



## **Analysis of landslide mitigation effects using Ground Penetrating Radar**

Aleksandar Ristic (1), Miro Govedarica (2), Milan Vrtunski (3), and Dusan Petrovacki (4)

(1) Faculty of technical sciences, University of Novi Sad, Novi Sad, Serbia (aristic@uns.ac.rs), (2) Faculty of technical sciences, University of Novi Sad, Novi Sad, Serbia (miro@uns.ac.rs), (3) Faculty of technical sciences, University of Novi Sad, Novi Sad, Serbia (milanv@uns.ac.rs), (4) Faculty of technical sciences, University of Novi Sad, Novi Sad, Serbia (petrovacki@uns.ac.rs)

Area of Ground Penetrating Radar (GPR) technology applications becomes wider nowadays. It includes utility mapping as important part of civil engineering applications, geological structure and soil analyses, applications in agriculture, etc. Characteristics of the technology make it suitable for structure analysis of shallow landslides, whose number and impact on environment is dominant in the region. Especially when shallow landslide endangers some man-made structures such as buildings, roads or bridges, analysis of GPR data can yield very useful results.

The results of GPR data analysis of the shallow landslide are represented here. It is situated on the mountain Fruska Gora in Serbia. Despite its dimensions (50x20m) this landslide was interesting for analysis for two reasons:

- The landslide occurred at the part of the single road between the cement factory and the marl mine. The cement factory "Lafarge" in Beocin (Fruska Gora) is the largest cement manufacturer in the country. One of major priorities of the factory management is to keep the function of this road. The road is heavily exploited and over the years it led to landslide movements and damaging of the road itself.
- The landslide dates back to earlier period and the mitigation measures were performed twice. Laying the foundation of the retaining wall was not performed during the first mitigation measures. The second mitigation measures were performed in 2010 and included detailed geotechnical analysis of the location with the appropriate foundation laying.

Since the GPR technology can produce high resolution images of subsurface it provides clear insight into the current state of surveyed location. That kind of analysis is necessary to maintain permanent functionality of the road and to check the status of mitigation measures. Furthermore, the location characteristics do not allow easy access so the possibilities of other analysis technologies application are limited.

In order to assess the effects of these measures in October 2012 GPR scanning of the landslide was performed. Twelve GPR profiles on different locations on the landslide were collected. GPR profiles were processed and analyzed. The results showed that mitigation measures were effective and that the road is not endangered from the landslide for the time being. Nevertheless, due to extensive use and commercial significance of the road, assessments should be done periodically.