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Provisional Working Stresses for Steel Columns

Formula for Determining Safe Strength of Pin End Columns—Recommendations of the American Society of Civil Engineers Not to be Taken Too Exclusively—Suggestive Formula Expressive of Strength of Columns as Disclosed by all Tests to Date

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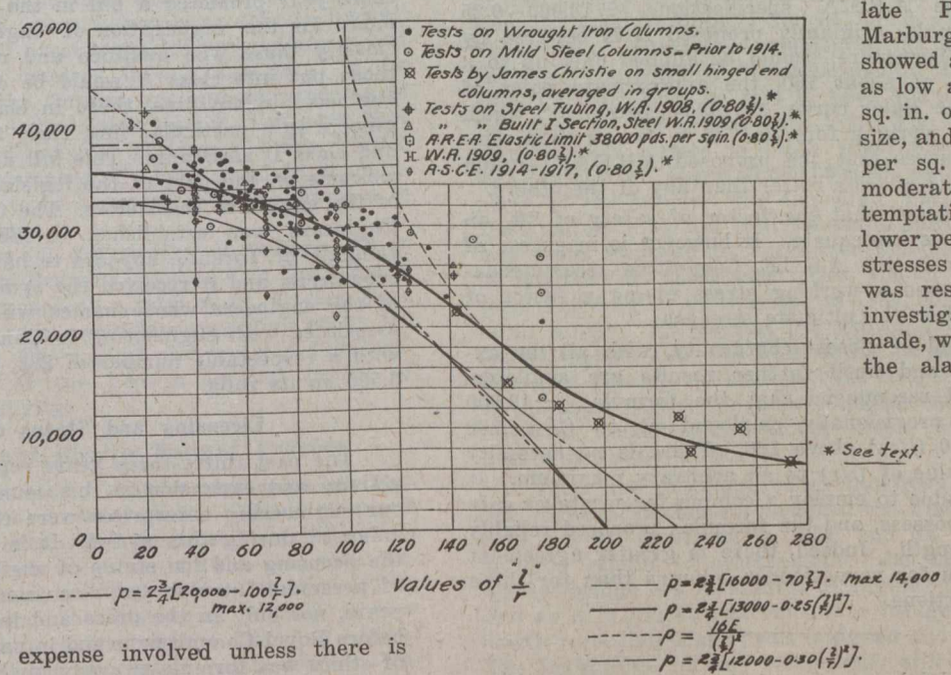
IN the new and revised structural steel specifications that have recently been proposed, a tendency to drastic downward departure from hitherto generally accepted column formulas is disclosed. Thus, in the draft specification for steel railway bridges, prepared by a committee of the Engineering Institute of Canada, the recommended working stress on steel columns for slenderness ratios up to 175 is $p=12{,}000-0.3\ (l/r)^2$. Conformity with this provision would, as compared with the requirements of the Dominion Government specifications, 1908, still in force, necessitate a considerable addition of material in columns of low slenderness ratios. Thus, for columns with medium end conditions, the excess of area required by the proposed Engineering Institute specification would range from 33 per cent., when (l/r) is zero to nothing when (l/r) is 90. It is obvious that the purchasers of structurad steel work should not be saddled with the extra expense involved unless there is good reason for it.



Although for some years a conservative attitude has been adopted with respect to the proportioning of columns of low slenderness ratio, as evidenced by the truncating of working formulas to a maximum of 14,000 or to 13,000 lbs. per sq. in., it was not until the publication in detail of the tests made by the special committee on columns of the American Society of Civil Engineers that the existing state of semi-panic arose amongst structural engineers concerning the low strength of short columns. In its report, as will be recalled, the committee recommended that working stresses on columns of 60,000-lb. steel be limited to 12,000 lbs. per sq. in. and that this stress be used up to a value of $(l/r)=80$. Above 80, the working stress was to be reduced uniformly to 8,000 lbs. per sq. in, when $(l/r)=120$, that is the reduction would be in accordance with the formula $p=20{,}000-100\ (l/r)$.

Although unexpected weakness was disclosed in some of the columns tested by the A.S.C.E. Committee, it does not seem prudent to hastily accept as final the disquieting features of the tests, and without further ado bring specifications down to conform rigidly to them. There are several reasons for more cautious action. Some ten years ago the structural engineering world experienced a rude jolt, analogous to the present one, on the publication of the results of tests on I-beams by the late Professor Edgar Marburg. These tests showed an elastic limit of as low as 10,800 lbs. per sq. in. on beams of large size, and below 20,000 lbs. per sq. in. on some of moderate size. The temptation to at once lower permissible bending stresses on rolled beams was resisted till further investigation could be made, with the result that the alarming conditions were shown to be largely transient, and specifications were generally left as they were. Would it not be well to take a hint from this incident and defer extreme action till more is known concerning the strength of columns? The American Railway Engineering Association is apparently taking this attitude in revising its column formula only moderately and in undertaking a series of tests itself as a basis for further revisions.

Then, too, for many years, engineers employed with a feeling of satisfied conservatism, formulas for the design of steel columns based upon a safe stress of 16,000 lbs. per sq. in. properly reduced, and in recent years truncated as well. Many thousands of bridge and building columns were built upon this basis, and the writer does not know of a single column that has failed through the inherent inadequacy of such a formula as $p=16{,}000-70\ (l/r)$, with maximum of 13,000, to express its safe strength. Where failures have occurred, they appear to have arisen from such causes as the neglect to properly support the column laterally, or