ordinary range in height of 30 to 40 feet, has always aroused the interest of practical men. A number of small mills throughout the Maritime Provinces are run intermittently at periods of low tide with water stored in small reservoirs at high tide by means of flap gates inserted in the impounding dams. So far, this is the only practical use made of the energy in the tidal flow.

Various schemes have been proposed to use this tidal energy in a commercial way, and some years ago a somewhat ingenious scheme was patented by a local surveyor. Recently, new interest has been given to the whole problem, due to investigations carried on by officials of Acadia University and a proposed new type of current motor. These investigations are still under way, but so far as is known neither in these investigations as carried out to date or in any previous investigations has any scheme been evolved which can successfully compete in a large way with other and immediate sources of power. Tidal energy, however, offers a rich field for investigation, and the time may come when decreasing resources of coal, wood, gas or oil will warrant the necessary expense to derive power from these sources.

## NEW STANDARD SPECIFICATIONS ISSUED BY ONT. R'Y AND MUNICIPAL BOARD.

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NEW standard specifications for bridges, viaducts, trestles and other structures have just been issued by the Ontario Railway and Municipal Board. The 1910 standard specifications are superseded by the 1916 specifications which have been prepared to meet the requirements of the latest practices in bridge engineering. For instance, the growing demand for modern type movable bridges was given careful consideration.

To facilitate the work of designing engineers, all matters pertaining to the design of steel bridges, of both fixed and movable types, are treated in Part 1, and amplified by thirteen data sheets in Part 8.

Part 2 deals with the "Quality of Materials," covering all material requirements and tests, while "Manufacture and Workmanship" is treated in Part 3. The clauses pertaining to "Field Erection and Painting" are given in Part 4.

Thus, all the requirements governing the construction of a fixed or movable steel bridge are conveniently grouped under Parts 2, 3 and 4, comprising a complete set of construction specifications to accompany the plans whereon all matters of design have been previously determined in accordance with the requirements of Part 1.

A similar arrangement was adopted in Part 5, dealing with concrete bridges, where the clauses on design are again separated from those governing the construction.

Part 6, relating to stone masonry, will not be used frequently owing to the general adoption of concrete and reinforced concrete in modern bridges. However, the use of stone masonry should not be discouraged, and will continue to occupy a limited field, chiefly for aesthetic reasons.

Timber trestles are treated in Part 7. They still find frequent use as temporary and semi-permanent structures, especially on new railway lines.

It is desirable to discuss a few of the new designing requirements chiefly for the purpose of illustrating their justification and application. It will be found upon reading sections B, C and D of Part 1, that the new specifications include some new departures on the subjects of impact, combination of stresses, and allowable unit working stresses.

The method of treating impact stress employed in the 1910 specifications was cumbersome and illogical. According to that method the impact stress was expressed as a function of both dead and live load stresses in each member, and this was further complicated by a factor for increasing the live load for all spans not exceeding 80 ft. While the live load stresses can be definitely found for any given case of truss and loading, the dead load stresses are never definitely known until the structure is completely designed in all details and its weight finally computed. Hence the impact stresses also remain in doubt until the dead load stresses are fixed. This involves the extra labor of adjusting the sections of members to satisfy two variables. Furthermore, the method cannot be harmonized with the results of actual experiments. The article by E. H. Darling, in *The Canadian Engineer* of April 13th, 1916, devotes considerable space to a discussion of this formula, so that no further comment seems necessary.

The impact formulae given in the new specifications depend only on the loaded length producing the stress, so that the impact stress becomes a fixed function of the live load or live load stress, independent of the dead load. This makes it possible to compute the live load and impact stresses for each member, without first knowing the dead load stresses, and subsequent modifications or adjustments in the dead load will not alter the impact stresses. Especially for combination loadings does this method offer many advantages in practical designing.

As to the accuracy of these formulae, it may be said that the first gives safe values in all cases of steam railway bridges and is based on the elaborate experiments made in recent years by the American Railway Engineering Association. The formulae for electric railway and highway bridges undoubtedly err on the side of safety and, in the absence of experimental data, are based entirely on judgment, using the formula for steam railways as a guide.

The formulae for steam and electric railways were evolved by the writer in August, 1911, and the one for highway bridges was proposed by Dr. Waddell in his "De Pontibus," page 369. Dr. Waddell strongly advocates the general adoption of the writer's formula for steam railways in his recent book on Bridge Engineering, 1916.

It should be stated that the curve represented by an impact formula is an enveloping curve of all experimental data on bridges for one specific class of loading, as for example, steam railway trains. This is because impacts, even for the same structure, vary from zero to a maximum, and only the maximum value for each span will govern the safe design.

The subjects of stress reversals and combination of stresses have received widely different treatment in the past, and the 1910 specifications were rather misty on these points.

The clauses under section C, Part 1, of the new specifications cover all cases of combination of stresses of the same or opposite character for all conditions of loading. These should be self-explanatory, but the following is given to show the exact purport of the two last clauses of this section:—

A structure designed for unit stresses approaching the elastic limit simultaneously in all its members, for