CHARACTERIZATION AND MONITORING OF SLOPE MOVEMENTS (28)

I Main Topics
- A Evidence for different types of movement
- B Slope stability reconnaissance procedure (Step I)
- C Miscellaneous tips for aerial photography
- D Ground surveys (Step 2)
- E Comments on uses and limitations of borehole and piezometer data

I I Evidence for different types of movement (See p. 74-75 in SR 176)
- A Type of rock or soil
- B Topography/slope
- C Fractures
- D Water

III Slope stability reconnaissance procedure (Step I)
1. Obtain and review existing literature. Focus beyond immediate site limits. {reports and maps (geologic, topographic, & soil)}
2. Obtain and review aerial photographs (or other imagery) of site. Photos for different years or different times of year are helpful.
3. VISIT THE SITE and perform field reconnaissance

Note: The order of steps 1-3 should be rearranged as appropriate

4. Repeat steps 1-3 as necessary
5. Decide where more detailed field tests are required.

IV Miscellaneous tips for aerial photography
1. Aerial photography usually more effective and less costly than other types of remote sensing imagery.
2. Low sun angle vs. high sun angle
3. Slope moisture and vegetation response depends of the time of year.
4. Fine-grained, low-permeability surficial materials commonly have fine-grained drainage patterns.
5. Moist slopes often appear darker than light slopes (probably partly a function of vegetation)
6. Vegetation sensitive to material, moisture, and stability

V Engineering Geologic Mapping and Ground surveys (Step 2)
- A Prepare engineering geologic map that defines major geomorphic elements of slide, key geologic features (rock type, bedding dip, faults, potential high- and low-permeability units, etc.), particularly important vegetation features, sites of water inflow/outflow, and slope angles.
- B Construct geologic/topographic profile along slide.
- C For complicated large slides a fence diagram may be useful.
- D Establish survey points for monitoring slide; some must extend beyond area of movement.
- E Survey the diagonals between grid points.
- F Displacement and strain in landslide (see handout)
- G Determine best locations for exploratory boreholes, trenches, and piezometers (if needed).
- H Drill boreholes, update geologic maps and cross-sections, monitor holes

VI Comments on uses and limitations of borehole and piezometer data
- A Boreholes
  - 1 Useful method for directly detecting features at depth.
  - 2 Sampling by drilling alters sample properties and water content. Lab tests on extracted samples may or may not be useful.
  - 3 Boreholes sample a statistically insignificant part of a body. Need to use judgment as to how far to extrapolate drilling data, how many holes to drill, and where to drill them; this is a very persistent problem in geotechnical practice.
- B Piezometers
  - 1 In many cases piezometers can be installed inexpensively and give enormously useful information.
  - 2 Coupling of displacement and piezometer information can be invaluable. See GSA paper by Iverson and Major (1987).
  - 3 See comment 3 above.
  - 4 Movement of the slide can radically rearrange the hydrology of a slide. Opening of cracks (or animal burrows) is a particular problem. See GSA paper by Harp and others (1990) for details.
  - 5 In some cases installing the piezometer can change the hydrology of a slide.
  - 6 Note any ground water withdrawal/recharge offsite.

DISPLACEMENT AND STRAIN IN A LANDSLIDE