

has not interfered with natural conditions to the extent of making drainage more difficult or expensive than it would otherwise have been.

On the other hand, there are circumstances in which natural conditions have been so altered that it is difficult to procure drainage in any other way than along the railway ditches and borrow pits, and under such circumstances we see no objection to the location of award ditches or municipal drains along the railway lands.

Section 250 of the Railway Act recognizes this principle, and requires the railway company, independently of the drainage laws of the province, to "make and maintain suitable ditches and drains along each side of, and across and under the railway, to connect with ditches, drains, drainage works and watercourses upon the lands through which the railway runs so as to afford sufficient outlet to drain and carry off the water, and so that the then natural, artificial or existing drainage of the said lands shall not be obstructed or impeded by the railway."

Bridges at Farm Crossings

In case of municipal drains being so located along the right-of-way, and bridges becoming necessary at farm crossings, these should be properly provided for under subsection 3 of section 9 of the Drainage Act, the allowance or payment being to the railway company.

Crossing a railway track with any drainage work is expensive in comparison with other portions of the work, and should not be required under the award or report of an engineer without careful consideration. Since railway companies are required to pay practically the whole cost of these crossings, they are frequently asked for by owners who would see the railway company put to great expense for a crossing rather than spend a small sum to obtain drainage in some other way.

Regardless of whose money is used to obtain the required result, the engineer should see that no expenditure is required unless some commensurate benefit will be derived. In the words of the drainage referee (Grand Trunk Railway and Canadian Pacific Railway vs. Rochester): "The underlying idea is that the construction of the railway has interfered with natural conditions, and that the intention of the legislation is to permit the parties to revert to natural conditions as far as they can possibly do so, but, of course, subject to proper limitations. In other words, the railway should not be permitted to interfere with any work which is reasonably necessary to the proper cultivation of lands in the neighborhood, but if this is a sound proposition, the converse must be equally sound, and unless it is reasonably necessary for the proper cultivation of the lands in the neighborhood, the municipal authorities should not be permitted to interfere with the railway. . . . The question of the cost of these culverts is of great importance. On the part of the township, there is, of course, a natural tendency to think that money spent by the railway company is not to be considered, but I must, and do, treat the matter of expenditure by the railway company exactly the same way as I would treat expenditure of a farmer of limited means."

Some Requests Entirely Unreasonable

Let us illustrate from real life how unreasonable some requests are in regard to these railway crossings. An existing municipal drain runs west along the south side of a railway, crosses to the north side through a 5 ft. iron culvert, continues west along the north side about 100 ft. to a farm boundary, and then turns north along the boundary line. When a survey was being made for the repair of the drain, the landowner asked to have the culvert moved to a point opposite the boundary, in order to do away with two rectangular turns, which he considered very objectionable.

When it was pointed out to him that a better result could be accomplished at a cost of \$25, instead of \$500, by locating about 200 ft. of ditch in the depression across the corner of his field, he suddenly discovered that those rectangular

turns were old friends of his, and he did not want them interfered with.

In another instance a landowner, planning a system of tile drainage, wanted a main or outlet tile on one side of the railway, with several branches or laterals across the railway. These are perhaps extreme cases, but they show what the drainage engineer has to consider before these matters ever come to the attention of the railways.

Grades to Fit Culverts

Drainage works across railway lands should, as far as possible, accommodate themselves to existing openings under the tracks, both as to grade and dimensions. It is absurd, for instance, to ask a railway to lower a pipe culvert 3 or 4 ins. to the arbitrary grade line established by the drainage engineer. The grade line should be made to fit the culvert unless a substantial deepening is required.

As to the size and character of the opening, the existing structure, if there be one, should be first considered, and if it reasonably meets the requirements of the drainage work, the railway should not be obliged to incur a heavy expenditure for a trifling enlargement. Water will go through any opening, however small, if given sufficient time or sufficient head. The effect of a slight contraction in a ditch, due to a bridge or culvert opening being somewhat smaller than the sectional area of the ditch, is to raise the surface of the water a little higher on the upper side of the opening than on the lower, and the water goes through with a greater velocity. The flow through the bridge or culvert may also be accelerated by the decrease in friction of the walls as compared with the banks of the ditch.

There are many masonry and concrete culverts which, while having sufficient width and sectional area, are found to have insufficient depth for the improved drainage which is now general throughout the country. In such cases, additional depth may be secured by using a pipe culvert in addition to the larger opening, or by the construction of a solid invert between the footings of the culvert, or, in case of a solid invert already constructed but not of the proper depth, the central portion of this may be removed and re-constructed. In all cases of this kind, the drainage engineer should consult with the engineering department of the railway.

Avoiding Skew Bridges

When new openings are being provided for, the convenience and the standard practice of the railway should be considered. It is more convenient and less expensive for a railway company to construct bridges or culverts at right angles to the tracks than it is to construct them obliquely, and this should be borne in mind by the drainage engineer, particularly in the case of small openings. The diversion of a small ditch by slight curves at either end of the culvert is not so serious a matter as the opening up of a considerable section of road-bed in order to put a pipe or box culvert obliquely under the tracks. For the larger ditches, such as are constructed by dredging, it may not be practicable to cross the tracks at right angles, and then skew bridges are a necessity.

The railway company has "the option of constructing the portion of any drain or drainage work, required to be constructed upon, along, under, or across its railways or lands," and from this apparently simple provision of the Railway Act some interesting questions arise.

For instance, under the Drainage Act, where assessment is made in money, can the company under this option choose to construct only a part of a drainage work upon its land, say the portion under the tracks, leaving the remainder to be done by the municipal council or its servants or contractors? Or is the option which the company has, to construct the whole of the work on the railway lands or none at all? Again, if the company constructs the whole of the work along and across the railway lands and the value of this work exceeds the assessment against the railway, as it sometimes does, is the difference to be paid over to the company as if to a contractor?