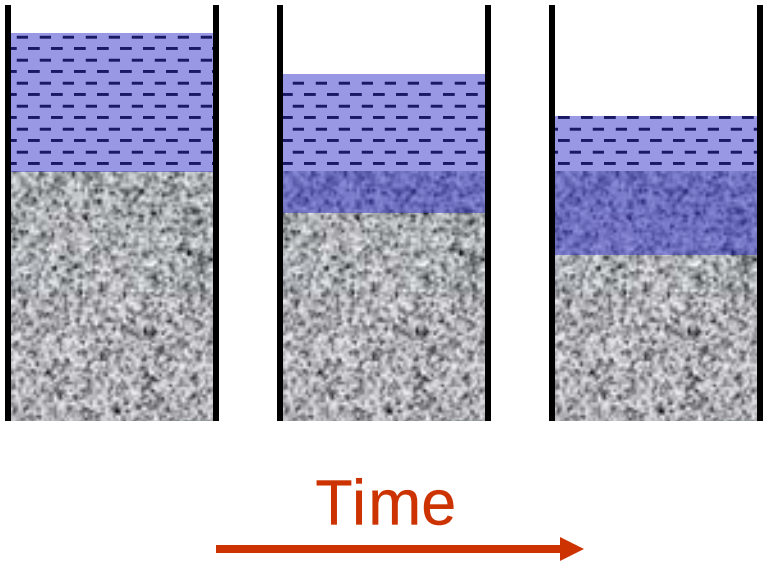
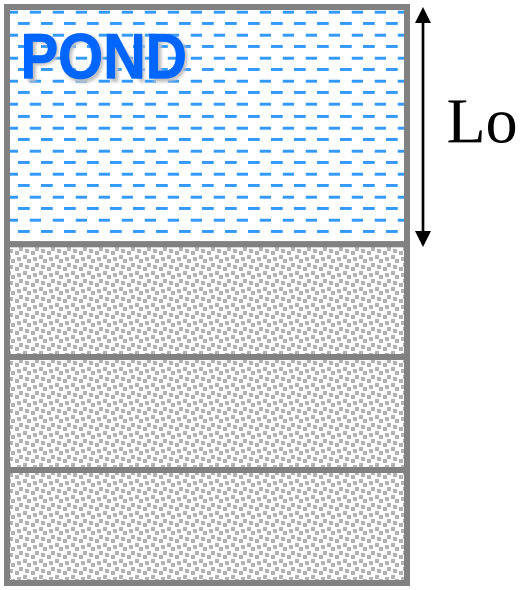
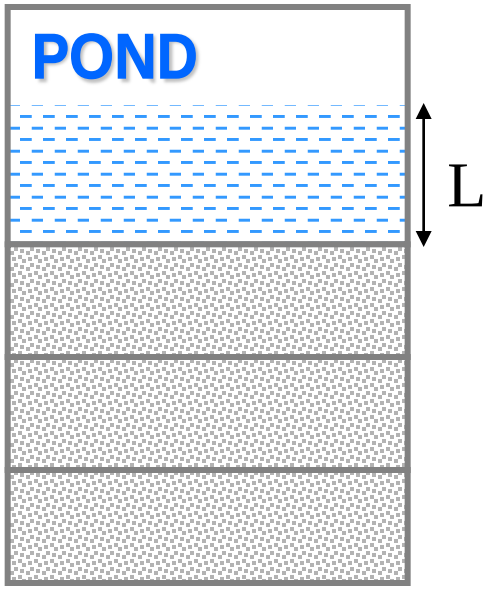
Modeling Falling Head Boundary Condition



Infiltration of fixed volume of liquid into a porous medium requires involves variable boundary condition

Trick: Step 1





$S = L/Lo$

Volume and Porosity of Pond Element

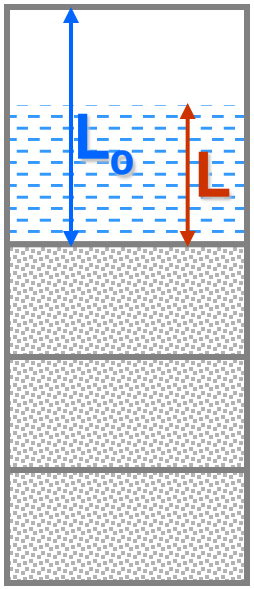
Volume = maximum liquid volume

Porosity = 1.00

Assuming cylindrical pond the foregoing imply

Pond saturation = Liquid height / Total height

Trick: Step 2



Convert Pond Saturation to Surface Liquid Pressure

Note that surface pressure is given by

$P = \rho \cdot g \cdot L \quad (S = L/Lo)$

RECALL: In Darcy law flow is driven by total head

$P_T = \rho \cdot g \cdot z - Pcap$

where Pcap is capillary pressure

Therefore set

CONNE pond to surface = Lo

$Pcap = \rho \cdot g \cdot Lo \cdot [1-S]$

Then $P_T = \rho \cdot g \cdot Lo - \rho \cdot g \cdot Lo \cdot [1-S] = \rho \cdot g \cdot Lo \cdot S$

Example

```
Infiltraometer
ROCKS----1----*----2----*----3----*----4----*----5----*----6----*----7----*----8
INFIL    2 2650.          0.999   1.0E-11   1.0E-11   1.0E-11    0.     1000.
```

Porosity = 1

```
   2        0.0000
   1        10000.     0.0000    1.0000
```

Linear $\rho \cdot gLo = 1000 \cdot 10 \cdot 1$

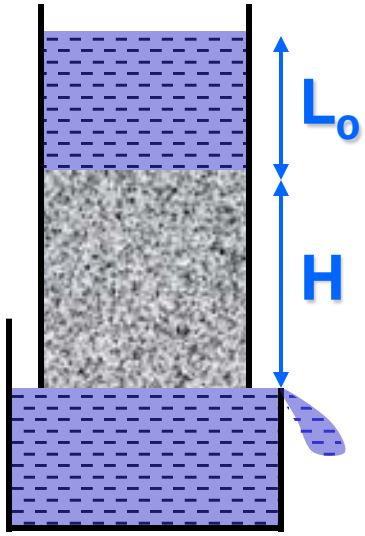
```
A11 1               10.1000E-010.0000E+00          0.5000E+000.5000E+00-.9850E+00
.
.
CU1 1               10.1000E-010.1000E+01          0.5000E+000.5000E+00-.9950E+00
TOP99          INFIL0.1000E+01
BOT99          DRAIN0.1000E+50

CONNE
TOP99A11 1                     3    1.0000    0.0050    1.0000    1.0000
CU1 1BOT99                     30.5000E-020.1000E-090.1000E+010.1000E+01
A11 1A21 1                     30.5000E-020.5000E-020.1000E+010.1000E+01
.
.
```

$V = 1\ m^3$

$L_o = 1\ m$

Example



$$\frac{L(t)}{L_o} = \exp\left[\frac{K_S}{H}t\right]$$

NOTE: with slight modifications the approach can also be used to represent conical reservoirs