

Joints between Plates or I Sections and a Circular Hollow Section Chord

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ABSTRACT

Recently Sub-commission IIW-XV-E has drafted new design recommendations for hollow section joints. The joint strength equations for circular hollow section (CHS) joints in these new recommendations are the result of extensive re-analyses. This paper deals with design recommendations for uniplanar T and X joints between plates or I section braces and a CHS chord. These new design recommendations are directly related to those for CHS joints. However, small modifications are used in the constants to make the equations in line with the available test data.

The design recommendations for joints loaded by in-plane or out-of-plane bending are related to those for axially loading by simple factors.

This paper further shows that considerable differences exist between the results of the various test data and additional numerical investigations are recommended to solve these contradictions.

KEY WORDS: Plate to CHS joints, tubular joints, static strength.

NOMENCLATURE

CHS	circular hollow sections
FE	finite element
RHS	rectangular hollow sections
C_1	exponent in chord stress function
$M_{pl,0}$	chord plastic moment resistance for class 1 and 2 sections
$M_{el,0}$	chord elastic moment resistance for class 3 sections
M_0	bending moment applied to the chord
N_1	axial brace load
N_0	chord axial load
$N_{pl,0}$	chord plastic axial load resistance
$N_{u,k}$	characteristic axial load resistance
Q_f	chord stress function
Q_u	function $f(\beta, \gamma, \eta)$ in the design strength equations
W_{el}	elastic section modulus (ip; in-plane; op: out-of-plane)

a	exponent for n
b_1	external width of brace
c_{ip}	coefficient for in-plane bending moment capacity
c_{op}	coefficient for out-of-plane bending moment capacity
d_0	external diameter of chord
f_{y0}	yield strength of chord
h_1	external height of brace
n	non-dimensional chord stress ratio; in analysis $N_0 / N_{pl,0}$
t_0	wall thickness of chord
t_1	wall thickness of brace
β	width ratio between brace and chord
γ	half diameter to thickness ratio of the chord, $\gamma = d_0 / 2t_0$
γ_m	partial factor
η	brace height to chord diameter ratio h_1 / d_0
θ_1	angle between brace member and the chord

INTRODUCTION

Recently Sub-commission IIW-XV-E has updated the design recommendations for hollow section joints, designated as IIW (2008). The joint capacity equations for CHS joints in these new recommendations are the result of extensive re-analyses discussed in van der Vegte et al. (2008), Wardenier et al. (2008), and Zhao et al. (2008).

One of the main differences with the previous IIW (1989) design recommendations is that in the new IIW (2008) recommendations the influence function for the chord stress effect on the joint capacity is based on the maximum chord stress instead of so-called prestress, i.e. based on the chord loading excluding the effect of the brace loading components. This required a full re-analysis of data, including numerical data. Further, for tension loaded chords, a strength reduction due to chord stress is included whereas this was not the case in the previous IIW (1989) recommendations.

The updated IIW (2008) design recommendations also include strength formulae for plate and I to CHS chord joints which are the subject of this publication.