COLLABORATIVE RESEARCH CENTER 837

INTERACTION MODELING IN MECHANIZED TUNNELING

RUB

ON ADAPTIVE POLYGONAL FINITE ELEMENTS: AN APPLICATION TO COLLAPSE PLASTIC ANALYSIS

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Polygons occur extensively in nature. Polygonal finite elements have been applied to a wide range of mechanics problems. They offer more flexibility in mesh design for arbitrary geometries (Fig. 1b). However, adaptive polygonal finite elements have not been found sufficiently in the literature and furthermore in collapse plastic analysis of solids.

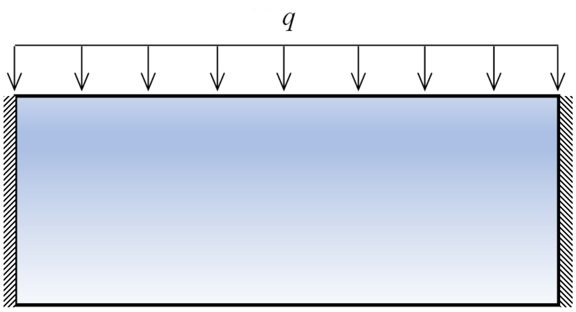

Fig.1a) Deck arch bridge: Model in 2D view

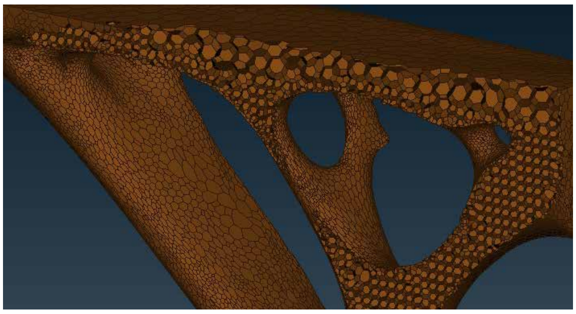

Fig. 1b) Deck arch bridge: Optimization

The present research contributes into four crucial points: 1) a spatial decomposition structure obtained from a so-called polytree mesh scheme; 2) Wachspress shape functions at vertex and bubble nodes handled at a primal-mesh level; 3) plastic strain rates and dissipation performed over a dual-mesh level; and 4) a new adaptive primal-mesh strategy driven by the L^2-norm-based indicator of strain rates (Fig. 2). Investigating both purely cohesive and cohesive-frictional materials. It is proved numerically that the present method performs well for volumetric locking problem. In addition, the optimization formulation of limit analysis is written by the form of second-order cone programming (SOCP) in order to exploit the high efficiency of interior-point solvers. The present method retains a low number of optimization variables and allows us to design and solve the large-scale optimization problems effectively.

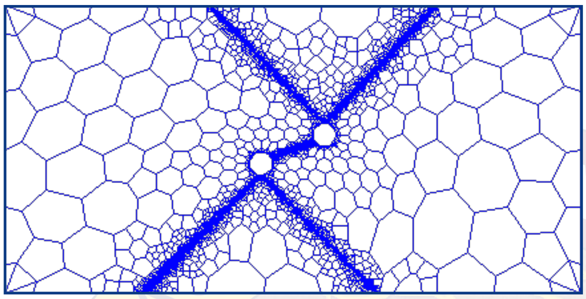

Fig. 2a) Plastic collapse analysis: Adaptivity

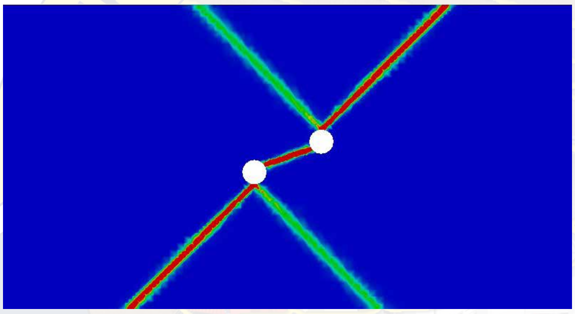

Fig. 2b) Plastic collapse analysis: Damage zone

Guests are welcome!