A New Cross-Sectional Form of Plate Girder

Nouveau profil de poutre à âme pleine

Ein neuer Querschnitt für Blechträger

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The Proposed New Configuration of Cross-Sectional Form of Plate Girder(Fig.1) have enough buckling strength(Fig.2) and post-buckling strength(Fig.3).

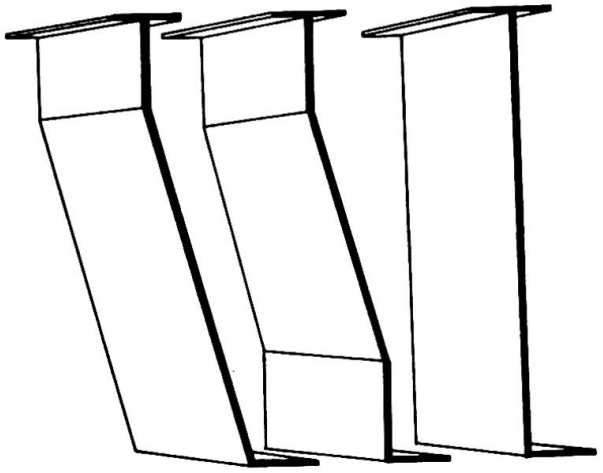

Fig.1 Proposed Configuration of Cross Section.

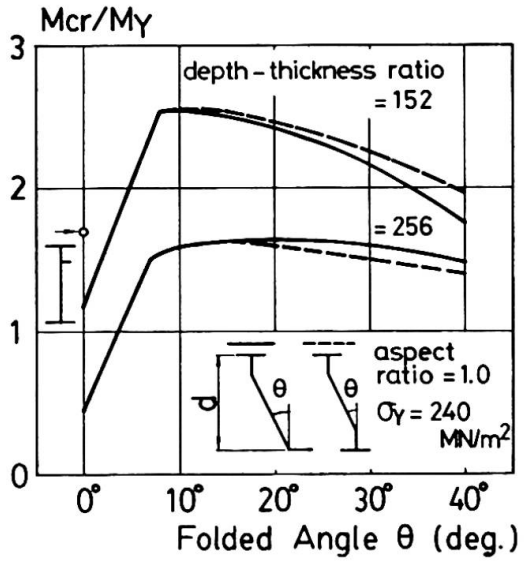

Fig.2 Relationship between Elastic Bending Buckling Strength and Folded Angle.

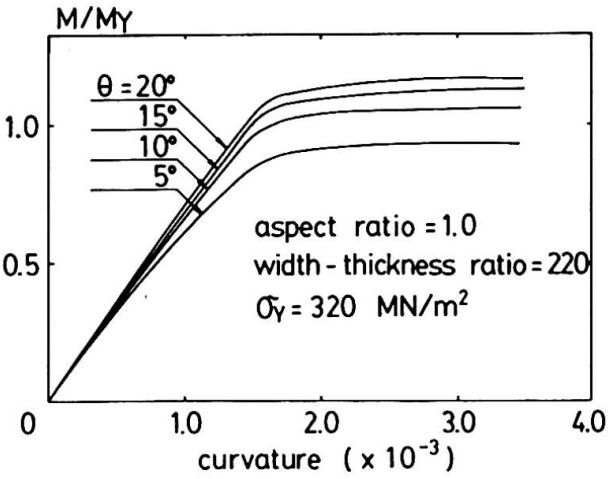

Fig.3 Bending Moment-Curvature Curves.

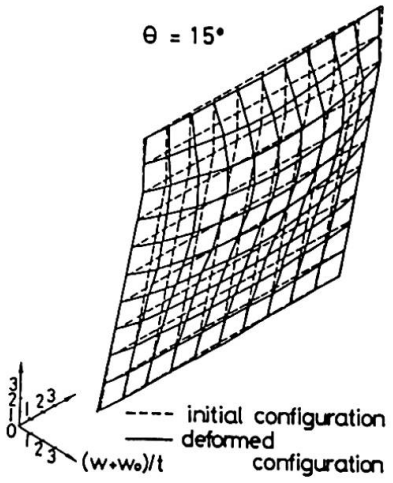

Fig.4 Deformed configuration.

The so-called folded plate or hipped plate are widely used in the lightweight structures, being taken advantage of its high bending strength and rigidity as a whole in spite of its simple form. This structural feature of folded plates is also effective in the application to the web of plate girders. The high bending rigidity as a whole which comes from the mutual constraining action of the plate connected at a certain angle is sufficient to keep the distance between the flanges and bestows the high buckling strength on the web. In this case, buckling under the bending moment occurs locally in the flat plates between the adjacent folded lines. It is shown through the numerical and experimetnal analysis that this type of buckling can be realized folding them at such a small angle as 10-15 degree. Consequently, the folded web plates behave like a plate with the longitudinal stiffener connected on the folded line and their buckling strength is even compatible to that of the usual stiffened plate. As an example, the relationship between the buckling strength in bending and the folded angle is shown in Fig.2.

The ultimate strength analysis taken into account of the effect of the finite displacements, yielding and initial imperfections shows that the folded web plates have a sufficient post buckling strength and the resistance capacity against the initial imperfections in shear and bending. Fig.5 and 6 show the post buckling behavior in bending for an example.

One-sided flanges have a higher rigidity than usual both-sided flanges which have the same cross-sectional area and the same width-thickness ratio as one-sided ones. This higher rigidity gets over the structural handicap resulted from the asymmetry of cross sections and gives the sufficient bending strength to the plate girders. Especially, the objection due to the asymmetry will be released when main plate girders with one-sided flanges are placed face to face in a pair and form a symmetrical cross section as a whole or used in a structural system, namely in constrained conditions. The strength is demonstrated in Fig.6 by the ultimate strength analysis of a beam with channel cross sections.

Adding those mechanical features of the plate girders using the folded web plate or one-sided flange, these are expected to improve the appearance of rather monotonic and poor-looking plate girders and make them more beautiful.

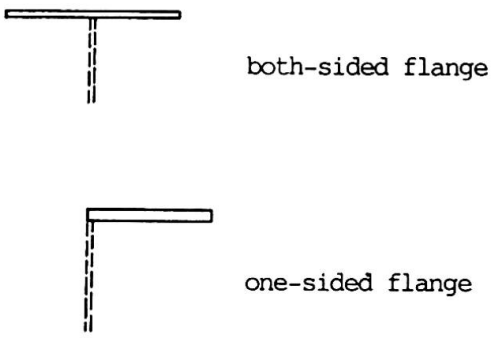

Fig.5 Both-sided Flange and One-sided Flange.

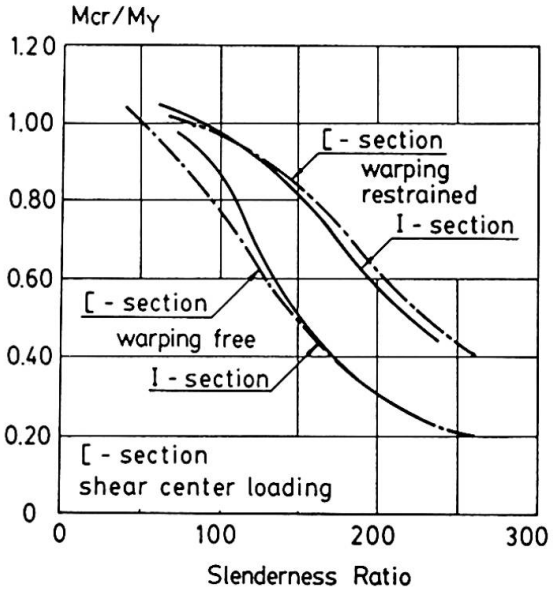

Fig.6 Comparison of The Bending Strength of [- & I - Section Girders.