

Abrasion Tests.—If the relation between the number of revolutions of the specimen and the traffic were known it would be possible from the test to determine how long a concrete road could be expected to be satisfactory. It does not seem unreasonable to suppose that the effect of one revolution of the specimen is equivalent to that of ten steel-tired vehicles. Certainly the tests show this in a relative sense, which is quite satisfactory.

One of the most important factors in road construction is to procure a surface that is uniform and will wear uniformly. Especially is this true with a rigid road such as concrete makes. It should be smooth enough to allow the vehicles to roll over the surface without appreciable impact, and yet rough enough to afford a horse good footing, especially in wet weather and upon steep grades. It is, therefore, just as important to know the character of the surface of the concrete after the test as it is to know the numerical loss.

The Gravel Aggregate.—The surface of most of the gravel concrete specimens was rough. Such gravel specimens as No. 2930-A and No. 2732, containing pebbles of varying hardness, produce a surface in which the hard flints wear but little, while the softer limestones wear equally with the mortar. In many cases these flints protrude as much as $\frac{1}{2}$ in. above the surrounding surface. Other gravels, such as No. 2765, are composed of pebbles of equal hardness. However, they are so much harder than the surrounding mortar that the latter wears much faster than the stones, causing a somewhat uniform, but extremely rough, surface. The hard stones are knocked out, causing more than normal pitting and loss in the specimen. An exception to the general run of the gravels is one such as No. 2872, composed of limestone and sandstone pebbles only, which have approximately the same hardness. In this case the pebbles themselves were but little, if any, harder than the mortar, and consequently the specimen wore surprisingly uniformly. In this particular instance it should be noted that the gravel contained no pebbles over $1\frac{1}{4}$ ins. in size, which undoubtedly influenced the satisfactory condition of the surface.

Crushed Stone Aggregates.—Where crushed limestone was used as the coarse aggregate the surface as a rule was smooth and uniform. The limestones tested were all comparatively soft and they wore equally with the mortar. In specimens where the aggregate contained some large stones (No. 2830) the surface became somewhat wavy, due to the fact that the larger stones did not wear as fast as the smaller ones. In those specimens in which the aggregate was below $1\frac{1}{2}$ ins. in size the surfaces were very satisfactory. In one or two of the specimens that contained some very soft stones there was a tendency for these stones to be pitted. This, however, does not seem to be any serious disadvantage.

With the crushed trap rock specimens the results are interesting. The stone is a basalt, having high resistance to abrasion in the Deval machine, and very tough. Trap rock from the same quarry was used in all the tests. In the 1:2:4 concrete specimens the mortar wore faster than the stone, giving the surface a distinctly mosaic appearance. This was more noticeable with the larger sized aggregates.

In the 1:1½:3 concrete specimens the mosaic appearance of the surface was still apparent with the larger sized aggregate; but with that graded only to 1 in. the surface was very satisfactory, having but few protruding stones. This latter specimen also had a high resistance to abrasion.

The specimen in which slag was used for the coarse aggregate (No. 2889) had a rather high resistance to abrasion and a fairly uniform surface. It is believed that if this aggregate were limited in size to about $1\frac{1}{4}$ ins. the surface would be very smooth. The surface appeared rather porous when enough of the slag fragments had been worn away to expose their interior. From this apparent porosity of the specimen it would seem that it should make a satisfactory surface for a treatment of asphalt or tar.

Tension Tests.—From the results obtained it is apparent that no relation exists between the compressive and tensile strengths of any given concrete. When the limestone concrete fails in tension practically all of the stones are broken, but with gravel there is always quite a number of stones that are pulled out rather than broken. The number broken depends upon the smoothness of the stones, but even with the very smooth stones a good proportion of them break.

It is preferable that the tensile strength of concrete for road construction shall be obtained by using superior aggregates rather than additional cement, because the contraction due to setting of the concrete increases with the amount of cement, which tends to nullify the extra strength obtained.

CHRISTMAS CARDS AND TOBACCO TO MEMBERS OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS ON ACTIVE SERVICE

The Canadian Society of Civil Engineers has over 800 of its members in khaki, over fifty of whom have been killed. The society is sending to each of the men whose addresses are available to the number of 600, a parcel of tobacco and cigarettes, each package to be accompanied by a neatly printed Christmas card. The message on the card is addressed to "The Men on Our Honor Roll," and reads as follows:

The Council and Members of the Canadian Society of Civil Engineers desire to express to you their heartiest greetings and best wishes for your good health and well-being.

Your fellow members at home have a very definite appreciation of the good work you are doing, both for the profession and for the Empire. You have sacrificed much, risked much and done much to make us all proud of you. Your name has been inscribed on the Honor Roll, to hang for all time on the wall at the headquarters of the Society, as evidence of the fact that you have done your share in fighting for the Empire and for civilization.

It gives me much pleasure to convey this message to you, as well as the parcel herewith, which expresses in a very slight degree our high regard and the esteem in which you are held.

The card is signed on behalf of the society by the secretary, Fraser S. Keith.

The port of Antofagasta, Chile, is to be improved by the government at a cost of \$8,273,000.