and 2½ ins.; and four water-concrete ratios; six specimens were made of each kind, or 216 specimens in all.

The results of the 28-day tests of the 6-sack, 1¼ ins. maximum size aggregate, are shown in Fig. 1 for three water-cement ratios; it appears from this figure that, for this particular concrete, the values shown by Prof Abrams' curve are about 28% too low when the water-cement ratio is based on the quantity of water used in mixing the concrete, and about 26% too high when the ratio is based on the quantity of water remaining in the concrete after rodding.

Our 28-day results for the 4-sack and 8-sack concretes are very similar to those for the 6-sack shown here.

In the issue of November 27th, 1919, *The Canadian Engineer* published a discussion of our work by Prof. Abrams, and I wish to offer the following corrections and additions to Prof. Abrams' comments:—

Reply to Prof. Abrams

1. Prof. Abrams states: "The author properly attributes the increase in strength (of the concrete) to the removal of the excess water by rodding." I stated in "Engineering News-Record," Vol. 82, pp. 958: "The increase in strength produced by the rodding is no doubt due to the removal of the excess water and the entrapped air and to the compacting of the aggregate. . . . To a certain extent the excess water may act as a lubricant to permit a better compacting of the aggregate."

In the same article I stated that rodding had increased the density of our concrete from 142.1 to 147.9 lbs. per cu. ft., or about 4%. This increase in density due to rodding is the same as that secured at Lehigh University by subjecting the fresh concrete to a pressure of about 2,000 lbs. per sq. in. in an experiment by Prof. McKibben.

2. Prof. Abrams believes that it is not safe for me to assume that his expression ($14{,}000/7^x$) gives the strength of unrodded concrete with sufficient accuracy for comparison with the strength of rodded concrete because of "differences in the quality of cement, temperature, curing conditions, time of mixing, or numerous other variations" and regrets that we did not make parallel groups of tests of unrodded specimens for comparison with rodded specimens.

Fig. 2 shows Prof. Abrams' curve and the results of three parallel groups of tests of rodded and unrodded concrete made by us. The average strength of our nine unrodded specimens made at three different times, widely separated, is 1,811 lbs. and falls almost exactly on Prof. Abrams' curve; this shows that our materials and methods must be very similar to those employed by Prof. Abrams.

Since our results with unrodded concrete agreed with Prof. Abrams' curve near the middle of that curve and for that type of concrete which is most generally used in reinforced concrete work, and since Prof. Abrams concluded from his extensive tests that "it is seen that for given concrete materials the strength depends on only one factor,—the ratio of water to cement," I see no reason for a further checking of Prof. Abrams' curve.

Water Stood on Group B Specimens

Group A of Fig. 2 consists of three unrodded and nine rodded specimens; these results were obtained June to October, 1918, and published in "Engineering News-Record," Vol. 82, p. 958.

Group B consists of three unrodded and thirty-two rodded specimens; these results were obtained in May, 1919, and have not yet been published.

Group C consists of three unrodded and thirty-two rodded specimens; these results were obtained in June, 1919, and published in *The Canadian Engineer*, August 14th, 1919.

The reason why the strengths of the Group B rodded specimens are so much lower than those of Group C, is that in the case of Group B the water which was worked out of the specimens by rodding was allowed to remain on the specimens so that the same were practically standing under water, whereas, with Group C, concrete was added as the rodding compacted the specimens, so that the molds were always practically full of concrete and the water which was rodded out of the specimens could run off over the tops of the molds, our molds being practically water-tight.

3. Prof. Abrams states that I fell into error in plotting my diagram by failing to make an allowance for the change in water-cement ratio due to rodding.

No, this was no error; Fig. 1 shows that Prof. Abrams' curve does not give the strength of our rodded concrete either when plotted with reference to the quantity of mixing water or with reference to the quantity of water remaining in the concrete after rodding; Fig. 2 shows that Prof. Abrams' curve does give the strength of our unrodded concrete very accurately, and that the strength of our rodded concrete is very much higher than that of our unrodded concrete.

However, the diagrams published in *The Canadian Engineer*, August 14th, 1919, were not intended as a study of Prof. Abrams' curve; they were intended to show that concrete prepared with excess water can be very materially improved in strength by rodding, and that consequently it is a mistake to assume that we can not use excess mixing water and still secure good concrete; the diagrams were to show that we can use enough mixing water to make the concrete so fluid that it can be handled economically and that it will fill the forms well, and then, by rodding, still make as good if not better concrete than could have been made if no excess mixing water had been used.

Greater Strength Despite More Water

Notice, for example, the series of tests described by Prof. Abrams in *The Canadian Engineer*, November 27th. 1919; he reports that he used a 1: 5 normal consistency mix, with a water-cement ratio of 0.87 and aggregate grading up to 1½ ins., and that he secured, by tamping in four-inch layers, a maximum average strength of 2,810 lbs. at 28-days in 6 by 12-in. cylinders. Compare these results with those of our series shown and described in *The Canadian Engineer*, August 14th, 1919, in which we used practically a 1: 6 mix, by weight, with a water-cement ratio of 1.05 and aggregate grading up to 1¼ ins. and secured an average strength of 4,073 lbs. for thirty-two specimens at 28-days in 6 by 12-in. cylinders.

In other words, we used about 21% more mixing water per unit of cement, and secured about 45% more strength, than did Prof. Abrams.

This comparison brings out the point I wish to make, namely, that by rodding the concrete it may frequently be very much better to use excess mixing water than to use a mix which contains only sufficient water to produce a workable consistency.

F. E. GIESECKE,
Professor of Architectual Engineering,
University of Texas.
Austin, Tex., December 23rd, 1919.

TRADE UNIONISM AND ENGINEERS

Sir,—I have just read, with a great deal of interest, the letter of N. C. Mills, vice-president and managing director of the Montreal Armature Works, Ltd., which appeared in your issue of December 25th, 1919. I had previously read the statement signed unanimously by the directors of the American Association of Engineers, printed on page 498, and the statement of the membership of this organization, printed on page 499 of your issue of November 27th, 1919; also the letter of Fred Christie, from Peterboro', Ont., published in your issue of December 18th, 1919.

I am inclined to think that the rank and file of the American Association is not likely to be as unanimous on this point as were the directors, and that the directors are very likely to hear from the men underneath.

I wish to voice my "amen" to what Mr. Christie and Mr. Mills have said on the subject of "Trade Unionism and Engineers," and to express my own thought that we really need more than a "trade union." Our engineering societies can, and I believe they will, gradually develop into that general form of organization, even though under some more