From a consideration of the sources of irregularities in the field operation of measuring the sand content of batches of concrete two conclusions may readily be drawn. They are: That, with the present practice of volume measurement of aggregates, the most consistent results can be secured by maintaining the moisture in the sand as nearly uniform as possible, allowance being made for the "bulking" effect of this moisture; That the adoption of appliances whereby the sand content of the batches will be measured by weight rather than by loose volume will unquestionably result in an important increase in both the uniformity and the reliability of the concrete produced.

Concerning the former conclusion, it may be said that, since the maximum "bulking" effect for all sands adapted to concrete making is produced by a moisture content of 6% to 8% by weight, a simple test involving the measuring, drying and remeasuring of, say four cubic feet of sand, will determine a visual appearance indicating very closely this range of moisture content.

Concerning the latter conclusion, it will readily be seen that its application to field operations involves the construction of a comparatively simple weighing device into which the sand is shoveled and from which it is dumped by overturning into the barrows. The adoption of such a device would, under certain conditions, result in an economy of labor, since the operation of shoveling up the sand from the stock heap would be practically continuous.

### Consistency of Concrete

In a recent issue of *The Canadian Engineer* (May 1, 1919), Mr. H. M. Thomson, laboratory engineer, Greater Winnipeg Water District, in an article "Physical Properties of Mortars and Concretes," has called attention to the fact that water is thrown off from concrete mixtures, even when the water content is only slightly in excess of that required to produce a saturated, semi-plastic mortar, adhering freely to the particles of stone aggregate or, in other words, a concrete of a consistency that, although saturated, shows no free water when taken from the mixer. The quantity of water required to produce concretes of this consistency is dependent upon the quantity required to wet the cement and the quantity required to wet the surface of the sand and stone aggregates. Concerning the former, tests made by the author have shown that water will be thrown off from neat cement paste containing quantities of water approximately 4% in excess of those required to produce pastes of standard normal consistency.

Fig. 2 shows the method used to ascertain the consistencies of neat cement pastes at which the water content will not be entirely retained. The water stain left by the slight accumulations of water at the apexes of the trowel indentations are plainly visible in the photograph. This method was also used in similar investigations of mortars. However, it is not well adapted to the examination of lean-mix mortars which permit the water content to sink below the surface.

In a series of mortar tests made with the object of developing the surface area (Heath-Edwards) method of proportioning (see *The Canadian Engineer*, Vol. 35, page 5), it was found that the surface area of the sand bore a direct relation to the quantity of water required to produce "normal" uniform consistency mixes. Doubtless, the quantity of water required for uniform consistency concrete mixes, bears a somewhat similar relation to the total surface area of the sand and stone aggregates.

### Laboratory Testing of Concretes

For a proposed concrete structure the consideration of possible sources of supply of aggregates frequently involves the laboratory examination of the concrete making qualities of two or more different aggregates varying in their sieve analyses and other physical properties. The field conditions attending the mixing, handling, placing and finishing of the concrete, as well as the ultimate strength, toughness, etc., of the concrete producible from them require that the relative merits of these aggregates be determined under conditions eliminating variations in the relative plasticity and final strength of the cement matrix.

The surface-area method of designing concrete mixtures bears no direct relation to other methods which have been proposed from time to time. It is believed that this method more nearly fulfils the requirements of the complicated conditions attending both laboratory investigation and field construction work than does other methods. In this connection a comparison of the general characteristics of the "surface area" method with those of Abram's "fineness modulus" method, is of interest. The latter is fully described in a paper by Prof. Duff A. Abrams, published as Bulletin No. 1, Lewis Institute, Chicago, Ill.

| Materials and physical properties. | Fineness modulus method. | Surface area method. |
|---|---|---|
| Area of aggregates ..... | Variable | Variable |
| Cement ..... | Uniform | " |
| Water ..... | " | " |
| Consistency (plasticity) . | Variable | Uniform |
| Strength ..... | Uniform | " |
| Toughness ..... | Variable | " |

It is obvious from the above comparison that these two methods approach the problem of concrete design from quite different angles. It is believed that on account of simplicity of application to both laboratory and field operations, the surface area method is the more practical and tends toward greater economy, efficiency and excellence of results.

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## PUBLICATIONS RECEIVED

EXAMPLES IN MAGNETISM.—Third edition, 1919; published by Prof. F. E. Austin, Hanover, N.H.; price, $1.10. Ninety pages and cover, 4¾ by 7½ ins., illustrated; flexible binding.

ANALYSIS AND TESTS OF RIGIDLY CONNECTED REINFORCED CONCRETE FRAMES.—Published as Bulletin No. 107 of the Engineering Experiment Station, University of Illinois, Urbana, Ill. By Dr. Mikishi Abe; price, 50c; 106 pages and cover; 6 by 9 ins.; 59 illustrations and 16 tables. This bulletin presents a résumé of the analytical treatment of rigidly connected reinforced concrete frames and the principal results of the experimental work on reinforced concrete frames which were given in the thesis of Mikishi Abe as presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Engineering in the Graduate School of the University of Illinois, June, 1914. The work of condensation and reformulation necessary to bring the text within the space available for the bulletin was done by members of the department of Theoretical and Applied Mechanics, University of Illinois.

MIAMI CONSERVANCY DISTRICT.—Part VI. of the technical reports of the district has been issued, accompanied by an atlas containing 139 selected contract and information drawings, illustrating the principal features of the flood-protection system. Part VI. contains the district's standard contract forms and specifications for building the dams and channel improvements. It also contains the information originally printed for the use of bidders and lists of principal quantities involved in each section of the work. To date six volumes, or "parts," of the technical reports of the district have been published and others are in preparation. The problems attending the design and construction of the $27,000,000 flood-control works for the Miami valley required study and research work of an exhaustive character and some of the data published in these reports are entirely new and in other respects of a kind not available in convenient form elsewhere. A pamphlet describing these six volumes has been issued by the district (head office, Dayton, Ohio) and the volumes are being sold to the engineering profession at from 50c. to 75c. each and $1.50 for the atlas.