Rock falls and protective measures at the upslope area of Drimon village, in Lefkas island, during the earthquake of 14/8/03 (Ms=6.4)

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The present paper refers to preliminary results of the study of the analysis of rock falls, in Lefkas island, related to the earthquake of 14/8/03 (Ms=6.4). The rock falls were activated at the top of the hill, located upslope of Drimon village causing damage to the village (Figs. 1, 2b).

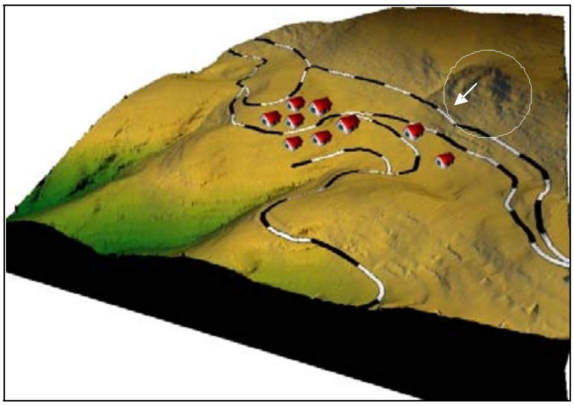

Fig. 1. 3D model of the rock fall area

The area is composed of Upper Triassic white limestones. The slope angle is >50^0 to the NW. The directions of the joints activate the sliding and the toppling of big blocks with minimum diameter of 2 m (Fig. 2a).

In the present paper the sliding and toppling of the blocks were analysed and the safety factors were estimated for representative and more active parts of the slope (Fig. 1). In the analysis static and dynamic forces, related to the earthquake, were taken into account. The rebound of the rock falls was calculated regarding to the geometry of the slope, the characteristics of the rock material and the dimensions of the blocks. Furthermore, the places, the dimensions and the necessary absorption capacity of barriers needed to be installed for restraining probably falling blocks were also estimated (Fig. 3c). For this purpose, the software "RocFall" of RocScience Inc (www.rocscience.com) was used (RocFall user's guide, 2001, Hoek, 1986, 2000).

According to our study, the blocks are necessary to be tied, in place, at the upper part of the slope, using bolting, wire cable and wire netting techniques. Nevertheless, two elastic metallic barriers, approximately 100 m long and 5 m high, able to absorb kinetic energy of 3000 kJ, were decided to be installed on the slope, for the case that blocks, of mean dimensions 2.5x2.5x2.5 m, fall down. These barriers will be placed at horizontal distances of 38.22 m and 94.08 m, from the rock-falls starting point.

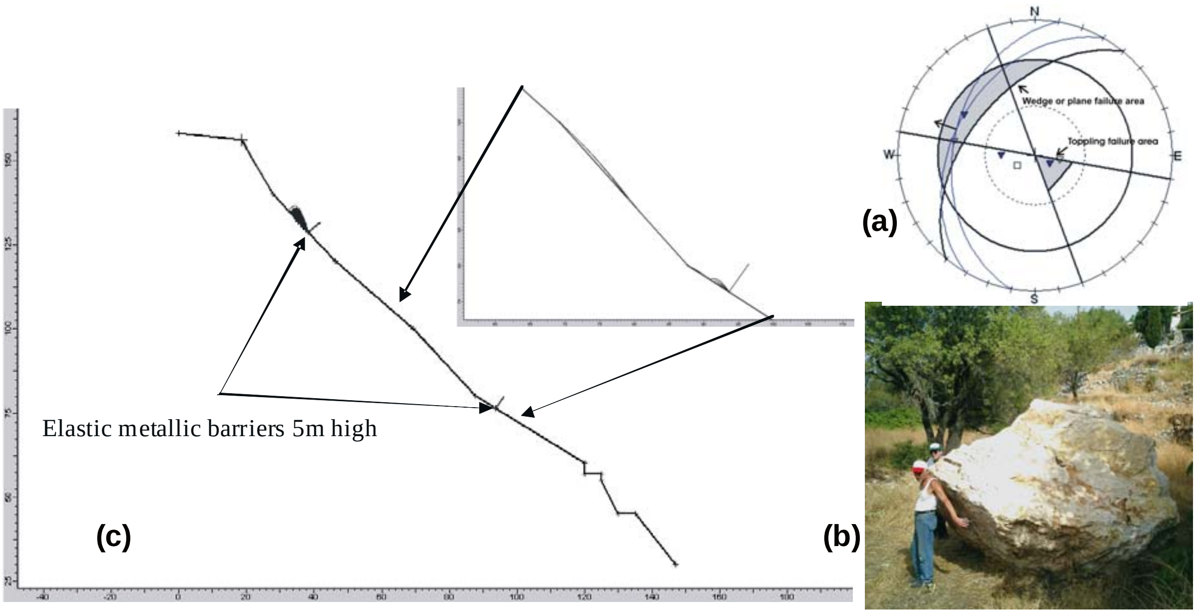

Fig. 2. a) Stereo-diagram showing toppling and sliding directions (Markland, 1972), b) representative fallen block, c) analysis of the fallen blocks rebounds and places of barriers installation (Vogiatzis et al., 2004).

References

Hoek, E. (1986). Rockfall: a computer program for predicting rockfall trajectories. Unpubl. intern. notes, Golder Associates, Vancouver.

Hoek E.,2000 rock engineering pp115-121.

Markland, J.T (1972). A useful technique for estimating the stability of rock slopes when the rigid wedge sliding type of failure is expected. Imp. Coll. Rock Mechanics Res. Rep., 19, p 1-10

RocFall User's Guide (2001). "Rocfall – Risk analysis of falling rocks on steep slopes". Rocsience Inc. Torondo, 59 p

VOGIATZIS D., DIMITIOU, AN., PAPATHANASIOU, G.,., KANTIRANIS N., FILIPPIDES AN. MORAITI E. AND CHRISTARA,S B. (2004). Rock falls during the earthquake of 14/8/03 (Ms=6.4) and possible protective measures of the up slope area of Drimon village (Municipality of Sfakiotes) in Lefkas island, Greece, Thessaloniki, Bull. Geol. Soc. Gr., vol. XXXVI, Thessaloniki, 10p.