the most straightforward beams and floor slabs, at least half the bars are bent upwards from the points of contraflexion and carried over the supports. The polygonal form so obtained ensures the most secure anchorage possible.

IV.—Portland Cement.

The quality of Portland cement used in ferro-concrete is of the greatest importance. The author prefers cement of the finest grinding, giving not more than a 20 per cent. residue on a 180 by 180 mesh sieve. The fineness of grinding after calcination is not a very conclusive test by itself. It would be better to have evidence of a very intimate mixing of the chalk and clay before calcination, but such a test would be very difficult to supervise, and in practice the best one can do is to see that the cement is delivered to the requisite fineness. The permissible expansion specified by the author under the Le Chatelier test is only half of that allowed by the British standard specification—viz., 6 mm. and 3 mm. fresh or seven days old. The time of setting should be from fifty to ninety minutes initial, and from seven to nine hours final.

Test blocks of 4-in. cube are required to stand the compressive stress of 600 pounds per square inch at the age of twenty-eight days.

V.—Sand.

The sand to be used for cement mortar and concrete is specified by the author to be sharp and coarse, of all sizes from ⅛-in. downwards, and to be washed perfectly free from all traces of chalk, lime, clay or earth matter. Sand of even size like "standard" sand is undesirable.

VI.—Aggregates.

The aggregate for the concrete should consist of the hardest local stone obtainable other than limestone, which is not admissible owing to its disintegrating under heat. Brick, cinder, coke breeze or slag concretes should be avoided for reinforced concrete work, as the concretes made with such materials are porous, or, as in the case of many slags, corrosive, owing to the sulphates and similar impurities in the material itself. Judging a slag from a chemically pure sample is not safe, for, as the nature of the charges in the furnaces vary, the slag from the same ironworks may not be the same quality for many hours together.

In the choice of stone, a rounded shingle or gravel of hard stone is preferable to broken stones, as so many stones have a flaky cleavage, and the rounded pebbles make a more even and sounder concrete than these flaky pieces owing to the ease with which the sand and cement can fill the voids.

For ferro-concrete construction the author is in the habit of specifying that the aggregate shall be of all sizes from ¾in. down to ⅛-in. As in the case of sand it is highly important that the aggregate should be perfectly free from earthy matter of any kind.

VII.—Proportions of Concrete.

The proportions of the materials for reinforced-concrete necessarily vary with the character of the work to be executed.

In all engineering construction strength and durability are the most important considerations, but it is very often necessary, as in the case of pipes, reservoirs and marine constructions, to pay special attention to the question of impermeability. For resistance to fire it is well-known that iron and steel are adequately protected when embedded in good stone or gravel concrete.

The voids in the sand should be ascertained by filling a receptacle with perfectly dry sand, and measuring the amount of water it is possible to add without overflowing; then it is easy to calculate the voids as a percentage of the sand. The percentage of voids in the aggregate can be determined in a similar manner. As the proportion of voids differs very much with the class of sand and stone, and the size and shape of the particles, it is desirable to test the percentage of the voids before arranging the exact mixture to be used in any work.

The average mixture adopted in reinforced concrete construction is as follows:

Portland cement	6	cwt.
Sharp sand	13½	cubic feet
Washed gravel	27	cubic feet

These quantities when properly rammed yield about 31 cubic feet of concrete.

VIII.—Concrete Mixing.

The proper mixing of the concrete is of the greatest importance, and as good concrete may be improved 100 per cent. in strength by thorough mixing, it is preferable to employ a good machine mixer than to attempt to do this work by hand. The machine is certain to do it all alike, whereas no workman, however much he is looked after, can perform the operation so effectively. The concrete mixture should be just plastic, and must always be well rammed.

OBITUARY.

The death occurred on November 28th, following a minor operation, of Robert Frederick Tate, resident engineer for Mackenzie, Mann & Company. Deceased was born in Belleville, Ont., in 1854, his father's headquarters during the construction of the Grand Trunk Railway in Canada, who was in charge of the work between Kingston and Toronto. He was a born engineer, having inherited mechanical instinct from his father, who was a trained civil engineer. He started his career in railway civil engineering, and his thirty-seven years of actual professional life were spent almost exclusively in that branch. He commenced business at the age of sixteen with a contractor in the construction of bridges on the Toronto and Nipissing Railway. A year later he entered the employ of the Midland Railway of Canada (now part of the Grand Trunk system)

R. F. Tate.

as a chainman on surveys. Five years later he was appointed chief engineer, and held that position for five years, when he retired to seek a wider field for experience. In 1893 he located the line of the British Columbia Southern Railway from the summit of Crow's Nest Pass to Tobacco Plains in East Kootenay, on the international boundary. He was also engineer in charge of a portion of double track of the Grand Trunk Railway in their Sarnia tunnel, connecting from Blackwell to the east end of the tunnel yard. In 1899 he was appointed resident engineer for MacKenzie, Mann & Company, with headquarters at Toronto, which position he held up to the time of his death. He was fifty-three years of age, was a charter member of the Canadian Society of Civil Engineers, was president of the Engineers' Club, Toronto, during 1905, and was a member since its inception.

DR. BERNARD J. HARRINGTON, director of the Macdonald chemistry and mining building of McGill University, died on November 29th. He was a graduate of McGill, and had been connected with the teaching staff of that institution for 36 years.