

# Mass Wasting

== downslope movement of soil, sediment, and rock.

- Causes more damage in the U.S. each year than earthquakes, volcanoes, tornadoes, and hurricanes combined. Avg. 25-50 deaths & \$2 billion.
- Increasing because of more hillside development

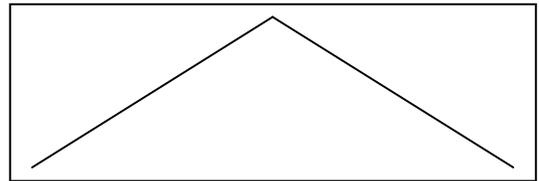
Gravity driven ∴ slope is important

**Angle of repose** – natural slope of a loose pile of sediment.

~ 35° for dry sand

Stability of a material depends on:

- 1) grain size
- 2) angularity
- 3) cohesiveness (usu. moisture content)  
sand castle example



Slope becomes **unstable** (will move) if angle of repose is exceeded by:

- a) adding material to top
- b) removing material from bottom
- c) changing moisture content
- d) changing mass (saturate with water)
- e) shaking

## Types of Mass Wasting

- 1) Rock falls
  - a) sediment (from wx.) simply tumble down slope
  - b) forms **talus** slope at base

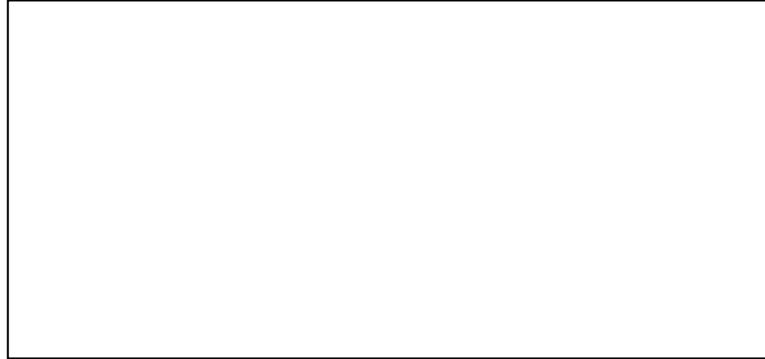
### Cass History

Yosemite (Happy Isles) rock fall – July 10, 1996

- 68,000 tons of rock broke loose above Happy Isles Nature Center
- Slid 500 feet and launched into a 1700 foot free fall
- Hit the ground 100 feet from the base of the cliff at 160 mph
- Impact registered ~ MI = 2.1
- The crushed rock buried 10 acres
- Air blast damaged 10 acres more, uprooting & snapping 200 trees
- One person was killed by trees, a number of others injured

## 2) Slides

- a) down-slope movement of rock or soil on a slide plane  
(may be fast or slow)
  - i) planes of weakness
    - (1) bedding planes
    - (2) joints
    - (3) clay layers
  - ii) spoon shaped glide plane (amphitheater-shaped head-scarp)



- b) triggers
  - i) saturation (rainfall, irrigation, vegetation loss, etc.)
  - ii) earthquakes
  - iii) undermining (wave or river erosion, road building, mining)

### Case History

#### Turnagain Heights – Anchorage Alaska, 1964

- triggered by Good Friday earthquake (ML 8.6)
- Bootlegger Cove clay (~7m thick) was glide plane (liquefaction)
- 7 blocks slid as much as 600m (2,000 ft), took ~ 5 min.
- 75 homes destroyed, 130 acres



### 3) Flows

- a) water saturated sediment – flows like water
- b) types:
  - i) mudflows
  - ii) debris flows (> ½ coarser than sand)
  - iii) lahars – cool volcanic ash

### Case Histories...

#### Armero, Columbia --- Nevado Del Ruiz, 1985

- lahar caused by rapid thaw of snow on volcano
- 15 m high, 70 km/hr
- flowed 48 km down river valley and inundated town
- buried ~25,000 people

#### Shields Canyon - 1978

### 4) Creep

- a) slow downhill creep of surface layer (1-10mm/yr)
- b) signs of creep
  - i) tilted posts, walls, trees, etc.
  - ii) cracks upslope
- c) Special type – solifluction
  - i) permafrost creeps because of freeze-thaw (frost heave)

## Prevention and Mitigation

- 1) Limits on hillside development
- 2) Building codes & engineering (grading)
  - a) limits on slopes
  - b) compaction of fill
  - c) retaining walls, anchors
  - d) vegetation
  - e) drainage
    - i) prevent infiltration
    - ii) dewatering