kneading and squeezing which forces the component materials into the closest possible contact with each other. In the field the mixing and frequently much of the work of transporting and placing tends to separate and break up rather than to knead and compact the mortar mass.

Field construction conditions are never ideal, even when carried on under the most careful supervision. In consequence, the strengths and other physical properties of field-made mortars and concretes frequently differ widely from the results obtained by tests made in the laboratory, in accordance with standard laboratory practice, with the object of obtaining a measure of the constructive value of the materials.

Coarse vs. Fine Sands.—Mortars in which the sand aggregate contains a comparatively large proportion of coarse particles are subject, during mixing and placing operations in the field, to an intensified movement of the water content which tends to produce an improper distribution of the cement. This condition is most noticeable in concreting operations.

When mixed to "normal" consistency, so-called well-graded sands do not produce mortars which are as "workable" as those in which the sand aggregate contains larger percentages of smaller sized particles.

As compared with mortars containing well-graded sand aggregate, mortars containing aggregates composed entirely of fine particles must be subjected to a greater amount of mixing in order to secure a uniform distribution of the cement by a thorough abrasion which will separate the fine particles of aggregate tending to cling together.

Wet vs. Dry Sand.—The amount of moisture existing in the sand aggregate constitutes one of the most commonly disregarded sources of variation in the strength of field-made mortars and concretes. Various tests have shown that the surface tension of the water film enveloping the sand particles holds the particles apart, thus producing a decided increase in the gross volume. Sands made up of fine particles, and in consequence having greater surface area, increase more in volume than coarse sands. It is evident that a disregard for this important factor may produce materials the ultimate strengths of which are quite different from those contemplated in the design.

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JOINT MEETING AT TORONTO

TWO addresses were delivered on Wednesday evening, July 3rd, at a joint meeting of the Ontario Section of the American Society of Mechanical Engineers and the Toronto Branch of the Engineering Institute of Canada. The meeting was held in the lecture room of the Engineers' Club, Toronto. Edward Maybee, a well-known patent attorney of Toronto, read a paper on "Patents of Invention," covering particularly the part of the patent field which is of interest to engineers. The second address was by Mr. Holmes, of the Invalid Soldiers' Commission, on "Training of Disabled Soldiers in the Industries."

ABRASION TEST FOR STONE, GRAVEL AND SIMILAR AGGREGATES*

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IT has been found that the standard Deval test for road materials is somewhat misleading in its results due to the retention within the abrasion chamber of the dust worn from the charge. This dust cushion would obviously decrease the rate of loss during the later stages of the test and would be more noticeable in tests of the softer materials than in those materials which yield little dust. The test described in this paper is devised to do away with this objection, and also to furnish a more rapid and practical test as well as a simpler machine.

The resistance of stone and gravel or other road materials to the abrasive action of service must be recognized as an important quality. The careful and wise selection of such materials would be considerably aided by a rapid and efficient laboratory test. The results of such a test should, of course, be studied in connection with the important test, that of service.

In 1916 the writer called attention to a seeming weakness in the standard Deval abrasion test for rock, in that the dust resulting from the abrasion is retained in the container and acts as a cushion to cut down loss in the later stages of the test. This is illustrated by the tests given in Table I., in which a medium stone and an extra soft stone were tested by the standard Deval machine.

Table I.—Tests to Show Effect of Dust in Deval Abrasion Apparatus

Kind of Test.	Wear, per cent.		Ratio of Soft to Medium.
	Medi m Stone.	Extra Soft Stone.	
Deval Test, regular (10,000 revolutions)	5.28	10.3	1.95
Deval Test with all dust removed after every 1000 revolutions	10.7	25.8	2 41

It is evident that the ratio in Table I. would be considerably larger if the container were so arranged as to remove the dust as fast as formed. This has been done with success in one or two laboratories.

A simple abrasion machine has been devised to do away with the objection. The machine is a small type rattler in which the dust and chips abraded from the sample escape between the staves as fast as formed. The opening between staves is 1/16 in. The abrasion chamber is octagonal in shape with a volume equivalent to that of the Deval cylinder.

Recent tests with this apparatus upon twelve Indiana limestones in the Laboratory for Testing Materials, Purdue University, are shown in Table II. In general, the new test gives a greater range of results and a consequent better differentiation of quality. The effect of the dust cushion in the Deval test is apparent in the more or less regular increase in the ratio of the results of the new test to those of the Deval test as the stones tested vary from hard to soft.

It became apparent from these tests that to shorten the time to a practical limit, it would be necessary to use an abrasive agent and to cut down the size of sample from 5,000 to 2,500 g. It also appeared from further

*Abstracted from paper presented to the Atlantic City convention of the Amerian Society for Testing Materials.