

*– PhD position, Grenoble, France –*

## **Local field modelling of interaction between a soil body and a falling boulder**

### **Context**

Rockfall constitutes a major threat in mountainous regions for people, buildings and transportation lines. When a boulder detaches from the cliff, it encounters different soil bodies on its trajectory down the slope. These can either be natural or man-made, covering the slope or constituting protection structures. For instance, falling boulders can be deviated or stopped by protection galleries, catch ditches and embankments, which are made up from fine or coarse soils. Thus, both the whole trajectory of the boulder and the response of the structures are governed by the interaction between the boulder and soil bodies. While this issue is of paramount importance for defining optimum protection strategies and designing protection structures, the computational tools in practice to date appear to be inappropriate in accounting satisfactorily for the complexity of the phenomenon involved.

### **Objectives**

The proposed research work aims at investigating the response of soil subjected to a localized impact through numerical developments, using a discrete element method (DEM). The aim is to identify and quantify the mechanisms involved in load transfer in the neighbourhood of the impact and to estimate their consequences on the global response of the granular layer. Parameters concerning the soil and the boulder will be varied. The numerical results will be compared to experimental ones, from the literature or from experiments performed specifically for this purpose. The analysis will help defining the limits of the current computational tools both for stress transmission within protection structures and for the reaction force acting on the boulder. Eventually it will allow proposing more advanced computational tools accounting for the influence of these mechanisms.

### **Profile of applicants**

A highly motivated candidate is looked for. The selection will be based on the excellence of the CV.

Applicants should have a master in engineering, applied mathematics or physical sciences (master or equivalent). A good background and/or previous work in Continuum Mechanics, Computer Modelling and Soil Mechanics will be considered

an advantage. Candidates should have a scientific autonomy, and be able to work in close connection with a team.

### **Application**

For applying, first send the contact persons a description of your past work, a motivation letter including statement of your research interests and a curriculum vitae (including grades, courses followed, the title of the master thesis and a list of publications if any).

The applicants will receive the application file to be completed and returned by the 16th of May 2011.

### **Selection process and Contract**

Successful applications will be selected by the Cemagref Committee, in June 2011. Applicants will be notified with the decisions in July 2011.

PhD students have fixed-term contracts with Cemagref giving them standard social protection. The contract term is three years, beginning in autumn 2011. The gross monthly salary is €1,852.11.

The thesis will be conducted on the site of Grenoble, team ETNA, with probable stays in Italy (Milano).

### **Contact Persons:**

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### **The Research Institute – The Team**

Cemagref is a public scientific and technological research institute under the joint supervision of the Ministry of Research and the Ministry of Agriculture. It employs 1,350 people, including 950 permanent members of staff and 240 PhD or post-doctoral students.

The team ETNA conducts research in the field of natural risks in mountainous regions (snow avalanches, torrents, rock falls), based on experimental and numerical developments. Among these, discrete element methods have been used for modelling water and snow flows, rigid discontinuous structures as well as boulder impacts on structures.