EFFECT OF RODDING CONCRETE

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In a series of tests made at the University of Texas to determine the physical properties of dense concrete as determined by the relative quantity of cement, described in Bulletin No. 1815, published March 10th, 1918, only sufficient mixing water was used to secure a concrete of workable consistency. For comparison, however, a few specimens were prepared with an excess of water, which produced a very considerable reduction in strength, as was shown in Fig. 8 of the above-mentioned bulletin.

In practical operation it is almost absolutely necessary to use enough excess water to make the concrete sufficiently fluid to be handled in wheel-barrows, carriages or tubes, and so that it will flow readily into the forms and between and around the reinforcing steel.

With these facts before us—that an excess of water must be used to place the concrete correctly and economically, and that this excess water materially reduces the strength of the concrete—the question naturally arises, what, if anything, can be done to repair the injury that is done by the excess water?

To answer this question, G. A. Parkinson, assistant testing engineer, University of Texas, made a number of

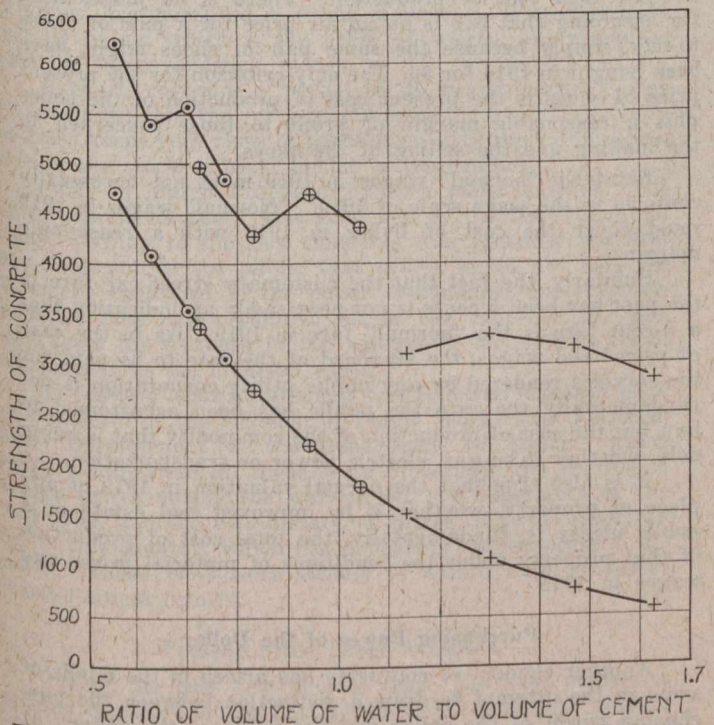

Fig. 1—Increase of Strength of Concrete Due to Rodding

Curve Shows Theoretical Strengths Calculated from Prof. Abrams' Cement-Water Formula (Assuming the Constants as 7 and 14,000). While Broken Lines Show Tested Strengths of Same Concrete after Roddings.

experiments in the fall and winter of 1917, to determine the effect of removing the excess water from the concrete after the latter had been deposited in the forms.

In these experiments the excess water was removed by forcing a pointed iron rod into the concrete while the latter was still soft; the effect of running such a rod into the concrete is to permit the excess water and entrapped air to escape upward, and to compact the aggregate; as a result the density of the concrete is increased about 4%.

This method of treating concrete has been named "rodding"; it is quite similar to "spading," but differs materially from "tamping." The results of Mr. Parkinson's early work were so very satisfactory that an extended series of tests was begun in June, 1918, and this was followed by other series of tests as new phases of this method of treating concrete developed. Some of these tests are still incomplete; but considerable important data have been secured and the following will be of interest.

Fig. 2 shows graphically the ultimate unit compressive strengths of fifty-four 6 by 12-in. cylinders. The concrete had the following composition:—

Material.	Percentage.
Cement	14.40
Passing 35-mesh sieve	4.35
Passing 12-mesh sieve and retained on 35-mesh sieve	9.00
Passing ¼-in. sieve and retained on 12-mesh sieve	13.00
Passing ¾-in. sieve and retained on ¼-in. sieve	29.50
Passing 1¼-in. sieve and retained on ¾-in. sieve	29.75
	100.00
Water	10.00

The 54 cylinders were divided into three groups of 18 cylinders each. In each group one cylinder was not rodded; the remaining 17 were rodded from one to seventeen times. In one group a 10-min. interval was allowed between roddings; in another a 20-min. interval; and in the third group, a 30-min. interval. The first rodding was applied soon after the moulds were filled; i.e., without waiting for the full interval of time assigned the particular series to pass. By one rodding is to be understood the pushing of a pointed

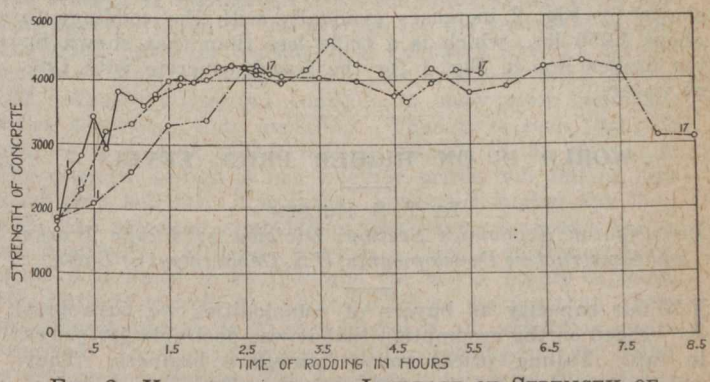

Fig. 2—Variation in the Increase of Strength of Concrete, Due to Rodding, with the Number of Roddings

iron rod into the concrete to the full depth of the concrete once for every surface area of about 3 sq. ins.; i.e., about ten times for a 6-in. cylinder.

It is interesting to note:—

(a)—That the maximum strength is about 130% more than that of the unrodded specimens.

(b)—That all three series acquired their maximum strength in about 2 or 2½ hrs.

(c)—That for the 30-min. interval it required 5 roddings; for the 20-min. interval, 7 roddings; and for the 10-min. interval, 14 roddings, to secure the maximum strength.

It is probable that the length of time and the number of roddings necessary to secure the maximum strength vary with the temperature and with the percentages of cement and water.

Fig. 1 shows graphically by the broken lines the average ultimate unit compressive strengths of thirty-six 6 by 12-in. cylinders arranged in twelve groups of three cylinders each.

The intermediate group, represented by crosses within circles, was made of concrete having the same composition as that represented in Fig. 2; but the mixing water was 7% for three cylinders, 8% for three, 9% for three, and 10% for three. This concrete contains cement at the rate of about six sacks of cement per cubic yard of concrete.

The two other groups are of similar composition, but the cement content changed to about four and eight sacks respectively per cubic yard. The percentages of water for the lean mixes were the same as for the intermediate, but for the rich mixes they were increased, respectively, to 7½, 8½, 9½ and 10½%.

To compare these results with the strength of plain concrete, the work of the Lewis Institute, of Chicago, as reported by Prof. Abrams, was selected as being probably the latest and most reliable, and probably also the most appropriate, since it gave special attention to the effect of excess water on the strength of the resulting concrete.