SAND CUSHION vs. GROUT BASE FOR STANDPIPES.

THE following discussion relates to the comparative merits of the grouted base and the sand cushion for standpipes. It is from a paper read by Mr. Chas. W. Sherman before a recent meeting of the New England Waterworks Association.

The writer points out that probably the most common method of transmitting the pressure from the bottom of a standpipe to the masonry or concrete foundation is by means of a sand cushion, or in some cases a cushion of sand mixed with cement. Without such a supporting layer it is obvious that the empty tank would rest upon the rivet heads, and when filled the plates between the rivets would be bent in such a way that a considerable part of the plates would come in direct contact with the foundation.

As far as transmitting the loads from the plates to the foundation is concerned, there is no material criticism of the sand cushion. It is a fact, however, that even with the best of workmanship the bottom of the standpipe is not absolutely flat. Certain plates or parts of plates will bulge either up or down. Those parts which bulge up, or "dome," will not rest upon the sand cushion when the tank is empty, as the sand cannot be caused to flow enough to fill these empty spaces, and the confined air has no opportunity to escape. When the tank is filled with water the plate is bent down into contact with the sand, but when the tank is emptied the plate will spring back to its original position.

It is, of course, impossible to get at the under side of the bottom of the tank for cleaning and painting, and it is, therefore, of importance that the material with which the plate comes in contact should have a preservative action upon the metal. It is well known that hydraulic cement has such a preservative action. Probably for this reason it has been customary in many cases to mix dry cement with the sand cushion on the supposition that in the course of time slight leaks in the bottom plate, or water absorbed from the atmosphere, or by capillarity through foundation, may be sufficient to cause the cement to set. It is obvious, however, that if the cement should set, when the tank is empty the domed places in the bottom plate would again spring back to their original position, leaving voids between the metal and the cushion.

As an alternative method it has been attempted in some cases to grout the space between the bottom plate and the foundation by pouring cement grout through holes left in the bottom plate, these holes being afterward stopped by iron plugs. Although it is somewhat difficult to fill all the voids under the bottom plate by this method without forcing in the grout under so great a pressure as to lift the bottom plate itself, nevertheless it is possible, by careful work, substantially to fill the entire space. When the bottom is well grouted in this way the plate should be in intimate contact with the cement mortar through its entire extent, and accordingly should be subject to the preservative action of the cement. As an example of the use of the latter method the writer describes the recent installation of a standpipe, 55 ft. in diameter and 44 ft. high, resting on a foundation of cement concrete. The holes for grouting were arbitrarily spaced 10 ft. apart in both directions. This spacing was unfortunate, as it left a few plates without any grouting holes whatever in them, and in several cases brought the holes close to the seams between the plates. The holes were 2 in. in diameter and were fitted with 2-in. pipe 2 ft. in length and with threaded plugs.

The grout was made of a 1:1 mixture of cement and screened sand, using sufficient water to make it of the consistency of cream, and was poured from coalhods into tin funnels inserted in the tops of the 2-ft. lengths of 2-in. pipe. A stick about ¾ in. in diameter and somewhat uneven was worked up and down in the grouting pipe while the grout was being poured, thus assisting in keeping the grout well mixed and in causing it to flow freely through the pipe.

The experience in pouring the grout varied considerably. In some cases the grout would flow freely to a long distance from the hole through which it was poured; in others, it could not be made to run more than a short distance. In one case, at least, the grout flowed to a distance of 7 ft. on one side and 8 ft. on the opposite side of a particular hole. In one case where the grouting hole was located close to a seam the grout apparently did not flow past the seam at all.

It was found practicable to determine closely the extent of the filling beneath the plate by pounding upon the bottom with a heavy stick. When the grout at last ceased to flow from any pipe it was apparently due to a stoppage at the bottom of the pipe itself, and there was no evidence that hydrostatic pressure was transmitted to any distance around the pipe in such a manner as to tend to lift the bottom plate.

As previously stated, the spacing of the grouting holes was somewhat unfortunate, and complete filling of the space beneath the bottom plate from the holes originally drilled was not successful. Nearly all of the space was filled, however, and 132 bags of cement were used in the grout poured through the original 27 holes. By pounding the bottom after this work was completed the points where additional grouting was required were determined and were marked. Additional holes were drilled at these points and the grouting continued.

If the points for the grout pipes had been spotted upon the bottom in advance of drilling, instead of being arbitrarily located at a fixed distance apart, there would probably have been no difficulty in completing the job from the first set of holes. The holes should have been so located that there would be at least one in every plate. They should be located approximately axially upon the centre line of the plate, and also in the high spots of the bottom if any exist.

A different method of insuring that the bottom of a standpipe is in perfect contact with the foundation has been employed by Mr. William Wheeler, of Boston, in twelve or fourteen cases and with entire satisfaction. This method consists in constructing the bottom of the tank in the form of an inverted cone. In Mr. Wheeler's practice the altitude of this cone has been uniformly 2 ft., and this method has been used on tanks as large as 40 ft. in diameter.

It is obvious that the conical form possesses the advantage of being able to resist pressure from beneath without deformation, so that it is possible to put in grout under pressure without in any way lifting the bottom, and also that there is no opportunity for air pockets. In setting these tanks it has been Mr. Wheeler's practice to lower them into final position about 2 ins. above the previously constructed masonry foundation and to fill the 2-in. space with a 1:1 mortar mixed rather wet and forced into place by a long, thin rammer, working from the outside.