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GW Model
Assignment 1

1. The model is steady state in both cases heterogeneous and homogeneous because when looking at the downward flux vs. column height we can see it is constant in both cases.

2. We can see that steady state flux agrees with the direct calculation because the value for each cell iteration in the q column is equal to the q in the direct solution.

$$Direct\ solution\ for\ flux(q) = K_{eq}\left(\frac{dH}{dz}\right)$$

Direct solution for flux		
	K	num cells
zone 1	0.5	12
zone 2	0.01	0
zone 3	0.0001	0
Keq	0.5	
q	0.833333	

z	K zone cell	K cell	H	q
60	1	0.5	100	
55	1	0.5	91.66667	0.833333
50	1	0.5	83.33333	0.833333
45	1	0.5	75	0.833333
40	1	0.5	66.66667	0.833333
35	1	0.5	58.33333	0.833333
30	1	0.5	50	0.833333
25	1	0.5	41.66667	0.833333
20	1	0.5	33.33333	0.833333
15	1	0.5	25	0.833333
10	1	0.5	16.66667	0.833333
5	1	0.5	8.333333	0.833333
0	1	0.5	0	0.833333

3. The Keq is closer to the lower of the K values because when looking at the head profile we can see that the smaller K1 value is over a larger number of cells (6.5) vs. the larger K2 value which is over 5.5 cells. When computing harmonic mean(see equation below) which computes Keq this will make the denominator of the equation larger and therefore Keq smaller. You can see in the plot below that the head is changing slowly (flatter slope) from 60-25 cm, which is a total height of 35 cm, because the K1 is small. The head is changing quickly from 25-0 cm (steeper slope), which is a total height of 25 cm because the K2 is larger. Water flow in the column is being limited by the layer with small K.

$$harmonic\ mean = \frac{total\ \#\ of\ cells}{\frac{\#\ cells\ K1}{K1} + \frac{\#\ cells\ K2}{K2} + \frac{\#\ cells\ K3}{K3}}$$

Direct solution for flux		
	K	num cells
zone 1	0.001	6.5
zone 2	0.01	5.5
zone 3	0.0001	0
Keq	0.001702	
q	0.002837	

z	K zone cell	K cell	H	q	zone 1	zone 2	zone 3
60	1	0.001	100		1	0	0
55	1	0.001	85.81883	0.002836	1	0	0
50	1	0.001	71.6371	0.002836	1	0	0
45	1	0.001	57.45463	0.002836	1	0	0
40	1	0.001	43.27132	0.002837	1	0	0
35	1	0.001	29.08715	0.002837	1	0	0
30	1	0.001	14.90218	0.002837	1	0	0
25	2	0.01	7.099729	0.002837	0	1	0
20	2	0.01	5.680469	0.002839	0	1	0
15	2	0.01	4.260701	0.00284	0	1	0
10	2	0.01	2.840584	0.00284	0	1	0
5	2	0.01	1.420292	0.002841	0	1	0
0	2	0.01	0	0.002841	0	1	0