Description.—The reservoir as built is circular in form, 200 feet in diameter on the inside, and 31 feet deep in the centre. The walls of the tank are supported by fifty buttresses, radially spaced. The deck is carried straight between the buttresses, thus the reservoir is not truly circular but a fifty-sided polygon. For a distance of 10 feet below the water level, the sides are carried down straight; below this point, the sides are inclined at an angle of 45°. The bottom of the reservoir is a segment of a sphere, with a maximum ordinate of 5 feet at the centre.

The shape adopted is one in which practically all of the available water is stored above the surface of the ground. Of the total storage, amounting to 6,000,000 gallons, only 580,000 gallons, or 9.7 per cent. of the total storage, is below the finished grade, and approximately 40 per cent. is stored in the upper 10 feet, thus making it a very effective pressure-equalizing reservoir.

Fig. 1 shows the stresses acting on a portion of the dam subtending an angle of 7° 12′ at the centre, all of which is supported by one buttress. In this figure are shown all of the forces acting on the section.

The horizontal component "P" of the water pressure acts radially outward and amounts to 244,880 lbs. Its line of action is 8.92 feet above the line a-b (Fig. 1). The total weight of the water—W′—resting on the inclined deck is 218,560 lbs. with its line of action 7.26 feet to the right of the line a-c. The prismoidal form of the body of water resting on the inclined deck makes the computations, both for the amount of these pressures and their locations, somewhat involved, and for this reason they are not reproduced in this paper.

The weight of the concrete section—W″—based on 145 lbs. per cubic foot of concrete, amounts to 191,000 lbs. Its centre of gravity is 14.6 feet from the line a-c.

As several intermediate factors enter into the computations necessary to determine the line of pressure in the buttress and the distribution of the foundation pressure over the footing course of each buttress, it was deemed best to compute the limiting values of these pressures under the following assumptions:

Case A.—Based on the assumption that each section must stand independent of its neighbor.

Case B.—Based on the assumption that the various sections are united into a monolithic structure and that all the forces resulting therefrom are taken into account to the full extent that they may be counted upon to develop in the structure.

Case A.—The point where the resultant pierces the base, e-f, under this assumption can be obtained by taking moments about the point "e," as follows:

P	(= 244,880) × (8.92 + 5.75 + 1.25)	= 3,898,490
W′	(= 218,560) × 7.26	= 1,586,700
W″	(= 191,000) × 14.60	= 2,788,600
	ΣM	= 8,273,790

$$z = \frac{\Sigma M}{W' + W''} = \frac{8{,}273{,}790}{409{,}560} = 20.21$$

"z" is the distance from the line e-a to the point where the resultant pressure on the foundation pierces the base.

The total width of the base is 28.75 ft. Therefore, the line of pressure falls 1.13 ft. outside of the middle third, thus making it appear that there will be considerable uplift at the heel of the buttress. This, however, is not the case. The total supporting area amounts to 117.65 sq. ft. Under the assumptions of Case A, the maximum pressure at the toe would amount to 6,727 lbs. per square foot, and the minimum to 29 lbs. per square foot. There is no uplift whatever at the heel. If, instead of a spread footing, a rectangular-shaped footing of the same area were used, the maximum pressure in the footing would be 7,755 lbs. per square foot, and the minimum, a tension of 795 lbs. per square foot.

Case B.—The line of pressure determined under Case A will not be the true line of pressure in the complete structure. In the complete structure a number of forces are developed, all of which add to the stability. The effect of these on the stability of the structure will be taken up in detail.

Effect of Bottom Connection.—Prior to placing the concrete in the bottom of the reservoir, further study of the problem indicated a probable weakness in the design of allowing the 6-in. bottom slab to span the refilled excavation made necessary in building the cut-off wall between buttresses. The plans of the bottom, therefore, were revised as follows:

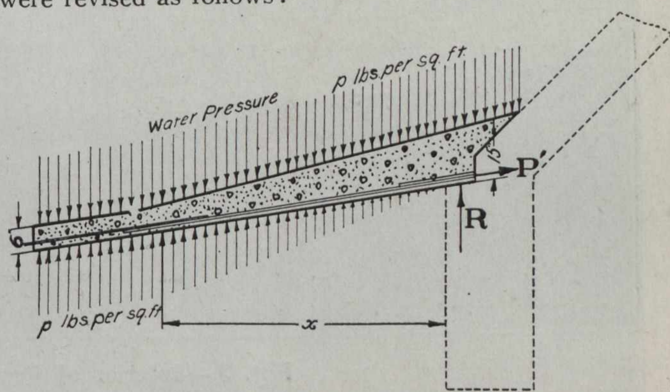

Fig. 2.—Connections at Base, Showing Acting Forces.

To strengthen the structure, the reinforced concrete bottom rests upon and is tied into the face slab by steel reinforcement. The concrete bottom is 6 inches thick and is reinforced wih ⅜-in. bars spaced 12-inch centres. Seven feet from the wall, the thickness of the concrete bottom was gradually increased from 6 ins. to a depth of 15 ins. directly over the supporting wall. The reinforcement in the bottom immediately adjacent to the wall consists of ⅜-in. square bars spaced 6 inches at the perimeter. The bottom is tied into the deck by half-inch bars, 5 feet long, spaced 12-inch centres.

Fig. 2 shows the connection of the bottom to the sides. In this figure are shown all of the forces that act on the section A, viz., the weight of the water resting on the bottom with an intensity of "p" pounds per square foot, the supporting pressure of the foundation increasing from zero at the support to a maximum of "p" pounds per square foot, "x" feet distant from the support; R, the reaction per lineal foot of the supporting wall, and P′, the pull per lineal foot exerted by the side walls. This construction would add appreciably to the stability of the buttresses in transferring the line of pressure nearer to the centre of the wall.

In Fig. 2 the distance "x" is limited by the strength of the bottom slab. Assuming a fibre stress of 20,000 pounds per square inch as the limiting stress that can be developed in the steel without permanently impairing the strength of the structure, we obtain a value of 6.28 ft. for x and a value of 3,400 pounds for R. The force T is developed in the ½-in. bars spaced 12-inch centres along the perimeter of the bottom and can reach 5,000 pounds per lineal foot without injury to the structure.