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Three-dimensional visualization of the Andy Gump Landslide, Grand Mesa, Colorado, USA

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Reconstruction of a slope prior to failure is necessary for engineering geomorphologists and geotechnical engineers to understand the mechanics of slope failure. We developed a methodology of reconstructing a slope condition before failure and visualizing the failure mechanism in three-dimensions by using elevation data before and after slope failure, GIS, and immersive technology. This method is useful to determine the geometry of slope and failure surface, and simulate the movement of the slope. Knowing the geometry of the slope pre-and post-failure is fundamental to understanding geomorphological parameters, such as morphology, movement mechanics, and triggering mechanisms, which are essential to study a surface on which to predict future movement.

The study area, located on the south facing slopes of Grand Mesa in Colorado, consists of numerous landslides. The geology consists of consolidated deposits of weathered volcanics, clays, and sandstones. During the summer of 2005, heavy rainfall triggered a landslide that locals refer to as the Andy Gump Landslide.

We collected coordinates and elevations of 3,000 points on the surface of the Andy Gump landslide by using a high resolution GPS. We also mapped the surrounding terrain, the surface of the landslide and the depth of regolith. These elevation data were interpolated and used to develop a digital elevation model of the failed surface.

This surface was subtracted from the Digital Elevation Model (DEM), representing the terrain before the occurrence of the landslide to determine the geometry and volume of mass that was moved and deposited.

The landslide, rotational in nature, is $\sim$380 m long and $\sim$65 m wide and incorporated more than 10 m depth of regolith. Precision surveying of the adjacent slope and the current slide surface shows a slight change in slope from 20° to 15°, $\sim$59,000m^3 of debris was transported as the landslide. Several large blocks of rock-soil debris remained intact as the landslide mobilized. We used these blocks as tag points in the dynamic visualization of the landslide. ESRI ArcGIS®, VTK® and PARAVIEW® were used in conjunction with a SEOS® system to perform the dynamic immersive visualization. This visual approach provides an important tool to assess landslide mechanics and demonstrates how change occurred.