spading and working. When 24 hours old all surplus water was removed from the top of the cylinder and the surface was roughed to receive a 1 : 2 mortar cap. After capping, the specimens were covered with a damp cloth and at 48 hours age the moulds were stripped. The specimens were then placed in water tank. Those for 28-day test were kept in the tank until a few hours before testing, while those for 90-day test were placed in air after having been kept in water for a month.

The forty-seven crushing test specimens were broken in the University of Manitoba Testing Laboratory; a 200,000 lb. Riehle testing machine equipped with spherical bearing head was used.

Permeability Tests.—Twenty-nine permeability specimens were made up from a corresponding number of mixtures. These specimens consisted of cylinders 13 ins. in diameter and 14½ ins. long. A 2-in. pipe with stop-water and lock-nut was cast 7 ins. into the specimen and led to a pressure chamber 2 ins. deep by 2 ins. in diameter. Galvanized iron cans were used for outside forms and a brass plug was used as a form for the pressure chamber. The mixture, which was of medium consistency after mixing in a cube mixer, was placed in the form with sufficient working to ensure a uniform distribution of material throughout the mass. As soon as the concrete had set, the brass plug used for forming the pressure chamber was withdrawn and the surface of the pressure chamber was scraped with a chisel and a wire brush. Water was then placed in the pipe in the specimen and over the top of the specimen in the can. When ready for testing, the galvanized outer form was removed and the pressure chamber was washed out, after which Ottawa sand was placed in the pressure chamber.

The quantity of cement per cubic yard of field concrete has been more than that used in a number of laboratory specimens which showed that impermeable concrete could be obtained with certain aggregates, using one barrel of cement per yard of set concrete. Under field conditions there are variations in the grading of the sand and of the gravel in the aggregate and variations in field proportioning due to slight segregation on platforms and due to irregularities in measurement, that require an additional quantity of cement to insure impermeable concrete. The field mixture adopted of 3 bags (87½ lbs. each) of cement to 16 cubic feet of loose aggregate was chosen to give a concrete having a mortar with 1 part of cement by weight to 3 parts of dry sand, when the aggregate contained moisture and when the sand in the aggregate was as high as 40 per cent. by weight of the aggregate. Due to the field variations set out above, the actual quantity of cement per cubic yard of set concrete of the standard mixture varied from 1.25 to 1.38 barrels.

Conclusions.—From observation of these tests it was concluded that with lean mixtures and with the gravel materials available, the addition of fine sand would give for the work contemplated impermeable concrete of desired strength.

The McCorkell Gravel Deposit, District Pit No. 1.—Among the gravel deposits investigated during the summer and fall of 1914, the McCorkell pit, situated close to the District railway at Mile 31, appeared from examination of some 38 test pits thereon to be a desirable source of supply for concrete aggregate. It appeared to contain large quantities of gravel with a well-graded sand. The southeast corner of the deposit contains fine sand. The oversize present is available to give on crushing, stone to satisfy much of the surplus sand in the deposit. This pit was secured by the District and opened up in the spring of 1915. As the pit was opened up it became evident that the deposit was more irregular than had been shown by the test pits. It also contained more surplus sand than had been anticipated.

The cement which was required to be tested by standard methods of the Canadian Society of Civil Engineers, and to conform to District Specifications (which are similar to those of the American Society for Testing Materials), for acceptance was given the following tests in the District Laboratory in the Boyd Building:—

(1) Every sample was tested for soundness.

(2) Every third sample from the belt was tested for fineness, time of set, tensile strength neat, and with three parts by weight of standard Ottawa sand.

(3) One test per bin was made for specific gravity; some long-time tests were also made.

The cement supplied was of first-class quality, and not a single car had to be turned down for failure to pass tests.

The cement was shipped from the cement plant daily as required to G.W.W.D. siding at Paddington Transfer. Every Monday, Wednesday and Friday the car load lots as required were hauled out by District train and spotted at the contractor's field store houses. Here they were unloaded by the contractors, and the empty cars were collected the following day on the return trip of the train. A cement storehouse of 6,000 barrels capacity was located at Deacon to ensure against interruption in supply to the contractors.

Aqueduct Concrete.—The concrete was mixed to a wet consistency for the arch, and to a mushy consistency for the invert. On water-bearing foundation the invert concrete was poured drier and was tamped into place. The invert was shaped to the profile form by means of screeds formed from 3½-in. x 3-in. x ¼-in. angles 16 ft. 0 in. long, provided with handles at each end so that each could be handled by two men. A smooth finish was given to the surface by floating and trowelling.

Different methods were tried by the contractors to obtain the required smooth finish on the inside of the arch, free from pittings due to air bubbles or drops of water. The best results appeared to be obtained from the use of a wet mixture with careful spading. Too much or too energetic spading resulted in the inclusion rather than the expulsion of air.

The time of stripping forms depended on the temperature of the air, on the wetness of the concrete as poured, and varied also with the season. By artificially heating the interior of the arches the forms could be stripped at early periods. In good weather in the summer months the outside arch forms were stripped in twelve hours and the interior forms in 24 to 48 hours after pouring.

The 3 : 16 mixture gave better results than the sandier mixtures, which were more difficult to work due to the larger quantities of water required for proper consistency.

Field tests for permeability on various sections of completed aqueduct were made under natural working heads. No signs of leakage were found except slight seeping at the arch joints and through the grout in occasional form-spacing bolt-holes which showed slight signs of dampness.

Permeability tests were made on two pieces of concrete taken from an arch removed on account of structural defects. The mixture used for this arch was the adopted field mixture of three bags of cement to 16 cubic feet of aggregate. The arch had been poured on October 13th and was removed on October 22nd and 23rd. One of the blocks was taken from the concrete underneath the chute

(Continued on page 344.)