Quasi-conforming formulation method based on couple stress theory

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Abstract

The basic idea of quasi-conforming method is that the strain-displacement equations are weakened as well as the equilibrium equations, and the weighted weakened strains are approximated by element nodal displacement parameters. In this work, a new formulation of quasi-conforming method is presented. The element formulation starts from initial assumed stress, and the strain can be derived by using the constitutive equations. Then the stress-function matrix is treated as the weighted function to weaken the strain-displacement equation. Finally, appropriate interpolation functions are chosen to calculate strain integration. As an example, an 18-DOF triangular element based on couple stress theory is formulated. The proposed element can pass the enhanced patch test and does not exhibit extra zero energy modes. The element stiffness matrix is given explicitly, which makes the current formulation extremely efficient and attractive. Numerical examples presented show that the element keeps higher accuracy and can capture the scale effects of microstructure.

Keywords: Quasi-conforming, assumed stress, couple stress, patch test