Test holes should be drilled to sufficient depths, 10 to 20 ft., more or less, to be sure that no seams or underlying strata of clay underly the rock, and tested with compressed air or water to at least 100 lb. pressure, and pressure maintained for such a time as will surely determine the condition in these test holes. Shale formations are liable to large seams; overlying strata of clay and limestone formations to water channels or recesses. The holes should be drilled from 10 to 15 ft. apart, more or less, depending on the conditions found to exist.

There seems to be no reason why solid section dams should not be constructed in the form of arches that extend from the toe to the cut-off wall, and the spaces under these arches would effectually care for any uplift due to water seeping through or under the dam, supports to the arches, or haunches of the arches, of course, being carried sufficiently below the surface to effectually protect them from wash and undermining, and would be more satisfactory than large pipe placed 8 to 10 ft. apart, more or less. Or 10-in. split tile may be employed for this purpose, which would be more satisfactory than a solid tile, but in any event should be covered with loose stone so as to allow free access to the tile from all sides.

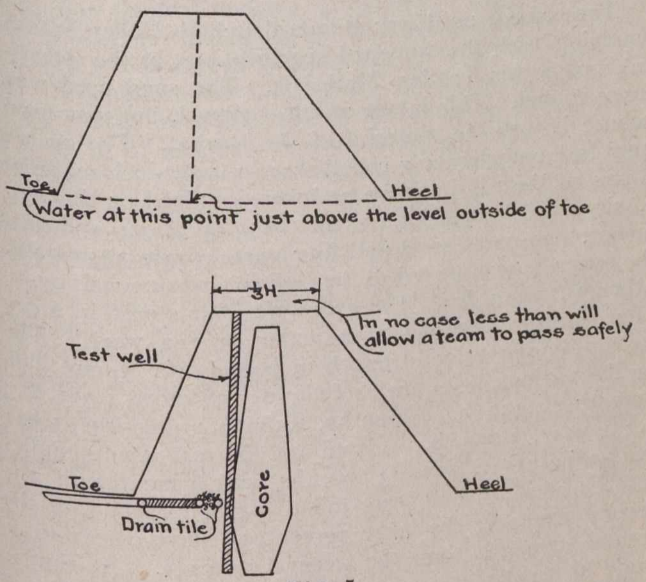

Fig. 5.

There is another condition that must be given consideration in this work, and that is, at the toe of the dam there will usually be found a pool cut out in the rock or other surface, that at or near the centre of the spillway section will have a depth of from one-third to one-fourth of the height of the dam; and it will be found that if this pool is filled with concrete, it will eventually wear to this same depth and there remain about stationary. It would seem to be good policy to retain these pools, unless some other method were taken to care for the action of the water at this point. Some types of dams would probably be less affected than others.

The solid dam may be reinforced and tied to bedrock in the cut-off portion, as described before and as shown here, and thus would take tension in the upstream face of the dam, in addition to which the diagonal bars at some angle would tend to take the tension due to sheer and prevent any tendency to sheer in the horizontal plane, or where new work was tied to old, in case that the joint was not properly cleaned.

The trenches for the haunches for the supports of the arches should have a depth at least equal to the pool and the cut-off wall, preferably somewhat below this. These arches should extend back to the cut-off wall, which should be made sufficiently strong for the purpose, and will give a more efficient drainage than it will be possible to obtain with pipes of any kind.

Referring to the earthen embankment as employed at the abutment ends of some dams, the following construction was employed by the writer, and tests carried on every day for several years to see if there was any increase of the water in the test well (Fig. 5) but no increase was found.

Again, from the core out to the toe every 20 ft., double lines of porous drainage tile were laid from the double line of tile that skirts the core to the double line that skirts the embankment just under the toe and to the outside of the embankment to some suitable disposal plant that would allow of the amount of water running to waste to be measured, from time to time, these drains being covered in turn with crushed stone to a depth of 6 in.; the reason for this being that the writer excavated on one such embankment to the centre of the same, the embankment being composed of a gravelly soil, and found no water until the centre of the embankment, or core, was reached, showing that the drainage kept the embankment dry from a point above the centre to the outside.

As before stated, the surface or foundation on which the dam or embankment is to be constructed should be excavated either in trenches or as shown, as this gives the foundation a greater frictional or sheering resistance.

Table I. gives data on dams, the depth and velocities of waters at the crest for which these were designed; and the actual depth obtained will give an indication of the conditions as they actually exist.

TABLE I.

1	4,185	8.5	9	16.5	1,000	50
2	4,475	8.5	13.5	14.4	1,000	50
3	3,085	...	16.4	18	1,000	..
4	1,545	8	8	9.5	890	60
5	7,000	...	6	....	318	..
6	19,600	...	12 and 5	....	1,500	..
7	66,000	...	12	10	700	..
8	1,380	...	7	2.2	400	..
9	5,760	...	15	12	1,078	..
10	400	...	5	3.6	120	..
11	3,560	...	(Could stand 9; stand flood of 50,000 sec. ft.)	4.4	1,108	..
12	15,800	...	15	....	480	..
13	16,600	...	15	....	500	..
14	1,270	...	5.5	8	260	..
15	.....	...	...	....	....	..
16	26,766	...	17.5	....	2,350	..
17	300	...	5	11	200	..
18	320	...	5	8	119	..

Dam No. 18 was designed to care for 4,400 sec. ft.; had a total crest length of 450 ft. and a spillway section of about 120 ft., and under flood conditions water rose 8 ft. above spillway section and 3 ft. over the crest, the estimated discharge being 14,500 sec. ft.

There is one other point in the case of gravity dams (Fig. 6) in that the factor of safety of 4 for deck loads has been used, but consideration should be given the following sketch (Fig. 6), also the cost of such work. It is manifestly certain that no load will ever be obtained that would stress the deck to call for a factor of 4, or even a factor of 2, and that a factor of 2*H* would be amply safe even for ice, as with a sloping deck such a factor would protect it from floating blocks or a plane of solid