Zeitschrift: IABSE congress report = Rapport du congrès AIPC = IVBH

Kongressbericht

Band: 8 (1968)

Artikel: Comments by the author of the introductory report

Autor: Winter, George

DOI: https://doi.org/10.5169/seals-8773

Nutzungsbedingungen

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften auf E-Periodica. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. Das Veröffentlichen von Bildern in Print- und Online-Publikationen sowie auf Social Media-Kanälen oder Webseiten ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. Mehr erfahren

Conditions d'utilisation

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. La reproduction d'images dans des publications imprimées ou en ligne ainsi que sur des canaux de médias sociaux ou des sites web n'est autorisée qu'avec l'accord préalable des détenteurs des droits. En savoir plus

Terms of use

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. Publishing images in print and online publications, as well as on social media channels or websites, is only permitted with the prior consent of the rights holders. Find out more

Download PDF: 28.11.2025

ETH-Bibliothek Zürich, E-Periodica, https://www.e-periodica.ch

Comments by the author of the introductory report Remarques de l'auteur du rapport introductif Bemerkungen des Verfassers des Einführungsberichtes

GEORGE WINTER U.S.A.

It is gratifying to note that utilizing the post-buckling strength in thin-walled construction is at last becoming universally accepted. This is reflected in the prepared contributions by Möller and Donat; Reiss and Chilver; and T. R. Graves Smith, and in some of the free discussion.

The writer wishes to correct the re-interpretation of his own work given by Reiss and Chilver because it results in loss of generality and of utility for design use. Post-buckling behavior was first formulated by v. Karman, Marguerre, and later by the writer in terms of an effective width $b_{\rm e},$ which is related to the maximum stress $\sigma_{\rm max}$ at the supported edge or edges. In particular, the writer's equation (see Preliminary Publication, Theme IIa, p. 104) reads

$$b_e/b = (\sigma_{cr}/\sigma_{max})^{\frac{1}{2}}[1 - 0.25(\sigma_{cr}/\sigma_{max})^{\frac{1}{2}}]$$

This equation is valid not only at failure, when $\sigma_{max} = \sigma_y (\sigma_y = y)$ yield stress) but also for edge stresses smaller than σ_y . This makes it possible to predict the behavior of thin-walled slender columns where failure occurs at stresses smaller than the yield stress. It also makes it possible to calculate sub-ultimate stresses, deflections and strengths of flexural members whose compression flanges perform in the post-buckling domain. In this case the neutral axis shifts as σ_{max} increases with increasing load, which is properly reflected in the variation of the effective width be, and of the corresponding effective cross-section and its properties.

In contrast, Reiss and Chilver re-write the writer's equation in the form

$$\sigma_{\text{ave,f}}/\sigma_{\text{y}} = (\sigma_{\text{cr}}/\sigma_{\text{y}})^{\frac{1}{2}} [1 - 0.25(\sigma_{\text{cr}}/\sigma_{\text{y}})^{\frac{1}{2}}]$$

where $\sigma_{\rm ave,f}$ is the average stress in the plate when failure starts by yielding at the edges. For isolated plates, or for short compression members which fail in this manner, the two formulations give the same calculated strength. However, any formulation which is in terms of an average stress rather than an effective width, and which holds only at the yield stress $\sigma_{_{\bf V}}$

364 COMMENTS

rather than at any maximum edge stress $\sigma_{max} = \sigma_y$, is incapable of predicting the complete behavior of all types of members. Fundamentally, the effective width is an approximate tool for calculating actual deformations and actual maximum edge stresses at subultimate as well as ultimate loads, neither of which can be computed when only an average stress at yield failure is determined.

The difference is illustrated by the valuable investigation of Graves-Smith, which involves deformational analysis of considerable rigor. His results of the interaction of local and column buckling, as given in his Fig. 7, can be well approximated in design by an effective width approach somewhat similar to the Q-method in current American design codes, but not in terms of an average stress at yield failure.

Modern computing techniques permit deeper theoretical analyses of postcritical behavior than was possible heretofore. The writer agrees with Möller and Donat who emphasize the deviations between theory and test and state that "one must realize that the empirical approximate equations seem better to reflect the actual situations than those derived from theoretical calculations."

The increasing utilization of strength increase obtained through cold-forming is another noticeable development, reflected in the contributions by Marx, Goeben, Schröder, Richter, Bader; and by V. Hlavacek. The writer is intrigued by Hlavacek's manner of analyzing the strain-hardening effect of close-corrugating on the basis of a method first developed by Karren in the writer's department. (Hlavacek's equations 1 through 10 are identical with those used or developed by Karren, Ref. 6, on p. 111 of Preliminary Report). It is gratifying to note that Hlavacek was able to modify Karren's method for this entirely different process of cold-forming.

The paper by the five authors from the DDR further illustrates the possibilities of cold-strengthening. Their critique of the Karren method, to the effect that it leads assymptotically to zero rather than to the original yield strength, is quite correct. However, the Karren method explicitly was limited to a/t-ratios smaller than about 7, for which this problem does not arise. It is clear a priori that the method cannot apply to closed square tubes where the same piece of metal has been bent first in one direction and then in the other. Hence, the authors' Fig. ll is somewhat misleading in two respects: it plots test results far beyond the a/t-range for which Karren's method was devised, and it includes results from square tubes which have been subjected to a double forming process different from that analyzed by Karren.

This merely illustrates that the cold-forming processes employed in producting many practical shapes are so complex that their effects probably will never become completely calculable. Design methods have to be based on strength calculations where possible, and on test results in more complex situations.