to be porous and water-bearing and while offering a firmer foundation would be probably less favorable during construction.

Concrete will form the bulk of the material to be used, the total amounting to 71,000 cubic yards. There will be about 650 tons of castiron in the pipes, nosings, manhole covers and drainage systems. The total excavation exclusive of dredging is upward of 200,000 cubic yards. An investigation was made of local building materials and it was found that an excellent crushed stone can be obtained from the deposits of lava rock. A satisfactory sand can be obtained only by crushing and rolling the lava rock. The coral sand is too soft and absorptive. The materials will give a heavy concrete weighing 160 pounds per cubic foot. Cement must be imported.

Design of the Dock.

It may be of advantage to state here briefly the fundamental features of the drydock. It is a closed basin having a gate at one end and a pumping plant. With the dock full of water the ship is floated in and the gate closed. Then upon the water is pumped out and the ship settles down on a series of timber blocks. The entire bottom of the ship is thus exposed for cleaning and repairs. After completing work on the ship, water is allowed to flow into the dock and when full the gate is removed and the ship floated out. It is necessary that all these operations be performed rapidly, since the time of the working force and ship's crew is valuable and above all in war time occasion may arise when docking must be carried on with the utmost speed.

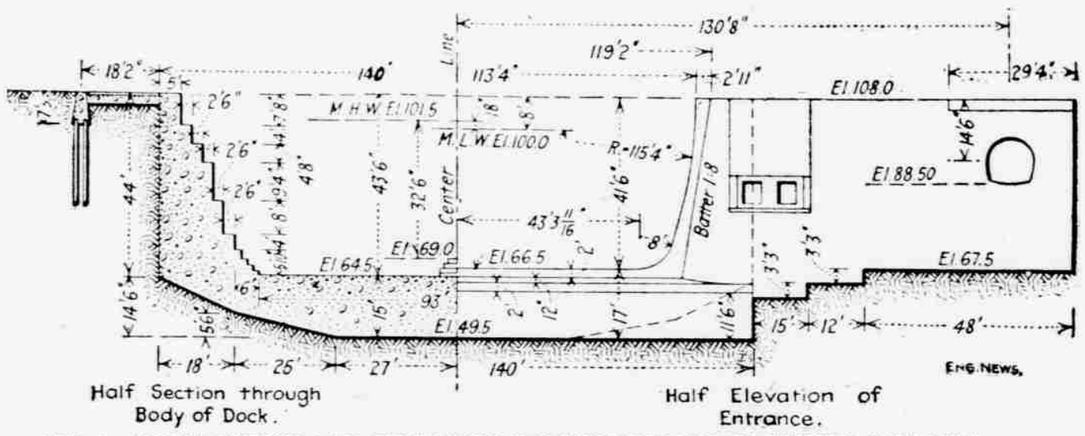

FIG. 2. CROSS-SECTION AND ELEVATION OF ENTRANCE, PEARL HARBOR DRYDOCK.

Structural Elements.

The problems involved in the design of a drydock are manifold. The side walls of the dock basin act as retaining walls, with a continuous earth pressure on the back and a varying water pressure on the front as the dock is full or empty. The inside faces of the side walls have altars or steps which are working platforms for the men during the docking operations. The floor of the dock carries the load on the timber blocking to the foundation and takes the thrust at the toe of the side walls. With an empty dock the combined dead weight of the floor and side walls, aided by earth friction on the side walls, must be capable of resisting the upward hydrostatic pressure on the foundation. The entrance to the dock must be sufficiently wide and deep to admit the largest ship which the dock body can accommodate and must provide one or two seats for the gate. The gate seats must transmit to the side walls the enormous water pressure on the caisson. The floor drainage system carries the water to the pump chamber. The pumping plant draws the water from the dock and discharges it overboard.

The entrnce to the dock is slightly narrower than the dock body. It is provided with two caisson seats of identical shape twenty feet apart. The entrance width at coping level is 113 feet 4 inches. At the level of the top of the keel blocks the width is 104 feet. The depth of water over the sill at mean high water is 35 feet and at mean low water is approximately 33 feet 6 inches. These dimensions will be more fully appreciated by recalling that the Panama Canal locks are only 110 feet wide and that the greatest ocean liners have a breadth of 88 feet and that there are few ships indeed, that have a light draft over 33 feet.

Blocking and Support of Ship.

The ship's weight is carried principally on the row of keel-blocks spaced 2 feet on centers along the middle of the dock. To steady her, heavy shores are placed from the altars to the ship's side. In addition, with certain ships, bilge blocks with inclined tops are pulled into place and support the ship at the side.

The modern battleship cannot be supported by these means alone. On account of the wide beam, and the great weight of the turrets, guns, etc., so called docking keels are provided, about half way between the center keel and the sides of the ship. The docking keel blocks take the weight from the docking keels and steady the ship without use of other shores or bilge blocks. The tops of the keel blocks and also of the docking keel blocks are in a level plane 4 feet 6 inches above the floor of the dock so that the workmen may have ample headroom. In case of a ship with unusual draft or of a disabled ship the top keel blocks can be taken off, as the tops of the blocks are normally 2 feet 6 inches above the entrance sill.

As the ship's docking keels are not always the same distance out from the center keel, the docking keel blocks must be movable. To provide a suitable bed for accomplishing this, a timber bearer has usually been set on the floor with a level top. A similar scheme has generally been used for the bilge blocks, which must be guided by the bearer while being pulled under water against the ship. These timber bearers are objectionable because they obstruct the floor, interfere with floor drainage and greatly hamper the workmen, especially on account of the reduced headroom. Various methods have been proposed to overcome the difficulty, nearly always involving the use of a guide or slot embedded in the floor. The problem of keeping such slots free from silt and scrapings has usually resulted in a recourse to the time-honored method.

In the studies for the Pearl Harbor dock an entirely new idea was developed, in devising slots that not only are guides and holding-down devices for the movable blocks but also feeders for the floor drainage culverts. They will thus be flushed from two to four times each time a ship is docked. The slots are formed in the tops of castiron boxes which have bottoms sloping towards the drainage culverts. The tops of the boxes are on a level with the floor and have a flange to take the full width of the keel-block. The dock floor will be free from obstruction of any kind; even the bilge-block pulling chains will be enclosed in the castiron boxes.

Caisson Gate.

The closure of the entrance, in conformity with the usual American practise, is effected by means of a steel floating caisson or gate. The total water pressure to be sustained is 4,600,000 lbs. or about 13 1-2 tons per linear foot. The maximum intensity of pressure is 2200 pounds, per square foot. Not only must the caisson structure be designed to sustain the water pressure but it also must float, have stability, and be provided with water ballast chambers and pumps so that its draft and trim may be controlled between limits at will. The designs for the caisson for the Pearl Harbor dock have not yet been completed, but the type will no doubt be a combination of the fin keel and hydrometer types. This shape is particularly well adapted to conditions at Pearl Harbor, where the tide is only 18 inches. The portion of the caisson which emerges when the water ballast is pumped out is made as narrow as possible, so that the displacement per foot of height is a minimum and consequently the amount of water to be pumped and the time required to float the caisson are a minimum. The keel of the caisson instead of being on the middle may possibly be arranged at one side, which will afford the advantage that about 10 feet in length of dock is saved over the center keel type because this necessarily projects into the dock's body.

Stairways.

The stairways are important in the daily use of the dock as they control the speed of egress and ingress of the working force. Six flights of stairs are provided for a dock 620 feet long. The width of the stairs is 24 inches, the rise is approximately 8 inches, the tread 9 inches, and the number of risers from floor to coping is 65. The flights of stairs have been so placed that passage along the principal altars is not interrupted. To this end one-half of the width of the stair projects into the dock body and one-half is laid into the face of the altar, leaving a passage 18 inches on the altars.

Equipment.

The dock will be provided with seven electrically operated capstans and with an ample supply of cleats, chocks, slings, winches and similar devices.

Materials.

The dock walls and floor will be of concrete composed of 100 pounds of cement to an aggregate of 6½ cubic feet of stone. The amount of sand is variable and is determined by experiment so as to give the heaviest mixture of stone and sand by weight. This method of mixing gives the densest possible mixture with the actual materials to be used and gives a fixed or uniform amount of cement per cubic yard of concrete.

The inner face of the dock is lined with lavalithic (so-called becaused it is analagous to granolithic except that crushed lava is used in place of crushed granite). The proportions are 100 pounds of cement to 2 cubic feet of fine material. The outer surface of the dock—all that portion in contact with earth—is lined with concrete having 100 pounds of cement to 4 cubic feet of stone with a variable amount of sand. The richest concrete is thus put where the conditions during construction are the most severe; also the richer concrete is the more water retarding and should be on the outside.

Cast iron is used for altar nosings, drainage boxes and for miscellaneous piping. For blocking any one of the following is allowed: American rock elm, American white oak, Australian tallow wood or "stringy bark," South American bullet tree, South American purple heart, yellow laurel or the Hawaiian ohia.

Contract for constructing the dock was recently awarded by the navy department and construction work will soon be in progress.

The Pearl Harbor drydock was designed by the writer, with Jos. Michaelson as assistant and expert aid, under Rear-Admiral R. C. Hollyday, chief of bureau of yards and docks, and Mr. Geo. von L. Meyer, secretary of the navy.

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