Jaboyedoff, M., Couture, R. and Locat, P. (2004): Structural analysis of Turtle Mountain (Alberta) using digital elevation model. 57ème conférence canadienne de géotechnique - Québec, Octobre 24-26, 2004.

STRUCTURAL ANALYSIS OF TURTLE MOUNTAIN (ALBERTA) USING DIGITAL ELEVATION MODEL

M. Jaboyedoff [1], R. Couture[2], P. Locat[3]
[1] Quanterra, Lausanne, Switzerland, [2]Geological Survey of Canada, Ottawa, Canada, [3]Laval University, Quebec City, Canada

Key words: Turtle Mountain, Sloping Local Base Level (SLBL), Digital Elevation Model (DEM), COLTOP, Frank Slide.

The use of Digital Elevation Models (DEM) and the software COLTOP to create a 3D shaded, colored relief maps revealing the topography orientation makes it possible to perform topographic structural analysis leading to the identification of structural features (main joint set, fault scarps, or a landslide scarp) that are involved in rock instabilities.

Structural analysis using COLTOP has been applied to the summit of Turtle Mountain (Alberta), from which a 30 M m^3 rock mass of limestone detached and partially destroyed the town of Frank in 1903. The Frank Slide is Canada's most disastrous landslide in which more than 70 people lost their life. The rockslide took place on the east flank of Turtle Mountain along bedding planes and main joint sets. An anticline shapes Turtle Mountain and controls its fracture system (Jones 1993). The 1903 rockslide has left a very fractured headscarp at the summit of Turtle Mountain that has experienced numerous small rockfalls and instabilities since the main failure event. Movements at Turtle Mountain are now scrutinized through an important monitoring program.

The results of our study have partly confirmed and refined the structural analysis by Cruden and Krahn (1973). Five main joint sets are identified using 1-meter DEM. Three of them are shaping the west side of Turtle Mountain and three are involved in the failure surface of the 1903 rockslide including one set common to both sides. The failure surface appears as composite and shaped by a wedge and by the bedding as proposed by Cruden and Khran (1973). The large-scale discontinuity sets deduced from the DEM are slightly different of the structural data acquired by field survey (Couture, 1998), because of different sampling scales.

Results obtained from analyses of DEM allow characterising the large-scale geological structures with respect to their orientation. The results indicate that the structural analysis obtained from digital elevation models allows determining the main structural features that contributed to rock slope instabilities. The above approach should be considered as a preliminary technique to be undertaken before carrying out field investigation.

References:

Couture, R. (1998). Contributions aux aspects mécaniques, et physiques des écroulements rocheux. PhD thesis, Laval University, 573 p.

Cruden, D.M. & Krahn, J.(1973). A re-examination of the geology of Frank slide. *Can. Geotech. J.*, 10, 581-591.

Jones P.B. (1993). Structural geology of the modern Frank Slide and ancient Bluff Mountain Slide, Crownest, Alberta. Bulletin of Canadian Petroleum Geology, vol. 41, No. 2, June 1993: 232-243.