

The summer is the season for doing the systematic work of repairing, renewing, filling or replacing with permanent structures every bridge on the line as it may need. The work is done by gangs of various sizes which may be either permanent or extra gangs as the work may demand. The pile driver is generally handled by a regular gang, although the method of having each bridge gang educated so that it can also handle the pile driver is sometimes advocated. However, as each road tries to get along with a minimum number of pile drivers so that it is desirable to keep them working at their maximum efficiency at all times, this latter method is of doubtful economy.

On account of the scarcity of foremen and of labor and the advantage of getting work done immediately with as little travelling as possible the combining of the bridge work with section work, signal work and other maintenance work is beginning to be advocated. There are many strong arguments in favor of this and should it be found successful it is likely to reorganize our entire maintenance system and methods. The past 15 years have witnessed very radical changes in the construction of permanent waterway openings due to the use of concrete and steel, and the future will be likely to add to these and thereby also change our methods of maintenance.

As temporary bridge structures are replaced by steel and concrete the amount of maintenance work is very materially decreased. Bridge gangs are replaced with carpenter gangs, painters' gangs, plumbing gangs, etc., as development of the country necessitates. The building up of towns and cities makes it necessary to do much more work around the station grounds than formerly, and the quality and kind of work varies with the nature of the public improvements. Sewers, pavements, permanent platforms, water supplies, plumbing, electric lighting, electric power and other features of latter day progress make it necessary for the railroads to employ specialists who can best handle the necessary work.

Small jobs of construction work and indeed all construction work that it is possible for them to handle should be done by the regular maintenance organization, but large construction jobs require a separate organization which should be flexible as to size and which can be moved from place to place as exigency requires.

Permanent structures in the past have been largely put in by contractors, mainly for the reason that the railroads have not had the necessary equipment for handling the work. However, as they have become larger and permanent work has become more general, it is now becoming customary for the railroads to do their own masonry and steel erection work. Whether they save money in all cases by doing this is questionable, when the cost of the equipment with interest and depreciation is taken into consideration. Undoubtedly where construction work is continued from year to year requiring permanent forces, outfits and machinery, they save the contractor's profit, but in many cases the amount of work and the inexperience of the men makes the cost more to the railroad company, although this fact may not be evident on the surface of their accounts.

During the summer months all the bridge work should be pushed to completion as rapidly as possible, so that in the fall all that remains to do will be to get every bridge and opening in shape for the winter. This not only means that its strength and condition should be cared for, but that the waterways themselves, including the channels and ditches, should be clean and free from obstructions, so that there will be a free flow of water to and from the

openings, that the openings may fulfil the purpose for which they were constructed.

As most of the railroads in this country were constructed in a time when timber was cheap, many pile and trestle bridges and timber culverts were built which are being replaced more or less rapidly with permanent structures. This has been accelerated of late years by the use of concrete and the consequent cheapening of the permanent openings. The life of the timber bridges has also been lengthened in many cases by the use of creosoted timber. This material is especially applicable in cases where the bridge decks have to be replaced oftener than the piles, and many years are often added to the life of the bridge by the use of a creosoted deck which may be filled in and ballasted.

When the original timber bridges were built, but little attention was paid to the size of opening required to properly carry the water, so long as it was large enough.

With permanent structures this is not a sufficient rule on account of the greater cost, and the size of openings should be proportioned to the use required of them. This makes necessary complete surveys and investigations of the bridge, its drainage area and outlet. These surveys should be made or started as early in the fall as possible, so that time may be had for considering each bridge and designing the necessary structure, culvert or pipe for the opening in order that the material may be ordered and delivered in time for the next summer's building.

In considering the amount which can profitably be spent for replacing temporary with permanent structures, the first cost of the temporary bridge should be taken together with such an amount as will, when put at interest at current rates, provide for its maintenance and periodical replacement at such times as it may wear out. A common wooden pile bridge can be replaced by a permanent reinforced concrete pile bridge on a ratio at present-day prices of about 3 to 1, while there are many cases of bridges or trestles which can be replaced by reinforced concrete culverts, boxes or pipes for even less than the cost of a wooden structure. The use of reinforced concrete for many railroad structures is growing rapidly and merits the full investigation of every railroad engineer. Pipes, culverts, boxes, highway bridges, subways and over-crossings, arches, trestles, bridges and retaining walls are now being permanently and cheaply constructed of this material, to say nothing of buildings, tanks, coal chutes and other uses for which it is being rapidly adopted.

RAILROADS OF BRITISH COLUMBIA.

It is estimated that during 1913, 650 miles of new railway, not including double-tracking, were laid in British Columbia, of which 285 miles are credited to the Grand Trunk Pacific, 212 to the Canadian Northern, 75 to the Kettle Valley Railway, 65 to the Canadian Pacific, 19 to the Esquimalt and Nanaimo Railway, 18 to the Pacific and Great Eastern, 5 to the Victoria, Vancouver and Eastern, and one-half mile to the Western Canada Power Co. There were also 66 miles of double-tracking, 59 of which is credited to the Canadian Pacific, and 7 to the Victoria, Vancouver and Eastern.

It is announced in the Scientific American that earthquake construction has now reached a very practical stage in the seismic districts of Italy, where all new buildings are being erected under strict supervision with regard to their ability to resist earthquake shocks. Professor Omori, the Japanese authority, has estimated that 99.8 per cent. of the deaths in the great Messina earthquake of 1908 would have been prevented if the buildings had been properly constructed.