

of the upper lateral and portal struts, especially when no vertical sway bracing is used.

On the other hand, those who wish to proportion bridges by the latest theories may object to the employment of C. Shaler Smith's formula (which fails to take into account the radius of gyration of the section) and to the non-employment of the results of Wöhler's and Weyrauch's recent investigations concerning intensities of working-stresses. To the first objection, the author would reply, that designers of ordinary highway-bridges cannot afford the time to spend at least fifteen minutes in obtaining the theoretically best intensity of working-stress for each strut, but must have for this purpose tables which will give the intensities without calculation: besides, the best theoretical intensity is merely approximate. To the second objection, he would reply, that the results of the investigations referred to have not yet been generally adopted, and that the variation of intensity of working-stress for the main diagonals used in this treatise is, in his opinion, for ordinary highway-bridge designing, a sufficient concession to the general correctness of the theory of those writers.

The units used throughout this work are as follows: the American ton (two thousand pounds) for the units of weight and stress, the foot for the unit of length, and the square inch for the unit of area.

It is presupposed that the reader, if he intend to design, or even study the designing of, iron bridges, has procured a copy of Carnegie's "Pocket-Companion," the most useful little book of its kind for bridge builders that has ever been printed: so the tables therein are here referred to, instead of being reproduced.

The sections of iron employed are those rolled at the Union Iron Mills, for the reason that not only is there more iron rolled in these mills than anywhere else in America, but the properties of the sections are tabulated in a much more convenient form than are those of any other mills. The author intended to prepare a table of channels rolled by the New-Jersey Steel and Iron Company of Trenton, N.J., similar to Table XXVIII.; but the information in that company's pocket-book is not