I - 38 Comparison of a Design Approach of Stiffened Compression Flanges with ECCS Ones

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1. Introduction Evaluation of the ultimate strength is essential to promote the ultimate limit-state design method. There have been extensive investigations on the compressive ultimate strength of plates both for unstiffened and stiffened. However, a wide variety of load carrying capacity curves of compressive steel plates is used for different specificationsin many countries. In Europe, there are two approaches, that is, column approach and orthotropic plate one, in the ECCS recommendations. Moreover, in Japan, as results of studies, several approches have been proposed. Therefore, an unified evaluation of ultimate strength are required. This study is aimed at the evaluation of approaches for the design of stiffenedcompression flanges.

2. Main Features of Study The present study consists of the following contens, (a) selection of paramaters which dominate the ultimate strength of the stiffened plate, (b) range of the selected paraneters, (c) approaches for design of stiffened compression flanges, (d) numerical analysis and results of parametric study.

3. Selection of Parameters (1) Properties of Ultimate Strength Results of numerous investigations on the ultimate strength of stiffened plate have been obtained for more than 20 years[1]. Terefore, a lot of parameters which dominate the ultimate strength of stiffened plates are selected based on behavior of the stiffened plate. Design variables of the stiffened flange which mainly dominate the ultimate strength are as follows, a/is:slenderness ratio of a stiffener, b'/t:width of an individual sub-panel. A number of stiffeners n and ratio of cross-section δ are important parameters, however, it can be assumed that n and δ are dependent on a/b and a/is, respectively. Because, b'/t is distributed within the narrow range in the case of steel briges, and width-thickness ratio of the stiffener d/t_w is limited from tortional buckling point of view. is denotes radius of gyration of a stiffener.

(2) Design Variables (a) Direct yield stress is 235(N/mm^2). (b) Variables of stiffened plate panels are plate slenderness b'/t and aspect ratio a/b. (c) Longitudinal stiffener has three parameters, which are cross-section, number of stiffeners n, and slenderness ratio a/is. Fig.1 shows assumed cross-sections of stiffeners.

(3) Range of Prameters According to the steel girder bridges, the range of the parameters are as follows, $20 \leqq a/is \leqq 80$, $0.3 \leqq a/b \leqq 2.5$, $15 \leqq b'/t \leqq 60$. Therefore, the values of the variables are assumed as follows, a/is=20, 30, 40, 50, 60, 80, a/b=0.3, 0.5, 0.9, 1.4, 2.2, b'/t=20, 30, 40, 50, 60, m=3, 6, 9.

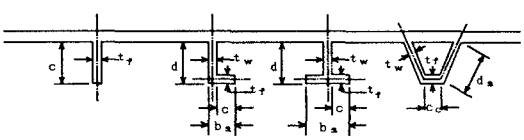

Fig.1 Assumed Cross-Sections of Longitudinal Stiffeners

4. Approaches for Design of Stiffened Compression Fanges The following four approaches are examined, (1) European column approach[2], (2) European orthotropic plate approach[2],

(3) extended column approach(95% Fractile)[3], (4) extended column approach(Mean Value)[3], References[2,3] describe the details of these approaches, respectively.

5. Numerical Analysis and Results of Parametric Study Procedure of the present parametric study is as follows, (1) assumption of geometrical quantities of flange plates, (2) calculation of parameters of cross-sections and common design variales for each approach, (3) ultimate strength by the ECCS column approach, the ECCS orthotropic plate approach, and the extended column approach(95% Fractile), the extended column approach(Mean Value), (4) storage of design variables and ulimate strength. Ranges are determined for the parameters, in accodance with practice approach situations. Obtained are 270 data on ultimate strengrh for each design approach. As results of the parametric study, six graphs are shown in Fig.2,3,4.

6. Conclusion The conclusions of the paper are as follows,

(1) There is a big diffrence of the ultimate strengh of stiffened compression flanges between four approachs under some parameters.

(2) Especially, ECCS orthotropic plate approach take big values against the other approches in wide ranges. The values are scattered.

(3) ECCS column approach is in good agreement with extened column approach(95% Fractile) exceptfor some parameters. approches.

(4) *a/is* and *b'/t* have a great influence against the ultimate strengh of stiffened compression flanes between four approachs.

Finally, this study is expected to the development of Eurocode 3 - Part 2.

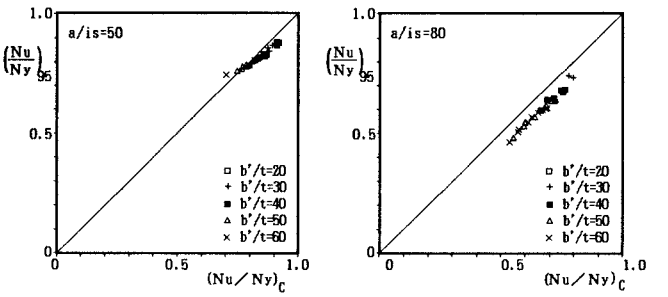

Fig.2 Comparison between Design Approaches

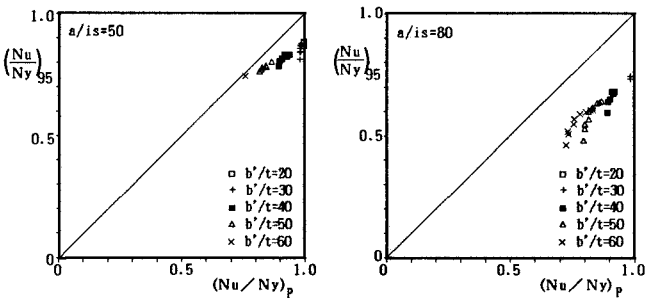

Fig.3 Comparison between Design Approaches

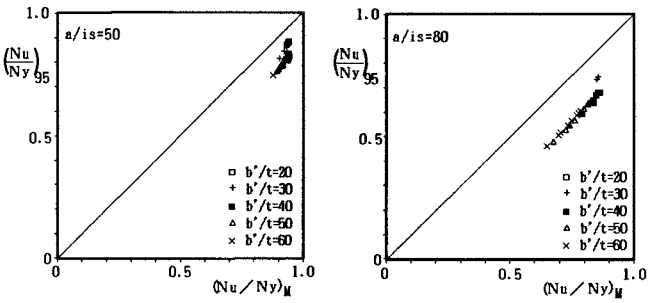

Fig.4 Comparison between Design Approaches

References [1] Dubas,P. and Gerri,E.,"behavior and Design of Steel Structures," ECCS Publication, Zürich,1986. [2] ECCS - Technical Committee 8 - Structural Stability Technical Working Group 8.3 - Plated Structures, Recommendations for the Design of Longitudinally Stiffened Webs and of Stiffened Compression Flanges, July, 1990. [3] Nara,S. and Fukumoto,Y., "Evaluation of Ultimate Strength and Ductility of Longitudinally Stiffened Plates under Uniaxial Compression", Proc.of Annual Technical Session, SSRC, Chicago, Illinois, April 15-17, 1991, pp.391-402.