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论文

基于梯度塑性理论的断层活化机理

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摘要：

基于梯度塑性理论，将断层视为内部连续、有厚度的地质体，分析断层带应变软化及其应变局部化问题。将梯度塑性理论引入断层带模型，得到了断层带沿倾向相对错动位移的理论表达式，定义了“断层带等效剪切刚度”；通过对上盘岩体的下边缘界面处单元体应力分析，得到上盘岩体沿断层倾向的相对错动位移并定义了“两盘岩体等效剪切刚度”。根据“断层带等效剪切刚度” 与“两盘岩体等效剪切刚度”的关系得到了断层活化的判据。结果表明：断层的活化不仅与断层内部地质体材料的性质 (断层内部地质体材料的脆性、内部结构尺寸) 有关，还与两盘岩石的特征参数(剪切弹性模量、泊松比)及包括断层倾向长度的最小岩层尺寸相关；断层内部地质体材料的内部参数越小、“两盘岩体等效剪切刚度”越小、断层内部地质体材料越脆及包括断层倾向长度的岩层最小尺寸越大，断层越易活化。

关键词： 梯度塑性理论；断层活化；活化判据；力学分析；剪切位移；剪切刚度

Faults activation mechanism based on gradient dependent plasticity

Abstract:

Analyzed the strain softening and consequent strain localization behavior for fault based on gradient dependent plasticity.Regarded fault as continuous geological bodies with thickness.The gradient dependent plasticity was introduced into the fault model.The theoretical expression of fault band displacement in direction of fault azimuth was presented, and ‘the equivalent shear stiffness of the fault band’ was defined.The displacement of fault hanging wall in direction of fault azimuth was presented and ‘the equivalent shear stiffness of the fault hanging foot wall’ was defined considering the stress conditions of element body in interface at the lower edge of fault hanging wall.The fault activation criterion was obtained according to comparing ‘the equivalent shear stiffness of the fault hanging foot wall’ with ‘the equivalent shear stiffness of the fault band’.The results show that fault activation is determined with the factors which not only include the material properties(such as brittleness, the internal structure size of geo materials in fault), but also include fault hanging foot wall characteristic parameters(such as shear elastic modulus, Poisson’s ratio).Besides, fault activation is determined with the minimum width of the rock mass which include the integral fault.It is found that the lower internal parameter or ‘the shear equivalent stiffness of fault hanging foot wall’, and the higher brittleness of fault geo materials or the minimum width of the rock mass which include the integral fault lead to increasing the possibility of fault activation.

Keywords: gradient dependent plasticity; fault activation; activation criterion; mechanical analysis; shear displacement; shear stiffness

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