Comparative Study of Quasi-static and Dynamic Behaviours of a Reduced Model of ASM4 Rockfall Barriers

Romain Boulaud, Cyril Douthe

Laboratoire Navier – UMR 8205 – Ecole des Ponts Paris-Tech, IFSTTAR, CNRS

6 et 8 avenue Blaise Pascal – Champs sur Marne – 77455 Marne la Vallée CEDEX 2

Contact: romain.boulaud@enpc.fr

Abstract

ASM4 rockfall barriers is a protection device against the risk of rocks falls. These structures undergo large deformation and due to high geometrical and material non-linearities, the development and the use of computational tools are essential to carry out predictive approaches and optimise their design at reduced cost. In order to reduce considerably computation times, this paper presents an original approach, which consists of considering a reduced model of rockfall barrier comprising only few degrees of freedom rather than many thousands for a complete structure. The model is developed from the numerical simulations results carried out from a quasi-static experiment. After the accuracy of the model is verified with this first experiment, its potential to reproduce the real dynamic behaviour of a barrier is studied.

Keywords: reduced model, sliding cable, non-linear behaviour, dynamic relaxation.

1   Introduction

The hazard of landslide, mainly in mountain areas, compromises the safety of inhabitants. The need to protect them, their properties and infrastructures against this risk requires the installation of protective structures. Rockfall barrier is an often used alternative because of its low weight and its high capacity to absorb energy. It can be installed, by specialized workers, on hardly accessible zones. These kits have complex structures which can be described schematically as follows: a wire net (intercepting the block) supported by cables connected by steel posts to the cliff. The dissipation of the rock kinetic energy is insured by the net itself and by brakes distributed along the cables. The first section of this paper is dedicated to the modelling of a rockfall barrier. The second section presents the simulations of quasi-static experiment on a barrier

prototype with a dynamic relaxation algorithm. The results of these simulations are then investigated to develop a simplified model of barrier whose accuracy is verified with the same experiment. This model is then subjected to a dynamic loading and the comparison of its behaviour with a full scale experiment is conducted in the last section. Every experiments presented in this paper were carried out in the framework of the French national project C2ROP (www.c2rop.fr) which brings together many public and private partners around the topics of landslide risk and protection devices.

2   Rockfall barrier modelling

In this paper, we focus on the numerical modelling of two components: the support cables and the net. All modelled behaviours presented in this section are elastic.