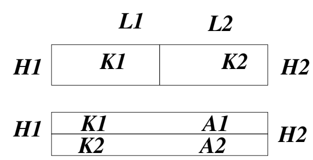
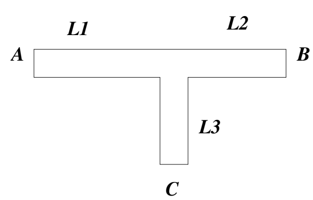
TD 603- Tutorial 3

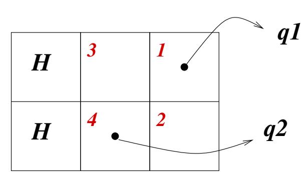
1. Examine the figures below of soil columns being held at heads H_1 and H_2 with $H_1 > H_2$. In the first *series* case, there is a common cross-section A, however, the lengths are L_1 and L_2. What is the net flow? What is the head at the junction? In the second case, there is a common length L, while the cross-section areas are A_1 and A_2. What is the net flow? What is the flow through each individual column? Define a suitable version of equivalent conductance and compute it for either case.



2. Consider a T-shaped pipe of cross-section a and lengths L_1, L_2, L_3 as shown and filled with a soil of conductivity K. Points A, B, C are the end-points with heads h_A, h_B, h_C and flows (into it) as q_A, q_B, q_C. Assume that a is small w.r.t L_i's. Compute the relationships between the 6 quantities above.

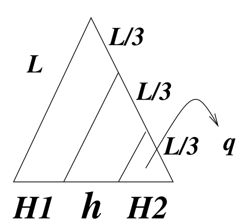
   Solve the system when h_A, h_B and q_C are known. If the customer must pay for the water that she extracts at C, what fraction of her payment should go to A, and to B?





3. Consider a rectangular grid as shown above and as done in class. The boundary of the grid are the two left-most cells with a known head H but with unknown inflows. The other cells have known inflows/extractions, viz. q_1 and q_2 for the cells shown and zero otherwise. Farmer in Cell 1 is proposing building a barrier between Cells 1 and 2. Please advise under what conditions is this useful.

4. A soil-box is of depth D and has the shape of an equilateral triangle of length L. One side of the triangle is held at H_1 and a corner is held at H_2, with $H_1 > H_2$. There is a drain in the that corner. Our objective is to compute the flow q. For that purpose, we approximate the triangle as being made of three boxes in series as shown in the figure. Use this to estimate the flow q. Suppose that while H_1 was fixed, H_2 was not and q was known. Can H_2 and h be computed?



5. Use the above to simulate the drop in head due to the operation of a well which is D meters deep and used to extract Q cu.m./day. Assume that the head at a distance L away from the well is H_1.

6. Consider a tube of lngth L and cross-section $A(x)$ which is a function of x, where $0 \leq x \leq L$. If either ends of the tube are held at H_1 and H_2, find the intermediate values of head $h(x)$ at distance x. Solve this when $A(x) = 3 - x$ and $0 \leq x \leq 2$.

7. Consider the apparatus shown in Lecture 3c where a tube is being held at heads H_1 and H_2. If the tubes which hold the water have cross-section a, compute the height in the first column $H_1(t)$ as a function of time.