an average of 125 working days was obtained. Average progress of superstructure was 900 lineal feet, or 150 lineal feet per month of superstructure 34 feet wide and from 24 feet to 28 feet high. Progress would have been better had blocks always been on hand. On one occasion 720 tons were set in 12 hours, which was at rate of one 30-ton block each half hour. Average rate = 8,000 tons per working month.

Manora—In a season of 4 months, containing 92 working days, 910 blocks, each 27 tons weight, were set to 710 lineal feet breakwater; average rate per working day = 10 blocks, or 270 tons, or about 6,000 tons per month.

Highest rate, 18 blocks per day; but at one time, under very favorable conditions, 6 blocks, or 162 tons, were set in 1 hour and 40 minutes. Rate of progress was usually controlled by the rate at which top of rubble mound could be prepared by divers.

Madras—Superstructure 24 feet wide and 30 feet high, advanced on south breakwater 990 lineal feet per season of 6 months, and on north breakwater 770 lineal feet per season, or 7,000 tons per month.

Mormugao—Superstructures 30 feet wide and 30 feet high. Average rate of progress was 109 lineal feet superstructure per month. Progress could easily have been 200 feet per month (10,000 tons), had blocks been on hand ready to lay.

From foregoing, it seems fair to assume that with blocks on hand, and with suitable appliances for handling them, 8,000 to 10,000 tons of concrete blocks could be placed in a superstructure each working month.

For THE CANADIAN ENGINEER.

WHY CIVIL ENGINEERS SHOULD TEST CEMENTS; AND HOW THE TEST SHOULD BE MADE.

BY PROF. CECIL B. SMITH, A.M., CAN. SOC. C. E.

There is by no means as much systematic testing of cements as one would suppose. Often, the testing, if any, consists in making a few neat briquettes, giving the tensile strength at one week and four weeks, while systematic and intelligent testing is confined to a few city departments and some of the larger Government contracts; this arises sometimes from ignorance, but not ordinarily so; usually, it is partly from indifference and partly from an idea that the appliances and time necessary are out of proportion to the benefit to be derived.

There are two things that the writer would like to urge on his fellow civil engineers.

(1) Whenever feasible, prescribe the tests advised by the Canadian Society of Civil Engineers, and let us get down to some basis by which dealers and manufacturers can tell where they are. At present, with stringent requirements, as in the Barrie specifications lately, and no tests at all, in a large Ontario city, with everyone going a different road, those dealing in the product hardly know what course of action to pursue. This is neither fair nor rational, and does not give our own manufacturers a fair chance or encouragement to excel.

(2) To reconsider their ideas of testing, and by using less cumbersome tests, to enable themselves to do it more persistently and for smaller orders and pieces of work. I take it that a large percentage of civil engineers, and almost all contractors and dealers, will insist on the idea that the criterion of a good cement is a high, *neat* tensile test at one week and four weeks.

It is probable that no more fallacious idea ever got into the brains of intelligent men on a strictly determinable fact than this. *It is absolutely no criterion of the value of a cement whatever*, because it can be found in *coarse, underburnt, unsound* cements, and all authorities on cement testing, and all who have had any amount of testing to do, assert it, and yet, because it is so easy to say that a cement will "stand so and so at 1 week and 4 weeks," and it is, seemingly, so plausible an index to the value of the cement, the error has become very widespread.

There are three qualities of a cement which are determined much more easily, and which are of infinitely more importance, and the writer would invite attention to the facility with which these can be arrived at. These are *soundness, fineness*, and *specific gravity*. Of these the first is paramount, and is the subject of much controversy. Undoubtedly, if any one of the tests ordinarily used is fully satisfied, the cement is reasonably safe. These tests are in order of their severity:

(*a*) Immersion in boiling water for 24 hours.
(*b*) " " water at 125° F. for 24 hours.
(*c*) Hot air bath at 150° F. to 175° F. for 24 hours.
(*d*) Immersion in cold water for one month.

The Germans have fallen back on the last one, but the writer's experience is that although it will detect bad cases of unsoundness, yet it will not detect those that are slightly so. The second test of immersion in water at 120° F. to 125° F. for 24 hours, after having been allowed to harden for three or four hours in the vapor of the same, is a sti[illegible]ent determination of the slightest tendency to "blow." This test evidently, therefore, requires very little time, a thermometer, a spirit lamp and tin receptacle of some kind, with cleats to hold a piece of glass on for the first three or four hours, and then to immerse the hardened pat in the water. If the cement is sound it will come out, after 24 hours, hard, smooth and stuck tight to the glass. Its badness may vary all the way from fine cracks to a complete disintegration.

The 2nd test for fineness is purely a matter of dollars. Cement not passing a No. 100 sieve is not a cement, but a sand, and if we have one cement with 25 per cent. residue on 100 sieve, and another with only 5 per cent. on 100 sieve, then in any 3 to 1 sand mixture the proportions are $\left\{\begin{matrix}75 \text{ to } 325\\ \text{and}\\ 95 \text{ to } 305,\end{matrix}\right\}$ and even this is not a full discrimination. It will be found that of the two cements referred to, if equally well burnt and of same constituents, the 1st will actually be barely half as strong as the 2nd *in a 3 to 1 sand mixture*. It is easy to see from this whether fine grinding is worth paying for, where *strength* is required. The outfit for this test is worth $3 or $4, and the test takes 10 minutes to 15 minutes to make, with the use of a good balance.

The 3rd test of specific gravity to determine the thoroughness of burning is easily made with a graduated tube, and is a check on the tendency to underburn, in order to be able to meet fineness requirements easily. Other things equal, a cement burnt well has much more cementing value when mixed with sand than an underburnt one. This test requires half an hour's time, some coal oil and a graduated test tube, with fittings worth $3 or $4.

If these three tests are made and found satisfactory, the neat tensile tests are merely *confirmatory*, and sand tests a vindication of fineness. Thus it will be seen that $15 to $25 in outfit, and a few hours' time for each sample, will give such a knowledge of its characteristics as will enable an engineer to classify the product and determine its relative value—leaving ten-