Iterative Global-local Methods to Consider the Local Deformation Effects in the Analysis of Thin-walled Beams

By

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Certificate of authorship and originality

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Ashkan Afnani Esfandabadi

To Vida

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Abstract

Thin walled members are one of the most widely used structural elements in modern structures. Beam-type finite elements, which are conventionally used to model these members, cannot capture cross-sectional deformation. On the other hand, the use of two-dimensional shell-type elements leads to computationally uneconomical models that cannot be adopted for common engineering practice.

The aim of this study is to develop a numerical method to incorporate the effect of local deformation on the global response of a thin-walled beam. For this purpose, the Iterative Global-local Method is developed in which beam elements are used as the global model while two-dimensional shell elements are placed at critical regions to constitute the local model. The two models are synchronised within each computational iteration via a kinematically appropriate mathematical link.

The Iterative Global-local Method is developed for elastic and elasto-plastic material response, for fibre-reinforced composite laminates, for pipes and curved thin-walled members. The accuracy and efficiency verification of the method is verified through comparisons with detailed finite element modelling and test data from the literature.

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