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Analysis of Concrete-Proportioning Theories

Data Upon Which Abrams' Fineness Modulus and Edwards' Surface Area Methods Are Based Show Validity of Water-Cement Ratio Theory and Demonstrate That Fineness Modulus Varies With Surface Area—Tests All Agree But Interpretations Differ

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IN the last eighteen months, much new information has been published on the laws underlying concrete mixtures, and at least two different methods of proportioning based on this new data have been proposed. These two methods, the "fineness modulus method" of Prof. Duff A. Abrams, and the "surface area method" of Lewellyn N. Edwards, have been described in detail in *The Canadian Engineer*. The two methods would seem to be conflicting. The discussion both for and against, which the publication of these methods has occasioned, and the direct contradiction of their basic principles made by the engineers of the Bureau of Standards, has further tended to strengthen this impression and to obscure the fact that the published data of the different parties to this controversy, if not the conclusions derived therefrom, are in striking agreement.

Prof. Abrams' method is based primarily upon a relationship which he has discovered between the compressive

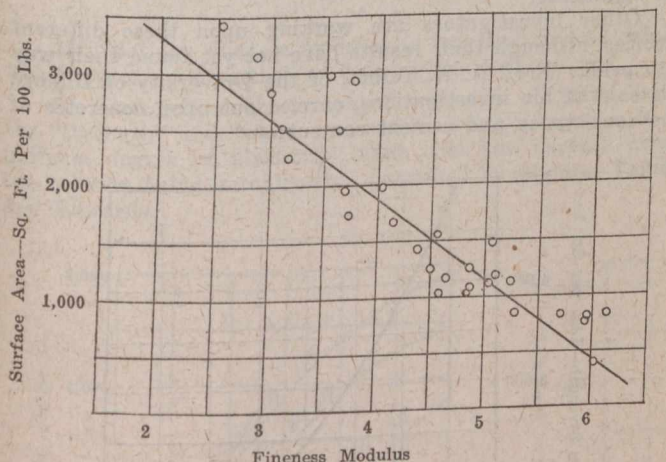

FIG. 1—RELATION BETWEEN FINENESS MODULUS AND SURFACE AREA OF GRADED AGGREGATES (FROM H. E. P. C. TESTS)

strength of a concrete and the ratio between the volume of water and volume of cement used in producing it. He claims that for given concrete materials, the strength depends on only one factor, the ratio of water to cement, called for convenience the water-cement ratio, that this relation holds so long as the concrete is workable, and that the character of the aggregate makes little difference so long as it is clean and not structurally deficient, and so long as proper account is taken of differences in their absorptive qualities. From this he concludes that the size and grading of the aggregate, and the quantity of cement, are of no importance except in so far as these factors influence the quantity of mixing water required to produce a workable concrete.

The fineness modulus of an aggregate is obtained from its sieve analysis. The percentages of material coarser than each of the sieves used, is summed and the result divided by 100. Prof. Abrams has standardized on a particular set of sieves, the basic sieve of which is the No. 100, having a sieve

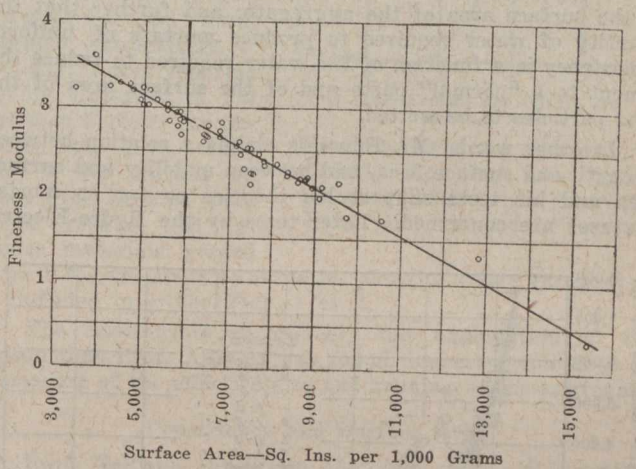

FIG. 2—MR. EDWARDS' DIAGRAM SHOWING RELATION BETWEEN SURFACE AREA AND FINENESS MODULUS

opening of 0.0058 in. In each succeeding sieve of the series, the opening is double the width of the preceding one.

Prof. Abrams claims that this fineness modulus enables one to interpret properly the sieve analyses of an aggregate, and that all aggregates of the same fineness modulus require the same quantity of water to produce a mix of the same

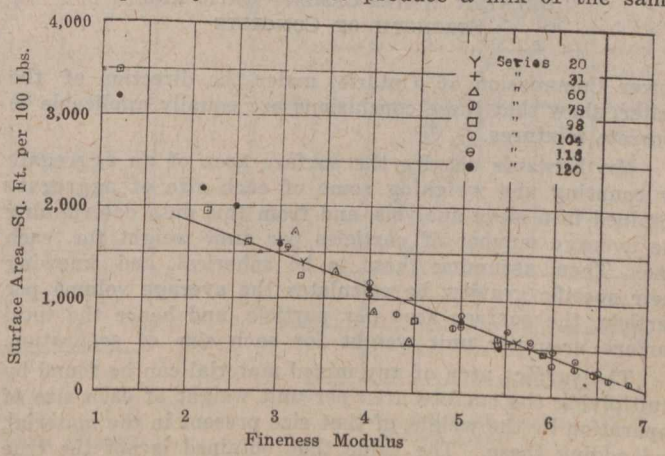

FIG. 3—RELATION BETWEEN FINENESS MODULUS AND SURFACE AREA—DERIVED FROM RESULTS OF PROF. ABRAMS' TESTS