Comparative Assessment of Methodologies for Quantifying Lateral Distortional Buckling Capacity in Steel-Concrete Composite Beams

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Steel-Concrete Composite Beams (SCCBs) employed within interior supports undergo negative moments, leading to compression on the bottom flange and a portion of the steel web. If the web of the steel profile lacks sufficient stiffness to resist lateral bending, it will deform, allowing the compressed flange to displace laterally and twist. This buckling mode is referred to as Lateral Distortional Buckling (LDB). Numerous publications have attempted to explain the behavior of LDB in SCCBs, which can be categorized into two research streams. The first stream focuses on exploring the elastic behavior of LDB by employing bifurcation equilibrium analyses to determine the critical moment at which elastic instability occurs. The second stream investigates the LDB strength of SCCBs through experimental studies or non-linear numerical analyses. However, there are discrepancies in the formulas presented in the literature for calculating the elastic critical moment and different approaches used to estimate LDB strength, deviating from standard procedures. These variations highlight the fact that LDB is still not fully understood by the structural engineering research and design community. Therefore, the main aim of this study is to examine the behavior of SCCBs and compare the theoretical and standard procedures for assessing LDB strength. Finite element (FE) models of SCCBs were developed using ABAQUS software, considering geometric imperfections and material non-linearity. The developed FE models exhibited a strong correlation with experimental results, precisely predicting the ultimate moment capacity of SCCBs with a maximum relative error of less than 2%. Substantial deviations were observed in the elastic critical moment and the ultimate moment when comparing the findings against established approaches. The significance of these insights lies in their ability to guide future research efforts and facilitate comprehensive specification reviews.

Keywords: Lateral distortional buckling, Negative moments, Nonlinear FE analysis, Steel-concrete composite beams