

MUNICIPAL DEPARTMENT

CONCRETE CULVERTS.*

BY A. W. CAMPBELL.

(Continued from last issue).

The stone arch is designed on the principle that it will remain in place without the use of mortar. The concrete arch, on the other hand, is a monolith, dependent upon cohesive strength points to the necessity, in construction, of a generous proportion of cement, very great care in mixing the concrete, and a good quality of all materials employed.

A concrete can best be regarded as a mixture of mortar and broken stone, the

mortar being formed from a mixture of sand and cement. Given a sample of broken stone in a vessel, the requisite quantity of mortar can be gauged by pouring water into the vessel until the stone is submerged. The quantity of water used will indicate the amount of mortar required to completely fill the voids in the stone. The proportionate amount of cement needed to fill the voids in the sand can be gauged in the same way. The proportions of cement, sand and broken stone obtained in this way would provide, with perfect mixing, a mortar in which the voids in the sand are filled with cement and each particle of sand is coated with cement; it would provide a concrete in which the interstices of the stone are filled with this mortar, and each stone coated with mortar. This would be the case with perfect mixing, and would provide a theoretically perfect concrete. Perfect mixing is not possible, however, and it is necessary to provide an amount of cement in excess of

the voids in the sand, and an amount of mortar in excess of the voids in the stone.

With proper mixing and good materials, a satisfactory concrete for bridge abutments can be formed from cement and broken stone, in the proportions of one, three and six. It is recognized that the greatest strength in concrete can be obtained by making the mortar rich in cement, rather than by lessening the quantity of stone, but beyond providing for a strong adhesion of mortar and stone, little is gained by making the mortar materially stronger than the stone. The foregoing applies to crushing strength, however, rather more than to the tensile strength required to some extent in the arch. For the arch proper, it will be well to use a richer concrete, in, say, the proportions of one of cement, two of sand and three of broken stone.

The cost of abutments may be lessened, where they are of sufficient thickness, by the use of rubble concrete. The casing or

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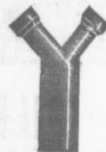
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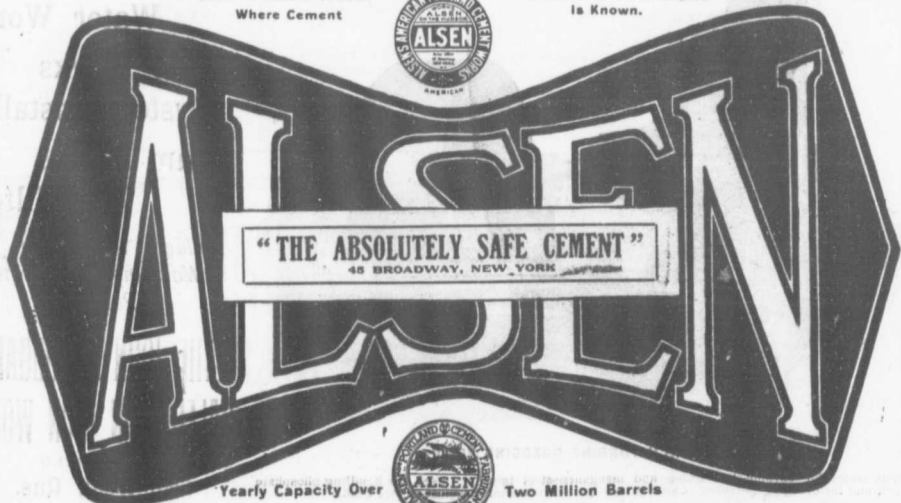
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