Letters to the Editor

EFFECT OF RODDING CONCRETE

Sir,—Prof. F. E. Giesecke's tests on rodded concrete, reported in your August 14th issue, are of interest in showing the increased strength due to this treatment, and in illustrating the extent to which fresh concrete may be disturbed without adversely affecting its strength. The author properly attributes the increase in strength to the removal of the excess water by rodding.

The writer believes, however, that Prof. Giesecke is not on safe ground when he compares his tests directly with certain results from this laboratory, and depends on that comparison for a measure of the effect of rodding when using concrete of different consistencies. It is unfortunate that he did not make a parallel group of tests from which the water-ratio strength relation could have been platted for the unrodded concrete. (The water-ratio is the ratio of the volume of water in the batch to the volume of cement, considering cement to weigh 94 lbs. per cu. ft.) The strength of his concrete was probably different from ours, due to many factors which had no relation whatever to the effect of rodding. In other words, in his Fig. 1 the water-ratio strength curve for unrodded concrete may have been entirely different from the curve shown (which is based on certain of our tests), due to differences in the quality of the cement, temperature, curing conditions, time of mixing, or numerous other variations which affected all tests alike. The comparison of his earlier tests with our curve is not very convincing.

In our discussions of the water-ratio strength relation for concrete, we have pointed out that the constants in the formula quoted by Prof. Giesecke ($14{,}000/7^R$ where R is the water-ratio, an exponent) depend on the quality of the cement, age of concrete and other conditions of the test.

Other tests made in this laboratory give different values of these constants, although the general relation between water-ratio and strength has been found to hold true for different proportions of given materials so long as the concrete has water enough to make it plastic and the aggregate is not too coarse for the quantity of cement used.

Prof. Giesecke's Error

Prof. Giesecke has fallen into an error in plotting his tests in Fig. 1, since no allowance was made for the reduction in the water-ratio of the concrete as a result of rodding, due to one or more of the following factors:—

1. Working water to the surface, which escaped, and consequently did not influence the final water-ratio.
2. Evaporation due to long exposure of the cylinder during rodding.
3. Absorption of water by the aggregate during rodding.

Concrete which was originally mixed with a water-ratio of 1.00, may after rodding have a water-ratio of 0.7, consequently the strength should be platted with reference to the latter figure and not the former. In other words, the curves from Prof. Giesecke's tests should all be moved to the left, the exact position being unknown on account of the uncertain effect of rodding on the final water-ratio. If this were done, we would find a very different relation from that given by the original figure, and at the same time attribute the increase in strength to the proper cause; that is, the artificial reduction in the water-ratio.

The time of setting of the cement used in Prof. Giesecke's tests would have been of interest. Undoubtedly the plastic condition was quite different for the concrete which had been rodded for long periods than at the beginning. This should be borne in mind in considering applications of this method. It seems probable that the strength would have been quite similar had the concrete been permitted to stand for the periods shown, before being placed in the forms, provided that sufficient water were used in the beginning to provide a plastic mix after the absorption and evaporation had occurred.

In a series of tests carried out by the writer several months ago, a study was made of the effect on the strength of the concrete of using different methods of moulding the specimen. We were interested only in methods which could be used in moulding test cylinders in the laboratory. Compression tests were made on 6 by 12-in. cylinders at the age of 28 days, using sand and pebbles graded up to 1½ in. A 1:5 normal consistency mix was used, with a water-ratio of 0.87. For 12 strokes of the ⅝-in. steel bar on each 4-in. layer of concrete, we secured a strength of 2,680 lbs. per sq. in.; for 25 strokes, 2,780; and for 50 strokes 2,810; an increase of about 4% for 25 strokes as compared with 12, and an increase of about 5% for 50 strokes as compared with 12.

The first and third values were the average of 5 tests; the second, the average of 15 tests made on different days. Puddling was done during the moulding of the specimen and the concrete was not subsequently disturbed.

Water-Ratio Determines Strength

These tests showed a comparatively slight effect due to the different number of strokes used on each layer. Twenty-five strokes for each 4-in. layer is the number regularly used in making our test pieces. It will be noted that the water-ratio of this concrete was not changed, consequently we would expect little effect due to the number of strokes, so long as the minimum number of strokes gave compact concrete. Several methods of tamping were also used. The same series covered a study of the effect of vibration, jigging and pressure. These tests brought out clearly that the increase in strength due to pressure on fresh concrete may be measured by the quantity of water which is forced out by the pressure. In other words, *it is the reduction in the water-ratio of the concrete which increases the strength.*

It is the writer's belief that much of the effect due to workmanship in handling and placing concrete can be traced to the influence of any particular practice on the final water-ratio of the mixture.

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Chicago, Ill., November 22nd, 1919.

EFFECT OF WATER UPLIFT ON OVERTURNING OF DAMS

Sir,—Replying to your comments in your issue of November 6th, regarding article on "Effect of Water Uplift on Overturning of Dams," the writer wishes to make a few explanatory remarks.

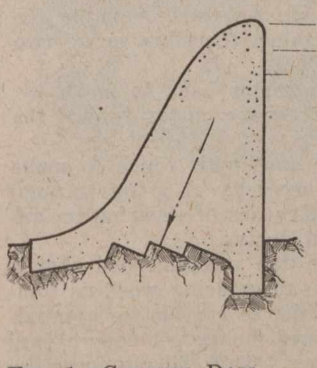

FIG. 1—GRAVITY DAM, ROCK FOUNDATION

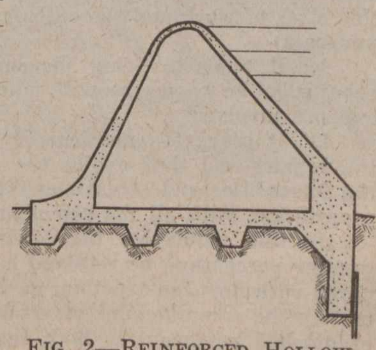

FIG. 2—REINFORCED HOLLOW DAM, EARTH FOUNDATION

Safety against sliding can be provided for in several ways: (1) Roughening between surfaces of contact; (2) increase in weight; (3) anchoring, by means of anchoring walls; (4) any combination of above.