University Of Technology
Building and Construction Eng. Dept.
Final Exam 2015/2016 (1st Attempt)

Subject :HY.Structures Design — **Class: 4th**

Branch : نازحين جامعة الموصل — **Time : 3 Hours**

Examiner : Dr.J.S.Maatooq — **Date :29 / 5/ 2016**

Open Lectures Exam (Answer Five Questions)

Q1] A warped expansion transition is to be designed to connect **1.9m** wide **flume** to **trapezoidal channel (Bc=3.3m, yc=1.2m, and Zc=2)**. If the difference in elevations between inverts of channel and flume is **0.35m**, use loss coefficient **K=0.2** and find:-

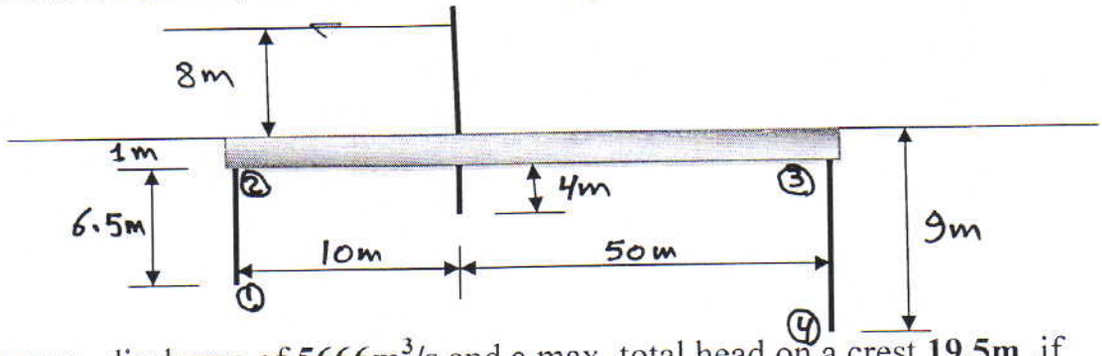
(a) Length of transition.
(b) At mid section of transition find its bed width and side slope.
(c) The depth of flow at flume.

Q2] The V-notch **65°** is to be used as a sharp crested weir in **2.83m** rectangular channel for measuring the discharge. The height of crest above the bed of channel is **0.85m**. If the head over the crest is **0.935m**, find the discharge for the following situations:- (a) Tail water depth is **1.44m** (b) Tail water depth is **1.7m**.

Q3] A circular concrete culvert has a diameter **0.9m** , slope **0.025** and length **10m**. The entrance of culvert is ***"square edge inlet with a head wall"*** . Determine **the Max. HW for Q=1 m^3/s** and show the type of flow control ?(Assume TW below the crown of culvert ,(**n=0.02**) .

Q4] The discharge is controlled from river into 4m wide irrigation canal by vertical sluice gate. If canal has **n=0.028** and bed slope is **0.002**. Calculate the required gate opening and the flow condition D/S the gate if the depth of flow in the river is **2m** and the irrigation demand is **$11 m^3/s$**.

Q5] Find the uplift pressure head under apron at key points as indicated in figure by using Khosla's charts , also calculate the exit gradient.



Q6] For a max. discharge of **$5666 m^3/s$** and a max. total head on a crest **19.5m** ,if the ratio of total head to the design head is 1.3. Determine the crest length without piers, the discharge at a design head, and the U/s and D/s structural profile of an **ogee spillway**, use **P=18m**.

*** ***Good Luck*** ***

Hydraulic Structures Exam / 3rd class
1st Attempt (2015-2016)
Water & Hydraulic Structures Branch
** Solutions **

Q1] $L_T = 2.35(b_c - b_f) + 1.65 z_c y_c$

$= 2.35(3.3 - 1.9) + 1.65 * 2 * 1.2 = 7.25\ m$

at mid sec. of Transition

$z_x = z_c - z_c\left(1 - \frac{X}{L_T}\right)^{1/2} = 2 - 2\left(1 - \frac{\frac{7.25}{2}}{7.25}\right)^{0.5} = 0.586$

$e = 0.8 - 0.26 z_c^{1/2} = 0.8 - 0.26(2)^{1/2} = 0.432$

$b_x = b_f + (b_c - b_f)\frac{X}{L_T}\left[1 - \left(1 - \frac{X}{L_T}\right)^e\right]$

$= 2.42\ m$

Q2] $\frac{P}{B_1} = \frac{0.85}{2.83} = 0.3$; $\frac{H}{P} = \frac{0.935}{0.85} = 1.1$

from Fig. $\rightarrow C_d = 0.59$

(a) $H_2 = 1.44 - 0.85 = 0.59\ m$

$0.8H = 0.8 * 0.935 = 0.748\ m$

$\because 0.748 > 0.59$ $\therefore$ the flow is un-submerged

$Q = C_d \left(\frac{8}{15}\right)\sqrt{2*9.81}\tan\frac{65^\circ}{2}(0.935)^{5/2} = 0.75\ m^3/s$

(b) $H_2 = 1.7 - 0.85 = 0.85\ m$

$0.8 * 0.935 = 0.748\ m$

$\because 0.85 > 0.748$ $\therefore$ the flow is Submerged

$H_1 = 0.935 - 0.85 = 0.085\ m$

& $Q = 0.59\left(\frac{8}{15}\right)\sqrt{2*9.81}\tan\frac{65}{2}(0.085)^{2.5}$

$Q = 0.0018\ m^3/s$

Q3] If inlet control

from chart 1 A $\Rightarrow \frac{Hw}{D} = 1.03$

$\therefore Hw = 1.03 * 0.9 = 0.927\ m$

If outlet control (chart 5A)

$L_1 = L\left(\frac{n_1}{n}\right)^2 = 10\left(\frac{0.02}{0.012}\right)^2 = 30\ m$

$k_e = 0.5$ (table 12)

$\therefore H = 0.24\ m \rightarrow$ chart 5A

$y_c = 0.55\ m \longrightarrow$ chart 4A

$h_o = \frac{0.55+0.9}{2} = 0.725\ m$

$Hw = 0.725 + 0.24 - 10 * 0.0025 \Rightarrow Hw = 0.715\ m$

$\therefore$ max. $Hw = 0.927\ m$ at inlet control.

Q4] $Q = \frac{1}{n} A R^{2/3} S_o^{1/2}$ assume $y_n = 1.73\ m$

$\Rightarrow A = 4 * 1.73 = 6.92 \rightarrow P = 2 + 1.73 + 4 = 7.46\ m$

$\longrightarrow R = \frac{6.92}{7.46} = 0.928\ m \Rightarrow Q \simeq 11\ m^3/s$

$\therefore y_n = 1.73\ m$ also assume $G = 1\ m$

then $C_d = \frac{0.61}{\sqrt{1 + 0.61\left(\frac{1}{2}\right)}} = 0.534$

now $0.8 * 1.73 \left(\frac{1.73}{1}\right)^{0.72} = 2.08$

$\therefore y_2 < y_1 < 2.08$ $\therefore$ the flow DIs gate is submerged

assume $G = 0.9\ m \longrightarrow$ مقارنة بين الخطوات للحصول على جريان unsubmerged

(في الامتحان نكتفي بفرضية واحدة)

Q3] ① U/s pile

$d = 6.5 + 1 = 7.5\,m$, $b = 60\,m$ $\Rightarrow \frac{1}{\alpha} = \frac{d}{b} = \frac{7.5}{60} = 0.125$

From Fig(9.6) $\phi_D = 23\%$, $\phi_{D1} = 100-23 = 77\%$

$\therefore \boxed{\phi_1 = 77\%}$

$\phi_E = 34\% \Rightarrow \phi_{C1} = 100-34 = 66\%$

$\therefore \boxed{\phi_2 = 66\%}$

Correction for floor thickness :-

Total drop on piling $= 77-66 = 11\%$

$\therefore$ Corr. $= \frac{4}{75} * 1 = +1.47$:

Corr. for interference :-

$D = 4\,m$ $b_1 = 10\,m$

$\therefore C = \frac{19\sqrt{\frac{4}{20}}\,(65+4)}{60} = +2.1\%$

$\therefore$ Corrected press. $\phi_2 = 66 + 1.47 + 2.1 = \boxed{69.57\%}$

② D/s pile

$d = 9\,m$, $b = 60\,m$ $\longrightarrow \frac{1}{\alpha} = \frac{9}{60} = 0.15$

$\phi_E = 38\%$ $\phi_D = 25\% \longrightarrow \phi_3 = 38\%$ $\phi_4 = 25\%$

Corr. for thickness $= \frac{38-25}{9} * 1 = -1.44\%$

interference neglected : $\phi_3 = 38 - 1.44 = \boxed{36.56\%}$

$\therefore$ pressure head will be :-

1 $= 0.77 * 8 = 6.16\,m$

2 $= 0.957 * 8 = 5.56\,m$

3 $= 0.3656 * 8 = 2.925\,m$

4 $= 0.25 * 8 = 2\,m$

$Ge = \frac{H}{\pi d\sqrt{\lambda}}$ & $\lambda = \frac{1}{2}(1+\sqrt{1+\alpha^2})$ $\alpha = \frac{60}{9} = 6.67$

$\therefore \lambda = 3.87$ & $\boxed{Ge = 0.144 \simeq \frac{1}{7}}$

Q6] $\frac{H_e}{H_o} = 1.3 \longrightarrow H_o = \frac{19.5}{1.3} = 15\,m$

from Fig.(5) $\longrightarrow \frac{C}{C_o} = 1.03$

$\frac{P}{H_o} = \frac{18}{15} = 1.2$ then from Fig. 4

$\longrightarrow C_o = 3.9$

$\Longrightarrow C = 3.9 * 1.03 = 4.017$

$\therefore L = \frac{5666}{4.017 * (19.5)^{1.5}} \simeq 16.5\,m$

& $Q_{des.} = C_o L H_o^{3/2} = 3.9 * 16.5 * 15^{1.5}$

$\simeq$ **3738 m^3/s**

أما عن profiles فهو تطبيق المعادلات

مباشرة ، لإيجاد X & Y & R_1 & R_2

وكذلك نقطة الاتصال T.P .