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

Band: 2 (1936)

Artikel: Design of the ends of a bridge with parallel booms

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DOI: https://doi.org/10.5169/seals-3325

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Design of the Ends of a Bridge with Parallel Booms.

Ausbildung der Enden einer Brücke mit Parallelträger.

Disposition des extrémités d'un pont à membrures parallèles

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The design of the ends of bridges with parallel booms is a matter in regard to which marked difference of opinion exists between engineers and architects. Some of the latter prefer, in particular, the arrangement shown in the accompanying sketch for the end features of bridges having parallel booms and rhomboidal web members. In addition to this it is very often demanded that the end portal frame shall be left completely open between the upper and lower boom — in other words that there shall be no intermediate transverse stays. In the design for one of the new bridges recently constructed over the Rhine it was originally proposed to carry down the upper wind bracing as far as the point marked a, but the idea was subsequently discarded and the necessity arose, therefore, to investigate the stability of the end portal frame. It was thereupon discovered that both in practice and in the literature the scope of such calculations is confined to symmetrical deformations (see, for instance, *Bleich*).

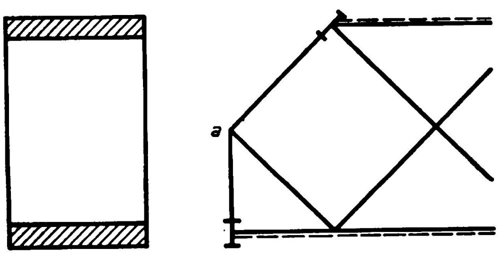

Fig. 1.

It is usual to consider only the most unfavourable assumption, namely that the uprights are hinged at both top and bottom, in which case the buckling load is given by the expression

$$P_K = \frac{\pi^2 E J_v}{h^2}.$$

Assuming, now, that for one sided deformation the moments of inertia J_o J_u are very large, so that the full restraint of the uprights can be taken into account, we find that the buckling load is the same as before:

$$P_K = \frac{\pi^2 E J_v}{h^2}.$$

As a rule, however, the moments of inertia J_o and J_u are not large enough to justify the use of this approximate formula resting on the hypothesis of one-sided deformation.

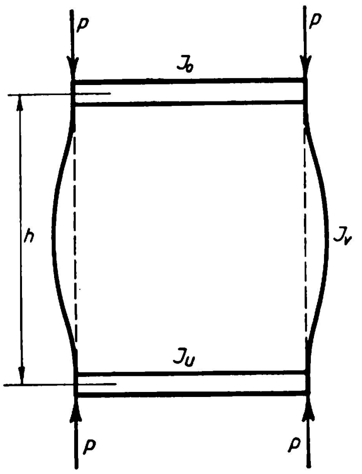

Fig. 2.

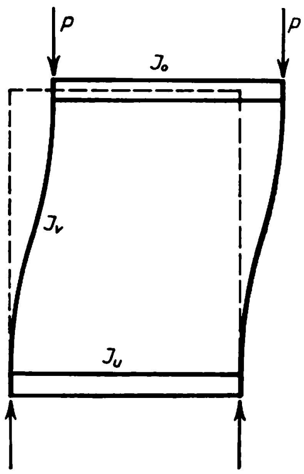

Fig. 3.

For the purpose of the Rhine bridge aforementioned, it was found necessary to provide a very heavy cross brace at the level of the upper boom, and the kink occurring in the line of the uprights at the end portal frame had a further unfavourable effect.

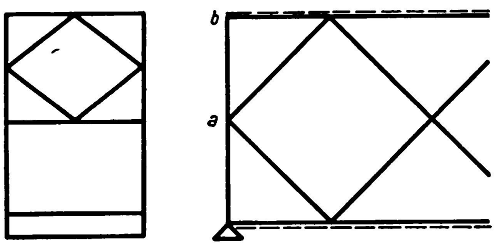

Fig. 4.

It has to be admitted, therefore, that the solution indicated in the sketch detracts from the quality of the structure at two important points solely for the sake of appearance.

If it is essential for the girder to have its corners cut off it is preferable that the wind bracing should be carried down to point a, and it is better still to design the end of the bridge after the manner of Fig. 4 with stays and braces between a and b.

A precise investigation of the buckling conditions in end frames under one sided deformation is given in the paper by *Hertwig* and *Pohl* which appeared in Stahlbau, 1936.