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Studies in Surface Area Proportioning Method

Discussion of R. B. Young's Paper Published Under Above Title in the June 26th, 1919, Issue of The Canadian Engineer—Surface Area vs. Fineness Modulus—Results of Tests on Bulking Effect of Moisture in Sands

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IN a theoretical study, having for its object the development of a well balanced, practical method for designing concretes, we are inevitably bound to recognize two natural divisions of the subject.

These divisions are, however, very closely interrelated and cannot be considered altogether independently. One of these involves a consideration of the physical and chemical properties of the constituent materials; the other a consideration of the methods and operations which enter into the "transition" or "making" stage.

Experience has amply proven that the latter may operate to vitalize and to develop in the finished product all the latent

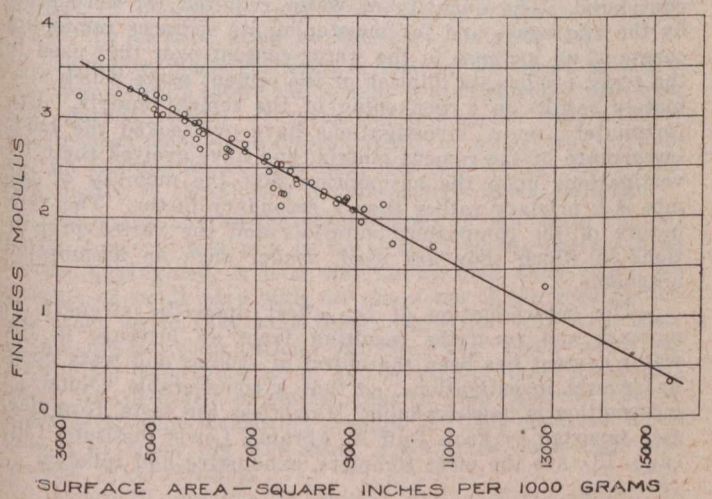

FIG. 1—SURFACE AREA VS. FINENESS MODULUS

functions possessed by the materials or, on the contrary, they may serve to render these functions wholly, or in part, impotent, inert and useless.

It is a situation in which we have two groups of forces tending under favorable conditions to co-ordinate and under unfavorable conditions to disrupt. Naturally enough this dual condition has resulted in a certain amount of confusion in the interpretation of results obtained from experimental tests.

The theoretical studies made by Mr. Young have shown quite conclusively that the grading of the aggregate, or more specifically its surface area, bears a very definite relation to the strengths of mortars and concretes. The relations which he has shown to exist between the surface area, and the cement and the water contents of the mix, are fundamental. Further studies and experimental tests will show a still wider application of this surface area factor than has yet been developed.

When the surface area method of proportioning mortar and concrete mixes was first presented, discussion brought forth the claim that the grading of the aggregate, and consequently its surface area, influenced the strength of a mortar or a concrete only to the extent of fixing the quantity of water necessary to produce a plastic mix. In view of my own investigations and the conclusions drawn from them, I was prepared to accept this notion only with definite limitations, rather than in the "blanket form" in which it was offered.

It is obvious that if we are to establish a uniform method for the testing of the mortar and concrete-making qualities of sand and stone aggregates, we must aim to eliminate factors depending upon the judgment and personal equation of laboratory operators.

The visual or "guess by eye" determination of a "plastic mix" is too indefinite for adoption as part and parcel of such a method.

The writer recognizes fully the importance of the water content of mortar and concrete mixes, both as regards its proper function and its influence when used in excess of that required for the fulfilment of that function. However, he is not prepared to believe that the interpretation of its full effect is based upon the relation of the water to the cement contained in the mix, that is, upon the water-cement ratio.

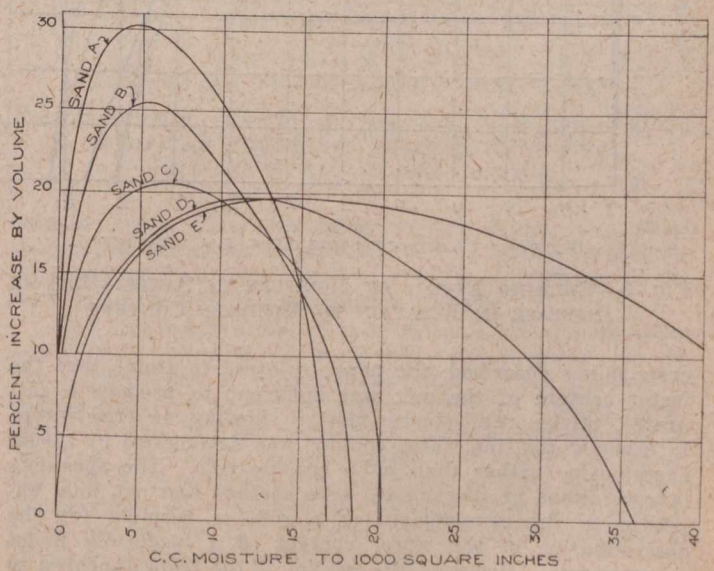

FIG. 2—BULKING EFFECT OF MOISTURE IN SANDS—VOLUME INCREASE IN RELATION TO AREA-WATER CONTENT

The fundamental principles of the surface area method of proportioning preclude the unqualified acceptance of this ratio. In so far as the surface area method is concerned, it is an indirect function rather than a primary one. It varies rather indirectly with the richness of the mortar or the concrete mix.