

MUNICIPAL DEPARTMENT

HIGHWAY CULVERTS AND BRIDGES*

By A. W. CAMPBELL, Ontario Road Commissioner
(Continued)

With regard to the masonry, first-class hydraulic cement should be used. The arch stones should be full-bedded in cement, and each course afterwards thoroughly grouted. Each stone should be cleaned and dampened before being placed in the arch. Improperly dressed stones should be re-cut, as no hammering should be allowed after the stones are set. The ring-stones should be dressed into a wedge shape, so that they will radiate truly from the centre of the circle, and should be so dressed that the joints need not exceed three-eighths of an inch in width. The ring-stone should be of such thickness as to expose ten inches on the inside or face of the arch. The exterior of the arch should be flushed with one inch coat of cement and the surface then smoothed off.

Arch-culverts and bridges of cement-concrete can be more cheaply constructed than can masonry arches, and, if careful workmanship is employed, are quite as serviceable. They are formed by constructing a curbing and thoroughly ramming the concrete into it in successive layers. The manner of mixing the concrete depends on the character of the cement used, some cements being slow setting, others quick setting; some will set well in water, while others will not; some will allow a considerable proportion of water to be used in forming the mortar, while other cements should be but slightly moistened.

One feature in connection with concrete culvert work is that, with the curbing and centres in place, an intelligent workman can, by following the instructions of the engineer, lay the concrete. Manufacturers complain that masons, in the great majority of cases, entirely disregard the instructions given them with respect to the mixing of cement, and follow their own methods of mixing common mortar, while a man totally unaccustomed to work of this description will obey instructions carefully and minutely. Concrete cannot be mixed and put in place like common mortar, and by overlooking this fact, much concrete work has failed, and has brought the material into disrepute in some localities.

BRIDGE ABUTMENTS.

The most substantial substructures of bridges are of either stone or concrete. In their construction sufficient excavation must at first be made to properly contain the abutment, and this earth may be re-filled again so as to form the approaches to the bridge.

The excavation completed, when concrete is used in whole or in part, the portion thus constructed must be boxed and curbed in a substantial manner the exact size and shape required. After the concrete has set, this boxing is removed and earth filled in solidly around the face of the abutments. Hammer dressed stone should crown the concrete to form a bridge seat.

Concrete should be composed of a first class cement, a clean sharp silicious sand entirely free from earthy particles and coarse enough to pass through a twenty mesh and be retained on a thirty mesh sieve: clean screened gravel, the largest

not to be more than two and one half inches in diameter, or in place of gravel, broken stone that will pass through a two inch ring. These materials should be mixed in the proportion of one of concrete, two of sand, and three of gravel or broken stone, with just sufficient water to form a plastic mass. The sand and cement should first be thoroughly mixed when dry, then water added to make a thick paste, and this thoroughly mixed again. This mortar is then spread out and the stone or gravel added, when the whole is mixed together until every stone is thoroughly coated with mortar. When this is done the concrete may be put in place and should be spread out and pounded until the excessive moisture appears on the surface.

Masonry abutments should be of rock-faced ashlar, first class in every respect. The projection of the rock-face should not be more than three inches from the line of pitch. The stone used should be approved quarried stone laid on their natural beds, and all beds of stone dressed parallel and true, the bed to be always as large as the stones will admit. Vertical joints should be dressed not less than twelve inches in from the face, and as much as the stone will admit, and particular care must be taken to have them well filled with mortar. Joints should in no case exceed one half of an inch in thickness. The courses ordinarily should not be less than eight inches in thickness. Each course should be dressed before laying, and not be moved after being laid, or if moved, should be taken up, cleaned and re-laid again in fresh mortar. The stones and work should be kept free from all dirt that will interfere with the adhesion of the mortar. Stones ought to be sprinkled with water before being placed in the work. Every stone must be laid with a full bed of mortar and beaten solid. Spaces in the vertical joints back from the face have to be built up, thoroughly grouted, and each course finished off so as to be perfectly solid. Stretchers should be two and one half feet in length with a depth of one and one half times the height.

Headers should be built in each course at least every four feet apart, and so arranged with the adjoining courses as to leave them equally distributed over the face of the structure. They should have a length in the face of the work of at least two feet and a depth of at least twice their length, unless the wall will not admit of this proportion, in which case they will pass through from side to side of the wall. The backing or filling ought to be of good sized stones, and of such shape and so arranged that they will break joints and thoroughly bond the wall in all directions, and leave no space of more than six inches in diameter. All spaces must be filled in with small stones and spawls laid in mortar and thoroughly grouted.

The coping stones should be of the necessary sizes and shapes, well bedded and closely jointed. The upper surface should be bush-hammered and the face and corners brought to a true line. A tail wall, if built upon each abutment, may be of rubble stonework.

All mortar used in the masonry should be composed of clean sharp sand and an approved brand of cement. It should be of the best quality and freshly ground. The cement and sand for the mortar should be mixed in the proportion of three parts of sand by measure and one part of cement, the mortar to be made in a box or on a floor, and in no case on the ground. The ingredients should be mixed thoroughly in a dry state, and the proper amount of water added afterwards and again thoroughly mixed. It must be used directly after mixing, or if not used within one hour after mixing should be discarded.

(To be Continued.)

Mr. Geo. Stewart, of Otonabee, has been appointed clerk and treasurer for the county of Peterborough.

Mr. A. W. Campbell, instructor in road-making, says that after a test at Petrolia the Southern system of using crude oil in road-making has been found unsuitable to Canadian climatic conditions.



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* Paper read before the Association of Ontario Land Surveyors.