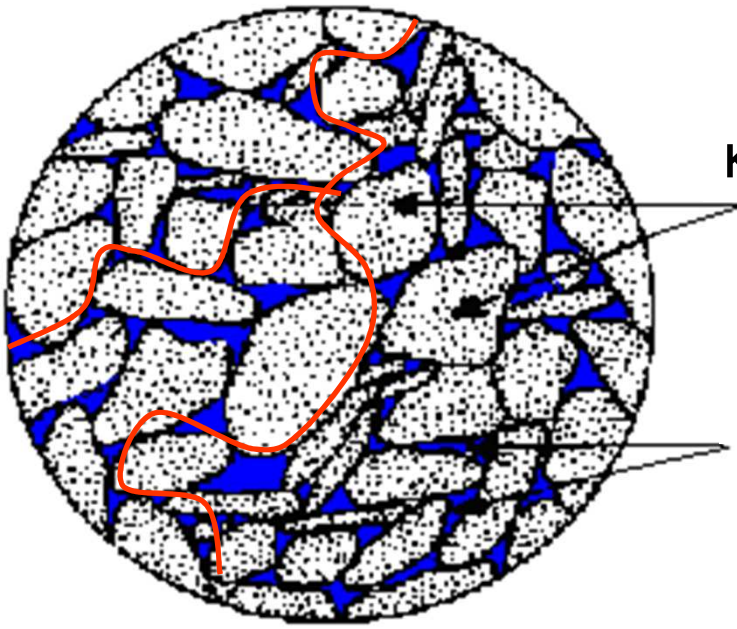
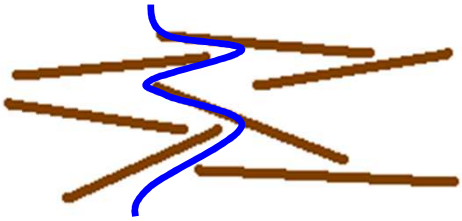
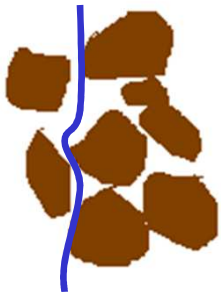
ΥΔΑΤΙΚΗ ΡΟΗ ΔΙΑΜΕΣΟΥ ΕΔΑΦΙΚΟΥ ΥΛΙΚΟΥ

Διαπερατά εδαφικά υλικά



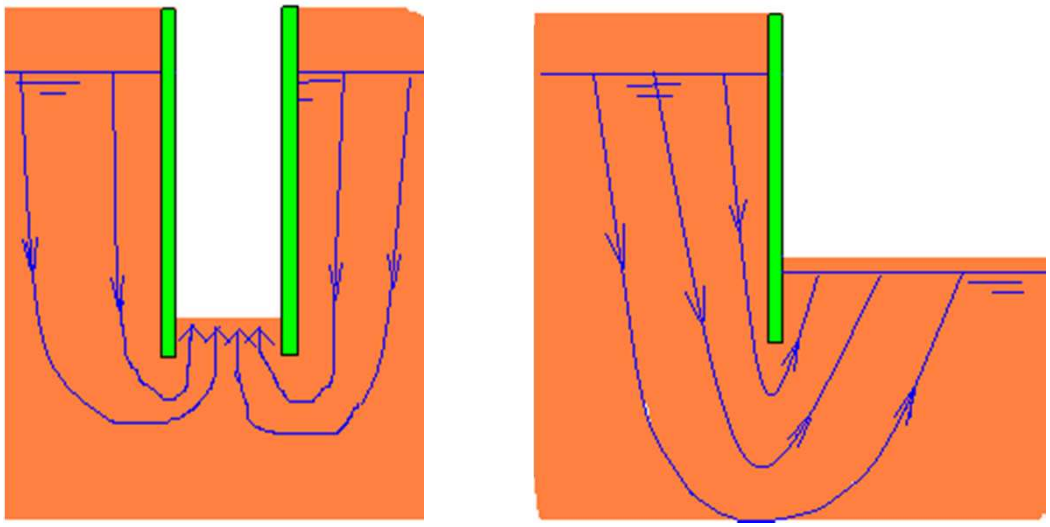


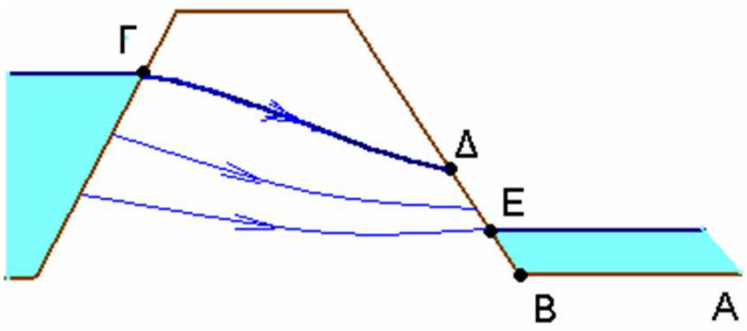


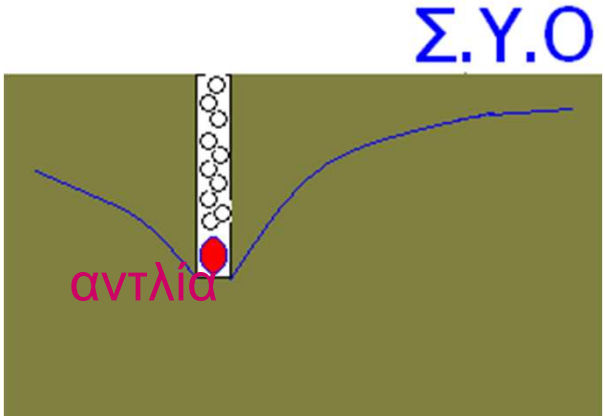
άργιλος
$K<10^{-7}$ m/s

άμμος
$K>10^{-2}$ m/s

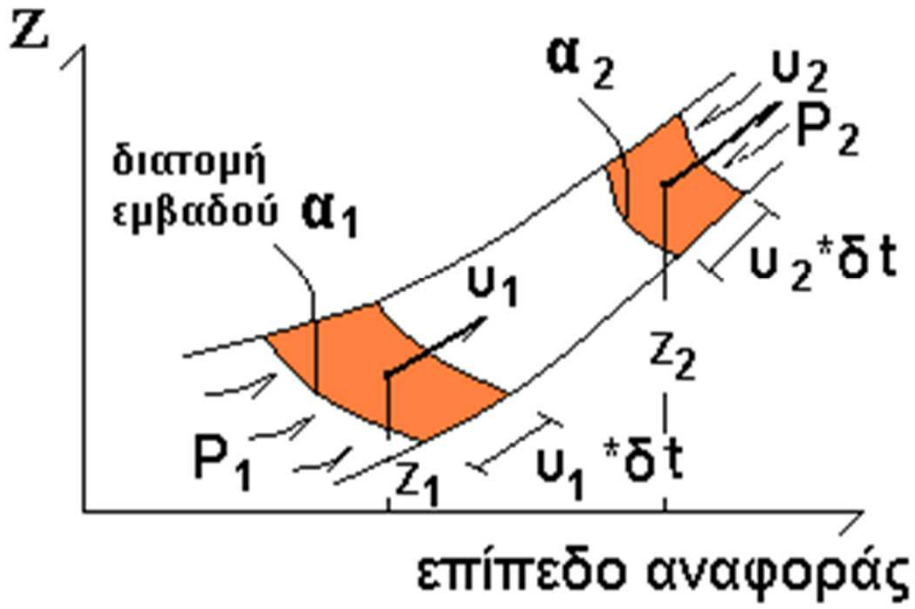
Προβλήματα υδατικής ροής





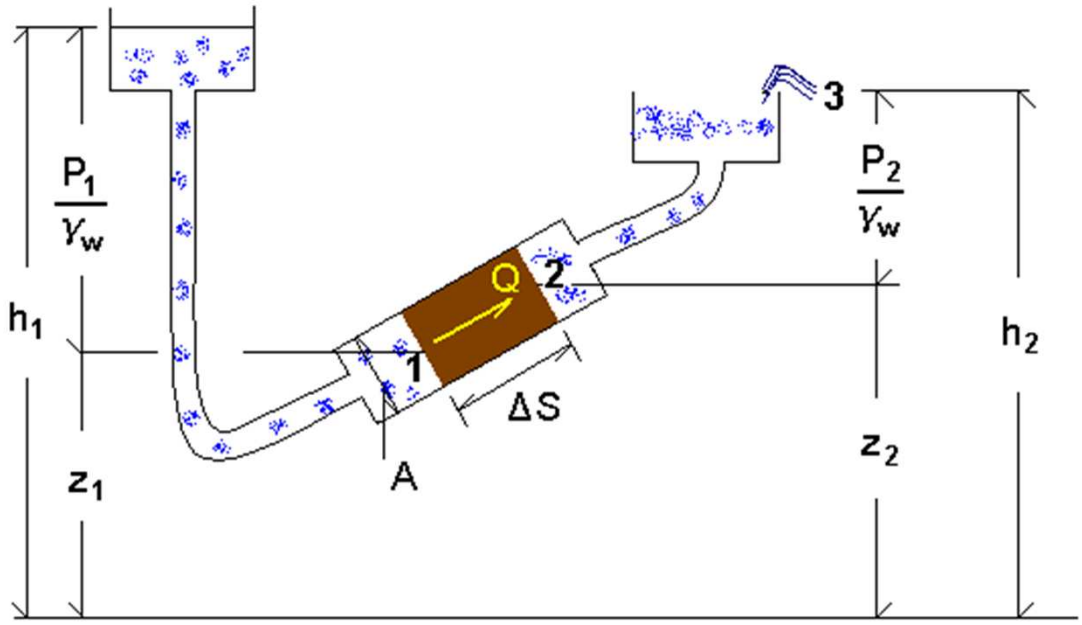


ΜΟΝΟΔΙΑΣΤΑΤΗ ΡΟΗ



$$\frac{P_1}{\gamma_w} + Z_1 + \frac{\upsilon_1^2}{2*g} = \frac{P_2}{\gamma_w} + Z_2 + \frac{\upsilon_2^2}{2*g} = h$$

Νόμος DARCY



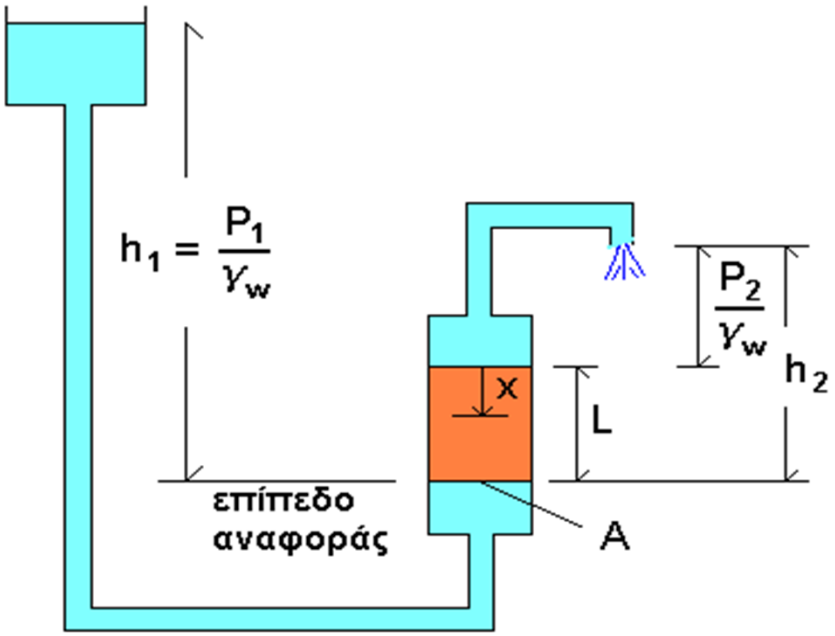
$$\frac{Q}{A} = k \cdot \frac{h_1 - h_2}{\Delta S} \qquad \frac{Q}{A} = \upsilon = \text{ταχύτητα ροής}$$

$$i = \frac{h_2 - h_1}{\Delta S} = \text{υδραυλική κλίση}$$

$$\upsilon = -k \cdot i \qquad \text{και} \qquad Q = -k \cdot i \cdot A$$

$k =$ συντελεστής διαπερατότητας (σε μονάδες ταχύτητας)

Μέτρηση Κ – Υδραυλική υποσκαφή



$$Q = A \cdot k \cdot \frac{h_1 - h_2}{L} = A \cdot k \cdot (-i)$$

$$\sigma_v = p_2 + \gamma \cdot x \qquad p_2 + \frac{p_1 - p_2}{L} \cdot x \qquad \frac{p_1 - p_2}{L} = \gamma$$

$$i_{crit} = \frac{h_2 - h_1}{L} = \frac{\frac{p_2}{\gamma_w} + L - \frac{p_1}{\gamma_w}}{L} = 1 - \frac{p_1 - p_2}{\gamma_w \cdot L}$$

$$-i_{crit} = \frac{\gamma}{\gamma_w} - 1$$

ΔΙΣΔΙΑΣΤΑΤΗ ΡΟΗ

$$q = q_x + q_y + q_z$$

$$q_z = k_z \cdot i \cdot A$$

$$A = dy \cdot dx$$

$$q_z = k_z \cdot \left(-\frac{\partial h}{\partial z} \right) \cdot dy \cdot dx$$

$$q_z = \left(k_z + \frac{\partial k_z}{\partial z} \cdot dz \right) \cdot \left(-\frac{\partial h}{\partial z} - \frac{\partial^2 h}{\partial z^2} \cdot dz \right) \cdot dy \cdot dx$$

$$\partial k_z / \partial z = 0$$

$$\Delta q_z = \left(k_z \cdot \frac{\partial^2 h}{\partial z^2} \right) \cdot dx \cdot dy \cdot dz = 0$$

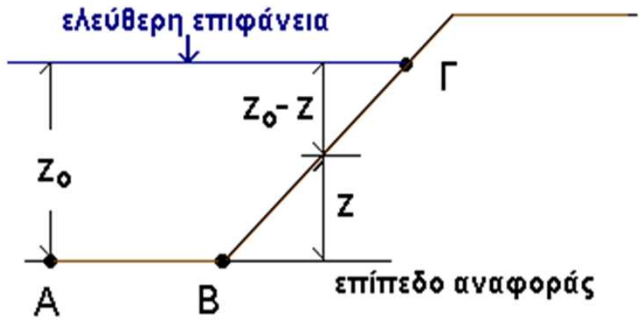
$$\Delta q_x = \left(k_x \cdot \frac{\partial^2 h}{\partial x^2} \right) \cdot dx \cdot dy \cdot dz = 0$$

$$\frac{\partial^2 h}{\partial z^2} + \frac{\partial^2 h}{\partial x^2} = 0$$

εάν $K_x = k_z$

- Για δισδιάστατη ροή το άθροισμα της μεταβολής της υδραυλικής κλίσης στις δύο κατευθύνσεις είναι μηδενικό

ΣΥΝΟΡΙΑΚΕΣ ΣΥΝΘΗΚΕΣ

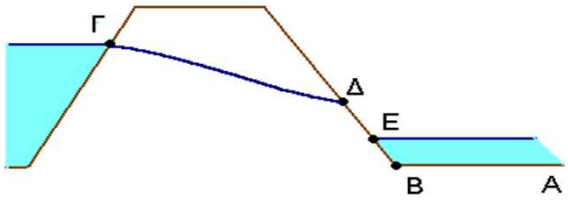


$$h = \frac{p}{\gamma_w} + z$$

$$p = \gamma_w \cdot (z_o - z)$$

$$h = z_o - z + z = z_o$$

επιφάνεια διήθησης

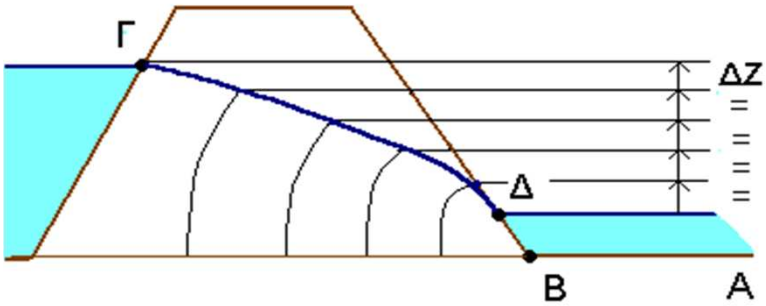


$$h = \frac{p}{\gamma_w} + z$$

$$p = 0$$

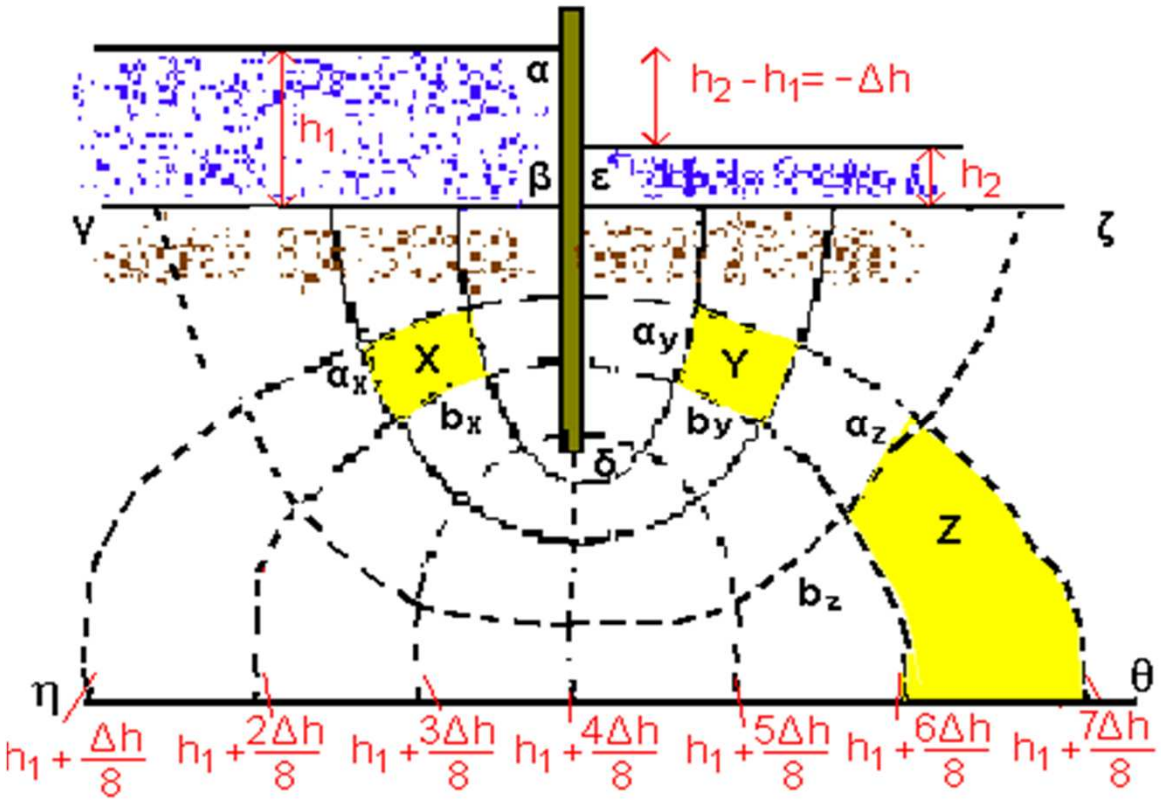
$$h = z$$

φρεατική γραμμή



Ισοδυναμικές τέμνουν τη φρεατική γραμμή ανά ίσες μεταβολές στάθμης

ΔΙΚΤΥΟ ΡΟΗΣ



$$q_x = -k \cdot \frac{-\frac{\Delta h}{8}}{a_x} \cdot b_x \cdot 1 \qquad q_y = -k \cdot \frac{-\frac{\Delta h}{8}}{a_y} \cdot b_y \cdot 1 \qquad q_z = -k \cdot \frac{-\frac{\Delta h}{8}}{a_z} \cdot b_z \cdot 1$$

$q_x = q_y \longrightarrow \frac{b_x}{a_x} = \frac{b_y}{a_y}$ εάν $\frac{b_z}{a_z} = \frac{b_y}{a_y} \longrightarrow q_z = q_y$

$N_\rho =$ αριθμός καναλιών ροής (4 στο παράδειγμα)

$q_x = q_y = q_z$ Εάν

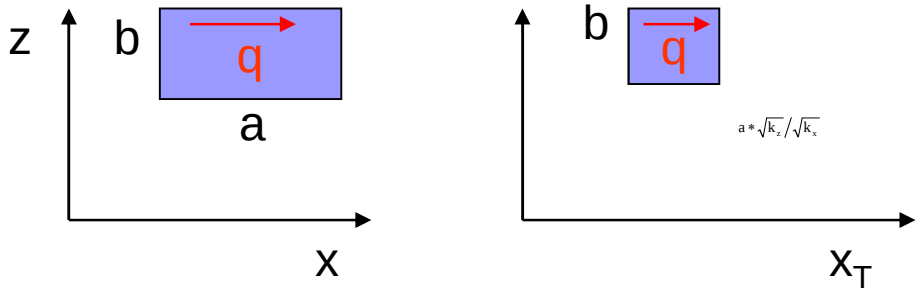
$N_\delta =$ αριθμός πτώσεων δυναμικού (8 στο παράδειγμα)

$$Q = N_\rho \cdot q_x = -N_\rho \cdot k \cdot \frac{-H}{N_\delta} \cdot \frac{b_x}{a_x} = k \cdot (h_1 - h_2) \cdot \frac{N_\rho}{N_\delta}$$

ΑΝΙΣΟΤΡΟΠΕΣ ΣΥΝΘΗΚΕΣ ΡΟΗΣ

$$k_z \cdot \frac{\partial^2 h}{\partial z^2} + k_x \cdot \frac{\partial^2 h}{\partial x^2} = 0 \rightarrow \frac{\partial^2 h}{\partial z^2} + \frac{\partial^2 h}{(\frac{k_z}{k_x}) \cdot \partial x^2} = 0$$

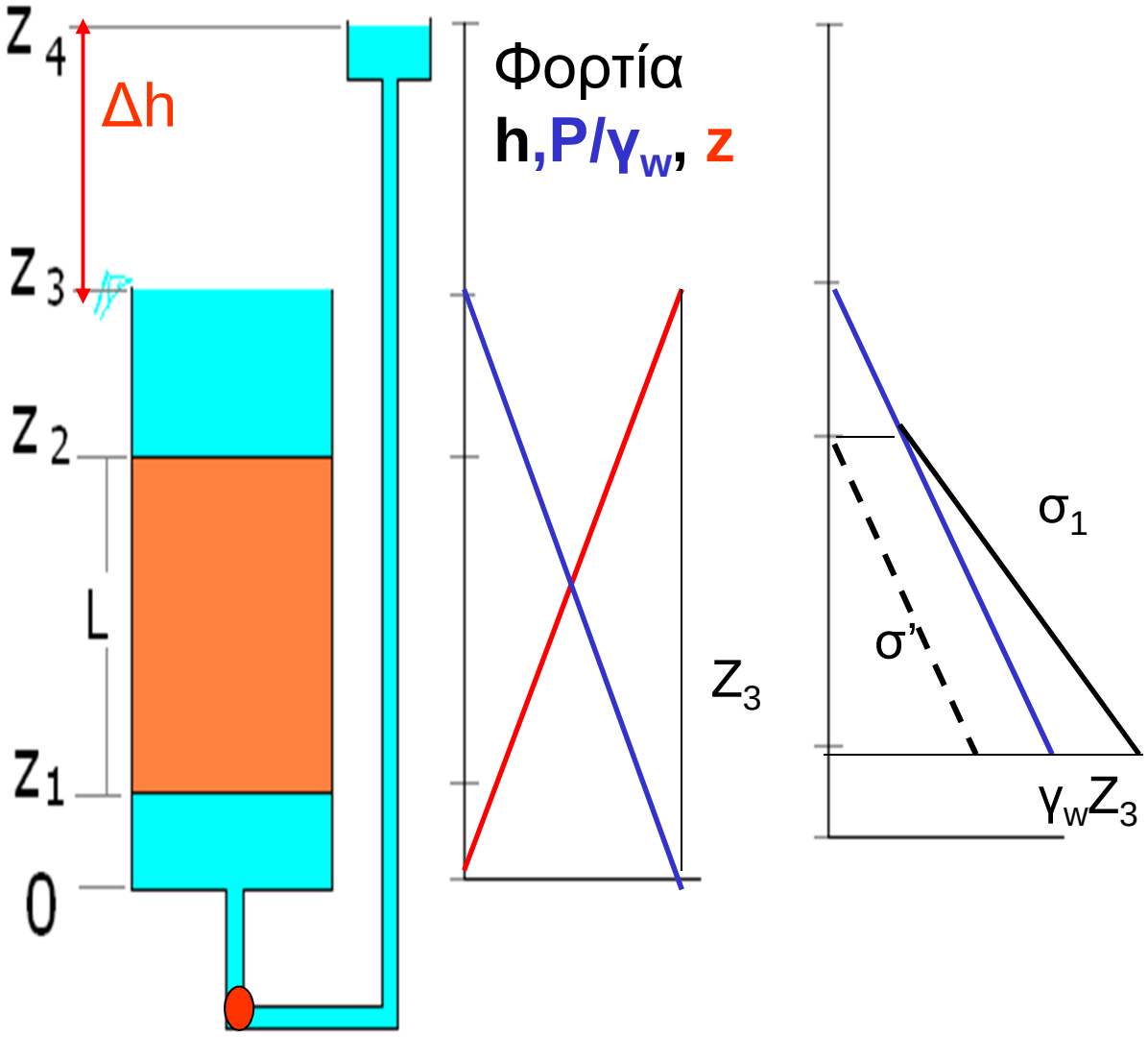
$$\frac{\partial^2 h}{\partial x^2} + \frac{\partial^2 h}{\partial x_T^2} = 0 \xrightarrow{\text{οπου}} x_T = (\frac{k_z}{k_x})^{\frac{1}{2}} \cdot x$$



$q=-k_x*(\delta h/a)*b*1 \;=\; q=-k' *(\delta h/a)*(\sqrt{k_x}/\sqrt{k_z})*b*1 \rightarrow k'=\sqrt{k_x}*\sqrt{k_z}$

$$Q = \sqrt{k_x \cdot k_z} \cdot (h_1 - h_2) \cdot \frac{N_\rho}{N_\delta}$$

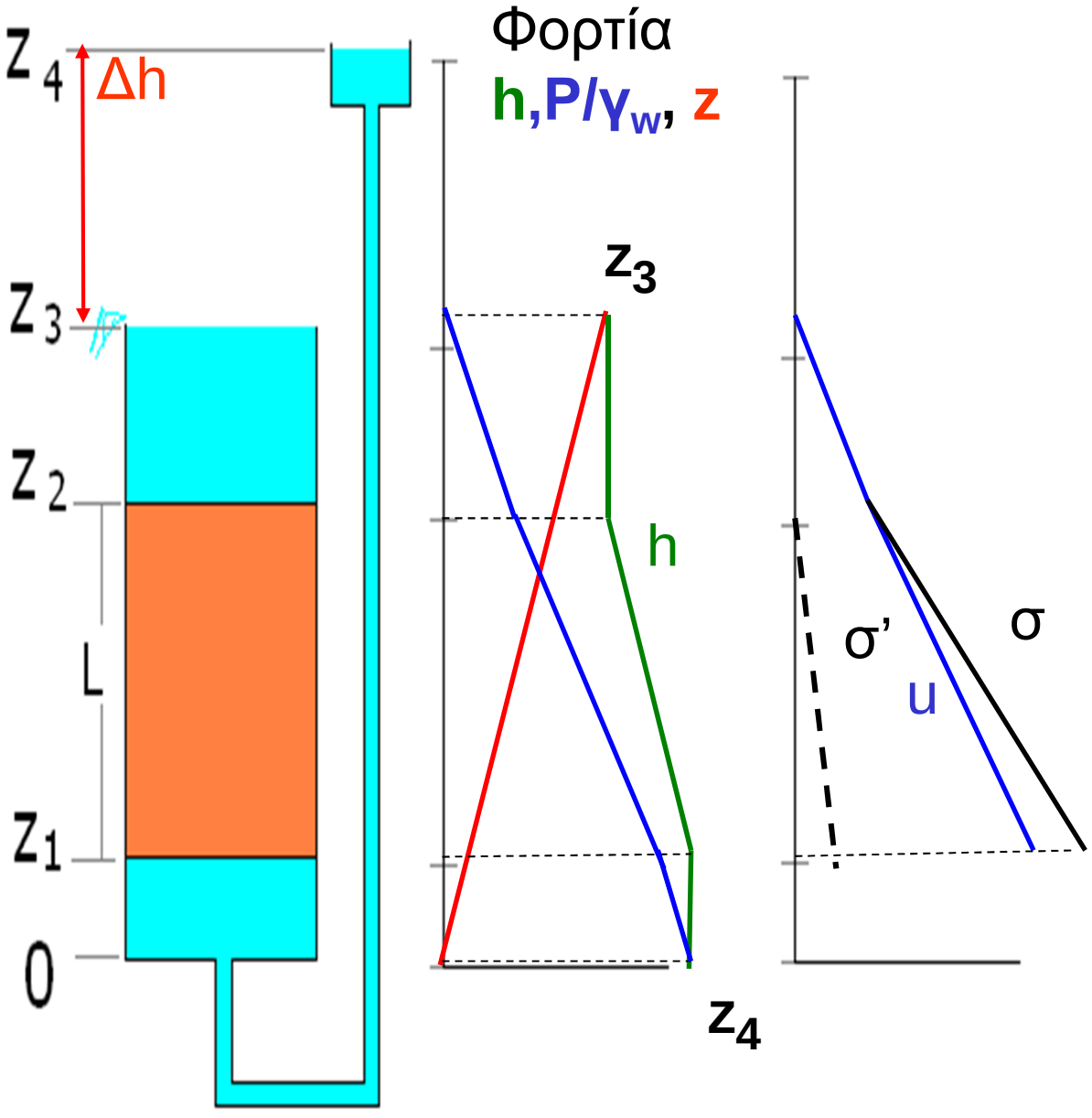
μεταβολή ενεργών τάσεων-υδροστατικές συνθήκες



- $\sigma_1' = \gamma_w(z_3-z_2)+\gamma(z_2-z_1)-\gamma_w(z_3-z_1) = \gamma' L$

σ P ή u

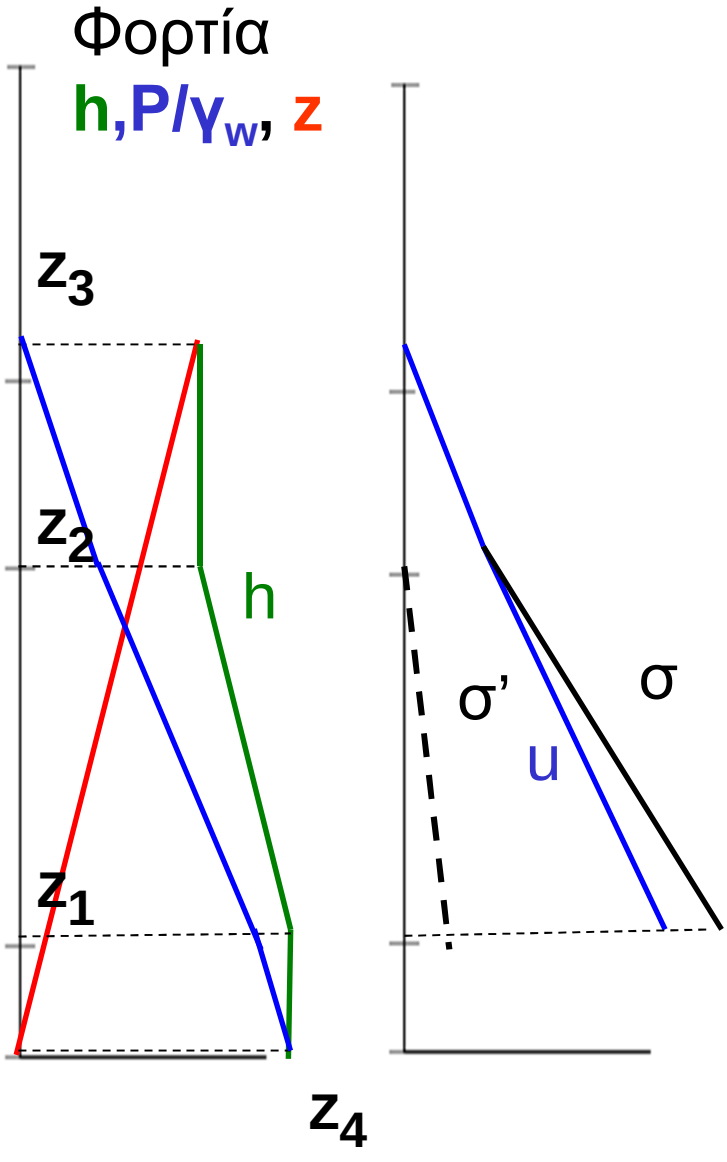
μεταβολή ενεργών τάσεων λόγω υδατικής ροής



$$\sigma' = (\gamma' - \gamma_w \Delta h/L)_{y=0} \rightarrow i_{cr} = \gamma'/\gamma_w$$

μεταβολή ενεργών τάσεων λόγω υδατικής ροής

- $\sigma_1 = \gamma_w(z_3 - z_2) + \gamma(z_2 - z_1)$
- $u = \gamma_w(z_4 - z_1)$
- **$\sigma_1' = \sigma_1 - u =$**
- **$\gamma' L - \gamma_w \Delta h$**



$$\sigma' = (\gamma' - \gamma_w \Delta h/L)y=0$$

$$\rightarrow i_{cr} = \gamma'/\gamma_w$$