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Editorial

Structural Performance of Cold-Formed Steel (CFS) Structures

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Cold-formed steel (CFS) has emerged as a prominent choice for structural components and sections in the construction industry. The manufacturing process of CFS involves shaping sheet steel into C-sections and other forms through pressing and roll-forming operations, eliminating the need for heat. Its remarkable growth in usage can be attributed to its ability to meet the demands of structural engineering while offering cost-effective and efficient design solutions with material savings [1]. In the contemporary construction market, CFS framing dominates both load-bearing and non-load-bearing partition walls due to its lightweight nature, exceptional strength, non-combustible properties, and ease of installation. Moreover, advancements in construction technologies, such as panelized systems, have extended the application of CFS to structural purposes in mid-rise and multi-housing buildings [2]. Consequently, CFS members have found widespread utilization in civil and structural engineering projects, including bridges and towers.

While CFS offers numerous advantages, its limited thickness makes it highly susceptible to buckling instabilities, necessitating careful consideration during the design and construction processes; however, only a few studies currently address this concern, focusing on allowable stress design, load and resistance factor design, and specifications for designing CFS structural members. As the use of CFS sections in load-bearing applications continues to rise, it becomes crucial for designers and researchers to pay special attention to load transfer and emphasize quality control in manufacturing and construction [3–5]. CFS members are widely employed as primary and secondary load-bearing elements in buildings due to their inherent advantages of being lightweight and their high load-carrying capacity, dimensional flexibility, recyclability, and dimensional stability [6,7]. The application of CFS has been further enhanced by sophisticated manufacturing technologies, advanced finite element simulation tools, and simplified design rules, such as the direct strength method and continuous strength method [8–10]. Optimizing CFS members to enhance load-bearing capacity, energy efficiency, and fire performance leads to reliable and economical building solutions. Non-linear finite element analysis and advanced optimization algorithms play essential roles in investigating the performance of CFS sections and achieving optimization [11,12].

The thin-walled nature of CFS makes it prone to local, distortional, and global buckling instabilities, even at stress levels below the yield strength. Unlike structural steel, there are height limitations when using CFS as a primary structure. To minimize buckling instabilities by eliminating free edges, hollow flange sections have been developed and extensively studied in the past [1,13–15]. These sections have been investigated for their structural behaviors in bending, shear, and web crippling actions. The development of the direct strength method has led to the exploration of innovative and complex section profiles for CFS members [1,16]. Advanced finite element software packages have facilitated detailed examinations of these innovative sections. Furthermore, advanced

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manufacturing technologies enable the production of these sophisticated and complex sections. Determining the mechanical properties of CFS members traditionally relies on destructive tensile tests; however, non-destructive 3MA techniques have proven successful in assessing material characteristics, including yield strength, tensile strength, and residual stress distribution [17–19]. This shift toward non-destructive testing methods has led to a focus on optimization frameworks, even if it results in complex section designs. Optimization methods, such as neural networks, genetic algorithms, and the trust region method, have been adopted to improve load-bearing capacity and energy as well as fire performance [20–22].

This Special Issue aims to provide new perspectives on the subject. It delves into principles related to the fire resistance, energy performance, and acoustic performance of CFS sections, along with methods with which to achieve them through appropriate protection and insulation. This Special Issue comprises eleven original research studies contributed by renowned research centers and university departments specializing in civil and construction engineering, design and built environments, civil and architectural engineering, structural engineering, and technical sciences. The international collaboration involves experts from the United Kingdom, Australia, New Zealand, Denmark, Sri Lanka, India, Chile, Colombia, Ireland, Croatia, Egypt, Jordan, and Serbia. The primary focus of this Special Issue is to disseminate the latest innovative research on CFS sections, aiming to positively impact the structural design and analysis of steel infrastructure. It explores topics such as optimizing CFS members, investigating their structural responses under various actions, utilizing advanced numerical modeling techniques, studying seismic performance, examining behavior under impact loading, evaluating fire as well as energy performance, developing novel connections and fastening systems, proposing innovative design solutions, and assessing sustainability as well as life cycle. The diverse range of topics covered in this Special Issue reflects the comprehensive nature of the research conducted in the field of the structural performance of cold-formed steel structures.

The Special Issue editors express their sincere gratitude to all of the authors who have generously shared their scientific knowledge and expertise. Their contributions have enriched this Special Issue and contributed to the advancement of the field. The meticulous evaluation of the numerous submissions by the peer reviewers also deserves acknowledgment. Their valuable insights and constructive feedback have significantly enhanced the quality of this Special Issue. Finally, the editors would like to extend their thanks to the Managing Editors of *Buildings* for their unwavering support throughout the entire process. Their dedication and assistance have played a pivotal role in ensuring the successful completion of this Special Issue. It is our hope that "Structural Performance of Cold-formed Steel Structures" will serve as a valuable resource for researchers, practitioners, and students in the fields of civil and structural engineering. We believe that the findings and insights presented in this Special Issue will contribute to a deeper understanding of the manufacturing process of cold-formed steel and its structural behavior as well as performance in buildings. Furthermore, we anticipate that the innovative solutions and approaches discussed herein will inspire further research and advancements in the design and analysis of cold-formed steel structures.

Conflicts of Interest: The author declare no conflict of interest.

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