

SEMESTER-1 (HONS.)

GEO-A-CC-1-TH

GEOTECHTONICS AND GEOMORPHOLOGY

TOPIC :5

Mass wasting / Mass movement

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INTRODUCTION

- *Processes of downslope movement of surficial Earth materials under the pull of gravity are collectively termed **mass wasting**.*
- It is The downslope transfer of material through the direct action of gravity.

• **Controls of Mass Wasting:**

- Gravity
- Angle of repose
- Water
- Time
- Type of material
- Climate
- Vegetation

• Role of Gravity

- Gravity causes the downward movement of rock body
- If gravity pull is greater than resistive force then body will move downward

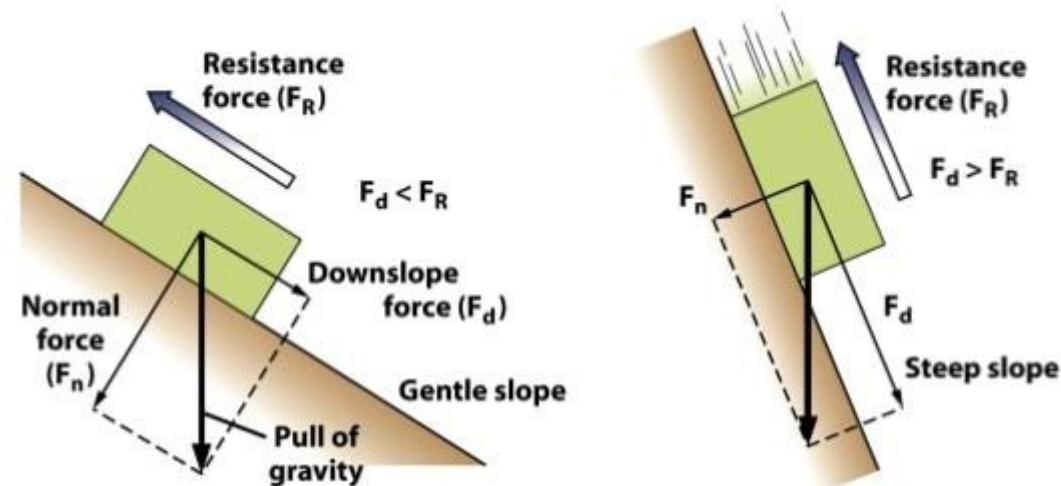
Slope Stability

1. Downslope forces (F_d) = gravity

Weight of earth materials

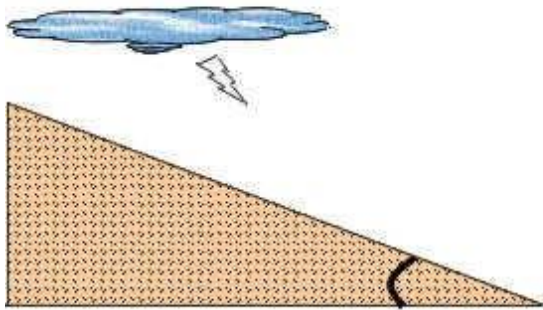
Resisting forces (F_r) = material strength

Cohesion friction

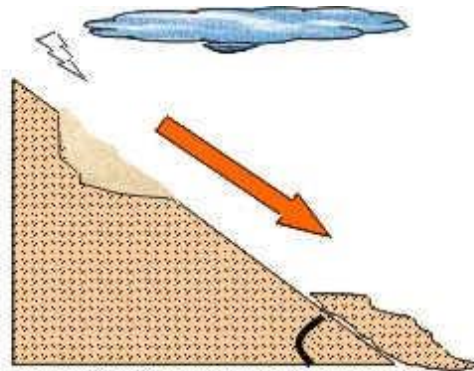


• Angle of repose

- Steepest angle at which material remains stable
- Depends upon - Particle size; Particle shape; Moisture Content
- Angle varies from 25 to 45 degrees
- Larger and more angular particles maintain steepest angle
- Small and round particles do not maintain steep angle



Slope angle less than the *angle of repose*: *slope remains stable*

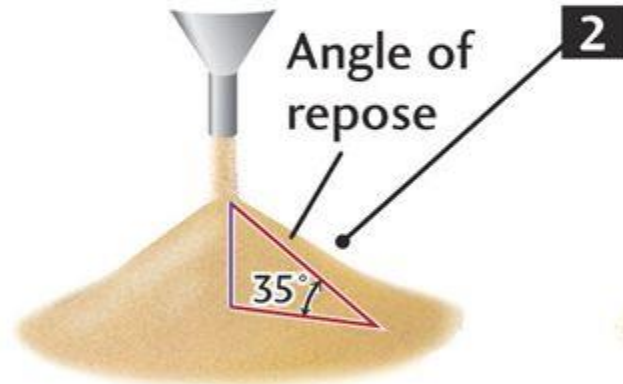


Slope angle greater than the *angle of repose*: *mass wasting will occur*

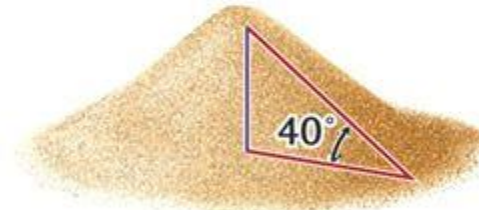
Angle of repose

MASS MOVEMENT DEPENDS ON THE NATURE OF MATERIAL, WATER CONTENT, AND SLOPE STEEPNESS

1



Fine sand



Coarse sand

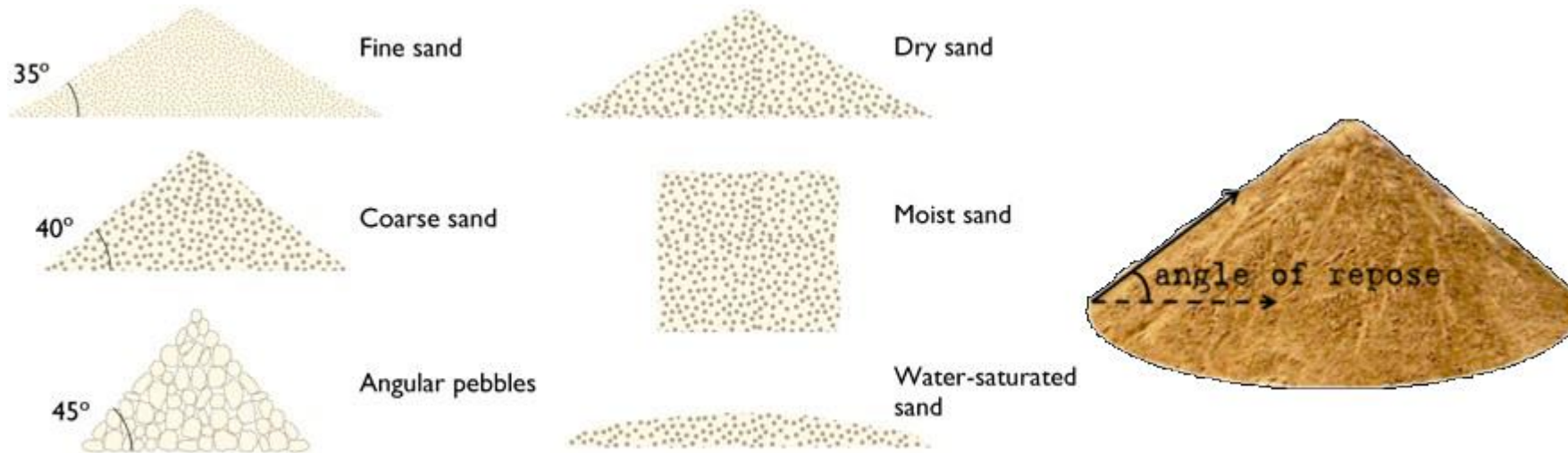


Angular pebbles

- In general, coarser grained, poorly sorted, and angular rocks have a higher angle of repose

- **Moisture effecting angle of repose**

- Moisture also increases the angle of repose of sediments
- A small amount of moisture between sand grains will bind them together due to surface tension. Surface tension is the attractive force between molecules at a surface
- Too much water will results in particles moving freely over one another and therefore dramatically reduces the angle of repose.



- **Role of Water**

- Sedimentary rocks commonly have porosities of 10 - 30%
- If pore spaces fill with water, the weight of the material is increased substantially, creating instability

- **Type of Material:**

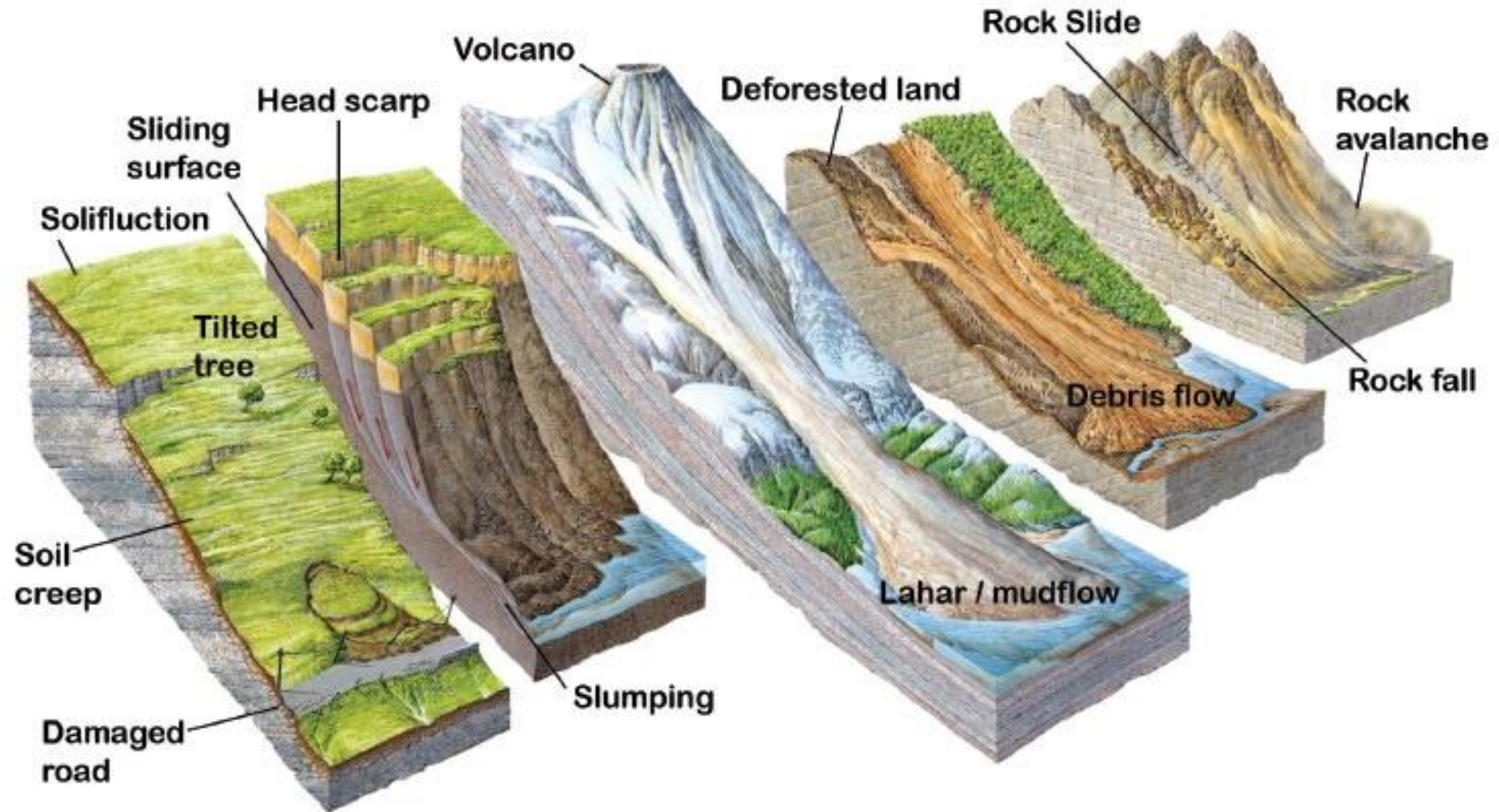


Figure 4.5 Mass movement

- ***Masses of material*** vary from tiny mineral grains tumbling downslope to enormous masses with volumes of rock and mineral material as great as thousands of cubic kilometers. (Yes, thousands; that's not a typo.)
- ***Speeds range*** from imperceptibly slow, less than a meter per year, to hundreds of meters per second.
- ***The nature of movement*** ranges from intact masses, which retain their original structure, to those that become thoroughly mixed and homogenized during the movement.

- **TYPES OF MASS WASTING :**

(CREEP)

- **creep** is used for *all slow downslope movements of regolith under the pull of gravity that are so slow as to be imperceptible except to observations with long duration.*
- creep to be a continuous process, as over the years we observe the slow downslope movement it engenders, but in fact it's the sum of innumerable small and discrete movements of the slope-mantling regolith.
- **Soil creep** : fine weathered rock debris as well as soil.
- **Rock creep**: involves downhill movement of rock debris having relatively great depth , movement is slow.
- **Solifluction** is a special kind of creep, by which *a surface layer of water-saturated regolith flows imperceptibly slowly downslope over an impermeable lower layer of some sort.* The impermeability of the lower layer prevents drainage of the overlying soil, causing it to remain for long periods of time in a thickly soupy condition, which predisposes it to downslope flow. It is common in, but not restricted to, high-latitude regions of permafrost, where summer thawing affects only the surface layer, leaving frozen and impermeable material beneath.

- **Flow :**

It involves downslope rapid movement of rock debris or soils saturated with water like viscous fluid

- **Mudflow:** Rapid movement of debris containing large amount of water
- Water get mixes with rock debris, soil or regolith and forms a mud which flow downward stream or mountain
- Caused when snow melts quickly creating a flood or cloud burst rapidly Mudflow is of two types: Lahar & Debris Flow
- **Debris flow:** downslope movement of enormous amount of boulders, mostly along river valley side.
- **Lahar:** Stream valleys on the flanks of active explosive volcanoes in humid regions are especially susceptible, because volcanic ash weathers readily to fine-grained, clay-rich material, and heavy rains can mobilize such material into a massive debris flow, called a *lahar* (an Indonesian word).

- **Falls:** *Instantaneous fall of weathered rock materials including large blocks from steep hillslopes or earthen materials from steep and cliffed valley sides under the influence of gravity is called fall.*
- **Rockfall:** Rapid fall of rock material down a cliff face.
- **Debris fall:**
A relatively free downward or forward falling of unconsolidated or poorly consolidated earth or rocky debris from a cliff.

- **Slides :**

Slide in rock is characterised by movement above a sharply defined shear plane.

- *Slump: a large mass of earth or rock material moves downslope along a discrete shear surface of failure, is called a **slump**.*
- **Rock slide:** a tabular mass of rock glides down a slope, which is usually underlain by more of the same rock, with planes of weakness parallel to the slope
- **Debris slide:** a mass of predominantly unconsolidated and incoherent soil and rock fragments that has slid or rolled rapidly down a steep slope when comparatively dry to form an irregular hummocky deposit.

Rock slide



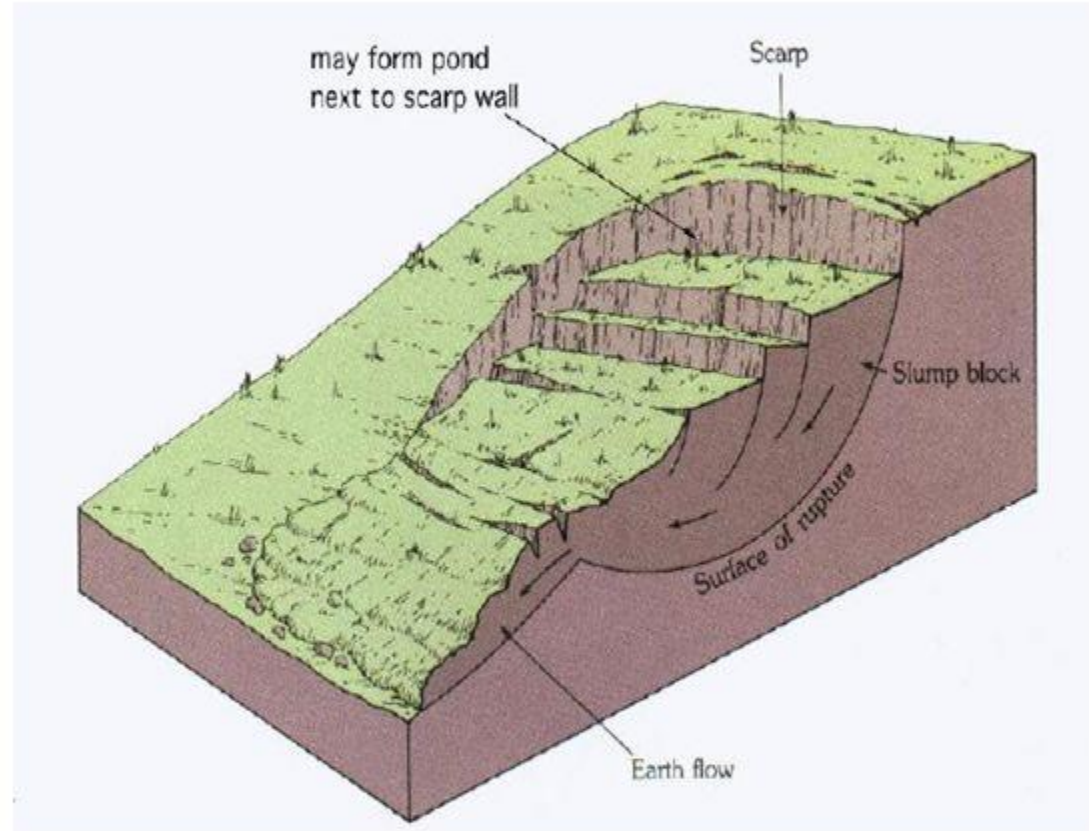
Land slide



SLUMP

1 huge chunk
of land
moves down

Occurs when
water soaks
the bottom of
soil rich in
clay



Effects Of Mass Wasting:

- Mass movements affect the following elements of the environment
- The topography of the earth's surface, particularly the morphologies of mountain and valley systems, both on the continents and on the ocean floors
- The character/quality of rivers and streams and groundwater flow
- The forests that cover much of the earth's sub-aerial surface
- Habitats of natural wildlife that exist on the earth's surface, including its rivers, lakes, and oceans.