



Stress Concentration Factors (SCFs) in Circular Hollow Section CHS-to-H-shaped Section Welded T-Joints under Axial Compression

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Abstract

The aim of this paper is to investigate the effects of non-dimensional geometric parameters on stress concentration factors (SCFs) of circular hollow section CHS brace-to-H-shaped section T-connections under axial compression. This type of welded joints is used increasingly in steel construction. However, its fatigue design is not covered by codes, and its fatigue strength has not been given the deserved attention by researchers. This research, however, bridges the gap on SCFs in this type of welded connections when being loaded in axial compression. Here, parametric study based on the numerical analysis was performed to evaluate the effect of CHS brace diameter to H-shaped chord flange width ratio (β), H-shaped chord flange width to thickness ratio (2γ) and CHS brace thickness to H-shaped chord flange thickness ratio (τ) on SCFs in the brace and the chord of the connection. Based on practical considerations, the validity range of these parameters was $0.3 \leq \beta \leq 0.7$, $16 \leq 2\gamma \leq 30$ and $0.2 \leq \tau \leq 0.1$. Three-dimensional finite element (FE) study using commercial software ABAQUS was performed to study the hot spot stress distribution and hence SCFs in this type of welded joints. To begin with, the results of FEM were verified against available experimental data and good agreement was achieved. Afterwards, 48 joints were modeled in Abaqus to study the effect of geometrical parameter on SCFs in brace and chord. Based on the results of this extensive study, the effect of geometrical parameters was revealed. The paper, thus, shows that whilst β increases, SCFs in the brace and chord increases. Moreover, increasing the parameter 2γ results in an increase in SCFs in the two members. However, the change in τ has no significant effect on the SCFs in the brace or the chord. Values of SCFs are found to be between 2 and 7.

Keywords: SCFs; Fatigue design; Welded connections; H-shaped; CHS sections.

1. Introduction

Steel hollow sections are being extensively used in steel construction due to their excellent performance. They are widely used in many engineering applications like power transmission columns, bridge engineering, industrial buildings and offshore structures [1]. In addition to their good structural behaviour, they have attractive aesthetic appearance. Specific type of welded joints is formed by welding circular hollow section (CHS) brace-to-H-shaped chord as shown in Figure 1. The use of such members is being increasingly used in steel construction because it has many advantages over the conventional CHS-to-CHS sections. For example, the use of H-shaped chord would provide flat surface so that purlins and sheeting could be properly installed. Moreover, the fabrication efforts are much lower in this type of connections because of flat plane provided by the flange of the H-shaped chord.

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