SOILS (06)

I Main Topics
- A Pedologic classification schemes
- B Engineering classification schemes
- C Behavior of soils and influence of geologic history

II Pedologic classification schemes
- A Soils: the part of the regolith that can support rooted plants
  - 1 Soils contain organic material
  - 2 Factors influencing soil development (Hans Jenny)
    - a Climate
    - b Organic factors
    - c Topography
    - d Parent material
    - e Time (Soils are in many senses non-renewable resources)
- B Master soil horizons
  - O horizon (surface accumulation of organic material)
  - A horizon (mixture of organic material and mineral soil)
    - a Zone of clay loss (zone of leaching of iron and aluminum)
    - b Moderately dark color
  - E horizon
    - a Less organic material than A (so lighter color)
    - b Less iron, aluminum, and clay than B
  - B horizon
    - a Zone of clay accumulation, ped development
    - b Clay can develop in place or be transported in
    - c Red color (iron and aluminum accumulation)
    - d Concentration of insoluble elements
  - K horizon (Carbonate horizon; desert soils)
  - C horizon (zone of weathered rock)
  - R horizon bedrock)

III Engineering classification schemes
- A Rock: requires blasting or heavy earth-moving equipment
- B Soils: can excavate by hand or with light earth-moving equipment
- C Soils as solid particles and fluid-filled voids (multiphase system)

IV Behavior of engineering soils (preview of consolidation theory)

A Properties of sands, silts, and clays

Particle	Grain size	Comments
Gravel	> 2 mm	Hurts toes. Gritty
Sand	1/16 mm - 2 mm	Visible to unaided eye. Beware quick sands
Silt	1/256 mm - 1/16 mm	Invisible to unaided eye. Gritty. Washes off fingers easily. Loess can fracture and collapse
Clay	< 1/256 mm	Invisible to unaided eye. Gives soil cohesion. Sticks to fingers when wet. Beware quick clays and expansive clays (montmorillonite)

B Effective stress, Pore pressure, and total stress (see handout)

1 **Effective stress**: normal stress load born by the solid skeleton

2 **Pore pressure**: normal stress load born by the pore fluid

3 **Total stress**: effective stress + normal stress

C Consolidation (volume loss) of unconsolidated materials

During consolidation porosity (void ratio) and water content decrease and strength increases. Usually soil strength increases with depth. Time for consolidation primarily controlled by the time it takes water to flow from material.

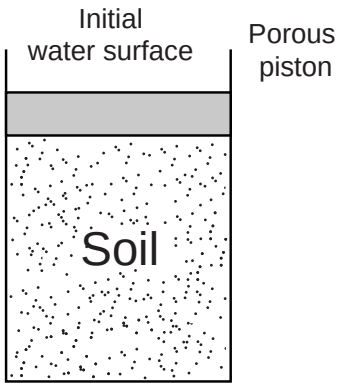
1 Soil memory and preconsolidation stress (see handout)

The mechanical behavior of an unconsolidated material hinges varies depending on the past loads imposed on it.

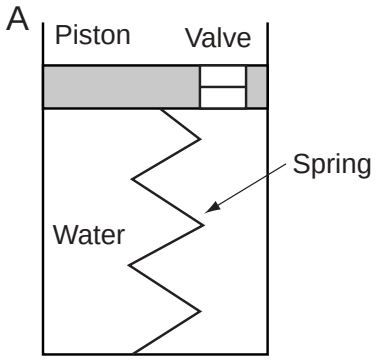
2 Influence of geologic history on soil behavior

- a Normally consolidated soil: soil has been consolidated by a load equivalent to that of the existing overburden
- b Overconsolidated soil: soil has been consolidated by a load greater than that of the existing overburden
  - i Erosion of overburden
  - i i Desiccation
- c Underconsolidated soil: soil has been consolidated by a load less than of the existing overburden
- d Effect of moisture on soil color
  - i Wet conditions = reducing environment: blue or black color
  - i i Dry conditions = oxidizing environment: yellow or red color

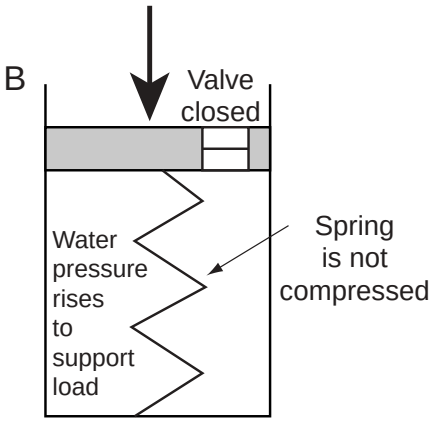
Hydromechanical Analog for Consolidation (from Lambe and Whitman, 1969)



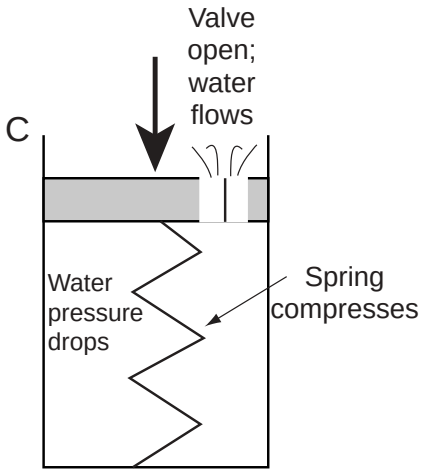
Physical Example



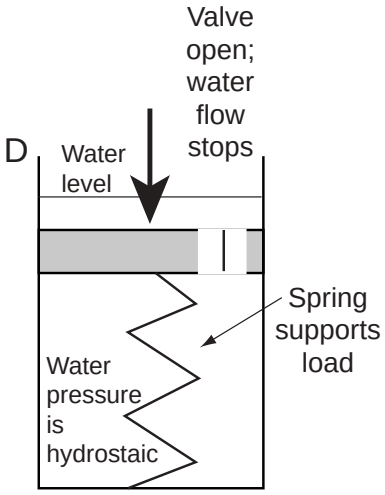
Hydromechanical Analog
initial state



Hydromechanical Analog
Load applied, valve closed

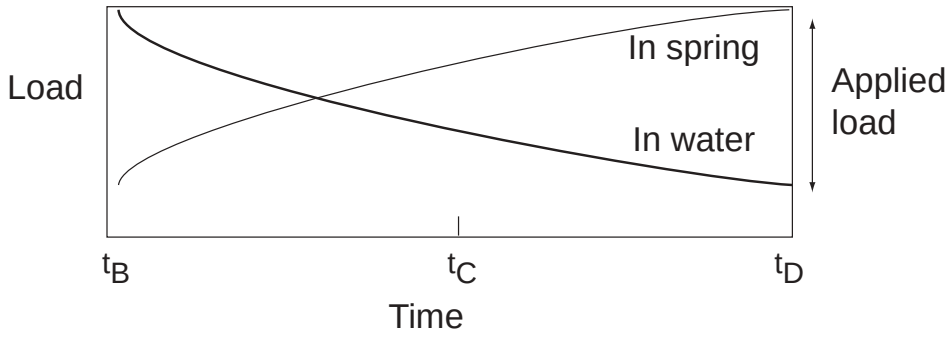


Hydromechanical Analog
Valve open, water flows



Hydromechanical Analog
Equilibrium

Variation of Loads in Spring and Water



REPRESENTATIVE SOIL CONSOLIDATION CURVE