Facilitating the Construction of Water and Sewerage Works by Means of the Cement-Gun

In recent years, the Cement-Gun has established itself as one of the dependable working tools of the engineering and contracting professions. We present herewith several specific examples of the successful application of the Cement-Gun process in the construction of water and sewerage works in various American cities:

COLUMBUS, OHIO

One of the views shown herewith illustrates the use of a Cement-Gun on the reconstruction of the well known sewage disposal works at Columbus, Ohio. This work was let with the specifications calling for 3 in. walls on the sides of the slope chambers. An unsuccessful attempt was made to pour concrete walls of this thickness. The resulting concrete was of such poor quality that it quickly disintegrated. A Cement-Gun was then brought on the job to correct this difficulty, and the trial was so successful that the practice of pouring thin walls was abandoned and the remaining walls were built up by the gun, as shown in the photograph, the gunite being shot against the reinforcing metal. The result was quite satisfactory.

ALBANY, NEW YORK

At Albany, N. Y., the Cement-Gun was used to cover concrete tanks with a coating of mortar. The operation of the gun at Albany was so rapid as at times to require the employment of 10 to 12 menans to trowel the applied surface.

Using the Cement Gun Process to Construct 3-Inch Walls in Columbus, Ohio, Sewage Settling Tanks.

Views are shown herewith of the sewage disposal plant at Albany, on which this work was done. One of the views shows a general view of the plant under construction, and the other view shows concrete being covered with cement-gun mortar. Note the fact that in this illustration, one cement-gun is keeping five menans busy troweling the surface.

In a letter to the editor, relative to this work, Mr. Stephen B. Vernon, engineer of Intercepting Sewer Design and Construction, of Albany, advised that the inner slope walls of the Imhoff tanks in the Albany sewage treatment plant, were covered with about 3/4 in. thickness of the gunite, and that this was troweled smooth. This was not done for water-proofing purposes, but rather to get an absolutely smooth surface, down which the sludge would easily flow to the sludge chambers. Mr. Vernon states that in the application of the gunite, they seem to have secured good results. As to the choice of methods for doing this kind of work, there is the use of the gun and troweling by hand, and the former was chosen because the cheaper. Undoubtedly the best results could have been obtained by troweling the original concrete soon after its initial set. This was impossible of accomplishment, since the work would have suffered during the after-construction and the smooth surfaces would have required a large amount of repair.

In troweling gunite, masons should be cautioned not to make too free use of their floats and trowels, because of the danger of injuring the permanency of the plastered coat.

ST. LOUIS, MO.

Some very interesting work has been done by the City of St. Louis, using the cement-gun in making repairs on old sewers. The engineers of the City of St. Louis conducted experiments to determine the availability of the cement-gun for relining old sewers of large diameter. Theoretical considerations indicated that the capacity of rough brick and ashlar sewers could be increased sufficiently by the addition of a smooth mortar lining to make possible a large saving in cost of proposed relief sewers. In addition to the increased carrying capacity of sewers so lined, the sewer structure is obviously made stronger by filling in the joints of the old masonry in this manner.

A length of sewer was selected for the demonstration, in

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Interior View of Ferry Street Sewer, St. Louis, Showing Old Surface Before and After Lining with Cement Gun Mortar.

which were combined both ashlar and brick masonry, and which was of small enough diameter so that all parts could be reached without the use of scaffolding. Wire brushes were first tried for preparing the sewer walls for the mortar coat, but were not found satisfactory. The sand blast was also tried, but failed because of insufficient compressed air. The method finally successfully adopted was to pick and scrape the mortar out of the wall with a tuck-pointer's tool.

It should be noted, however, that many old sewers are so thickly covered with foreign growths as to be unsuitable to any scouring method other than the sand blast, and sufficient air compressor capacity should be provided to convert the gun into a sand blower where necessary.

The St. Louis work was begun in the year 1915 and has been uniformly satisfactory. Many of the old brick sewers in that city were built with natural cement joints before the use of Portland cement became common. In many of these sewers the brick joints have been eroded to depths varying from several inches on the sewer invert to almost nothing around the sewer crown.
The sewers were treated with a mortar coating of the minimum thickness and were troweled where this was justifiable. Where the invert had disintegrated to a dangerous extent, the flow of the sewer was by-passed and the invert was reconstructed with vitrified brick up to the point reached by the guillotine. On this work, both the gun and the compressor were operated on the street surface, while only the nozzle man, one signal man, and the surfacers worked inside the sewer. Early in March of this year, Mr. L. Chienvs, Principal Assistant Engineer of Sewer Design, at the request of the editor, made another inspection of the work done by the cement-gun on the Ferry Street sewer in St. Louis, in 1915. This lining, he reports, most of which was put on without previously roughening the walls with a sand blast, is today in perfect condition. He advises that the present views of the St. Louis engineers on the utility of the process are very favorable, and they would probably be using it exclusively but for the present.

Mr. O'Shaughnessy states further that the bond between the cement plaster and the concrete wall was found to be perfect. Even when a hole was chipped through the plaster into the wall, it was difficult to find the joint between the plaster and the concrete, and upon attempting to chip the plaster off from the wall with a cold chisel and hammer, the plaster was found to be thoroughly bonded to the concrete.

Following the successful application of this process on the Twin Peaks Reservoir division wall, the engineering department of the City of San Francisco has used the cement-gun for plastering in both the inside and the outside walls of a car barn for the Municipal Railway and for a reinforced concrete building constructed for housing a garbage incinerator. Mr. O'Shaughnessy states that in all these cases he found the adhesion between the plaster and the cement to be perfect, and he considers the work far superior to any hand plastering which has come under his observation.

San Francisco, California

One of the first applications of the cement-gun in water works construction was the case of the water-proofing of the division walls in the Twin Peaks Reservoir in San Francisco. Mr. M. M. O'Shaughnessy, City Engineer, states that early in the year 1912, it was decided to attempt to make a concrete wall dividing two halves of the reservoir water-tight by means of cement plaster applied with a cement-gun. This wall was of reinforced concrete 280 ft. long on top, 16 ins. thick at the bottom, 10 ins. thick at the top and 27 ft. high.

When one-half of the reservoir was filled with water, to a depth of 8 ft., the water seeped through the wall and ran down into the other half of the reservoir. The reservoir was emptied and both sides of the wall plastered with cement plaster about \( \frac{1}{4} \) in. thick, applied by means of a cement-gun. After standing for about five days, the west half of the reservoir was then filled to a depth of 26\( \frac{1}{2} \) ft. and kept filled for five days. During all of this time, the surface of the wall on the unplied half of the reservoir showed no signs of dampness, indicating that the cement plaster was absolutely water tight. The wash water tower at the Torrivals Water Filtration Plant in the city of Philadelphia, was becoming dangerous due to the leakage of water along the lines of separation between successive days work in the original concrete operations. This seepage water froze and caused the spalling off and disintegration of the concrete. In 1916, a contract was let for the repair of this tower, it being specified that the inner walls should be dried, cleaned and coated with a 5-ply membrane water-proofing, over which 2 ins. of reinforced cement-gun mortar should be shot on. On attempting to place the water-proofing membrane, it was found that no adhesion could be obtained on account of the damp walls. The membrane was then painted and the walls were lined with 1 in. of guillotine, and reports indicate that all leaks from the tower are permanently stopped.

The city of Elmira, N.Y., built a large reservoir in 1911.

CONSTRUCTION VIEWS OF SEWAGE TREATMENT WORKS AT ALBANY, N. Y.

Left: General View of Plant. Right: Plastering Concrete Surfaces in Settling Tank with Cement Gun Mortar; One Gun Keeping Five Masons Busy Troweling the Surface.

Miscellaneous Examples

A reservoir at Muscatine, Ia., was built several years ago, partly on a fresh fill. This fill settled and the reservoir wall broke down to such an extent that the reservoir could not be used. The concrete lining was badly damaged. Repairs were made with the cement-gun, which proved to be highly successful.

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The city of Elmira, N.Y., built a large reservoir in 1911.
In 1916, the concrete walls had disintegrated to such an extent that in places pits were found from 3 to 4 ins. deep behind the reinforcing rods. A contract was let in 1916 for repairing this structure with the cement-gun and this proved quite successful.

An interesting application of the cement-gun process was made in the construction of the new reservoir of the Anaconda Copper Company at Great Falls, Montana. Instead of following the usual practice of lining a concrete reservoir with 1 to 2 ins. of reinforced gunite, the engineers of this company, Messrs. W. C. Tanner, Chief Engineer, and W. G. Capron, Asst. Chief Engineer, decided to line the basin entirely with gunite, with two layers of reinforcement. Reports of this work indicate great success in procuring an absolutely water-tight reservoir and also in getting this result at a very low cost, as the use of all transporting and other heavy machinery, as well as forms, was eliminated.