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Impact of Lip Length and Inside Radius-to-thickness Ratio on Buckling of Cold-formed Steel C-Sections

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Introduction

Cold-Formed Steel (CFS) sections are widely used in construction due to their versatility, cost-effectiveness and high strength-to-weight ratio. Understanding the buckling behavior of CFS sections is crucial for ensuring the structural integrity and safety of buildings and infrastructure. In particular, the lip length and inside radius-to-thickness ratio are key geometric parameters that influence the buckling resistance of CFS sections. This paper investigates the impact of lip length and inside radius-to-thickness ratio on the buckling behavior of cold-formed steel C-sections, aiming to provide insights into their design and optimization for structural applications [1].

Description

Buckling is a critical mode of failure in structural elements subjected to compressive loads. In cold-formed steel sections, buckling can occur in various modes, including local, distortional and global buckling. Local buckling typically occurs in thin-walled sections, such as C-sections, where the flanges or lips deform locally before the entire section buckles. Distortional buckling involves out-of-plane deformation of the section, while global buckling refers to overall lateral instability. The lip length of a C-section refers to the length of the horizontal flange that extends beyond the web. It is a critical geometric parameter that affects the buckling behavior of the section. Longer lip lengths generally result in higher resistance to local buckling due to increased torsional stiffness and restraint against flange deformation [2]. However, excessively long lip lengths can lead to distortional buckling or other stability issues, especially in slender sections. The inside radius-to-thickness ratio of a C-section's corners is another important geometric parameter influencing its buckling behavior. This ratio affects the severity of stress concentrations at the corners, where local buckling typically initiates. A smaller inside radius-to-thickness ratio results in higher stress concentrations and reduced buckling resistance, while a larger ratio helps distribute the stress more evenly and enhances the section's overall stability. Experimental and numerical studies have been conducted to investigate the influence of lip length and inside radius-to-thickness ratio on the buckling behavior of cold-formed steel C-sections. These studies involve conducting compression tests on C-section specimens with varying geometric parameters and analyzing their buckling modes, load-deflection behavior and failure mechanisms [3].

Experimental testing typically involves applying axial compressive loads to C-section specimens until buckling occurs. Strain gauges, extensometers, or digital image correlation techniques are used to measure strains and displacements during testing, providing valuable data for analyzing the buckling behavior of the sections. Numerical simulations using Finite Element Analysis (FEA) are also employed to complement experimental findings and explore the underlying mechanics of buckling in CFS sections [4]. The results of experimental and numerical studies reveal the complex interplay between lip length, inside radius-to-thickness ratio and buckling behavior in cold-formed steel C-sections. Longer lip lengths generally improve the buckling resistance of the sections by enhancing local and global stability. However, the optimal lip length depends on various factors, including section geometry, material properties and loading conditions. Similarly, the inside radius-to-thickness ratio significantly influences the buckling behavior of C-sections, with smaller ratios exacerbating stress concentrations and promoting premature local buckling. Design guidelines and standards, such as those provided by the American Iron and Steel Institute (AISI) and the European Committee for Standardization (CEN), often specify minimum inside radius-to-thickness ratios to ensure adequate buckling resistance in cold-formed steel sections [5].

Conclusion

The impact of lip length and inside radius-to-thickness ratio on the buckling behavior of cold-formed steel C-sections is a multifaceted issue with implications for structural design and optimization. Experimental and numerical studies have provided valuable insights into the complex interrelationships between these geometric parameters and the buckling resistance of CFS sections. Optimizing the design of C-sections requires careful consideration of factors such as section geometry, material properties, loading conditions and manufacturing constraints. Longer lip lengths generally enhance the buckling resistance of C-sections by improving local and global stability. However, the optimal lip length depends on various factors and excessively long lips may lead to distortional buckling or other stability issues.

Similarly, the inside radius-to-thickness ratio plays a crucial role in determining the severity of stress concentrations and the onset of local buckling in C-sections. Design guidelines and standards provide recommendations for minimum inside radius-to-thickness ratios to ensure adequate buckling resistance and structural performance. In conclusion, understanding the impact of lip length and inside radius-to-thickness ratio on the buckling behavior of cold-formed steel C-sections is essential for optimizing their design and ensuring the structural integrity and safety of buildings and infrastructure. Continued research efforts in this area will further advance our understanding of CFS section behavior and contribute to the development of more efficient and resilient structural systems.

Acknowledgement

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Conflict of Interest

None.

References

1. Yuan, Wei-bin, Shanshan Cheng, Long-yuan Li and Boksun Kim. "Web-flange distortional buckling of partially restrained cold-formed steel purlins under uplift loading." *Int J Mech Sci* 89 (2014): 476-481.

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2. Hussein, Ardalan B. and Diyari B. Hussein. "Effects of lip length and inside radius-to-thickness ratio on buckling behavior of cold-formed steel c-sections." *Bldg* 14 (2024): 587.

3. Zhao, Xi, Mazdak Tootkaboni and Benjamin W. Schafer. "Laser-based cross-section measurement of cold-formed steel members: Model reconstruction and application." *Thin-Walled Struct* 120 (2017): 70-80.

4. Pham, Cao Hung and Gregory J. Hancock. "Experimental investigation and direct strength design of high-strength, complex C-sections in pure bending." *J Struct Eng* 139 (2013): 1842-1852.

5. Laim, Luis, João Paulo C. Rodrigues and Hélder David Craveiro. "Flexural behaviour of beams made of cold-formed steel sigma-shaped sections at ambient and fire conditions." *Thin-Walled Struct* 87 (2015): 53-65.

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