

Mass Movements of Slope Soils



Mass Movements

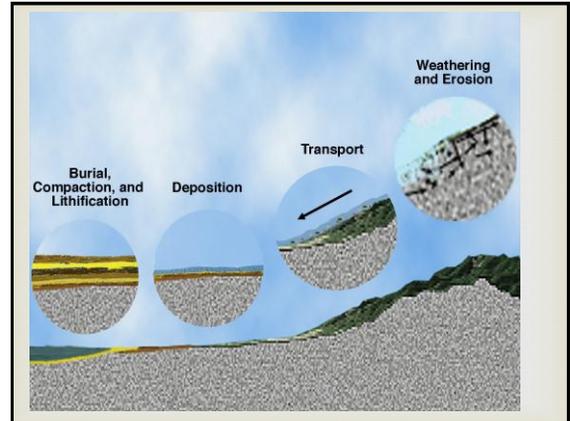


- ☞ Already talked a little about landslides with earthquakes...
- ☞ AKA "mass wasting"
- ☞ A mass movement is any displacement of large amounts of soil down slopes over (often) a comparatively short period of time
 - ☞ Destabilized soils that are triggered
 - ☞ Caused primarily by gravity
 - ☞ Landslides
 - ☞ Eventually massive erosion caused by numerous factors

Rock Weathering



- ☞ Weathering is the breakdown of parent material into soils which will eventually be removed
- ☞ Can be physical (water, wind, glaciers) or chemical (acid rain)
- ☞ Important for soil creation, nutrient cycling, topographic changes



Accumulation of Debris on Slopes



- ☞ Slopes more exposed to environmental weathering conditions
- ☞ As parent material weathers, soils build up on the slopes being weathered
- ☞ Material can't build up indefinitely, so it eventually must move
 - ☞ Slowly and naturally
 - ☞ Catastrophically



Landslides



- ☞ When a sheet of material shears off of a "failure plane" and slides downwards
- ☞ Causes large, concave scars
- ☞ Soil deposited downhill



La Conchita, CA 2005 landslide

Landslide Types

- ☞ Two main varieties:
- ☞ Rock falls
 - ☞ Large, more solid debris piles
 - ☞ Can be caused by earthquakes, deteriorated soil, etc.
- ☞ Mud flows
 - ☞ Fluid, watery soils
 - ☞ Caused by heavy rains, deforestation, agriculture, etc.

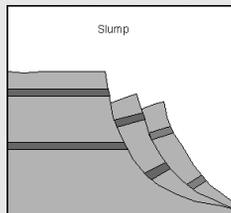


NatGeo Landslide Video

☞ http://www.youtube.com/watch?feature=player_embedded&v=mknStAMia0Q

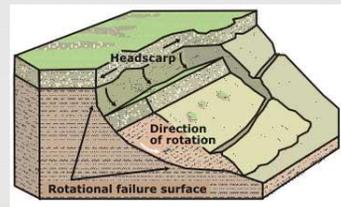
Earth slumps

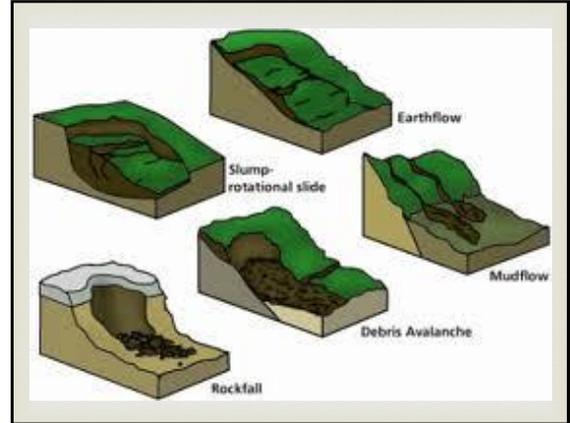
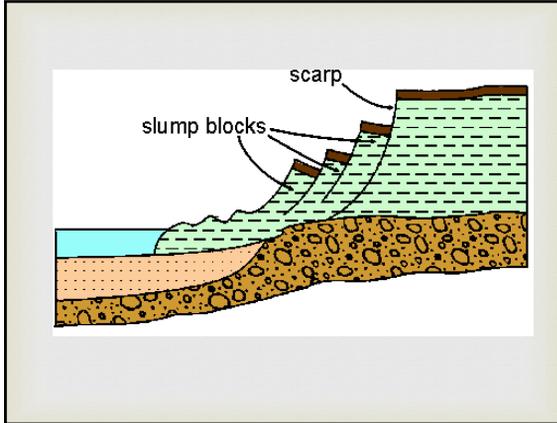
- ☞ Earth shears from a failure plane as in landslides, but the resulting scar is more of a cliff or scarp than an open gash
- ☞ Often formed by removing dirt at the base of a slope



Rotational slumping

- ☞ Slumping in which the main section of displaced Earth slumps into several smaller blocks





Soil creep and Solifluction



- ☞ Soil creep= slowest kind of soil movement
 - ☞ Soils move due to expansion and contraction. Frozen soils expanding and inch downwards, warmer soils contract.
 - ☞ Creates slow, almost unnoticeable movement downwards
- ☞ Solifluction= flowage of water saturated soils over impermeable ground



Soil creep



Solifluction



Manmade Causes of Mass Movements



- ☞ Deforestation: trees and plants hold soils in place.



Manmade Causes of Mass Movements



- ☞ Agriculture: replacing natural, anchoring vegetation with weaker plants



Manmade Causes of Mass Movements



- ☞ Building: involves drilling and removal of plants and occasionally parent material



Management of Sudden Mass Movements

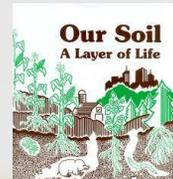


Slope soil conservation and restoration

Preventative methods largely involve conserving soil



- ☞ We can't prevent the triggers to releasing mass movements, but we can help prevent soils from being too loose
- ☞ Soil conservation, preservation, and restoration are all important



Initial Prevention



- ☞ Must first map vulnerable zones
 - ☞ Concave sections of slope
 - ☞ Areas of heavy agriculture or deforestation
- ☞ Aim control at these zones



Drainage



- ☞ Waterlogged soils become loosened from the parent material they rest on and can slide easily at a failure plane
- ☞ Several ways to drain:
 - ☞ Piping water or relocating to less vulnerable slopes
 - ☞ Cutting channels to collect water → Channels on slopes that are too steep are dangerous, however





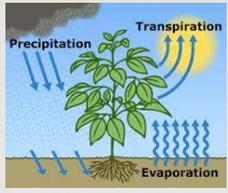
Perforated Drains

The diagram illustrates a cross-section of a slope with a bedrock layer at the base. A water table is shown above the bedrock. Perforated drains are installed in the soil, allowing groundwater to flow into them. Trees are shown on the slope, and their roots are shown extending down towards the drains.

Reforestation and Increasing Evapotranspiration

- ☞ Likely the best way – trees, grasses and other plants hold soils in place and prevent erosion
- ☞ Trees root deeply, but in heavy winds can transfer vibrations to their roots
- ☞ Extensive root system perennials effective on many slopes
- ☞ As plants photosynthesize and respire they pull water through their roots and release it to the atmosphere (evapotranspiration)
- ☞ Planting of plants that transpire a LOT (Ex- eucalyptus)
- ☞ Forests have high transpiration rates







Surface Protection

- ☞ Regulation on what can be done on slopes
- ☞ Preventing soil degradation and erosion from human activity
- ☞ Meshing and holding slopes in




Slope Angle Reduction

- ☞ On steeper slopes, shear stresses increase and the perpendicular force of gravity is easily overcome
- ☞ As a result, it is often good to reduce the angle of slopes
 - ☞ Terracing
 - ☞ Grading
 - ☞ Meshing or concreting over extremely steep slopes





Preventative Building Strategies

- ☞ DO NOT BUILD ON SLOPES, ESPECIALLY STEEP ONES.
- ☞ Really, that's it.



Direktan konstruksi Soldier Pile dalam kondisi kritis



Mass Movement Warning Signs

- ☞ Upwellings of water from Earth where there was no water prior
- ☞ Bent or crooked fencing
- ☞ Cracks or bends in building structures
- ☞ Sinking or settling of roads
- ☞ Leaning telephone poles, disrupted underground utilities

