ice, as the blow would be glancing; and again, the silt which fills in on the deck would act as a cushion. Then again, floating objects are most apparent at flood when the water on the crest is deepest, which would tend to carry these floating objects safely over the crest. And in any event, the stress in the material would not exceed the normal load stress effect. It may be said that load stress is uncertain. This may be true of some dams.

Now, the writer is not advocating a construction that would be unsafe under any consideration, but that more careful consideration be given these conditions on account of cost in a safety factor for loads that would be both safe and economical in so far as the cost of material and construction were concerned, but without going to extremes for a condition that will never be reached.

Records should be kept of the depths of the waters on the crest of the dams at all times, and the cost of an efficient instrument for this purpose is small. Such records, together with the records for rainfall, depth of

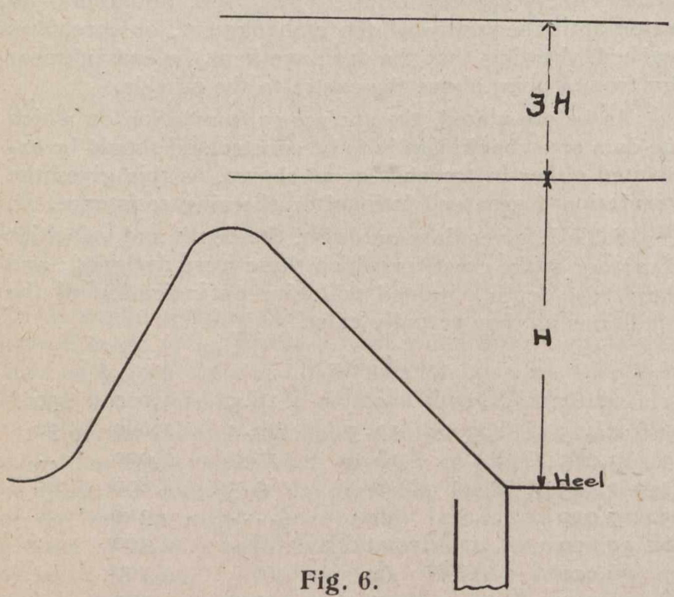

Fig. 6.

rise on the crest of the dam and the time relative to the maximum rainfall, would give data that would be invaluable, in a short time.

Records should also be kept of the soil strata through which excavations for test pipes and test holes pass.

The question of frost at times may have to be considered.

Every available record should be used to determine the run-off from the rainfall on a given watershed, as the run-off and the time of the maximum run-off are affected by so many conditions that there should be as few guesses as possible, and even the records should have a reasonable percentage added.

IMPROVEMENT WORK IN VANCOUVER.

The following is a summary of the street work during the past year in the city of Vancouver, according to a recent report of Mr. F. L. Fellowes, City Engineer. The various works are given in miles:—Pavements, 6.98; concrete sidewalks, 8.78; curbs and gutters, 1.44; curbs, 2.54; gutters, 4.41; clearing and rough grading streets, 11.79; clearing and rough grading lanes, 8.93; clearing and rough grading boulevards, 0.33; grading streets, 20.65; grading lanes, 3.26; grading boulevards, 11.89; rocking streets, 12.24; rocking lanes, 4.45; planking streets, 16.19; planking lanes, 5.87; three-plank walks, 18.03; sanding and oiling streets, 46.88.

BLAST FURNACE SLAG IN CONCRETE.

With the rapid growth of concrete construction, the advantage of blast furnace slag as an aggregate in reducing the dead weight has made a strong appeal to many engineers. The result has been that the building codes of several large cities have permitted the use of furnace slag equally with any other material ordinarily used for aggregate. An extended series of tests involving the manufacture of five hundred 6-in. cubes, 100 of these to be crushed at each of the several periods, 28 days, 3 months, 6 months, 9 months and one year, has been recently undertaken. Commenting upon these tests the Iron Trade Review states that as the work progressed, results were such that the number of cubes tested at the 9-month and one-year periods was reduced to 50 each, and it is proposed to crush the remaining 100 cubes at 6-month intervals up to 6 years, 10 cubes at each period. The materials used in the test were all produced commercially, and the work of making the specimens was no better than under ordinary field conditions of construction. Thorough mixing was assured, the work being done by hand.

The cement used was standard Lehigh Valley brand, complying with the standard specifications of the American Society for Testing Materials. The sand used was Jersey gravel. This is not an ideal gravel, but was used because it was the material of the market. The coarse aggregate commercially called three-quarter-inch material all passed the 1¼-in. sieve and were retained on the 1½-in. sieve. All material was in the proportions one part cement, two parts sand and four parts coarse aggregate. The concrete was mixed to the ordinary work consistency, rather wet than dry. The cubes were air stored in a dry cellar, being sprinkled with water once a week. The average compressive strength in pounds per square inch for the various tests are as follows: 28 days, 1,561 lb.; 3 months, 1,952 lb.; 6 months, 2,589 lb.; 9 months, 2,841 lb.; 1 year, 2,797 lb. A study of the test results shows that while at 28 days, 3 months and 6 months, if the number of individual tests fail to agree closely with the general average, the large percentage show considerable greater strength than the general average. A similar study of results at 9 months and one year shows that of the results not in close agreement that the general average, a somewhat larger percentage falls below this general average than runs above it. However, as the results which are above the general average are much more above the average than the low results are below, it may be assumed that the average results are conservative. This is more evident when it is considered that the sand used was not what could be considered as first-class material. Also, the comparatively small size of the slag aggregate must have lowered the strength of the concrete.

The findings seem to point that slag may be employed as an aggregate in competition with broken stone or gravel, since the crushing strength of broken stone or gravel concrete, made under ordinary field conditions, will not generally average much over 1,500 lb. per sq. in. at the age of 30 days. From the actual strength of the concrete developed in these tests, its weight per cubic foot, the recognized solubility of slag which permits it to act as a puzzolanic material, its alkaline nature which is especially conducive to rust-proof in the case of reinforced concrete, and from the relatively high combined percentages of silica, alumina and iron, which make for permanency of the resulting concrete, the conclusion is that slag is satisfactory for use as an aggregate in concrete.