

# The Canadian Engineer

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## Effects of Grading of Sands and Consistency of Mix Upon the Strength of Concrete

Increment of Strength Developed Between Ages of Ninety Days and One Year Not Constant and Cannot be Predetermined—Excess Water Reduces Resistance to Abrasion and Shock—Paper Read Before American Society For Testing Materials

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THIS paper is primarily intended as a supplement to the writer's paper presented under the same title at the last annual meeting of the American Society for Testing of Materials.† The curves showing the compressive strengths of the test cylinders for both the "Tests for Grading of Sands" and the "Tests for Consistency of Mix" have been revised to include the strength of cylinders tested at the age of one year. The information relating to the effect of consistency of mix is augmented by the addition of the results of a test made to show the decrease of the resistance to abrasion and shock resulting from the inclusion of a water content in the mix in excess of that required "to produce a concrete, the mortar component of which is of a saturated, sticky, semi-plastic consistency."

In 1917 a series of tests was made by the City of Toronto, Department of Works, to secure information relating to the strengths to be obtained from concretes in which gravel was used as aggregate. The description of materials, methods, etc., together with the results secured from these tests, are fully described in an appendix to this paper. The sand and gravel used came from the same pit as did the sand used in the 1916 broken-stone concrete tests. All tests were made under the direct supervision of the writer.

†Capt. Edwards' previous paper was printed in full in *The Canadian Engineer*, issues of August 16th, August 23rd, August 30th and September 6th, 1917.

In plotting the curves showing the compressive strengths of test specimens for ages of 90 days and under, the strengths obtained from the 90-day tests were in all cases assumed to be unchangeable and in a few cases slight variations from plotted strengths at 7, 30 and 60-day ages were made to secure uniform, even curves. In revising these strength curves to include the 1-year test strengths it has been found advisable, in a few cases and for the same reason, to vary from the plotted strengths at 90 days.

*Tests for Grading of Sands.* Fig. 1 shows the compressive strengths obtained from the tests of the cylinders in which the twelve specially graded sands were used.

*Tests for Consistency of Mix.*—Fig. 2 shows the compressive strengths obtained from the tests of the cylinders in which the consistency of mix

was varied from a sticky, semi-plastic to a very wet condition. In relation to the total weight of the cement and aggregates the quantity of water used in the first consistency mix was 6.17 per cent. or the 1:2:4 mix and 5.99 per cent. for the 1:2½:5 mix. This quantity was increased by 10, 20, 35 and 50 per cent., respectively, for each succeeding mix.

In the previous paper mention was made of the condition that "the inclusion of a greater quantity of water than is required for the development of its natural functions is decidedly detrimental to the strength and reliability of the final concrete," and photographs were

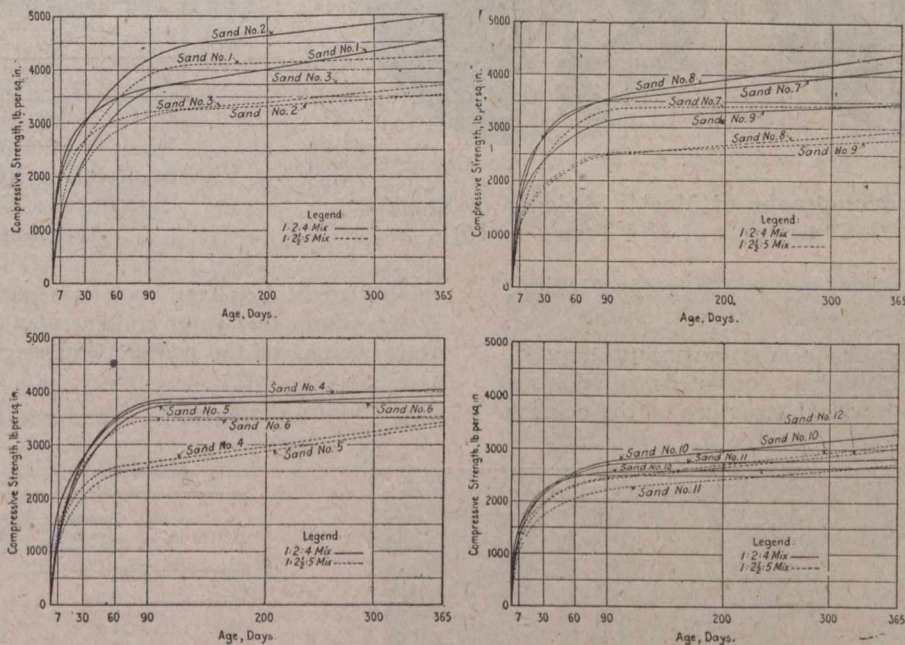


Fig. 1—Compressive Strengths of Test Cylinders: Grading of Sands Test