## ENGINEERING DEPARTMENT.

A. W. CAMPBELL,
O.L.S., C.E., M.C.S., C.E.

### Culverts and Bridges.

The majority of Canadians, when visiting Europe, are impressed with the durability and solidity which characterizes the structures of that country. Private residences are built to withstand the wear of centuries. Cathedrals, public halls, libraries and similar civic institutions are constructed, not merely for the present, but for future generations. Among the works marked by this durability are to be classed the public highways with all that pertains to them. Canada, in this regard, presents a very unfortunate contrast.

It can justly be argued that Canada is a very young country, and that England is a very old country; that Canada is not a wealthy country, and that England is a very wealthy country. While England is, in a way, a very old country, yet it is not so much older than this country in the arts of civilization which should teach our citizens and municipal councils the necessity for and the means of wisely spending money in permanent improvements. And while England is a richer country than Canada, that greater degree of wealth has been brought about, to some extent, by the very durability which we have so long avoided. Permanent improvements are the cheapest. Structures which need props and repairs within a year or two after they have been built, seem to be in a chronic state of starvation, with a ravenous appetite for money. Canadians have not yet entirely outgrown the idea that they live in a pioneer land, where the needs of the present entirely overwhelm the future.

In nothing is this temporary building more apparent than in our highways; and in no detail of our highways is it more striking than in the matter of bridges and culverts. At the same time there is no portion of the making of a road that offers more scope to the roadmaker than in providing substantial and permanent waterways. Instead of the handsome stone and concrete arches that span so many of the streams intersecting the highways of England, there are to-day in this country scores of wooden boxes and trusses—flimsy, disjointed, unsafe; the constant source of accident, and the bottomless pit into which councils are annually throwing money in a vain endeavor to keep them in repair.

There is no departure which would more enrich the highways than the general use of stone and concrete for the construction of bridges and culverts. They cost more in the first instance, but the longer life, the fewer repairs needed, the greater convenience, and lesser liability to accident, render them in every way desirable.

In the construction of a stone arch, the first consideration is the foundation. The depth to which the excavation must be made will depend chiefly on the span of the arch, and the nature of the natural soil on which it will rest. The chief object is that it shall be secure. If bed rock comes to the surface it may be safe to rest the base of the arch upon it without any further excavation. A firm hardpan may exist a short distance below the surface of the ground. But a quick-sand, or other insecure footing, may necessitate the sinking of piles, or the placing of a wide and, perhaps, deep concrete base. But the foundation must be sufficient to provide that the washing of water cannot undermine it, that the lateral thrust of the embankments cannot move it, nor that the weight of loads cannot cause it to sink. No more definite rule can safely be given than to make the most of local circumstances, with always a fair margin for safety.

Full-centre arches, that is, entire semi-circles, are easily formed, possess great strength, and have little lateral thrust, but with wide spans, they necessarily rise to a correspondingly great height, and cannot always be employed. A segmental or flat arch will lessen the rise, but has a considerable lateral thrust which necessitates very strong abutments. A compound arch, made up of a number of different circles, when rightly proportioned, combines the advantages of the two, reducing the height, lessening the lateral thrust, and at the same time having an excellent appearance.

The thickness of the arch depends on a number of details, the chief of which are: the form and size of the arch, the quality of the material composing it, and the character of the workmanship. A twelve-foot span is an average culvert, and with this, in the case of first-class masonry, 15 inches would do, but it might be necessary to increase it to 20 inches, or even more, to provide for various exigences.

The dimensions for the abutments of a similar arch, 12-foot span, are dependent upon a great many circumstances, as with the thickness of the arch itself but 5 feet may be considered a fair average with good masonry. The haunches or shoulders should be built from the spring of the arch half-way to the top.

With regard to the masonry, first-class Portland cement or other approved hydraulic cement must be used. Ordinary mortar will not do, except for work extending entirely out of the reach of moisture and dampness. 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, and improperly dressed stones should be recut, 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 a one-inch coat of cement and the surface then smoothed off.

Arch-culverts and bridges of cement concrete can frequently be constructed more cheaply than can masonry arches, and, if careful workmanship is employed, are quite as serviceable. They are formed by constructing crib-work 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.

The broken stone or gravel used in forming the concrete must be entirely free from dirt, clay and earthy material; otherwise the arch will quickly decay.

One feature in connection with concrete culvert work is that, with the crib-work and centres in place, any intelligent man 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.

### Japanese Roads.

While Canada and other civilized nations are worring over the heathen of Japan, and sending the missionaries, it might be appropriate for that country to send the gospel of good roads to some of their more enlightened sympathizers. For centuries Japan has had good roads. As long ago as 1691 the Kioto-Tokio highway, 307 miles in length, was noted for its excellence. The new class of traffic which civilization has introduced, caused Japan in 1875 to adopt road laws very similar to those of France. There are national roads, constructed by the state, prefecture roads, corresponding to our county roads built and maintained partly at the expense of the state, and partly at the expense of the prefecture (or county); township roads for which there is local taxation. All work done on these is performed under the supervision of skilled engineers.

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Druggist—Why, what's the matter?

Devil—A fellow paid three years' subscription in apple jack yesterday.