MUNICIPAL DEPARTMENT

HIGHWAY CULVERTS AND BRIDGES*

By A W Campbell, Ontario Road Commissioner.

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 for 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 road maker 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.

LOCATION.

Considerable attention is generally paid to the selection of a good site for a bridge, and an effort is made to decide in the interest of economy, usually with a considerable measure of success. There is, however, a tendency to cling to the line of original survey, rather than deviate the road slightly, when by doing so much would be gained in lessening the dimensions of the bridge, securing firm foundations for piers and abutments, reducing the cuts and fills of the approaches of the bridge, all of which, while they may not decrease materially the first cost, very frequently are of the utmost consequence with regard to maintenance, and may decide for good or bad the usefulness of the entire roadway. The utility of a road with respect to hauling heavy loads is not governed so much by the condition of the best section as by the worst; not so much by the level portion as by the steepest grade. Bridges forming as they do a means of crossing valleys, are intimately associated with a problem of judiciously choosing between directness of route, easy gradients, and details of construction.

The location of culverts is a matter of very common error. Water should be disposed of in small quantities, along natural watercourses, before it gathers force and headway. Instead of this principle being followed, water is frequently carried long distances by the roadside, past watercourse after watercourse, rather than build a culvert or culverts to carry it away without injury to the road. When culverts are needed, they should pass directly across the road and carry the water away from it.

The size of bridge or size of culvert involves nice discrimination, in which local circumstances and the class of construction introduce various factors. For the size of waterway, no hard and fast rule can be given. Many existing culverts and bridges were at one time of sufficient size, but the clearing, drainage and cultivation of the land now permit the water after rainfall to reach the watercourse in a shorter time with increased volume, causing submerged roadway and flooded roadsides, while culverts and bridges are swept away. The best guide to a proper size of waterway is an intimate acquaintance with the locality or the evidence of others who are, with respect to maximum rainfall, height of water line, previous experience with floods, form and inclination of the stream and area to be drained, kind and condition of the soil and similar details. Talbot's Formula proposed more as a guide to the judgment than as an unalterable rule, is at times very useful; area of waterway in square feet; C. $\sqrt{}$ (Drainage area, in acres.) C. is a variable coefficient and the values given are:

"For steep and rocky ground, C varies from $\frac{2}{3}$ to 1, etc. For rolling agricultural country subject to floods at times of melting snow, and with the length of valley three or four times its width, C is about $\frac{1}{3}$; and if the stream is longer in proportion to the area, decrease C. In districts not affected by accumulated snow, and where the length of the valley is several times the width, 1-5 or 1-6, or even less may be used. C should be increased for steep side slopes, especially if the upper part of the valley has a much greater fall than the channel at the culvert.

Waterways should be neither needlessly large nor of too small dimensions, involving on the one hand unnecessary expense for the first construction, and on the other hand, injury to the road, washouts, expensive repairs, and delay to traffic.

(To be Continued.)

* Paper read before the Association of Ontario Land Surveyors.