A new lattice element method (LEM) with integrated interface elements to determine the effective thermal conductivity of rock solids under thermo-mechanical processes

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Abstract

In order to determine the change of thermal conductivity of rock solids under coupled thermo-mechanical processes and developed microstructure fractures, an application of a new lattice element method (LEM) with additional interface elements representing the bond between the particles is investigated. The thermo-mechanical loadings in many engineering applications, such as deep geothermal systems, can result in a change of mechanical and thermal properties of rock solids. In the proposed model, the change of thermal conductivity under mechanical loading, thermal expansion and developed fractures due to coupled thermo-mechanical processes are considered. The main advantage of the new model is that it considers the thermal expansion while increasing the compression stresses in particles contact zone, which captures the true stress-strain behavior of the rock sample under coupled processes. The numerical results are eventually compared to the experimental results obtained from multi-anvil apparatus in Laboratory of CAU Kiel. It is shown that the new model is able to estimate the change of thermal conductivity under coupled thermo-mechanical loadings and developed microcracks.