

# Prepared discussion in regard to the report presented by Professor P. Dubas: "Essais sur le comportement postcritique de poutres en caisson raidies"

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Prepared Discussion in regard to the Report Presented by Professor P. Dubas:  
 "Essais sur le comportement postcritique de poutres en caisson raidies"

Discussion préparée du rapport du Prof. P. Dubas:  
 "Essais sur le comportement postcritique de poutres en caisson raidies"

Vorbereitete Diskussion zum von Prof. P. Dubas vorgelegten Bericht:  
 "Essais sur le comportement postcritique de poutres en caisson raidies"

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The author would like to support the very interesting and valuable conclusions quoted a) in Professor Dubas's report "Essais sur le comportement post-critique de poutres en caisson raidie" and the prepared discussion by Professor Massonnet and R. Maquoi, entitled "The Conventional Design of Box Girders Is Unsafe .....": both regarding the post-buckled behaviour of longitudinally stiffened compression plates of box girders.

Professor Massonnet has already mentioned some of our theoretical conclusions in his prepared discussion. Other theoretical and experimental evidence obtained by our team in Prague has the same trend; therefore, it does not need quoting here.

The author would only like to mention three general conclusions which sum up our main results and observations in the aforesaid field (/1/, /2/, /3/, /4/, /5/):

1) Longitudinal stiffeners designed by the linear theory of web buckling (s.c. concept of  $\psi^*$ ) do not provide sufficient support for the web in the whole post-buckled range of its behaviour. The limit of efficacy of such stiffeners is considerably reduced, so that the stiffeners practically do not operate in a significant part of the post-critical domain of the web in question. The ultimate strength of the plate (and, consequently, the load-carrying capacity of the whole girder) is then

substantially reduced.

2) It was noted that for the longitudinal stiffeners to remain rigid and fully effective up to the collapse of the girder, it was necessary that they should have a flexural rigidity equal to a multiple of the linear theoretical rigidity  $\gamma^*$  ( $\gamma_0 = k \gamma^*$ ).

For such rigid stiffeners, the load-carrying capacity attains the highest possible value. Then the thinnest possible (i.e. optimum) web is obtained.

3) An analysis of our results also indicates that the afore-said concept is only a limiting case of a more general philosophy.

The relationship between ultimate load and stiffener rigidity is shown in Fig.1. The reader will note there that for small values of  $\gamma$  the ultimate strength grows fast, but then the rate slows down so that, for values near to  $\gamma_0$ , the increase in the load-carrying capacity is only slight.

Therefore, by considerably reducing the stiffener rigidity with respect to  $\gamma_0$ , a very small reduction in ultimate load is obtained. In other words, if the stiffener dimensions are significantly diminished, only a slight increase in web thickness is needed. Considering that the number of available thin sheets of different thicknesses is limited, the slight reduction in load-carrying capacity does not frequently lead to any practical increase in web thickness.

From this it follows that the concept of rigid stiffeners, furnishing an optimum web, need not necessarily lead to the most economic alternative, if the designer has not in mind merely the web (or compression plate element) alone, but desires to optimize the whole system of web (or plate element) + stiffeners; or, in other words, desires to optimize the whole girder.

To conclude the author wishes to state that he shares the view, quoted in the two afore-mentioned contributions, that the current design concept based on the  $\gamma^*$  - value ought to be abandoned. Further research in regard to the post-buckled behaviour of compression plates fitted with longitudinal stiffeners should be conducted as soon as possible, in order that the afore-said efficiency factor  $k$  could be determined for various kinds of stiffening. A new design procedure, taking account of the post-critical performance of compressed stiffened elements of

box girders, can then be established; and further accidents, like those of Vienna, Milford Haven and Melbourne, will thereby be avoided.

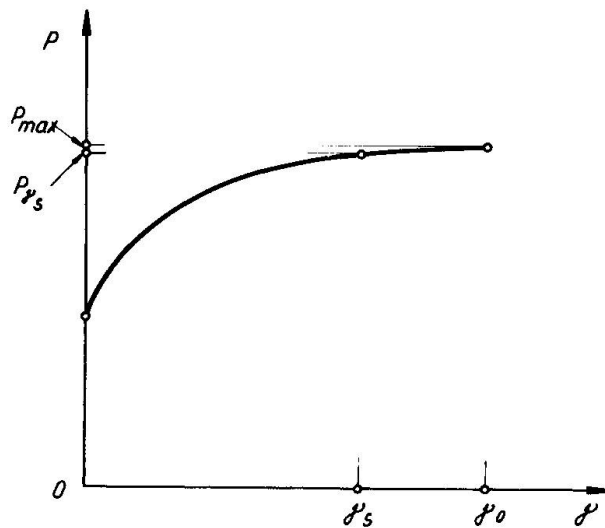


Fig. 1.

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