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Structures22

A numerical study on local web buckling behaviour of coped beams under combined axial and bending loads

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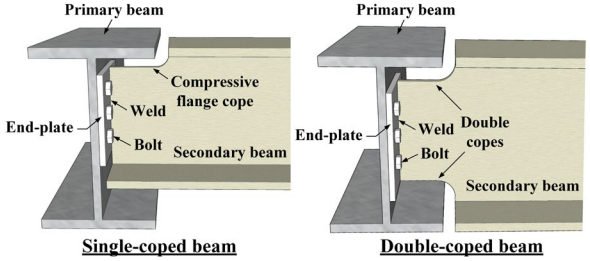
Abstract

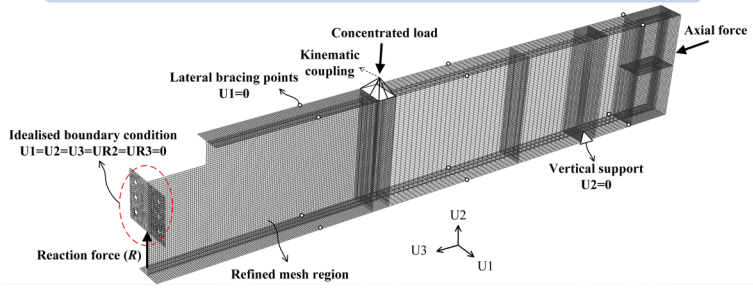
In this paper, a numerical analysis was performed to study the local web buckling behaviour and strength of single-coped beams under combined axial and bending loads. The investigated parameters included the axial stress in the coped region, cope details and slenderness ratios of the web. The numerical model was verified through single-coped beam tests in the literature, and local web buckling failure was observed for all of the models. The ultimate load of the single-coped beams was found to significantly decrease with the presence of axial compressive stress, whereas tensile stress contributed to increasing the local web buckling strength of the single-coped beams. The accuracy of the existing design formulas for quantifying the local web buckling strength of single-coped beams was evaluated based on the numerical results.

Introduction

Coped beam is a common practice in steel constructions to achieve the identical elevation of flanges for the intersecting secondary beams and primary beams. Previous studies assumed that coped beams were subjected to a combined loading of bending and shear, and none of them took axial force into account.



Numerical simulation of specimens in the literature



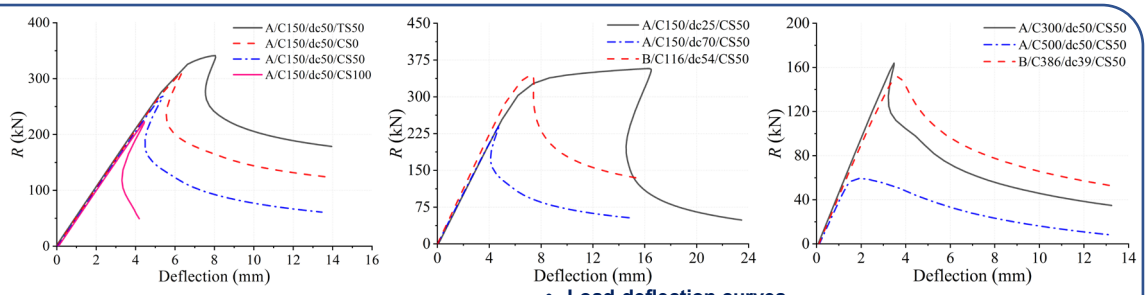
✓ The commercial finite element (FE) analysis software ABAQUS was used to develop the numerical models.

✓ The modelling techniques were verified through the test results of two specimens in the literature (Ke et al. 2018).

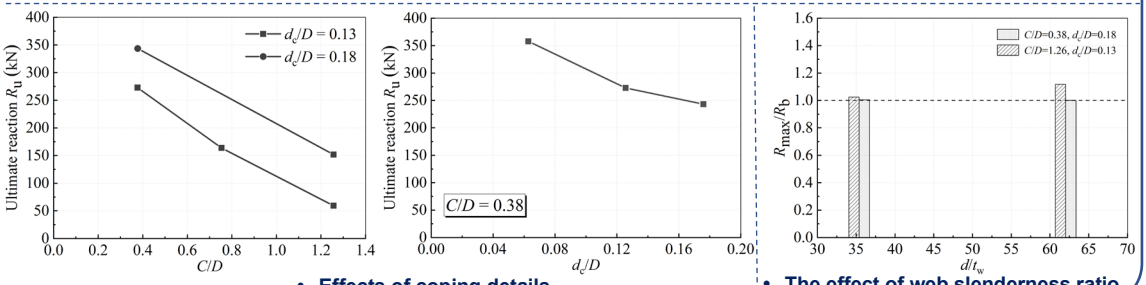
Parametric research & Assessment of current design equations

✓ Ten models were designed with variations in parameters of the axial stress in the coped region (σ_{cope}), cope details (C/D and d_c/D) and slenderness ratios of the web (d/t_w).

✓ The numerical results are compared with the predictions according to the design equations proposed by Cheng et al. (1986) and Yam et al. (2003), and it was found that both the Cheng's equations and Yam's equations gave unsafe predictions for some models.



• Load-deflection curves



• Effects of coping details

• The effect of web slenderness ratio

Conclusion

✓ The ultimate load was significantly decreased with the presence of axial compressive stress, whereas tensile stress contributed to increasing the local web buckling strength of the single-coped beams.

✓ The ultimate load was also significantly decreased with the increase of C/D ratio and d_c/D ratio under the axial compressive stress, and the post-buckling strength was considerable for models with more slender webs when the cope length was larger.

✓ According to the numerical results, both the Cheng's equations and the Yam's equations are quite unsafe for some models.

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