STRENGTH OF WROUGHT-IRON BRIDGE MEMBERS. PART I.- GENERAL THEORY OF BEAMS. PART II.- PRACTICAL FORMULAS FOR BEAMS, STRUTS, COLUMNS AND SEMI-COLUMNS. - EXTENDED COMPARISON OF VARIOUS FORMULAS WITH EXPERIMENT

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STRENGTH

OF

WROUGHT-IRON BRIDGE MEMBERS.

PART I.—GENERAL THEORY OF BEAMS.

PART II.—PRACTICAL FORMULAS FOR BEAMS, STRUTS, COLUMNS AND SEMI-COLUMNS.—EXTENDED COMPARISON OF VARIOUS FORMULAS WITH EXPERIMENT.

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PREFACE.

The examination of existing bridges for strength and trustworthiness has occasioned the use of formulas not accessible to the writer in published form. In procuring the formulas by direct solution, the amount of labor entailed has been great. The avoidance of a repetition of this labor, on the part of others who may require these formulas, is believed to be sufficient reason for now publishing the results obtained.

The formulas referred to are such as take account of longitudinal as well as simultaneously acting transverse loads, while the beam is itself held in various ways.

In general formulas of the kind just referred to, it seems evident that either form of load may be made inferior, or to vanish altogether, giving formulas for ordinary beams, for columns, or for semi-columns, &c., as the case may be.

Thus, expressions forming the basis of rational formulas for columns have been obtained—formulas which, besides transcending the ordinary empirical formulas in coincidence of computed and experimental results, have, by making known the composition of constants, furnished a true key to the law of safe loads.

Also the effect of pin friction in pin bearings has been provided for, as well as the limited lengths between failure by crushing and by simple flexure.

The investigations leading to these results were instanced by the State Railway Inspection Service, under the Hon.

H. Sabine, Commissioner of Railroads and Telegraphs for Ohio, in which service results were sought, in critical cases, that were worthy of the utmost possible confidence. S. W. R.

OHIO STATE UNIVERSITY,
April 24, 1882.

Strength of Wrought-Iron Bridge Members.

I.—General Theory of Beams.

Examples of beams coming under a more general theory than that of mere transverse loading are found in bridges; the same, for complete solution, requiring unusual formulas.

To make clear the nature of these formulas, the conditions to which certain bridge members are subject may be referred to. Thus, in some instances, the chords of truss bridges are required to carry the floor beams, one, two or more of them, to each panel. Now, when a train of cars comes upon a bridge, the floor-beam loads rest down upon the chord members and deflect them into downward bowing curves, causing "transverse strains," or "bending moments." Simultaneously, the load upon the bridge causes endlong strains in the same chord members; tension for the lower, and compression for the upper chord. Thus, an individual member of the chord of the bridge, such as an "eye bar," is to be treated as a beam subjected to a combined bending and stretch, or bending and compression, as the case may be.

The usual way of calculating the resulting maximum strain in the piece considered, is to compute as though the beam had only the "cross strain," and then compute separately for the endlong strain, and add the results. It is evident, however, from a casual consideration that as the bending load would separately give a certain curve to the beam, the tension would partially straighten that curve and diminish the bending moment. Again, in a compressive endlong strain, the curvature of the beam would be increased and the bending moment increased. Hence, the usual calculation would give too large a value to the maximum strain per square inch in one case, and too small in the other. The formulas given in this article correct these anomalies.