## SPECIFICATIONS FOR CONCRETE MASONRY IN HIGHWAY BRIDGES.

N September 11th issue of The Canadian Engineer there appeared under the heading "Typical Specification for Steel Highway Bridges," a portion of a set of typical specifications issued by the Department of Agriculture of the United States. The bulletin contains, in addition, a few specifications governing the use of concrete in masonry. Generally, it requires the concrete to be prepared and mixed in very strict accordance with specifications and plans, the cement to be of satisfactory standard conforming with Government specifications, not to contain lumps or any indications of exposure.

Aggregate.—The sand is required to consist of dry, clean, quartz grains and not to contain more than 5 per cent. of clay, loam, or other foreign materials. The grains shall be well graded and of such size that all will pass a <sup>1</sup>/<sub>4</sub>-inch mesh screen and not more than 20 per cent. will pass a No. 50 sieve.

The coarse aggregate may consist of either broken stone or gravel. Stone shall be sound, hard, and tough, broken to the sizes hereinafter specified, and when used shall be free from foreign material. No weathered or disintegrated material shall be used. Gravel shall be composed of hard, sound, durable particles of stone, thoroughly clean and well graded in size between the limits specified below.

Unless otherwise especially provided, there shall be three classes of concrete, known as class A, class B, and class C.

Class A concrete shall consist (by volume) of 1 part of cement, 2 parts of sand, 4 parts of coarse aggregate, and water. All of the coarse aggregate shall be retained on a  $\frac{1}{4}$ -inch mesh screen and shall pass a 1-inch mesh screen. Not more than 75 per cent. shall be retained on a  $\frac{1}{2}$ -inch mesh screen, and not more than 75 per cent. shall pass such a screen.

Class B concrete shall consist (by volume) of 1 part of cement,  $2\frac{1}{2}$  parts of sand, 5 parts of coarse aggregate, and water. All of the coarse aggregate shall be retained on a  $\frac{1}{4}$ -inch mesh screen and shall pass a  $1\frac{1}{2}$ -inch mesh screen. Not more than 75 per cent. shall be retained on a  $\frac{3}{4}$ -inch mesh screen, and not more than 75 per cent. shall pass such a screen.

Class C concrete shall consist (by volume) of 1 part of cement, 3 parts of sand, 6 parts of coarse aggregate, and water. All of the coarse aggregate shall be retained on a  $\frac{1}{4}$ -inch mesh screen and shall pass a  $2\frac{1}{2}$ -inch mesh screen. Not more than 75 per cent. shall be retained on a  $1\frac{1}{4}$ -inch mesh screen, and not more than 75 per cent. shall pass such a screen.

Mixing.—The cement and sand shall first be thoroughly mixed dry, in the proportions specified, on a proper mixing platform. Sufficient clean water shall then be admixed to produce a pasty mortar. To the mortar thus prepared shall be added the proper proportion of coarse aggregate, previously drenched with water, and the whole shall be mixed until every particle of the coarse aggregate is thoroughly coated with the mortar. Instead of the above method a mechanical mixer satisfactory to the engineer may be employed.

Concrete shall be mixed in batches of such size that the entire batch may be placed in the forms by the force employed within 45 minutes from the time that the first water is applied. No concrete is to be prepared from mortar which has taken an initial set and would require retempering.

**Placing.**—All concrete shall be carefully deposited in place and never allowed to fall from a height greater than 5 feet. Concrete shall never be deposited in running water, nor in still water, except under the direction of an engineer skilled and experienced in that special work.

As fast as concrete is put into place it shall be thoroughly tamped in layers not more than 6 inches thick, and the portion next to the forms shall be troweled by using a spade, or by other means, to bring the mortar into thorough contact with the forms.

Concrete shall not be deposited when the temperature of any of the materials composing it is below  $35^{\circ}$  F.; and if during the progress of the work freezing temperature threatens proper precautions shall be taken to protect from freezing all concrete laid within the four preceding days.

Forms shall be so constructed as to continue rigidly in place during and after depositing and tamping the concrete. If during the placing of the concrete the forms show signs of bulging or sagging at any point, that portion of the concrete causing the distortion shall be immediately removed and the forms properly supported before continuing the work. The amount of concrete to be removed shall be determined by the engineer, and the contractor shall receive no extra compensation on account of the extra work thus occasioned. Forms for exposed surfaces shall be constructed of dressed lumber.

All forms shall be left in place not less than 36 hours and all supporting forms not less than 10 days after the concrete has been deposited. These periods may be increased at the discretion of the engineer in charge.

It is understood that all prices for concrete masonry shall include furnishing all materials and properly constructing all necessary forms.

When the work of laying concrete is to be interrupted for a period greater than one hour and there are no reinforcing rods projecting, provision for a joint shall be made in the following manner: Square timbers 8 by 8 inches, or some other suitable size approved by the engineer, shall be bedded in the concrete throughout the length of the course for one-half their thickness and allowed to remain until the concrete has taken its initial set. When the work of laying concrete is resumed, the timbers shall be removed and the surface thoroughly wet. No joints will be permitted in reinforced-concrete beams, and in floor slabs the joints shall be vertical and parallel to the main reinforcing bars.

Forms covering surfaces of the concrete masonry which are to be exposed shall be removed immediately after the expiration of the period of time necessary for such forms to remain in place, as fixed by the engineer, and all crevices which may appear shall be filled with 1:2 cement mortar. These surfaces shall then be finished with 1:2 cement mortar and a wooden float, so as to present a smooth, neat appearance.

Reinforced Concrete.—All reinforced arches, beams floors, parapets, guard rails, and all concrete masonry measuring less than 9 inches in thickness shall be made of class A concrete, unless otherwise specified on the drawings or directed by the engineer in writing.

Unless otherwise specified on the drawings or in writing by the engineer, class B concrete shall be used for all abutments and wing walls the thickness of which is not less than 9 inches.