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Free Discussion

Discussion libre

Freie Diskussion

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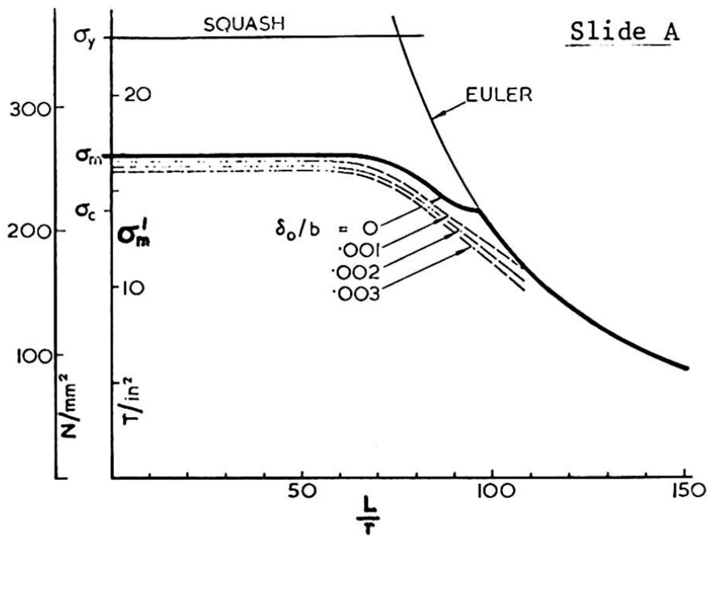
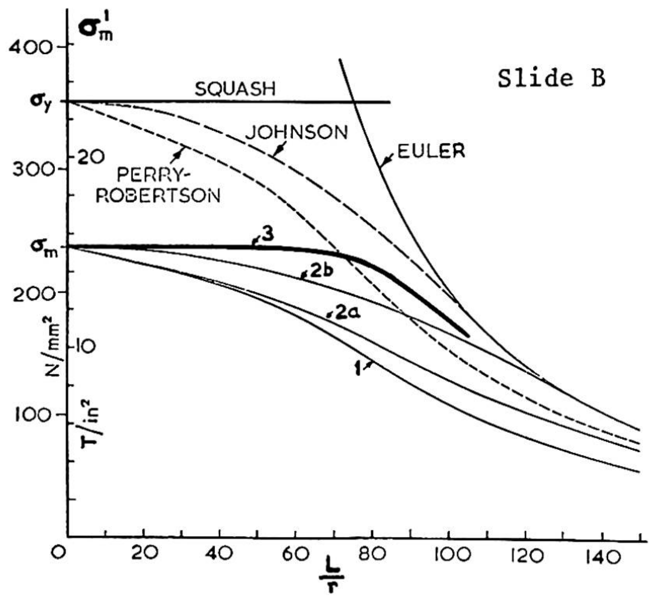
Dr. Graves Smith's interesting work on the interaction between local buckling and overall buckling could be of considerable importance in terms of practical design. Slide A shows some theoretical curves which he has given elsewhere and which refer to a square tubular column, having walls with a width to thickness ratio (b/t) of 60, in a steel with a yield stress of about 23 ton/in^2 (355 N/mm^2). They show failure stresses plotted against slenderness ratio, assuming pin-ends. The full curve refers to a perfect member, without imperfections, and is similar to those he shows for aluminium columns in fig. 7; curves of this type have also been obtained by Bijlaard and Fisher. The dashed curves refer to members which contain a slight initial sinusoidal waviness in the component plates. Real-life members always contain geometrical imperfections, and I think we must consider the dashed curves as being the more realistic in practical terms. Instinct would make one want to round off the corner, and I believe that Dr. Graves Smith has done some tests on steel columns, not reported here, that in fact agree with this view.



The interesting thing on all the curves is the long flat portion, showing that the full section strength can be developed up to a considerable member length. In slide B, which refers to the same section, these results are compared with two current design philosophies, curve 3 being Grave Smith's theoretical one for a member having a small initial waviness. In heavy steel design it is common to use a simple "effective width" procedure, in which one takes a fixed effective width for each plate and disregards the rest. Thus for a thin square tube a certain area in the middle of each side is assumed ineffective and is ignored, and the load carrying capacity is based on what is left, regardless of the length of the column. Curve 1 shows the effect of this procedure, and it is seen to be very over-safe when compared with Graves Smith's findings, and to under-estimate the strength by up to 30%.

The light-gauge steel people do it differently. Their procedure is to construct a modified strut-curve, based on a fictitious material with a yield stress equal to the maximum stress (σ_m) for a short column. Curves 2a and 2b show the effect of doing this, curve 2a being a Perry Robertson type of strut-curve (Great Britain), and curve 2b a Johnson parabola (United States). The variation between 2a and 2b is due not to any basic difference in local buckling philosophy, but simply to the different column formulas used in the two countries. It is seen that the British curve (2a) seems still too safe while the American curve (2b) appears more realistic. (For comparison there are also shown, dashed, the basic columns curves used in the two countries).



Slide B

I finish by saying that, although Graves Smith's general finding is very interesting and should lead to economies, it needs confirming by practical tests on larger specimens, with different section shapes and including residual stresses. Unsymmetrical sections might have a different behaviour.