The Mediterranean Workshop on Landslides (MWL)
Landslides in hard soils and weak rocks - an open problem for Mediterranean countries
(21-22 October) - Naples, Italy

Slopes Instability along an International Road in North Africa

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ABSTRACT:

Number of existing landslides incidences were observed along an international road in North Africa (Algeria). The instability incidences had to be dealt with during the development along the road by doubling the direction of traffic. The aim of this paper is to document:

a) two of the observed landslides areas along the road,
b) the investigation carried out to characterize the ground conditions as well as the geometry of the instability surfaces,
c) the investigation and analysis to determine the possible causes of the instability, and
d) the potential solutions to stabilize the landslides areas.

The ground conditions are almost similar to great extent in most of the landslides areas. Figure (1) shows a cross section and geotechnical stratification of one of the slide areas. The landslide area in Figure (1) consists of clay/silt/sandy colluviums layer that is underlain by marl.

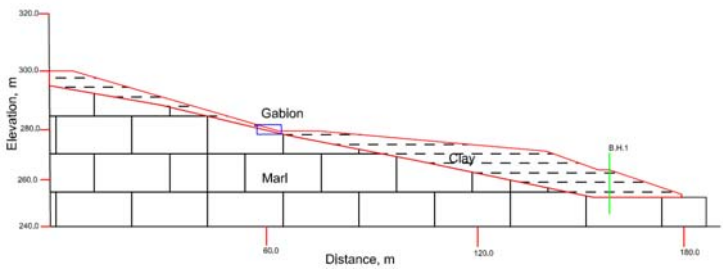

Figure (1): Cross Section of the Slope and Stratification at one of the landslides areas along the road.

The sites has several evidences of previous slides including

1) Surface cracks starting from the road level
2) Steps of settled area at the edge of the road showing the start of deep sliding surface (Fig. 2)
3) Surface scarp areas and
4) Previous attempts for slide stabilization including gabions that are sometimes seem to be not efficient.

Figure (2): Site evidence of instability at one of the landslides areas along the road

The presence of the clays and/or colluviums deposits over marly rocks as observed and reported in above are the main explanation for the failure. At the described sliding area, the slip surface starts from the cracks at the edge of the road and extends down to the interface between the Clay and the Marly rock. The slip surface follows the Clay-Marl interface down to the toe of the slope below the existing Gabions to the surface. The geometry of the slip surface at the sites are confirmed based on boreholes drilling and dynamic penetration resistance profiles that are carried out in the areas for the sake of characterizing the geometry of the slip surface and to characterize the stratification in the slope areas.

The main reason for the slides could be due to the rise of ground water at rainy season. Such a rise increases the water pressure resulting in a decrease in the effective normal stress along the slip surface. The decrease in effective stress leads to a decrease in the shear strength of the geomaterial along the slip surface.

Stability analyses of the slides are carried out using the residual drained strength along Clay-Marl interface. Intact to fully softened drained strength is used on the slip surface at locations other than the clay-Marl interface. The residual and fully softened strength of the Marl or the Clay are estimated using the empirical correlations published by Mesri and Shahien (2003). The potential influence of particle aggregation on the empirical correlation is taken into account based on the work by Eid (2001) and Mesri (2001). The intact strength used in the analysis are measured in the laboratory on samples obtained during the ground investigation.