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CONCRETE WHARF SUPPORTS IN SALT WATER*

DESCRIBES METHODS USED IN PREPARATION OF CONCRETE SUPPORTS FOR SERVICE IN SEA WATER.

By **THOMAS S. WILLIAMS,**
Board of State Harbor Commissioners, San Francisco, Cal.

SAN FRANCISCO harbor is situated on San Francisco Bay, which is connected with the Pacific Ocean by a strait called the Golden Gate, about three miles long by one mile wide. The waters of a number of large rivers eventually find their way into the bay, nevertheless, on account of its size and proximity to the ocean its waters are substantially as salt as the sea. The result is that salt-water marine borers, known as teredos and limnoria, familiar along the entire Pacific Coast and elsewhere in the salt waters of the globe, infest San Francisco harbor likewise, and on account of their destructiveness to wooden piles in their natural condition it has been found necessary by various means to guard against their depredations.

Different woods—pine, fir and eucalyptus—have been tried, but all proved unavailing.

Different methods of wrapping and otherwise preserving the natural wood, some of them patented, were used without satisfactory results.

An untreated wooden pile of fir or pine will last only about a year. The borers are fastidious enough to prefer clear salt water, consequently muddy water or water fouled by sewage is some protection to the wood. It is, however, substantially accurate to say that the life of a green pile is only a year.

A creosoted wooden pile lasts according to the clearness of the water, from fifteen to twenty years, but, of course, great care must be exercised to secure piles that are properly creosoted, not only as to the materials used, but as to the processes employed.

Finally, experience has forced us to settle in practice at the present time upon two main types of construction of wharf supports: First, creosoted wooden piles; second, concrete supports.

Notwithstanding that concrete construction is from two to three times as costly as creosoted wood, our present practice is to use concrete wherever the foundation conditions permit.

As is well known, the great advantage claimed for concrete is its durability. Frequently we see it described as "permanent" construction, but experience with this class of construction either in San Francisco harbor or elsewhere under modern traffic conditions has not been sufficiently long or varied to permit of a sure deduction as to just how "permanent" even the best concrete is.

Being a manufactured article composed of various ingredients, mixed in varying proportions and by different methods, all concrete is not the same. Some of it is good; much of it very bad.

Moreover, the chemical action of salt water upon even the best concrete is a mooted question among engineers. Whether such action is deleterious, in periods short or long, I do not undertake to discuss, but the result of twenty years' experience with concrete in San Francisco harbor shows that on good concrete no appreciable adverse effect due merely to the action of salt water has become visible.

Likewise, electrolysis, due to escaping electricity, is said in some localities frequently to have rapidly deteriorated the steel reinforcing rods used in concrete constructions and thus contributed to the disintegration of the concrete.

Of the alleged effect of electrolysis, we can furnish no evidence from San Francisco harbor, because steel reinforcement is of so recent use that data on the point mentioned are not forthcoming. Our practice now is, never to use concrete unless reinforced by steel rods.

Concrete supports, used in our piers, wharves or seawall, have been of two main types, one called cylinders and the other piles; the striking difference between the two being that the cylinders are put in as wet concrete fresh from the mixer and allowed to set in position inside of a wooden frame, whereas the piles are manufactured on shore, thoroughly seasoned by being allowed to set at least thirty days and frequently as long as sixty days, and then are driven into position by a pile-driver or steam hammer. Frequently it is necessary also to use with the hammer the aid of a water-jet, which is employed where certain hard bottoms require it.

I shall describe the concrete pile first, and afterwards the concrete cylinder, with a brief reference to our experience with both.

When I mention piles hereafter, please understand that I have reference only to this character of pile, made of concrete and thoroughly cured on shore and then carried to the work and driven into position.

The use of such a premoulded concrete pile in harbor construction is comparatively of very recent origin. We are not aware just where it was first employed, but San Francisco is, at any rate, among the pioneers in its use. We doubt whether any other American harbor has used them as freely. They were first driven in that harbor in 1911, at first rather gingerly for work close in shore, but emboldened by apparent success we gradually extended their use until we are now able to exhibit a new pier just completed, 200 feet wide and 900 feet long, entirely supported by concrete driven piles.

The first piles used by us were 66 feet long, 16 inches square, and were employed to sustain concrete masses under ferry aprons.

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