Geophysical Research Abstracts
Vol. 19, EGU2017-2606-1, 2017
EGU General Assembly 2017

Rheological model analysis on depth of toppling deformation in the anti-dip rock slope

Da Zheng

State Key Laboratory of Geohazard Prevention and Geoenvironment Protection(Chengdu University of Technology), Chengdu, China (zhengda@cdut.cn)

The failure of the toppling deformation occurred in the layered rock mass, it is a kind of mode of deformation and failure, which is bent towards free direction and gradually develops into the slope under the combined forces of in-situ stress, gravity, and groundwater dynamic (hydrostatic) pressure and so on. The most common toppling deformation is the toppling of ductile bending. Obtaining the developmental depth of bending deformation is of great significance for judging the development scale of the plasmodium and the stability of the slope. At present, the developmental depth of toppling deformation mainly depends on the survey and statistic of the exploration adit, or the simulation of the deformation and failure process through the numerical simulation method, there is little research on the developmental depth of toppling deformation from mechanics point of view.

In this paper, with the consideration of the time-sensitive characteristics of developmental process of the toppling deformation, the anti-dip layered slope can be considered as a multi-layer superposition cantilever with fixed end and free end, bending under self-weight and inter-layer stress. Under the premise of the initial stage of rheology of the rock slopes, which is considered to be the limit position of the toppling deformation and development, the Kelvin rheological model, which is usually used to describe the decay creep, is chosen to describe the time-sensitive process of rock slopes. The stress-strain analysis calculation is used to obtain the time-varying expression of a certain point on the rock beam. Furthermore, taking the time to infinity, the depth of the layered rock slopes is calculated as x=4Ccosβ/[2γcosαcos$\beta - \gamma^2$(cos ($\alpha + \beta$)+2sin($\alpha + \beta$)tanϕ)*((1+n) /2+(1-n) cos2α/ 2)] , which is obtained by using the strain reaches zero as the criterion of the depth at toppling deformation development limit position, combining the time-varying expression of a certain point on the beam. we obtain the mathematic analysis conditions by using the constant positive characteristic of depth of the toppling deformation, The result shows that the depth of the slope toppling deformation is influenced by the rock mass, strata inclination, rock thickness, interfacial friction coefficient, interlayer internal friction angle, slope angel and Poisson 's ratio of rock slopes. The toppling deformation only occurs when 2cosαcosβ-[cos($\alpha+\beta$)+2sin($\alpha+\beta$)tanϕ][(1+n)/2+(1-n) cos2α/2]$\geq$0. This study is an exploration to explain the time-sensitive characteristics of toppling deformation by using rheological theory. The conclusion is of great significance for the study of the location of the bending zone, the size of the toppling deformation, the stability analysis and the early identification of the toppling deformation based on the deformation characteristics.