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Damage propagation analyses by XFEM using the Cohesive Zone Model

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Damage propagation simulations of structures, is one of the most challenging issues in the field of the computational fracture mechanics. In the present study, the extended finite element method (XFEM) [1] using the cohesive zone model (CZM) [2] [3] is applied to damage propagation analyses of rock mass and Carbon Fiber Reinforced Plastic (CFRP) composite laminate.
In the proposed method, analyzed domain in 3-dimensional space is modeled by conventional 4-nodel tetrahedral finite elements, and crack is modeled independently of finite elements through the framework of XFEM. Cracks are modeled by the level set method and finite elements cut by cracks are classified into several patterns according to the level set values at nodes and cut points. Such patterns are utilized for partition of elements and nodal enrichment. Moreover, CZM is introduced to the crack, which is expressed as assemblage of cut planes.
In-house XFEM codes based on the proposed method were developed and applied to test specimens of artificial rock and CFRP composite laminate. The developed code can consider various cohesive zone models. The results including static/implicit dynamic/explicit dynamic analyses were verified through comparison with those by the conventional FEM. It was shown that the proposed method provides the appropriate results.

REFERENCES

[1] N. Moës, J. Dolbow, T. Belytschko: A finite element method for crack growth without remeshing, *International Journal for numerical methods in engineering*, Vol. 46, pp.131-150 (1999).
[2] P. P. Camanho, C. G. Davila, M. F. Moura: Numerical Simulation of Mixed-Mode Progressive Delamination in Composite Materials, *Journal of Composite Materials*, Vol. 37, pp. 1415-1438 (2003).
[3] I. Carol, P.C. Prat, C. M.. Lopez: Normal /shear cracking model: application to discrete crack analysis, *Journal of engineering mechanics*, pp.765-773 (1997).