# SSC 107 - LABORATORY EXERCISE 7

## Soil-Water Head Profiles and Water Movement in Large Soil Columns

### Introduction

This exercise will continue for the entire quarter. The 100 cm long soil columns will be used to determine values of the saturated and unsaturated hydraulic conductivity, and to evaluate how the soil-water potential (head) changes as a function of depth and time. The columns will also be used to demonstrate the effect of soil layering on soil-water potential profiles. The difference between steady-state and equilibrium head profiles in different soils will be explored.

### Procedure

1. After column is assembled, fill the water to make certain it does not leak.

2. Drain water and begin packing columns with dry soil. Establish different soil layers according to instructions given at beginning of lab period. Install tensiometers just as soil reaches the level of each tensiometer.

3. Saturate soil by wetting from the bottom with a constant head container. This device maintains a constant head of zero water pressure at the bottom of the copper tube inserted in the large plastic container.

4. When water is ponded approximately 2 cm deep on the soil surface, measure and plot the hydrostatic pressure head, gravitational head, and total head at each tensiometer. Use the bottom of the column as the reference level for the gravity head.

5. Set up steady-state with +2 cm of pressure head at soil surface and +50 cm at base of the soil column. Use constant head devices to maintain ponded water on the surface. The head at the base of the column is maintained by connecting tygon tubing to the column outlet. The end of the tubing should be 50 cm above the base. Steady-state is attained when the tensiometer readings do not change with time and when the outflow remains constant.

6. At steady-state, measure hydrostatic pressure, gravitational, and total heads at each tensiometer and plot the values of each as a function of soil depth.

7. Calculate the saturated hydraulic conductivity between each pair of tensiometers, using Darcy's Law.

8. Clamp off and remove he constant head devices supplying water to the soil surface.

9. Cover the surface of the column to prevent evaporation.

10. Maintain the hydrostatic pressure head at +50 cm at the bottom of the column until no water flows from the column.

11. Measure and plot the matric, hydrostatic pressure, gravitational, and total heads at each

tensiometer as a function of soil depth.

12. Lower the hydrostatic pressure head to 5 cm above the base of the soil column.

13. Maintain the 5 cm-head until no water flows from the column.

14. Measure and plot the matric, hydrostatic pressure, gravitational, and total heads at each tensiometer as a function of soil depth.

[Figure 1]

**Step 4**

- ?? NOTES: Equilibrium (No flow, $H_{total}$ everywhere the same)
- ?? 1. Cover column with aluminum foil.
- ?? 2. Equilibrium is achieved when:
  - ?? a. the constant head device (and water level) is maintained at the exact same height without any further adjusting up or down.
  - ?? b. manometer readings stop moving

[Figure 2]

**Steps 5 and 6**

- ?? NOTES: Steady-state (constant flow)
- ?? 1. When changing the apparatus from step 4 use clamps to keep air out of the tubes.
- ?? 2. Chech constant head devices at least twice daily and even more frequently at first until your group has an idea of how frequently they must be filled
- ?? 3. Never let water in the constant head device drop below the air inlet tube so that the ponded water disappears and the top of the column desaturates during these steps.
- ?? 4. Steady state is achieved when:
  - ?? a. the volume of water collected per unit time is constant
  - ?? b. manometer readings stop moving (pressure heads are equilibrated)

[Figure 3]

**Steps 8, 9, 10 and 11**

- ?? NOTES: Equilibrium (no flow, $H_{total}$ everywhere the same), Constant head devices no longer needed.
- ?? 1. Equilibrium is achieved when:
  - ?? a. water stops flowing from the outlet
  - ?? b. manometer readings are steady

[Figure 4]

**Steps 12, 13 and 14**

- ?? NOTES: Equilibrium (no flow, $H_{total}$ everywhere the same)
- ?? 1. Equilibrium is achieved when:
- ?? a. water stops flowing from the outlet
- ?? b. manometer readings are steady

**Lab Report Point Distribution**

Abstract: 1
Material and Methods: 0.5
Results: 4
Discussion: 8
Conclusion: 0.5
Overall Composition: 1
**Total:** 15