Revolutionizing global house construction with optimal off-site Cold-Formed-Steel building designs

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Impact in a nutshell

The current global housing crisis requires immediate action to address its significant economic and social impacts. The construction sector must innovate more sustainable homes and meet future carbon emission limits.

Cold-Formed-Steel (CFS) is a promising solution for rapidly built affordable homes. However, its uptake is hindered by a critical need for design and numerical modeling guidance. My research proposes guidance for the optimal design of CFS panelised buildings under extreme gravity-loading scenarios. This research has demonstrated improved structural safety and efficiency while considering real-world load and restraint conditions.

Research details

The potential of CFS panelised modern construction methods to meet construction sustainability targets is substantial. However, its limited uptake (6.6% worldwide) is a pressing issue caused by a lack of design guidance, which is currently restricted to ideal conditions that rarely exist.

The research proposes design and numerical modeling guidance for efficiently designing studs and bearers, the two critical gravity load-bearing structural components in CFS panelised construction, by applying real-world load and restraint conditions.

In Phase 1, 56 industry-standard CFS studs were experimentally investigated under gravity-loading scenarios. The study revealed that the track-boundary condition (BCT) in CFS buildings significantly influences the studs' axial compressive performance and failure mechanism. A new effective length factor was proposed for practitioners, optimizing the stud design by 35% with BCT.

Phase 2 proposed a new finite element contact modeling approach using softened pressure-overclosure that practitioners can use to accurately predict the strength, stiffness, and failure mechanism of studs with BCT under gravity loading. Phase 3 investigated the combined web-crippling and bending behaviour of CFS bearer sections in load-bearing CFS panelised constructions.

What is or will be the impact of your research?

This research could have a significant technological and economic impact on the construction sector.

The study developed new predictive equations and design coefficients that offer practitioners more efficient structural design methods, leading to an average of 30% optimization in the structural design of load-bearing CFS components.

This research will help promote modern CFS construction methods, to help address the global housing crisis. CFS can play a vital role in shaping a more sustainable economy marked by reduced carbon emissions and efficient resource use.