Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 6, No. 7, July, 2020

Net Section Fracture Assessment of Welded Rectangular Hollow Structural Sections

Mohammad Abedin [a*], Nafiseh Kiani [b], Esmail Shahrokhinasab [a], Sohrab Mokhtari [c]

[a] *Department of Civil and Environmental Engineering, Florida International University, Miami, FL 33174, United States.*

[b] *Department of Civil, Architectural and Environmental Engineering, University of Miami, Coral Gables, FL, United States.*

[c] *Department of Electrical and Computer Engineering, Florida International University, Miami, FL 33174, United States.*

Received 17 March 2020; Accepted 20 May 2020

Abstract

Rectangular Hollow Sections (RHS) because of their high resistance to tension, as well as compression, are commonly used as a bracing member with slotted gusset plate connections in steel structures. Since in this type of connection only part of the section contributes in transferring the tensile load to the gusset plate, shear lag failure may occur in the connection. The AISC specification decreases the effective section net area by a factor to consider the effect of shear lag for a limited connection configuration. This study investigates the effective parameters on the shear lag phenomenon for rectangular hollow section members connected at corners using a single concentric gusset plate. The results of the numerical analysis show that the connection length and connection eccentricity are the only effective parameters in the shear lag, and the effect of gusset plate thickness is negligible because of the symmetric connection. The ultimate tensile capacity of the suggested connection in this study were compared to the typical RHS connection presented in the AISC and the similar double angle sections connected at both legs. The comparison indicates that tensile performance of the suggested connection in this study because of its lower connection eccentricity is much higher than the typical slotted connection and double angle connections. Therefore, a new equation is suggested based on the finite element analyses to modify the AISC equation for these connections.

Keywords: Shear Lag; Tension Member; Welded Connection; Rectangular Hollow Sections; Net Section Fracture.

1. Introduction

Rectangular hollow sections (RHS) with the slotted gusset plate welded connection are commonly used in steel structures as a bracing member because of their high resistance to tension as well as compression. Three limit states are normally considered in the design of theses members in tension (Equations 1 to 5): tensile yielding in the gross section; shear rupture along shear failure paths; and tensile rupture in the net section. The presence of bending moment or stress concentration in tension members reduce the section capacity. In bracing members, moment and stress concentration may develop from connection eccentricity when the neutral axis of the bracing member does not coincide with the centroid of connection lines depending on the connection types. Gusset plate connections represent the easiest method of connecting RHS brace members and since in this type of connection only part of the section contributes in transferring the tensile load to the gusset plate, stress concentration near the connection area in addition to the secondary moment may results in connection failure under a load less than the section capacity which is known as a shear lag effect (see Figure 1).

* Corresponding author: mabed005@fiu.edu

http://dx.doi.org/10.28991/cej-2020-03091544

© 2020 by the authors. Licensee C.E.J, Tehran, Iran. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (http://creativecommons.org/licenses/by/4.0/).