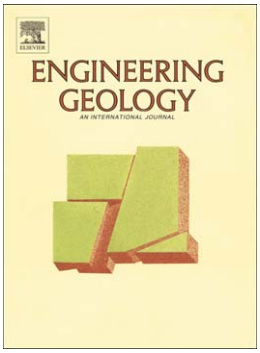

A general analytical solution for the evolution of cliffs accounting for strength degradation, seismic action, formation of tension cracks and seepage

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PII: S0013-7952(16)30363-5
DOI: doi:10.1016/j.enggeo.2016.09.005
Reference: ENGEO 4378

To appear in: *Engineering Geology*

Received date: 4 June 2016
Revised date: 16 September 2016
Accepted date: 18 September 2016

Please cite this article as: Voulgari, C., Utili, S., A general analytical solution for the evolution of cliffs accounting for strength degradation, seismic action, formation of tension cracks and seepage, *Engineering Geology* (2016), doi:10.1016/j.enggeo.2016.09.005

A general analytical solution for the evolution of cliffs accounting for strength degradation, seismic action, formation of tension cracks and seepage

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Abstract

The evolution of natural slopes over time is ruled by several concurrent physical phenomena, namely the strength of its component geomaterials and its weakening over time due to weathering processes, the occurrence of seismic events, seepage and the formation of tension cracks. The paper presents analytical solutions obtained considering a succession of discrete failure events (landslides) progressively altering the slope morphology over time. The model, derived in the framework of limit analysis assuming plane strain conditions, provides a tool for the assessment of whether manufacts and/or infrastructures located on a slope subject to various natural degradation phenomena will be affected by the occurrence of failures.

Unlike current empirical and semi-empirical models of slope evolution, the analytical solution that is here presented is derived by applying principles of soil and rock mechanics, therefore it is of general validity, so that no ad–hoc calibration against past observations of the evolving slope is needed. This analytical technique only requires knowledge of the (geotechnical) parameters characterising the geomaterials comprising the slope of interest, namely angle of shearing resistance, ϕ, cohesion, c, tensile strength, unit weight, together with knowledge of the relevant seepage scenarios, strength degradation processes, and seismic events likely to occur.