SHEAR STRENGTH

Landslides happen when the gravitational stress, in combination with **shear stress**, exceeds the **shear strength**, of the materials on a slope. Shear stress is a force which causes deformation of a material by slippage along a plane parallel to the stress. Sheer strength is the material's resistance to that shearing. The steepest angle that a slope can maintain without collapsing is called its **angle of repose.**

Shear strength is determined primarily by two factors: **frictional strength** and **cohesion.** The internal friction of a slope is the ability of its constituent particles (the sediment fabric) to resist movement. Cohesive strength refers to the bonding between particles. Another factor that plays a part in slope stability is the spatial disposition of the particles. Materials with a loose, open sediment fabric will weaken more easily when disturbed.

Most landslides have multiple causes. Sheer stress can be built up over time by a number of processes, including the steepening of a slope by erosion or excavation, overloading by water due to a rise in the groundwater table, and the accumulation of debris or sediment. Powerful, short term stresses such as earthquakes or rainstorms can then destabilize the slope, activating a landslide.

SHEAR STRENGTH LAB

Landslides are made up of several layers of sediment and debris, built up over time. These layers, some weak and some strong, play a part in the overall shear strength of a slope. This can be demonstrated with a few materials from around the house!

You will need:

- A baking sheet or large tray
- Flour
- Sand or sugar
- Crumbled potato chips or something else to represent larger sediment and debris
- Several books
- Protractor

1 Prop the baking sheet up on one of the books. Sprinkle a layer of flour on the sheet.

2 Continue to add books to the pile, one by one, steepening the angle of the slope. Take note of how many it takes to get the flour to slide down the baking sheet. Measure the angle with a protractor.

3 Repeat the process with the sand, and then the crumpled chips. Did the angle of the slope needed to cause a landslide change based on the material used?

4 Experiment with multiple layers, such as flour under, and then on top of chips. Can you determine which layers are "weakest" and prone to collapsing? Does having a "strong" layer on the bottom or top make a landslide occur more or less easily?