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BEARING CAPACITY OF COLD-FORMED UNLIPPED CHANNELS WITH RESTRAINED FLANGES - EOF AND IOF LOAD CASES

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Abstract: The current cold-formed steel specifications (AISI S100, AS/NZS 4600 and Eurocode) do not include any design rules to determine the bearing capacities of unlipped channel sections subjected to one flange loadings when their flanges are fastened to supports. Hence an experimental study consisting of 28 tests was conducted to determine the bearing capacities of these sections used in floor systems. Using the results from this study, a new equation was proposed within the AISI S100 guidelines to determine the bearing capacities of cold-formed unlipped channels. A new design rule was also proposed based on the direct strength method.

1 Introduction

Cold-formed steel sections are increasingly used in the construction industry over conventional hot-rolled sections due to their higher strength to weight ratio, accurate detailing and mass production, and many other reasons. Among them channel sections are commonly used as bearers and joists in many buildings as shown in Figure 1. These cold-formed channel sections are connected to joists and columns using different types of connections such as bolted and welded connections in floor systems. The conventional channel sections are categorized as stiffened flange and unstiffened flange channel sections based on their flange type. Bearing failure is a form of localized failure that occurs at points of transverse concentrated loads or supports of thin-walled beams. These beams are vulnerable to bearing failures due to their higher width to thickness ratio. The bearing capacity and failure modes of cold-formed steel channel sections mainly depend on the loading types, locations and connection types. Figure 2 shows the different bearing failure pattern of cold-formed unlipped channel sections under the End-One-Flange load case. In Figure 2a, the flanges rotated about the web-flange juncture, however, the rotation was restrained by the bolted connection as shown in Figure 2b. The current North American specification AISI S100 [1], Australian/New Zealand standard 4600 [2] and Eurocode 3 Part 1.3 [3] specify four types of load cases such as End-One-Flange (EOF), Interior-One-Flange (IOF), End-Two-Flange (ETF) and Interior-Two-Flange (ETF), by considering load types and failure locations as shown in Figure 3. The failure type is considered as end loading, if the failure region is within $1.5d_1$ from the edge of the specimen, otherwise it is considered as interior loading failure. The one-flange loading condition is considered if the distance between the edges of two opposite bearing plates is less than $1.5d_1$, otherwise it is considered as two-flange loading. Current bearing capacity design rules have been developed based on extensive experimental results obtained since 1939 (Winter and Pian [4], Prabakaran [5], Young and Hancock [6], Macdonald et al. [7]).