above undisputed facts, "what are we to do, or what do you propose as solution?" It is no doubt true that in the past some managers have had a too easy time; that is, the hard-worked, trustworthy under-foreman and superintendents have, like the sergeants in the British Army, been the backbone of the concern, in the sense of pushing the work and taking the brunt of the responsibility.

That time is gone, and it is now up to the managers, etc., to get out and hustle themselves, and to scheme ways and means to assimilate the conditions which obtain, and shall we say that this closer touch will not be beneficial in the long run? The manager has found out he has got to really manage, not delegate it to others; also that more time has to be spent in detail and arranging the several kinds of work.

Do the thinking, have a pattern or plan of every man's work, do not spare yourself, scatter your brains everywhere, leave nothing to chance, forget you ever had understudies to do your work, work harded than ever. Then watch the result!

CHAS. TAYLOR,
General Superintendent,
Raymond Construction Co.

Toronto, Ont., September 5th, 1918.

Proportioning Mortars and Concretes

Sir,—In your editorial section of July 4th, 1918, some comment is made on articles published lately by Prof. Abrams, of the Lewis Institute, Chicago, and Capt. Lewellyn Edwards, of Toronto. You remark that Capt. Edwards does not recognize that the compressive strength depends only upon the water/cement ratio. Capt. Edwards did not have the work of Prof. Abrams before him when he made his investigations and perhaps did not apply Prof. Abrams' methods to his results.

Capt. Edwards has kept the consistency consistent in the series of mortars, in which he proportions 1 gm. of cement to 13 sq. ins. of sand area, his idea being to eliminate variations due to the consistency factor, so that his result would compare the sands and not with effect of diluting the cement with more or less water.

On examination of the figures in table 7, page 29 of the issue of *The Canadian Engineer* of 11th July, 1918, it would appear that far from being any discrepancy between the results of these workers, they are in complete accord.

An error has been made in recording the ccs. of water for Sand C in this table. The figures 134.5 ccs. should be 168 ccs. Correcting these figures, the table can be rearranged as below:—

Strength Tests: Composition of Mortars—Test Series No. 1
Cement Content, 1 g.: 13 Square Inches

Sand Letter	Surface per 1000 gms. sq. in.=S	Water to Gage the Sand $=\frac{S}{210}$	Cement By Wt. gms.	Cement By Vol. ccs. C	Water for Mortar ccs. =M	Ratio of Cement to Aggreg. by Wt.	Water/Cement Ratio $=\frac{M}{C}$
A	5,857	28.0 ccs.	450.5	299	128	1:2:22	.428
B	5,106	24.4 "	392.0	260	111.5	1:2:55	.429
C	7,684	36.6 "	591.0	392	168.0	1:1:69	.429
D	6,758	32.2 "	520.0	345	148.0	1:1:92	.429
E	12,816	61.2 "	986.0	654	280.5	1:1:12	.429
F	6,769	32.3 "	521.0	345	148.0	1:1:92	.429
G	4,182	19.9 "	321.5	213	91.5	1:3:11	.430
H	6,565	31.3 "	505.0	335	143.5	1:1:98	.428
I	6,565	31.3 "	505.0	335	143.5	1:1:98	.428

One cubic foot of cement has been taken at 94 lbs. and the column for grams of cement converted to ccs.

It is evident that the reason why Capt. Edwards obtains the same strength for the sands of different granulometric composition is that the water/cement ratio is constant.

In series No. 2, where the ratio surface area/cement is varied, if the water/cement ratio is plotted as abscissa in Fig. 9, instead of the ratio surface area/cement, a series of straight lines is also obtained.

Prof. Abrams remarks that for a small range in the water/cement ratio this ratio plotted against compressive strength gives a straight-line tangent to the curve which is obtained by varying the water/cement ratio over a wide range. The strength is, therefore, proportional to the water/cement ratio, and when this ratio is kept constant, constant strength results even with sands of widely varying granulometric composition such as were used by Capt. Edwards.

A straight-line relation also holds between the volume of water required to gage the sand and the surface of the sand per unit weight.

The grading of a sand is, therefore, a measure of its surface area and, as Capt. Edwards has shown, the water required to gage the sand is proportional to this area. Apart from the cement which in these tests was kept at normal consistency, the grading of the sands was the only factor causing the different water absorption for the sands used.

It would seem, therefore, that the grading determines the water content and since this water content is the basis of all Prof. Abrams' work, it seems inconsistent on his part to give so little consideration to the grading.

It is assumed, of course, that we are discussing plastic mixtures and not those in which the cement is supersaturated with water. Then, of course, so much harm has been done the mixtures by the action of the water on the cement that the grading of the mix is indeed a secondary consideration. As has been shown by both Abrams and Edwards, the effect of the excess water is to reduce the cohesion between the cement particles and also the adhesion of the cement to the aggregate particles.

It would be interesting to know what figures Capt. Edwards obtained for absolute density of his mortars. In tests made for the Greater Winnipeg Water District in 1917 it was found that in well-worked concrete the absolute voids and the water content were practically identical. It would seem, therefore, that the recent work of Prof. Abrams and Capt. Edwards simply proves the law expressed by many early workers on concrete mixtures, namely:—

That for a given percentage cement and given consistency the strongest concrete is that having the highest density or the lowest absolute voids. Expressing the law according to Prof. Abrams, the strongest concrete is that in which the water/cement ratio is lowest. Expressing the law according to Capt. Edwards, the strongest concrete is that in which the surface area of aggregate/cement ratio is lowest.

There have been so many articles written on the proportioning of mortars and concretes that one is apt to