

# β' Άσκηση 2023-2024

Θεμα 1<sup>ο</sup>

Κλίση εδάφους για παλιούς αγρούς ομβρίων να προσδιοριστεί

η παροχή που μπορεί να προχετευτεί ο αγρός με σωτφική

διаметρο  $D=1000mm$ , Να θεωρηθεί συντελ. Μητρησ  $\lambda_0=0,016 s/n^{1/3}$

Κλίση εδάφους  $S_{AB}=0,0046$

Δεδομένα

$S_{AB}=0,0046$

$D=1000mm=1m$

$\lambda_0=0,016$

$y/D=0,8$  (παλιό ομβρίο)

Ζητούμεν

Q λειτουργική

Λύση

1<sup>ο</sup> Βήμα Υπολογισμός  $Q_0, V_0$

$$Q_0 = \frac{\pi}{4^{5/3}} \cdot \frac{1}{\lambda_0} \cdot D^{8/3} \cdot S_{AB}^{1/2} = \frac{\pi}{4^{5/3}} \cdot \frac{1}{0,016} \cdot 1^{8/3} \cdot 0,0046 = 1,32 m^3/s$$

$$V_0 = \frac{4Q_0}{\pi D^2} = \frac{4 \cdot 1,32}{3,14 \cdot 1^2} = 1,68 m/s$$

Βήμα 2<sup>ο</sup>

Από νομοσχέτιση γη  $\frac{y}{D}=0,8 \Rightarrow \frac{Q}{Q_0}=0,97$  και  $\frac{V}{V_0}=1,01$

Βήμα 3<sup>ο</sup>

$Q = 0,97 \cdot 1,32 = 1,149 m^3/s$

$V = 1,01 \cdot V_0 = 1,01 \cdot 1,68 = 1,697 m/s$

Ελέγχος

1<sup>ο</sup> ομβρίο  $D > \Phi_{min}=400mm$  (1σχυει)

2<sup>ο</sup>  $\frac{y}{D} \leq 0,8$  (γη παλιό) 1σχυει

3<sup>ο</sup>  $V_0 = 1,68 > V_{0,lim}=1,11$  1σχυει

3<sup>ο</sup> ⇒ Ελέγχ-γη μετ. Τίχτ.

Γη ομβρίο  $V_{max}=6 m/s$  1σχυ.

4<sup>ο</sup> ⇒ Ελέγχ-Τίχτ  $V \geq 0,6 m/s$  1σχυ.

Θέμα 2<sup>ο</sup>

(2)

$$H_A = H_B + \sum h_f + \sum h_{\text{τον}}$$

$$\sum h_{\text{τον}} = K_{\text{ε1}} \cdot \frac{U_{A5}^2}{2g} + K_{\text{ε3}} \cdot \frac{U_{5B}^2}{2g} + K_{\text{στει}} \cdot \frac{U_{5B}^2}{2g}$$

$$\frac{D_{5B}}{D_{A5}} = \frac{300}{400} = 0,75 > 0,55$$

$$K_{\text{στ}} = 0,7 \cdot \left(1 - \frac{D_2}{D_1}\right) = 0,7 \cdot (1 - 0,75) = 0,175$$

$$\sum h_{\text{τον}} = 0,5 \cdot \frac{U_{A5}^2}{2g} + \frac{U_{5B}^2}{2g} + 0,175 \cdot \frac{U_{5B}^2}{2g}$$

$$\sum h_f = f_{A5} \cdot \frac{L_{A5}}{D_{A5}} \cdot \frac{U_{A5}^2}{2g} + f_{5B} \cdot \frac{L_{5B}}{D_{5B}} \cdot \frac{U_{5B}^2}{2g}$$

$$Z_A - Z_B = 30 = f_{A5} \cdot \frac{L_{A5}}{D_{A5}} \cdot \frac{U_{A5}^2}{2g} + f_{5B} \cdot \frac{L_{5B}}{D_{5B}} \cdot \frac{U_{5B}^2}{2g} + 0,5 \cdot \frac{U_{A5}^2}{2g} + 1,175 \cdot \frac{U_{5B}^2}{2g}$$

$$30 = f_{A5} \cdot \frac{2800}{0,4} \cdot \frac{U_{A5}^2}{2g} + f_{5B} \cdot \frac{2200}{0,3} \cdot \frac{U_{5B}^2}{2g} + 0,5 \cdot \frac{U_{A5}^2}{2g} + 1,175 \cdot \frac{U_{5B}^2}{2g}$$

Εστω  $Q = 0,06 \text{ m}^3/\text{s}$

$$h_{f_{A5}} = 2,163 \quad U_{A5} = 0,478 \text{ m/s}$$

$$h_{f_{5B}} = 7,654 \quad U_{5B} = 0,849 \text{ m/s}$$

$$30 = 2,163 + 7,654 + 0,5 \cdot \frac{0,478^2}{2 \cdot 9,81} + 1,175 \cdot \frac{0,849^2}{2 \cdot 9,81}$$

$$30 = 2,163 + 7,654 + 0,0058 + 0,043$$

$$30 \neq 9,8658$$

$$\begin{aligned} & * 6,55 + 23,31 + 0,5 \cdot \frac{0,83759^2}{2g} \\ & + 1,175 \cdot \frac{1,489^2}{2g} \\ & = 6,55 + 23,31 + 0,017979 \\ & + 0,13277 = \underline{30,01 \text{ m}} \end{aligned}$$

$$H_A = H_H + \sum h_f + \sum h_{\text{τον}}$$

$$Z_A = Z_H + \frac{P_H}{\rho g} + \frac{U_{A5}^2}{2g} + f_{A5} \cdot \frac{L_{A5}}{D_{A5}} \cdot \frac{U_{A5}^2}{2g} + K_{\text{ε1}} \cdot \frac{U_{A5}^2}{2g}$$

$$60 - 40 + \frac{P_H}{\rho g} + \frac{0,83759^2}{2g} + 0,02617 \cdot \frac{1000}{0,4}$$

$$\frac{P_H}{\rho g} = 17,607 \text{ m}$$

Μετα από εναλλαγές

$$Q = 0,1052 \text{ m}^3/\text{s}$$

$$U_{A5} = 0,83759 \text{ m/s}$$

$$U_{5B} = 1,489 \text{ m/s}$$

$$R_{\text{ε}A5} = 296,488,36$$

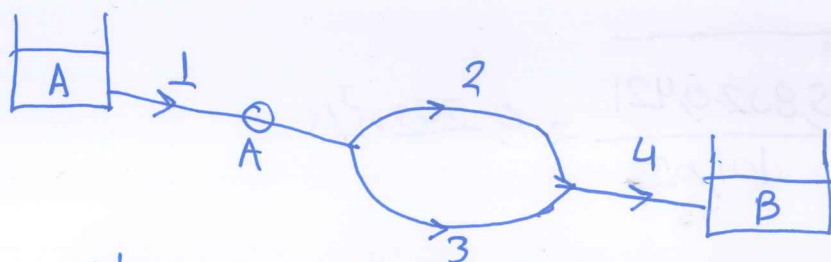
$$R_{\text{ε}5B} = 395,309,73$$

$$f_{A5} = 0,02617$$

$$f_{5B} = 0,02912$$

$$h_{f_{A5}} = 6,55 \text{ m} \quad h_{f_{5B}} = 23,31 \text{ m}$$

Θεμα 32°



	Μήκος (m)	D (mm)	f	R
1	2700	600	0,023	66,054
2	1600	500	0,024	101,635
3	2100	400	0,025	424,054
4	1200	600	0,023	29,357

$$R_1 = 8 f_1 \frac{L_1}{g n^2 D_1^5} = \frac{8 \cdot 0,023 \cdot 2700}{9,81 \cdot 3,14^2 \cdot 0,6^5} = 66,054$$

$$R_2 = 8 f_2 \frac{L_2}{g n^2 D_2^5} = \frac{8 \cdot 0,024 \cdot 1600}{9,81 \cdot 3,14^2 \cdot 0,5^5} = 101,635$$

$$R_3 = \frac{8 f_3 \cdot L_3}{g n^2 D_3^5} = \frac{8 \cdot 0,025 \cdot 2100}{9,81 \cdot 3,14^2 \cdot 0,4^5} = 424,054$$

$$R_4 = \frac{8 \cdot f_4 \cdot L_4}{g n^2 D_4^5} = \frac{8 \cdot 0,023 \cdot 1200}{9,81 \cdot 3,14^2 \cdot 0,6^5} = 29,357$$

Βρίσκω ισοδύναμο αγωγο

(2)-(3) είναι παράλληλα

$$\frac{1}{\sqrt{R_{23}}} = \frac{1}{\sqrt{R_2}} + \frac{1}{\sqrt{R_3}} \Rightarrow \frac{1}{\sqrt{R_{23}}} = \frac{1}{\sqrt{101,635}} + \frac{1}{\sqrt{424,054}}$$

$$R_{23} = 45,802$$

$$R_{\alpha\lambda} = R_1 + R_{23} + R_4 = 66,054 + 45,802 + 29,357 = 141,213$$

ΑΔΕ από A → B

$$H_A + H_{ave\lambda} = H_B + \sum h_f \Rightarrow Z_A + 20 = Z_B + R_{\alpha\lambda} Q^2$$

$$R_{\alpha\lambda} Q^2 = (Z_A - Z_B) + 20 \Rightarrow Q = \sqrt{(5+20)/141,213} = 0,42 \text{ m}^3/\text{s}$$

$$h_{f23} = h_{f2}$$

$$R_{23} \cdot Q_{02}^2 = R_2 \cdot Q_2$$

$$Q_2 = \sqrt{\frac{R_{23} \cdot Q_{02}^2}{R_2}} = \sqrt{\frac{45,802 \cdot 0,421}{101,635}} = 0,282 \text{ m}^3/\text{s}$$

$$\eta) P_{ave\lambda} = \frac{\rho \cdot g \cdot Q_{02} \cdot H_{ave\lambda}}{\eta} = \frac{1000 \cdot 9,81 \cdot 0,421 \cdot 20}{0,7} = 118.000,28 \text{ W} = 118 \text{ kW}$$

To prouto lampavei isxu  $\rho g Q_{02} \cdot H_{ave\lambda} = 1000 \cdot 9,81 \cdot 0,421 \cdot 20 = 82.600,2 \text{ Watt}$

Θεμα 4<sup>ο</sup>

$$H_A = H_E$$

$$Z_A + \frac{P_A}{\rho g} + \frac{U_A^2}{2g} = Z_E + \frac{P_E}{\rho g} + \frac{U_E^2}{2g} + \sum h_f$$

~~\* Q<sub>2</sub> = 0,9188 \cdot \frac{3,14 \cdot 0,2204^2}{4} = 0,0349 \text{ m}^3/\text{s}~~

~~Q<sub>02</sub> = 0,0516 \text{ m}^3/\text{s}~~

$$\frac{P_A}{\rho g} - \frac{P_E}{\rho g} = \sum h_f \Rightarrow \sum h_f = 14 \text{ m}$$

$$V_{AE} = -2 \sqrt{\frac{2g h_f \cdot D_E}{L_{AE}}} \cdot \log \left( \frac{K}{3,7 D_E} + \frac{2,51 V}{D_E} \cdot \sqrt{\frac{L_{AE}}{2g h_f \cdot D_E}} \right)$$

$$= -2 \sqrt{\frac{2 \cdot 9,81 \cdot 14 \cdot 0,2776}{3100}} \cdot \log \left( \frac{1}{3,7 \cdot 277,6} + \frac{2,51 \cdot 1,13 \cdot 10^{-6}}{0,2776} \right) = 0,9368 \text{ m/s}$$

~~Q<sub>mola</sub> V<sub>AE</sub><sup>(2)</sup> = 0,9188 \text{ m/s}~~

$$Q_1 = V_{AE}^{(1)} \cdot \eta \cdot D^{1/4} = 0,9368 \cdot 3,14 \cdot 0,2776^2/4 = 0,0567 \text{ m}^3/\text{s}$$

\*

$\Delta Z$	D	L	k	v
14	0.2776		3100	0.001 0.000001

V2	
0.936817	0.0567
0.936817	

$\Delta Z$	D	L	k	v
14	0.2776		1500	0.001 0.000001

V2	
1.350121	0.081715
1.350121	

$$V_{AE} = -2 \sqrt{\frac{2 \cdot 9,81 \cdot 14 \cdot 0,2776}{1500}} \cdot \log \left( \frac{1}{3,7 \cdot 277,6} + \frac{2,51 \cdot 113 \cdot 10^{-6}}{0,2776} \right) \cdot \sqrt{\frac{1500}{2 \cdot 9,81 \cdot 14 \cdot 0,2776}}$$

$$= -2 \sqrt{0,050834112} \cdot \log (0,000973596 + 10,217219 \cdot 10^{-6}) \cdot \sqrt{19,671829}$$

$$= -2 \cdot 0,225464 \log (0,000973596 + 0,00004531636)$$

$$= -2 \cdot 0,225464 \cdot (-2,991863)$$

$$= 1,34911 \approx 1,35$$

$$Q = 1,35 \cdot \frac{3,14 \cdot 0,2776^2}{4} = 0,08167 \text{ m}^3/\text{s}$$

$$Q_{\lambda} = 56,7 + 81,67 = 138,366 \text{ l/s}$$