Question Bank 2021-2022

University of Salahaddin Hawler

College of Engineering

water resources Engineering Department

Design of Hydraulic Structures

Hydraulic Structures 4th class and third classes

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1) Define a Gravity dam and describe the various forces acting on a gravity dam.

2) A masonry dam 10 m high is trapezoidal in section with a top width of 1 m and bottom with of 8.25 m. The face exposed to water has a batter of 1:10.Test the stability of the dam. Find out the principal stresses at the toe and heel of the dam. Assume unit weight of masonry as 2240 kg/m^3, unit wt of water 1000 kg/m^3 and permissible shear stress of joint as 14 kg/cm^2.

3) Design and sketch the practical profile of a gravity dam for storing 65 meters of water. Assume, relative density of dam material = 2.4 and free board = 2.5 m. Allowable stress = 150 N/cm^2.

4) Prove that the principal stress is always more than the normal stress acting at the toe of a gravity dam under reservoir full conditions.

5) List the various causes of failures of an earth dam and hence explain the structural failures of an earth dam

6) The cross-section of a low gravity dam is shown in Fig.1. Assume the reservoir to be full, determine:

(i) The normal stress;
(ii) The principal stress;
(iii) The shear friction factor at base.
Count full uplift. Neglect earthquake forces, wave pressure and silt pressure.

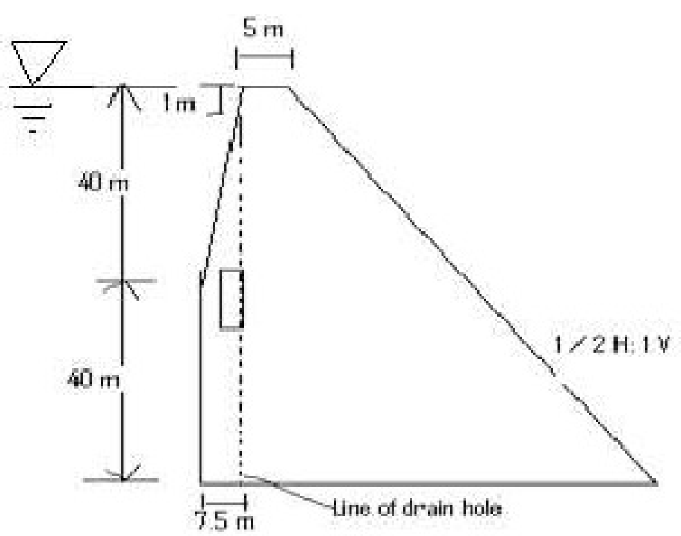


Fig. 1

7) A section of a homogeneous earth dam is shown in Fig.2. Calculate the seepage discharge per meter length through the body of the dam. The coefficient of permeability of the dam material may be taken as $8 * 10^{-5}$ m/sec. Determine also the phreatic line for this section.

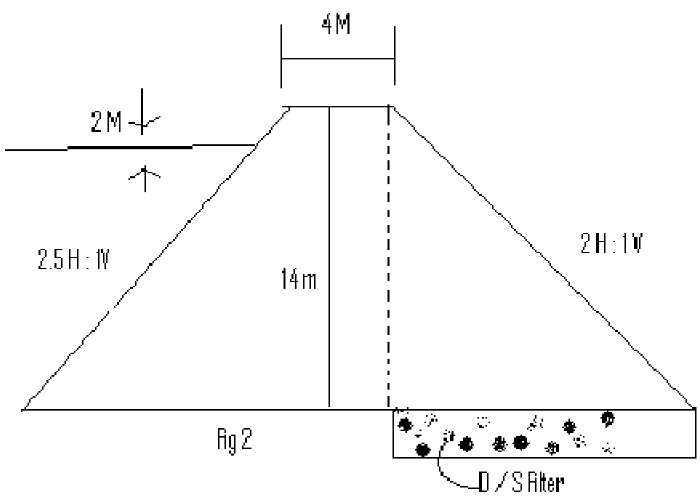


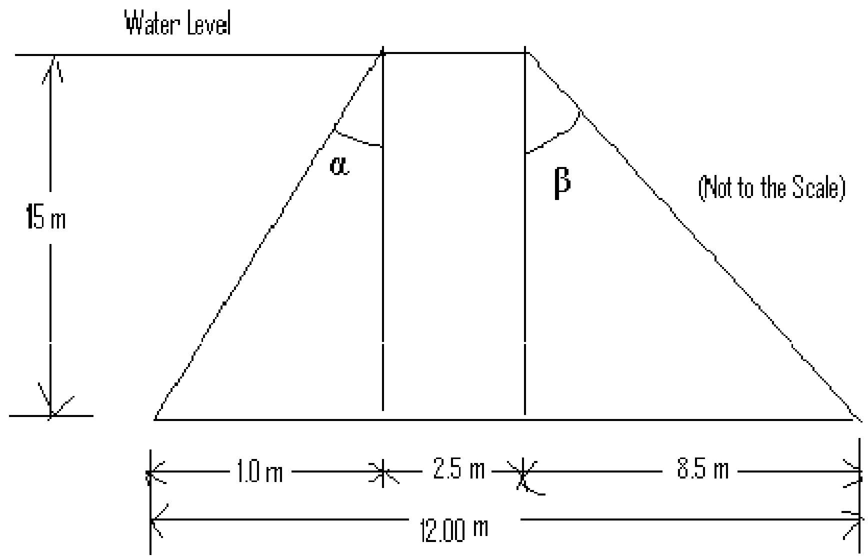
Fig 2

8) Design the practical profile of a gravity dam only of stone masonry, given the following data:
   R.L of base dam = 1250 m
   R.L. of H.F.L. = 1280 m
   Specific gravity of masonry = 2.4
   Safe compressive stress for masonry of dam = 120 t/m^2.

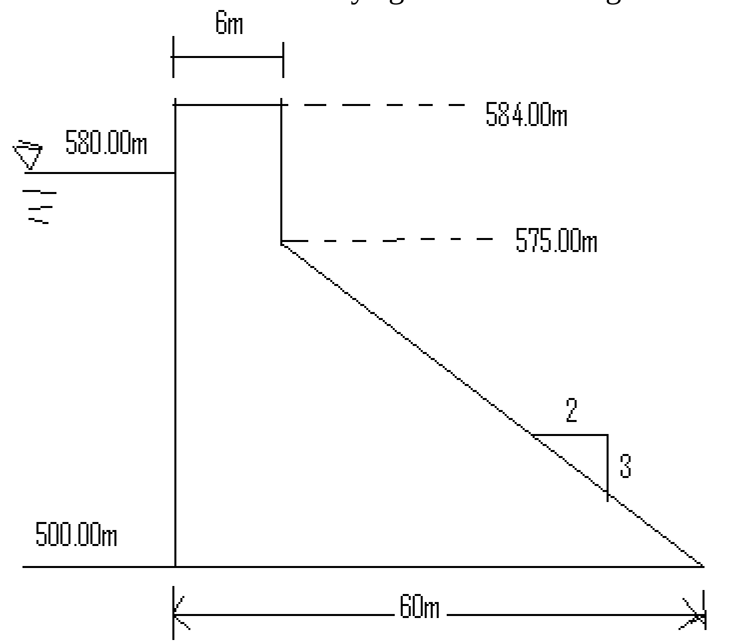
9) Define Earth Dam and Rock fill Dam and What are the factors governing the selection of a particular type of Dam. Explain briefly the various causes of failure of earthen Dam.

10) For the section of a gravity dam shown in the failure calculate.
   i) Stability of the dam
   (ii) The principal stress at the toe and heel of Dam.

Take unit weight of dam material as 2250 kg/m^3, density of water 1000 kg/m^3 and permissible shear of stress joint = 15 kg/cm . Assume value of coefficient of friction μ = 0.75.



11) (a) Define gravity dam and earth dam.
(b) For the section of a gravity dam shown in the figure, calculate:
i- Maximum vertical stress at the heel and toe of the dam.
ii-The major principal stress at the toe of the dam.
iii-Factor of safety against overturning and sliding.



12) A weir with a vertical drop has the following particulars:
Bligh's C = 12
Flood Discharge = 300 m3/s
Length of weir = 40 m
Height of weir above low water = 2 m
Height of falling shutter = 0.6 m
Top width of weir = 2.0 m
Bottom width of weir = 3.5 m

Design the length and thickness of apron and draw the cross-section of the weir.

13) (i) Explain the causes of failure of weirs on permeable foundation.
(ii) Explain Khosla's theory of seepage.

14)
(a) Differentiate between a weir and a barrage.
(b) With a neat sketch explain the various components of a diversion head works.

15) Explain the design procedure for a Glacis weir.

16) Using Bligh's theory design a vertical drop weir. The weir wall need not be designed and its cross section may be assumed as : Top width = 3 m, Bottom width = 6 m.

- Maximum flood discharge = 1250 m3/s
- H.F.L. Before construction of weir = 172.5
- River bed level = 168.0 m
- Full supply level of canal = 171.5 m
- Allowable afflux = 1 m,
- Coefficient of creep = 11

17) Design a head regulator for a distributary channel taking off from the parent channel for the following data:

- Discharge of parent channel = 120 cumecs
- Discharge of distributary = 17 cumecs
- F.S.L. of parent channel $\frac{/}{/} = \frac{.}{.}$
- Bed width of parent channel: $\frac{/}{/} =$
- Depth of water in parent channel: $\frac{/}{/} = \frac{.}{.}$
- F.S.L. of distributary = 217.10 m.
- Bed width of distributary = 16 m.
- Depth of water in distributary = 1.5 m
- Permissible exit gradient =1/5

(Projection works need not to be designed)

18) Discuss on the effect of construction of weir on the river regime

19) Design a vertical drop weir on Bligh's theory for the following data:

- Maximum flood discharge = 1200 cumecs
- H.F.L. before construction of weir = 172.5 m
- River bed level = 168.0 m
- F.S.L. of canal = 171.5 m
- Allowable aflux = 1 m
- Coefficient of creep = 11

The weir wall need to be designed and its dimensions may be taken as follows

(i) top width = 3 m

(ii) bottom width = 6 m.

20) A barrage is to be designed for a river with following data:

- Flood discharge = 9450 cumecs.
- Average bed level of river = 299.50 m
- High flood level = 304.50 m
- Pond level = 302.50 m
- Permissible afflux = 1.00 m
- Safe exit gradient = 1/6
- Lacey's silt factor = 1.0
- Bed retrogression = 0.50 m
- Concentration = 20%

Design the under sluice portion for high flood condition.

21) A barrage is to be designed for a river with following data:

- Flood discharge = 8100 m3/s
- Average bed level of river = 257.0 m
- High flood level = 262.2 m
- Pond level = 260.6 m
- Permissible afflux = 1.0 m
- Safe exit gradient = 1/6

Design the under sluice portion for high flood condition.

22) Discuss the causes of failure of weir on permissible foundations and their remedies. Draw the layout plan of diversion head works.

23) Design a cross regulator for the following data:

- Discharge of the parent channel = 100 cumecs
- Discharge of the distributary = 15 cumecs
- F.S.L. of the parent channel $\frac{/}{/} = \frac{.}{.}$
- Bed width of parent channel $\frac{/}{/} =$
- Full supply water depth in parent channel $\frac{/}{/} = \frac{.}{.}$
- F.S.L. of distributary = 207.10 m, Bed width of distributary = 15 m
- Full depth of water in the distributary = 1.5 m
- Permissible Khosla's safe exit gradient = 1/6

24) Define the Cross Drainage works. What are the design considerations for Aqueducts?

25) An impervious floor of a weir on permeable soil is 16 m long and has sheet piles at both the ends. The upstream pile is 4 m deep and the downstream pile is 5 m deep. The weir creates a net head of 2.5 m. Neglecting the thickness of the weir floor. Calculate the uplift pressures at the junction of the inner faces of the pile with the weir floor, by using Khosla's theory.

26) Discuss Bligh's-creep theory for the design of weir constructed over previous foundation and its limitation.

27) Differentiate between a weir and a barrage. Describe the design procedure for designing a head regulator for a distributary.

28) For a homogenous earth dam 62 m high. and 2 m free board, a flow net was constructed and the following results were obtained :-

- -Number of Potential drop = 25
- -Number of flow' channels = 5

The dam has a horizontal filter of 40 m lengths at the downstream end. Calculate the discharge per meter length of the dam. Given: Coefficient of permeability of dam = $3x10^{-3}$ cum/sec

29) Write short notes on any two of the following:-

(i) Galleries: its function and necessity.
(ii) Low and high gravity dams.
(iii) Earthquake effects in the design of a gravity dam

30) Compute the discharge over an ogee spillway with a coefficient of discharge C =2.5 at a head of 4 m. The effective length of the spillway is 150 m. Neglect the velocity of approach

31) Differentiate between Bligh's theory and Lane weighted creep theory

32) What is the purpose of providing launching apron and how is it designed?

33) Differentiate between a weir and a barrage. Why is a barrage preferred to a weir in modern times?

34) What are under sluices and what are their design considerations?

35) Explain the phenomenon of piping in hydraulic structures.

36) How will you locate the point of hydraulic jump formation on the d/s glacis?

37) A river discharges 1000 m^3/s of water at high flood level of RL 103.00m. A weir is constructed for flow diversion with a crest length of 255 m and total length of concrete floor as40 m. The weir has to sustain the under seepage at a maximum static head of 2.4 m. Determine the depth of d/s cut off. Take silt factor =1.1, Safe exit gradient =1/6, RL of d/s floor = 100.00 m.

38) In Khosla's method of independent variables, how would you apply corrections for thickness and slope of floor.

39) In Khosla's method of independent variables, how would you apply corrections for thickness and slope of floor.

40)

Following corrected ϕ values were computed from Khosla's curves for a barrage constructed on permeable foundations :

u/s sheet pile	ϕ_{E_1} =100%	ϕ_{D_1} =90%	ϕ_{C_1} =85%
Intermediate pile	ϕ_{E_2} =80%	ϕ_{D_2} =70%	ϕ_{C_2} =65%
d/s sheet pile	ϕ_{E_3} =55%	ϕ_{D_3} =45%	ϕ_{C_3} =0%

Distance between u/s and intermediate piles is 20 m and that between the intermediate and d/s pile is 40 m. Assuming that the floor is horizontal throughout, draw the hydraulic gradient line for subsurface flow. If the net head is 10 m, determine the thickness of the floor at distances of 20 m and 30 m away from the intermediate pile.

41)

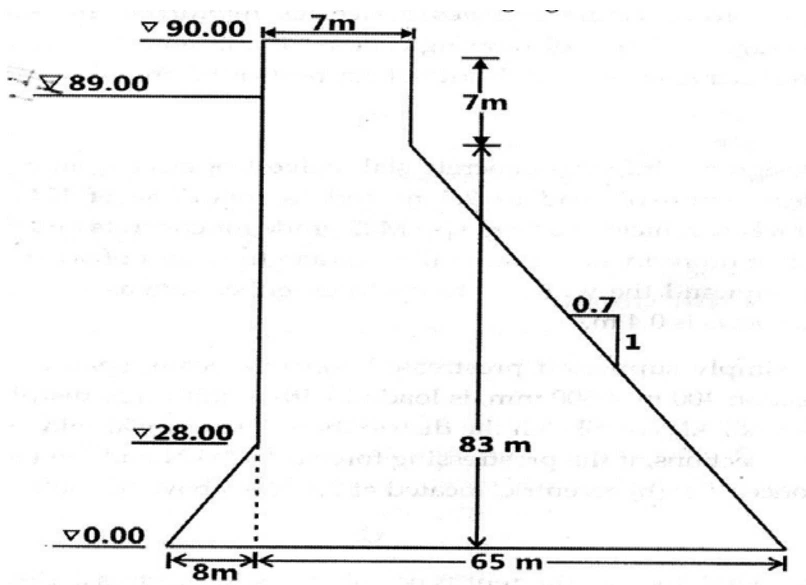
Design and draw a sloping glacis weir for the following site conditions:

(a) Maximum discharge intensity on weir crest =10 cumecs/m length
(b) H.F.L. before construction of weir =225.0 m.
(c) R.L of river bed = 249.5 m.
(d) Pond level = 254.0m.
(e) Height of crest shutters =1m.
(f) Anticipated downstream water level in the river when the weir is discharging with pond level upstream = 251.5m.
(g) Bed retrogression =0.5m.
(h) Lacey's silt factor =0.9.
(i) Permissible exit gradient =1/7.
(j) Permissible afflux = 1m.

42) Check the stability of the section. Find the magnitude and direction of principal stresses, normal stress and shear toe and heel. Analysis of dam section is to be carried out under the following conditions :

i. Effect of horizontal earthquake is to be considered(ά=0.1 and c_m=0.730.
ii. Reservoir full

Unit weight of concrete = 2400kg/m^3
Unit shear for concrete = 14kg/cm^2
Uplift pressure is considered to act over 2/3rd area of section.



43) Design and sketch the practical profile of a gravity dam for storing 65 meters of water. Assume relative density dam material=2.4 and free board=2.5m. Allowable stress = 150 n/cm^2.

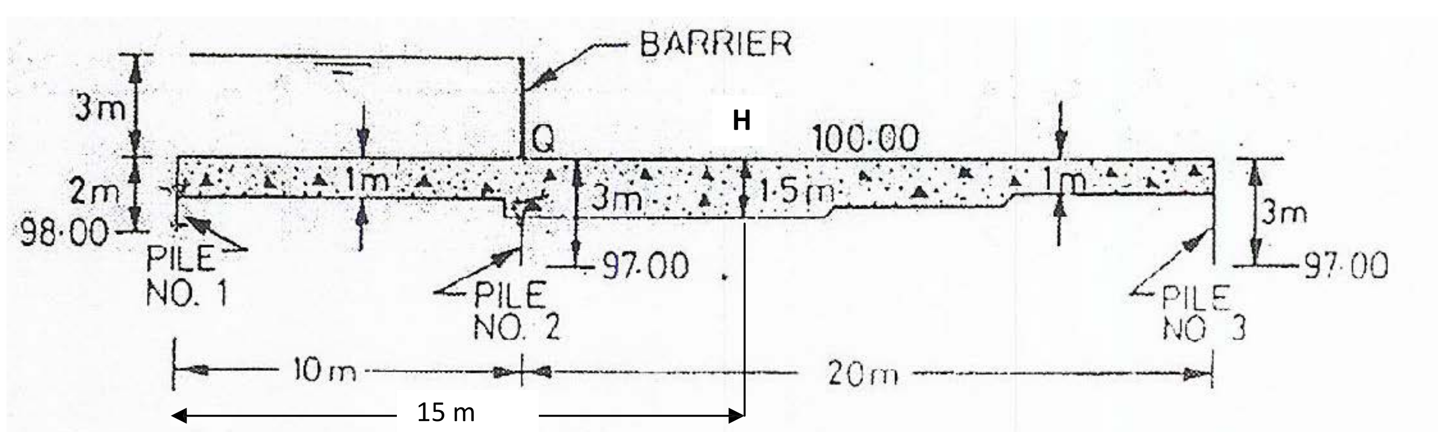
44) List the various causes of failures of an earth dam and hence explain the structural failures of an earth dam.

45) A barrage is to be constructed on a river having high flood discharge of about 8000 m^3/s, with the given data as follows:

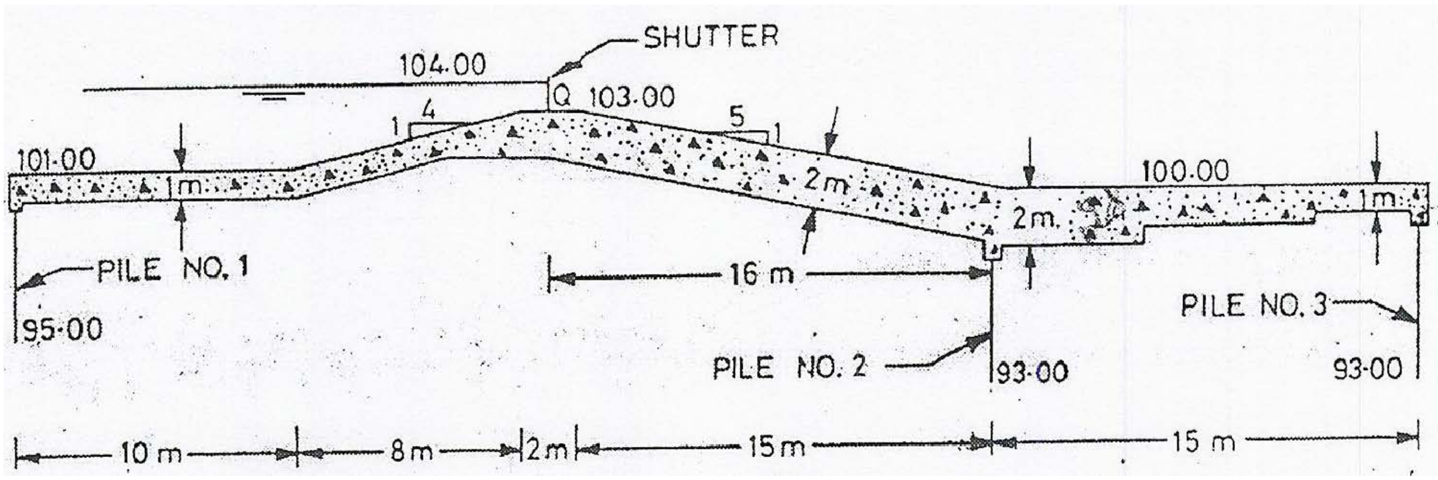
- Average bed level of the river = 100.0 m
- High flood level(before construction of barrage) = 105.2 m
- Permissible afflux = 1.0 m
- Pond level = 103.6 m

Prepare a complete hydraulic design for the other barrage bay section, for high flood condition. A safe exit gradient of 1/6 may be assumed

46) Using Khosla's theory, Calculate uplift pressures at key points of the pile of the structure shown below. Draw Subsoil Hydraulic Gradient Line Also check the thickness provided at point H and exit gradient. Safe G_E=1/5



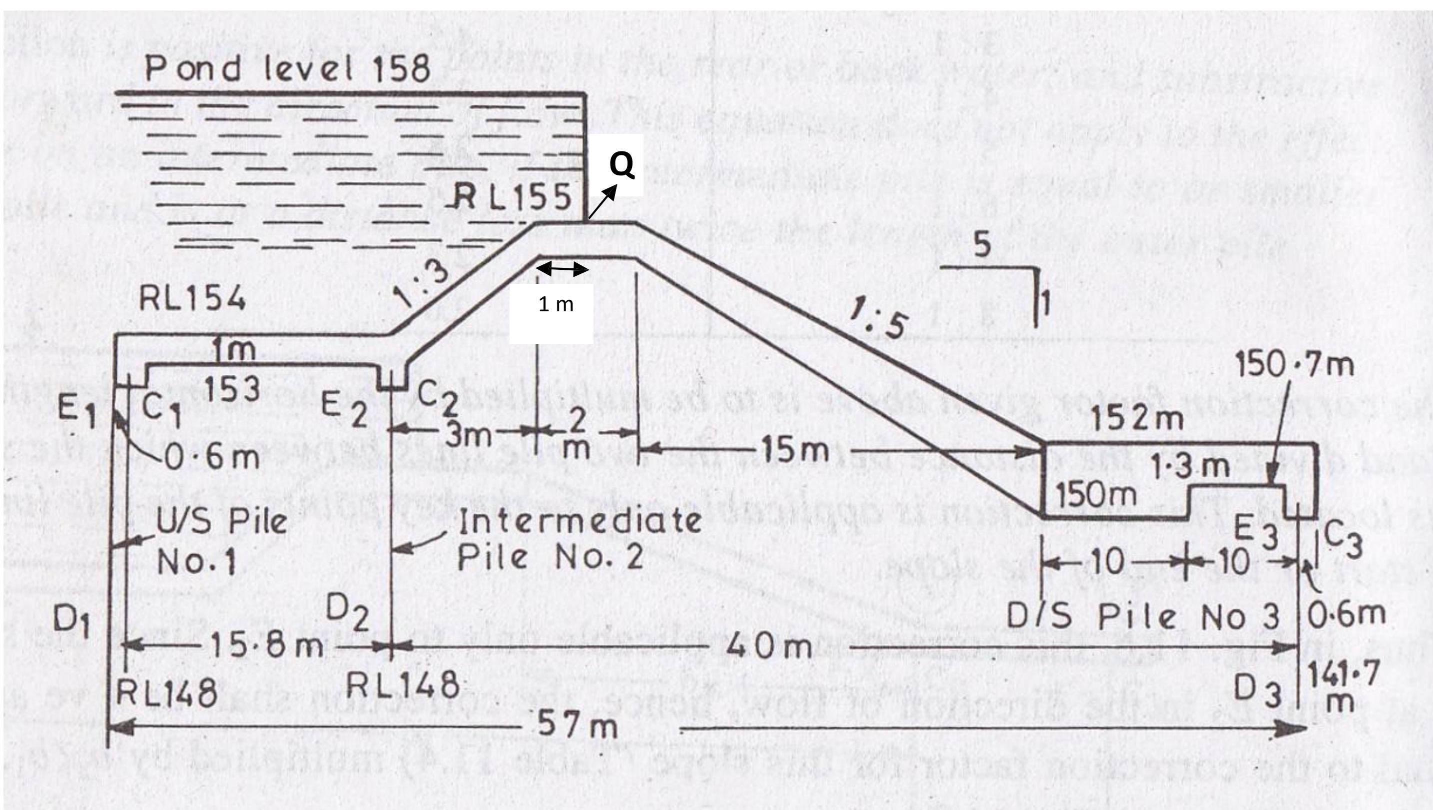
47) Check whether the weir shown below is safe against uplift pressure and piping. Take G_s=2.24 and Safe G_E=1/7. Use Khosla's theory



48) For the weir shown below .

i-Draw subsoil hydraulic gradient line

ii- Calculate thickness at Q



49) Using Khosla's theory. Determine the following for the apron shown below. Assume floor thickness =1m

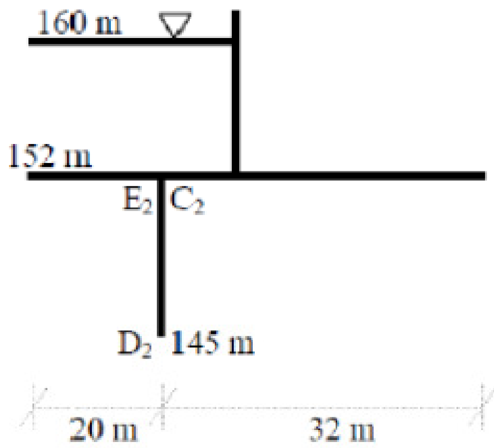


Fig. (i)

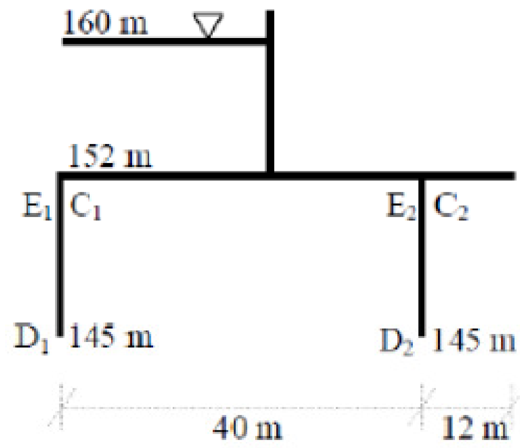
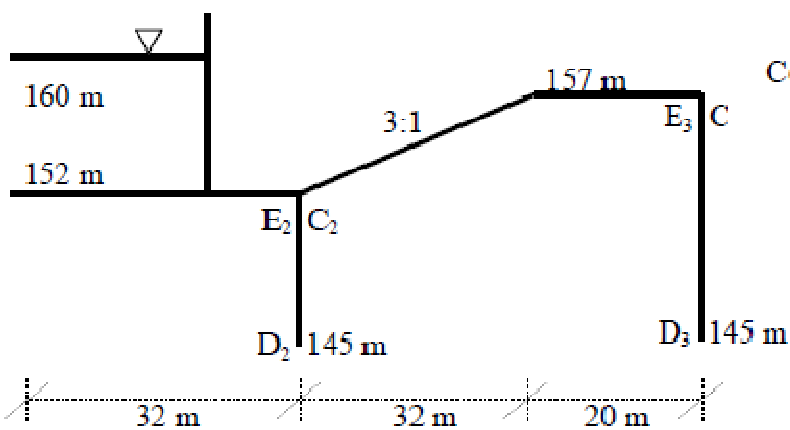


Fig. (ii)

(i) Find pressure at critical points with thickness correction

(ii) Find pressure at C_1 and E_2 with interference correction



Correction factor for slope, 3:1 = 4.5

Fig. (iii)

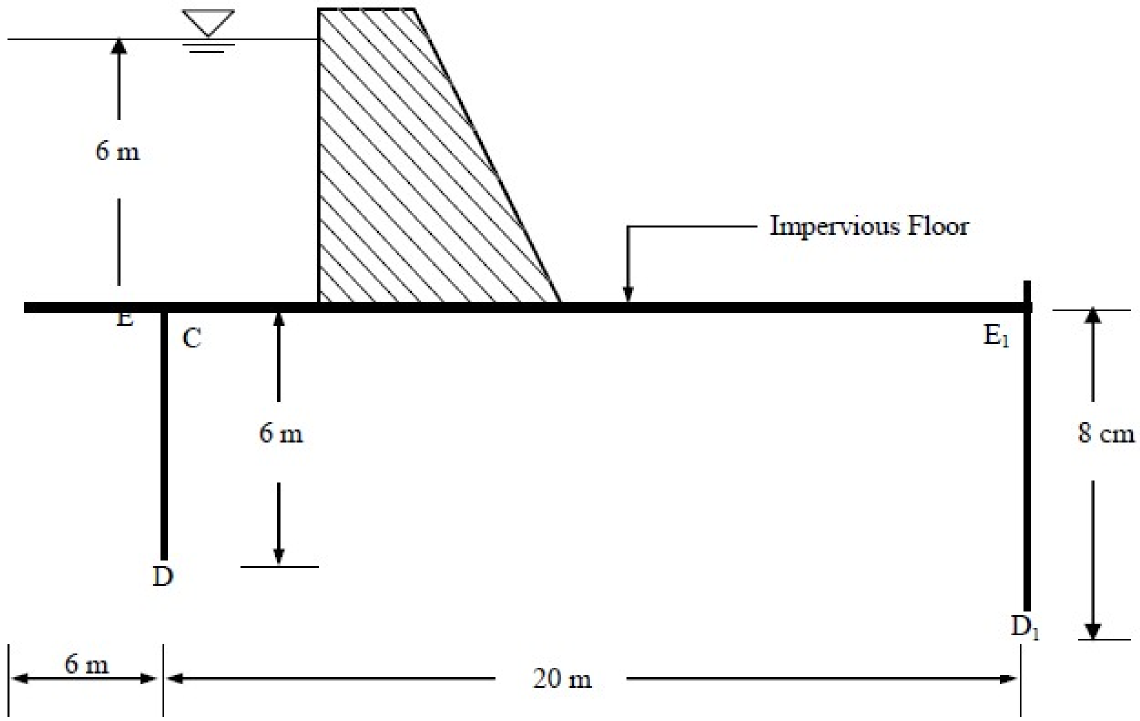
(iii) Find pressure at point C_2 with slope correction

50) Using Khosla's theory.Determine the following for the apron shown below

i- Uplift pressure at E,D,C,E_1, and D_1

ii- Exit gradient

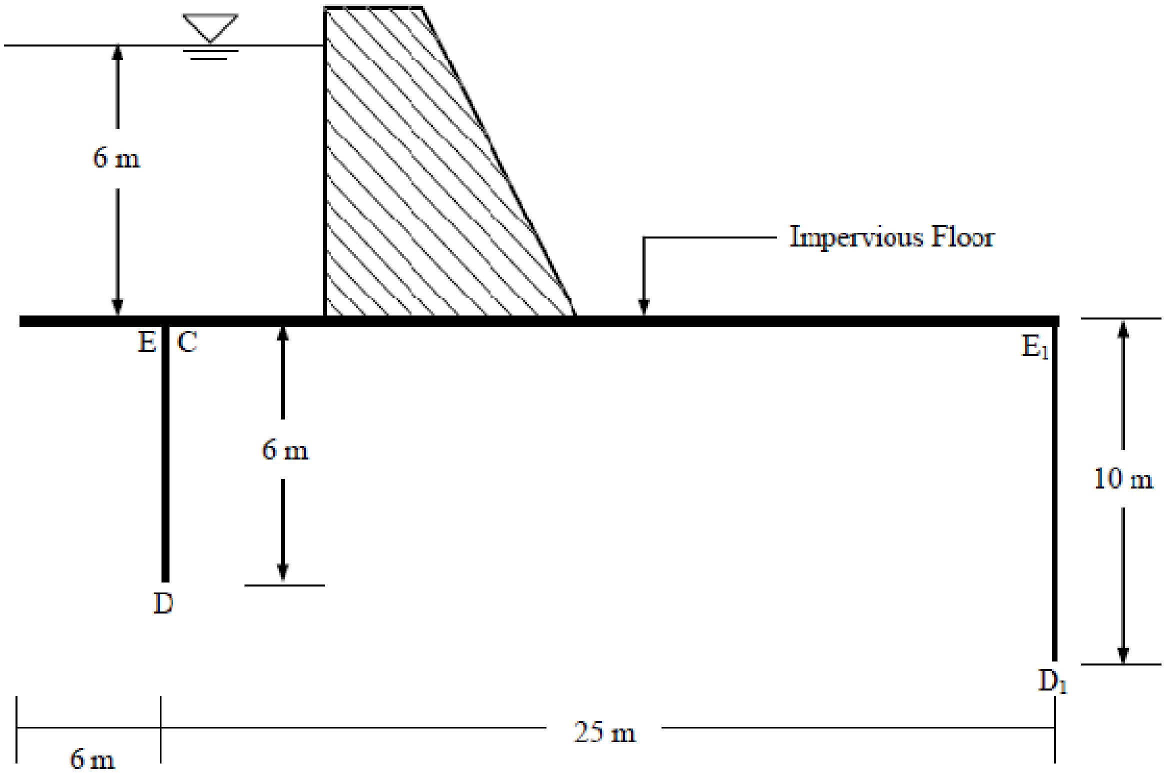
Neglect the effect of floor thickness



51) Using Khosla's theory, determine the following for the apron shown below

(i) Uplift pressure at points C, E_1 and D_1
(ii) Exit gradient

Assume floor thickness = 1 m



52) An impervious floor of a weir on permeable soil is 16 m long and has sheet piles at both the ends. The upstream pile is 4 m deep and the downstream pile is 5 m deep. The weir creates a net head of 2.5 m. Neglecting the thickness of the weir floor. Calculate the uplift pressures at the junction of the inner faces of the pile with the weir floor by using Khosla's theory

53) For part of a barrage in figure below:

a- Check the safety of floor against piping failure.
b- Find corrected coefficient of uplift pressure at key point E_2.
c- Check thickness of the floor at point A for 25% factor of safety for **static condition**.
d- Find water surface elevation at point A for **HFL** condition.8M

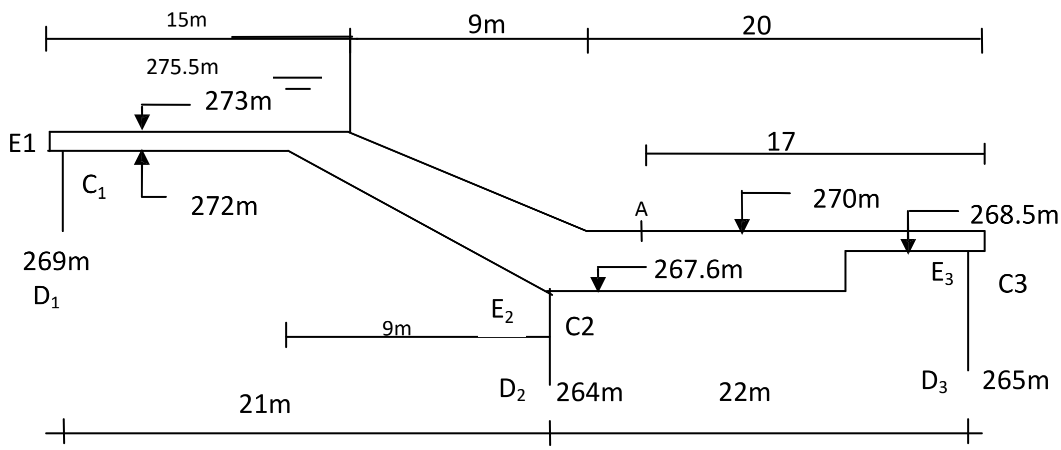
USHFL= +279.2m USTEL= +279.5m DSHFL=+ 278 m DSTEL= +278.3m

G_E safe = 1/5 Corrected values of (ϕ_{C1} = 0.7724, ϕ_{C2}=0.4625 & ϕ_{E3} = 0.2704)

$\mathbf{E_{f2} = q^{0.639} - H_L}$

For finding values of y1 and y2, start with 2.5m for y1 with acceptable error is ± 2cm and any **approximation** for lengths and levels is not allowed. **Neglect degree of submergence.**

F_{r1}^2				
	4	6	8	10
Xi/y1	Yi/y1			
1	1.25	1.28	1.3	1.3
2	1.6	1.65	1.7	1.7
3	1.8	1.9	2	2
4	1.97	2.11	2.25	2.26
5	2.1	2.3	2.5	2.53
Slope	**2:1**	**3:1**	**4:1**	**5:1**
Correction fac.	**0.065**	**0.045**	**0.033**	**0.028**



54) For the data given below, design the following elements of main canal head regulator:

1- Detail of waterway

2- Length of DS floor when full supply discharge passing the canal during HFL at US after Construction of the barrage.

3- Thickness of the floor at 5m from end of DS floor for static condition.

Notes:

HFL= +512m Afflux=1 Average bed level of the river= +506m

Width of a bay =8m width of a pier =1.25m Pond level =+510m DSFSWL= +509.25m

Area of flow in the canal = 150m^2 for full supply discharge = 140m^3/s. G_E= 1/4

Corrected ϕ at (ϕ_{C1}= 0.735 & $\phi_{E=}$ 0.194). US and DS cutoff depths are 4m with 0.75m

DSFL is lower than level of jump by **0.25m**.

For finding y_1 and y_2 start with o.5m for y1 and acceptable error is 3cms

$EF_2 = 1.65\ H_L^{\ 1.664} - q$

55) For the Barrage “other bays” shown below, determine:

1-Unbalanced static head at point B using Lane’s weighted creep theory.

2- Unbalanced static head at point B using Khosla’s theory.

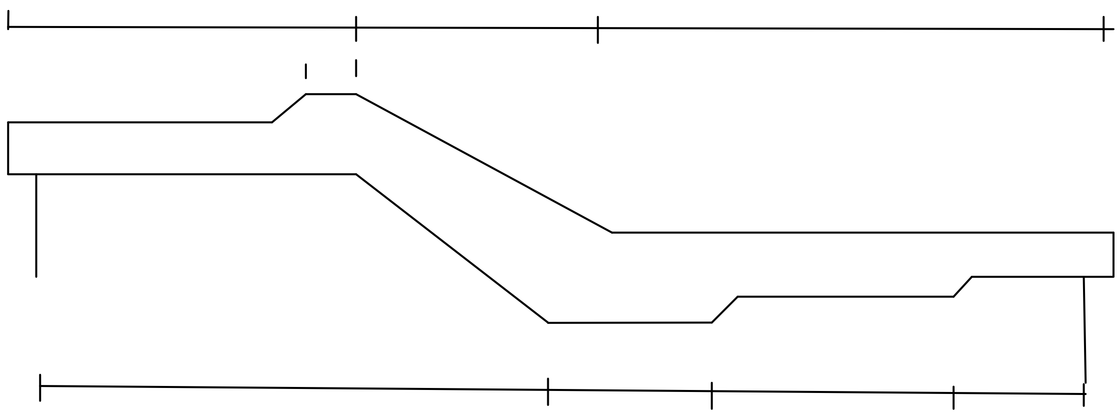
3- Check safety against piping using Lanes's weighted creep.

4- Unbalanced dynamic head at point A 1.5 m DS the crest.

Data:

HFL before construction=+ 204m. Pond level=+ 203m Safe weighted creep coefficient "Cw"= 5.8

Safe exit gradient = 1/5.5 Velocity head = 0.25m Afflux=1m



56) From the data shown in problem 55, determine the following elements for main canal head regulator:

1- Detail of waterway

2- The loss of energy when area of flow in the canal is $180m^2$, discharge is $200m^3/s$ and for HFL condition US the barrage.

Data given:

WL for mentioned discharge=+ 202.5 Width of 1 bay = 8m and width of a pier= 1.5m

57) Design a concrete lined channel (n = 0.016) to carry 18.9 m^3/s on a slope of 0.0016. Consider the most efficient hydraulically trapezoidal shape.

58) Design a trapezoidal channel to carry Q = 19.25 m^3/s, V = 1.4 m/s, n = 0.025, S_0 = 0.0017, side slope z = 2.3. Assume a bed width of 5.8 m.

59) A trapezoidal channel with bottom width of 5.8m, side slopes of 3.2H: 1V carries a flow of 49 $m^3 s^{-1}$ on a channel slope, So of 0.0015. The uniform flow of depth for the channel is 1.4 m with n = 0.0254. This channel is to be excavated in stiff clay. Check whether the channel will be susceptible to erosion or not. Take permissible velocity of V = 1.25 ms^{-1}

60) Open channel of width = 2m bed slope = 1:7000, d=1.3m , side slope 1:2.2find the flow rate using Manning equation, n=0.026.

61) A slightly rough brick-lined trapezoidal channel carrying a discharge of 29 m^3 is to have a longitudinal slope of 0.0005. Analyse the proportions of

(a) an efficient trapezoidal channel section having a side 1.5 horizontal: 1 vertical

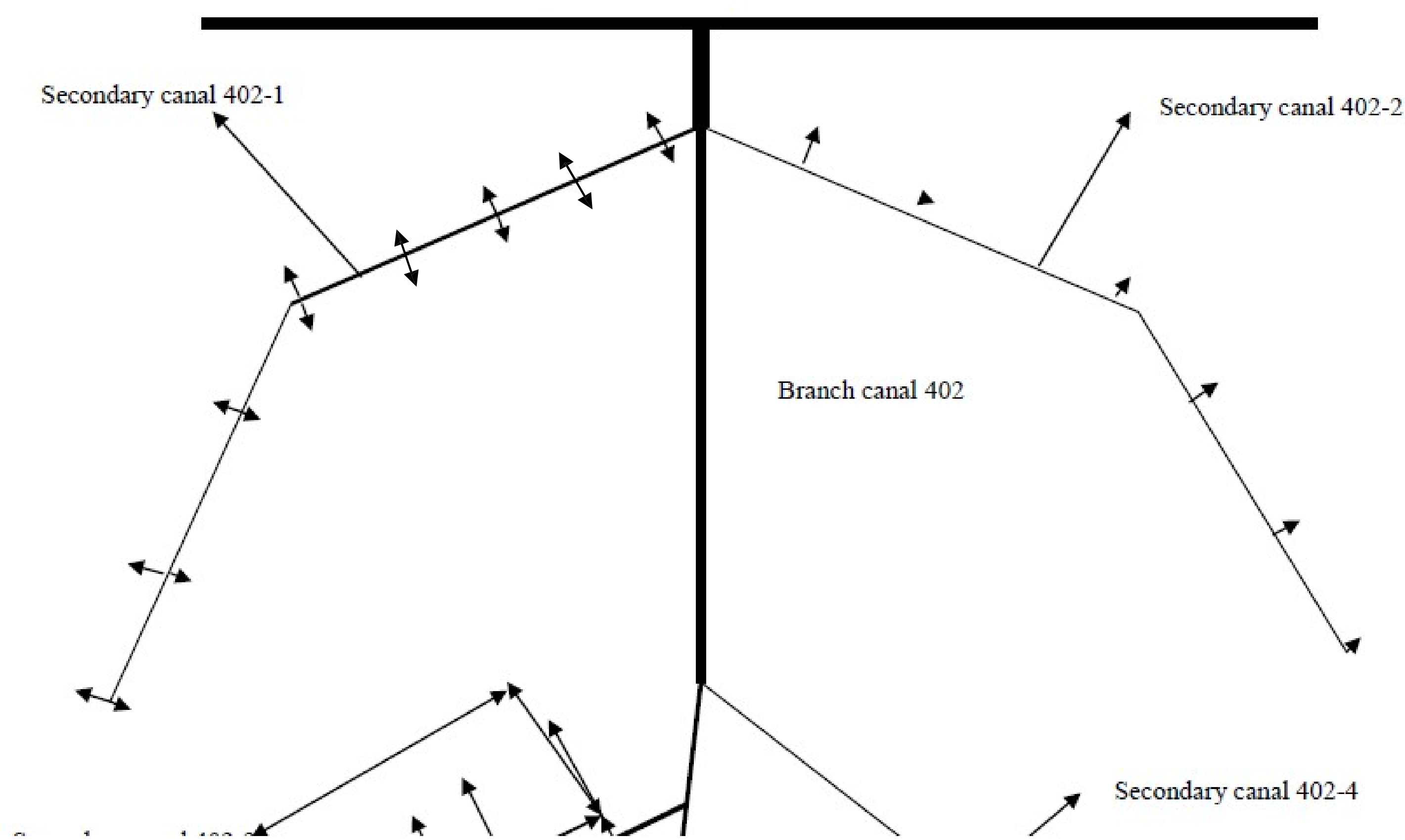
(b) most efficient section of trapezoidal shape

62) For a trapezoidal channel If z = 1.5, n = 0.016.5, S_o = 1/1300 and Q = 139 m^3/min
Determine width of the channel and water depth for most efficient section.

63) from the following data, design cross section for canal 402-1 in the network shown in the figure:

- Gross water requirement = 0.9 liter/s/ha.
- Each FTO services 65 hectares.
- All canals lined with concrete.
- Use trapezoidal section with 1.6H:1V
- Continuous irrigation is followed in the field.

Irrigation Layout for project 402

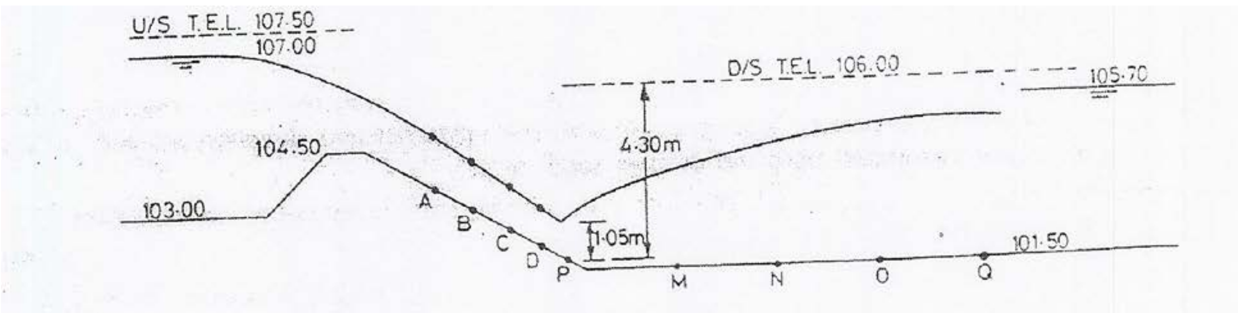


Q64) For the hydraulic structure shown below.

1) Estimate Unbalance Dynamic Head at point **P** where the hydraulic jump will be formed.

2) Determine the thickness of the floor at point **P**

Assume *q=10 cumecs/m*, H_L *=1.5 m. U/S TEL=107.50*



Q65) A barrage is to be designed on a river with following data Max flood Q =5300 m^3/s HFL before construction= 271.1 m average bed river =241.0 m crest level= 242.3 m slope of d/s glacis= 3H: 1V slope of u/s glacis= 1H: 1V afflux = 1m pond level= 246.0 m width of the gates for the other bays and under sluices are 6.0 m and 4.0 m respectively width of the piers for the other bays and under sluices =3.0 m number of bays for other bays and under sluices are 5.0 and 3.0 respectively d/s floor level is lower than jump level by 0.22 m u/s sheet pile depth=3.0 m G_S=2.24 f=1 crest width=2.0 m d/s water level =244.3 m.

For the other bay portion :Consider the condition of pond level with 15% concentration and 0.5 m d/s bed retrogression

Q.1: (30 Marks)

Estimate q and H_L

Q.2: (20 Marks)

Calculate the d/s sheet pile depth for1. 9 R. E_{f2}= 6.0 m

Q.3: (15 Marks)

Determine the d/s floor length for accepted error ± 0.02. Start with y_1 =1.3 m

Q.4: (20 Marks)

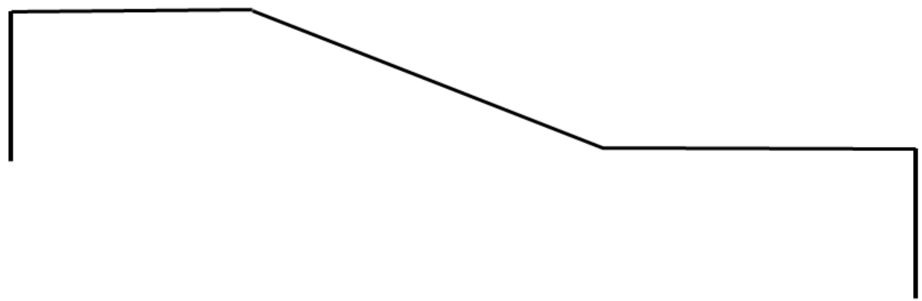
Estimate the entire floor length b for safe G_E =1/6.

Q.5: (15 Marks)

Calculate thickness of the floor at point **P** where the jump takes place using Bligh's creep theory

Q66) **Data for all questions**

The barrage shown below is operating under flow condition; G_S= 2.24 wall thickness =0.5 m E_{f2} =6.1 m pond level=103.0 m d/s floor level is lower than jump level by 0.22 m u/s floor length=10.0 m d/s floor length=16.0 m $v^2/2g$=0.12 m q =19.0 $m^3/s/m$



Q.1: (25 Marks)

Check Safety of the structure against piping using Khosla's theory. Permissible G_E=1/6

Q.2: (15 Marks)

Estimate depth of the water at point **P** where the hydraulic jump will be formed for accepted error = ±0. 001

Q.3: (15 Marks)

For point **A** which is 13 m far from d/s sheet pile using Khosla's theory. Estimate water profile w_A. No need to adjust the depth.

Q.4: (25 Marks)

For point **A** in Q.3. Calculate thickness of the floor. Corrected Φ_{C1}=0.723. Consider linear variation between (Φ_{C1} and Φ_{E2})

Q.5: (20 Marks)

For point **B** which is 16 m far from d/s sheet pile using Bligh's creep theory. Estimate the subsoil H.G.L for all possible conditions, and determine thickness of the floor considering static condition.

Q66)

Data for all questions

The following data is for under sluice portion of a barrage with one bay and operating under flow condition; H.F.L before construction =182.4 m pond level=181.5 m d/s floor level is lower than jump level by 0.24 m max flood discharge = 3195.1 m^3/s glacis slope 1V:3H afflux=1 m $L=4.83\ Q^{0.5}$ E_{f2} =4.6 m

Consider the condition of H.F.L

Q1) Estimate the under sluice crest elevation.

Q2) Estimate the d/s sheet pile depth.

Q3) Design and give a sketch of d/s protection works with all required details.

Q4) Calculate d/s floor length for accepted error = ± 0.02. Start with y_1=1.5 m.

Q67)

The following data is for the other bays portion of a barrage with 2 sheet piles u/s sheet pile depth= 3 m number of bays=7 width of bays= 10 m width of the piers= 1.5 m HFL before construction =105.6 m average river bed level 103.2 m pond level 104.9 m afflux=1.3 m crest elevation = 104.8 m crest width= 2 m u/s glacis slope 1V:2H d/s glacis slope 1V:3H d/s floor level is lower than jump by 0.2 m $v^2/2g$=0.53 m E_{f2} = 5.00 m

Consider the condition of HFL with 15% concentration

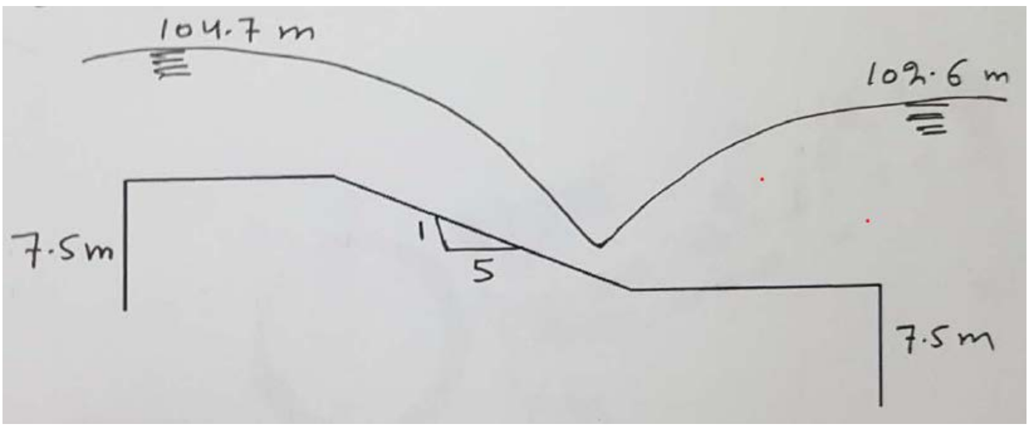
Q1) Calculate q, H_L

Q2) Determine the d/s sheet pile depth for 2 R.

Q3) Calculate the entire floor length for safe G_E =1/6

Q68)

The barrage shown below is operating under flow condition; G_S= 2.24 E_{f2} =6.1 m   pond level=103.0 m   d/s floor level is lower than jump level by 0.22 m   u/s floor length=10.0 m   d/s floor length=16.0 m $v^2/2g$=0.12 m   q =19.0 $m^3/s/m$.   For point **A** which is 14 m far from d/s sheet pile using Khosla's theory. Estimate thickness of the floor. No need to adjust the depth. Corrected Φ_A=0.470



Q69)

The following data is for the other bays portion of a barrage with 2 sheet piles   u/s sheet pile depth= 3 m   number of bays=9   width of bays= 8 m   width of the piers= 1.0 m   HFL before construction =106.1 m   average river bed level 103.9 m   pond level 104.9 m   afflux=1.**0** m   crest elevation = 105.1 m   crest width= 2 m   u/s glacis slope 1V:2H   d/s glacis slope 1V:3H   d/s floor level is lower than jump by 0.2 m $v^2/2g$=0.5**1** m E_{f2} = 5.00 m

Consider the condition of HFL with 25% concentration and 0.5 d/s bed retrogression

Q1) Calculate q, H_L

Q2) Determine the d/s floor length. Start with y1=1.00 m accepted error ±0.01

Q70)

Data for Q1 and Q2

The following data is for the under sluices portion of a barrage under flow condition: U.S.W.L= 106.7 m D.S.W.L= 105.2 m   U.S.T.E.L= 107.23 m   D.S.T.E.L=105.35 m   average bed river level= 103.0 m slope of d/s glacis= 3H: 1V   pond level= 104.9 m G_S=2.4   d/s floor length=19 m   u/s sheet pile depth= 3 m   intermediate sheet pile depth =3 m located at 19 m from d/s sheet pile   d/s sheet pile depth = 4.5 m   d/s floor level is lower than jump level by 0.3 m   sheet pile thickness =0.5 m   q =13 $m^3/s/m$ b= 40.0 m   accepted error for depth of water at location of jump is ± 0.01.

Q1) Check stability of the structure against piping for safe Bligh's creep coefficient of 15

Q2) For point **A** which is **16** m far from d/s sheet pile.

1. Calculate corrected uplift pressure head coefficient. Using Khosla's theory. Assume a linear variation of pressure between (Φ_{E2} & Φ_{E3}) and thickness at pile 2= 2 m. Corrected Φ_{E3} = 0.260**.**
2. Estimate thickness of the floor. No need to adjust depth of water.

Q71)

Check whether a tail escape required in the last part of a secondary lined canal in the network of an irrigation project consists from three sections with design discharges 0.58, 0.32, and 0.26 m^3/s respectively. Consider a trapezoidal shape with n= 0.016, z=1.5, b = 0.9 m , and S= 0.000327

Q72)

Data for all questions

The following data is for the other bays portion of a barrage under flow condition: U.S.W.L= 366.3 m D.S.W.L= 365.1 m average bed river level= 362.0 m crest level=363.0 m width of crest =2 m slope of u/s glacis= 1V:1H slope of d/s glacis=1V: 3H pond level= 365.4 m G_S=2.4 d/s floor length=15 m u/s sheet pile depth= 3.0 m d/s sheet pile depth = 4.0 m intermediate sheet pile depth =4.0 m located at15 m from d/s sheet pile d/s floor level is lower than jump level by 0.21 m sheet pile thickness =0.5 m q =11.03 m^3/s/m b= 38.0 m accepted error for depth of water at location of jump is ± 0.03 $v^2/2g$=0.11m E_{f2}= 4.4 m.

Note: For point **p** where the hydraulic jump takes place.

Q.1:

Compare the stability of the structure against piping using Khosla's theory to that by Lanes weighted creep theory for permissible G_E=1/6.5 , and C_W = 6.5 respectively.

Q.2

Calculate corrected uplift pressure head coefficient, using Khosla's theory. Assume a linear variation of pressure between (Φ_{C1} & Φ_{E2}), and t_2= 1m. Corrected Φ_{C1} = 0.766

Q.3:

Estimate the thickness of the floor by, Khosla's theory.

Q.4:

Proof that the thickness of the floor by Bligh’s creep theory approximately twice than by Khosla's theory.