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Nonlinear Performance of Castellated Steel Beams: Influence of Web Openings and CFRP Stiffening

Kunal Jagdale[1] and Popat Kumbhar[1]
Department of Civil Engineering[1-2]
K. E. Society's, Rajarambapu Institute of Technology. Rajaramnagar (Islampure), Sangli, MS, India

Abstract: *A castellated steel beam (CSB) is created by cutting a conventional steel I-beam along its centerline in a zig-zag pattern and rejoining the segments to form hexagonal web openings, resulting in increased depth and improved structural efficiency. This configuration offers benefits such as reduced self-weight, enhanced load-carrying capacity, and a better strength-to-weight ratio. However, the increased depth can lead to failure mechanisms like web post-buckling and lateral-torsional buckling under loading conditions, necessitating the use of stiffeners for reinforcement. Mild steel (MS) stiffeners are commonly employed and have been shown to improve load capacity and reduce deflection, but they add considerable weight and are susceptible to corrosion. In contrast, Carbon Fiber Reinforced Polymer (CFRP) has emerged as a superior alternative due to its lightweight nature, high strength, and excellent corrosion resistance. Research indicates that CFRP stiffeners can effectively enhance the structural performance of CSBs by increasing strength and minimizing deflection without the limitations of MS. This review focuses on the behavior of CSBs with different stiffening materials and concludes that CFRP offers promising potential. It also highlights the need for further exploration of the nonlinear behavior of CSBs with various web opening geometries and CFRP strengthening for more optimized structural applications.*

Keywords: Castellated beam, Non-linear stiffeners behavior, CFRP

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