Development of Isolated Element Method and Analysis of Upper and Lower bound solutions by a New Mixed-Hybrid Variational principle

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A new discretization analysis method named the isolated element method [1], that differ from conventional FEM, for solid mechanical problems is proposed. An object to be analyzed is divided into the elements that are separated from each other. A set of displacement functions providing arbitrary number of degrees of freedom is used for each isolated element which expresses the translation and rotation of a rigid body. The extended principle of minimum potential energy is applied to satisfy the continuity of the displacement of isolated elements adjoining to each other. Any node or spring, penalty functions and Lagrange multipliers are not used in this method. The displacement functions of the power series are used to describe the mechanical state of the isolated element and finally, the coefficients of series are determined by a variational principle derived from the extended principle of minimum potential energy.

Furthermore, a new mixed and hybrid variational principle [2] which is composed from the potential and the complemental energy functional is proposed. The pair of these energy are constrained by a formula. Using this new principle, in which stress and displacement can be used as independent variables, the stress and displacement are computed at the same time. Besides, upper and lower bounds solutions are analyzed using the new principle and the isolated element method.

Some computed examples of the plane stress problems are presented. We show the good convergency of the numerical results, and also present the upper and lower bound results of stress and displacement by the new mixed and hybrid variational principle using the isolated element method

REFERENCES

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