ABSTRACT

Geological literature reports a dependency of fracture density (number of fractures per rock volume) on the thickness of the fractured, competent rock layers: in otherwise identical situations, a thinner bed will have a higher fracture density than a thicker one. A shortcoming of the published studies is that they view beds individually and generally neglect the mechanical interaction between closely neighboured beds.

The main goal of the present work is to try to know some more of this mechanical interaction between closely neighboured beds. Thus, models of layers in which a mechanical interaction between the neighboured beds is possible are simulated. The study inspects conditions for formation of fractures, or a set of fractures, in multi-layered rocks, taking into account several variations in mechanical properties and thicknesses of the studied layers. The work consists basically of two different parts:

- A literature study, where it is summarized and abstracted a collection of publications about fracture studies and their conclusions.
- Simulations and modelling where it is inspected one aspect of fracturing, i.e. the effect of fractures on stress and strain in neighbouring beds. The fracture process itself is not studied, but the effect of fractures in one or two beds on their neighboured beds is investigated, applying some displacements and strains in the initial fractured bed(s), and seeing the result in the neighboured ones.

Some limitations and problems have been found carrying out these purposes, like the absence of very good previous studies in this topic, impossibility to introduce in the software some important geological features on this topic (e.g. fracture spacing to layer thickness ratio), impossibility to obtain fractured models directly from the software, and the scope of study limited to pre-fractured stage. For those reasons, it has been necessary to carry out a large number of models in order to try to establish the possible behaviour of the fractures in these conditions.

After having carried out all the interpretations, some conclusions have been obtained, as it follows:

- In the case of the application of small deformations or displacements, the introduction of a fracture (or some kind of flaw) in a simulated model of a soil by means of a finite element code is absolutely required in order to obtain some results to explain formation, development and propagation of a set of fractures.
- The intensity of propagation, in a layer, of fracture-caused stress and strain accumulations along the direction of this fracture toward a near competent layer, decreases with the increasing fracture spacing in the layer.
- Only the Young modulus of a layer and the thickness of this layer have an influence on the propagation of fracture-caused stress and strain accumulations. Thus, the intensity of propagation will decrease with the decreasing stiffness, and also with the increasing thickness of the incompetent layer.
- It has been observed a slight stress reduction shadow between the fractures in the models. That is the explanation for the stronger deformation at the fractures located at that side of the models, at which the displacement was applied.