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Dep : Civil Engineering

Sub : Hydraulic Structures

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Sec : "C"

Instructor : Engr Adeed Khan

Exam : Mid term

Date:_____

Question no 1

Part (a)

Define reserviour also explain which type of reserviour will be more encnomical and why?

Reserviour :-

A reserviour – artifical take or dam is used to store water.

⇒ Reserviour may be created in river valleys by the Construction of a dam or may be built by excavation in the ground or by Conventional Construction techniques such as brick work or Cast Concrete.

The term reserviour may also be used to describe underground reserviour such as an oil or water well.

Types of Reserviour

There are three main types of Reserviour are mentioned below.

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1) Valley dammed Reserviour
2) Bank-side Reserviour
3) Service Reserviour

1) Valley Dammad Reserviour

⇒A dam Constructed in a valley relies on the natural topography to provide most of the basin of the reserviour.

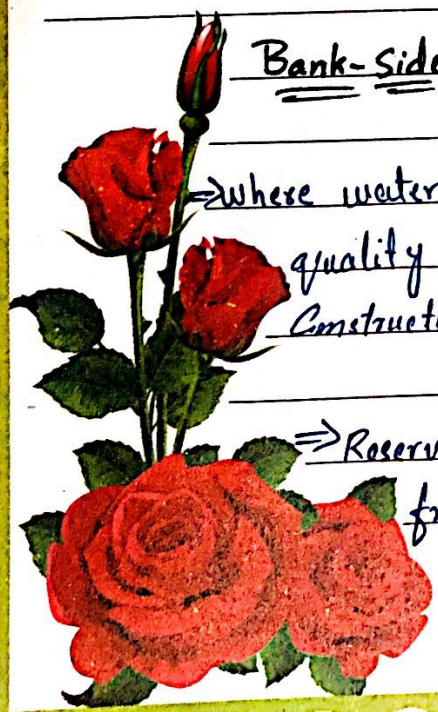
⇒Dams are typically located at a narrow part of a valley downstream of a natural basin.

⇒ The valleysides act as natural walls with the dam located at the narrowest practice point to provide strength and the lowest practical cost of Construction.

Bank-Side Reserviour

⇒Where water is taken from a river of variable quality or quality, bank side reserviour may be Constructed to store the water pumped.

⇒Reserviour are made by diverting water from local rivers or streams to an existing reserviour.



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⇒ Such reserviour are usually built partly by excavation and partly by the Construction of a Complete encircling embankment.

(3) Service Reservioir

⇒ Service Reservioir store fully treated portable water close to the point of distribution.

⇒ Many Service reservioir are Constructed as water towers, often as elevated structures on Concrete pillars where the landscape is relatively flat.

⇒ Other Service reservioir are entirely underground especially is more hilly on mountainous Country.

⇒ These reservioir are entirely man-made

⇒ Following are the economical reservioirs.

1) Dammd valley Reservioir
2) Bank Side Reservioir

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Date: _____ (4)

⇒ Above are economical reservoirs because it is naturally topography made.

⇒ Need some change and alignment, excavation etc.

x x x

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Question no 1

Part (b)

Embankment Dam:

There are two main types of Embankment Dam:

1) Earth fill dams
2) Rock fill dam

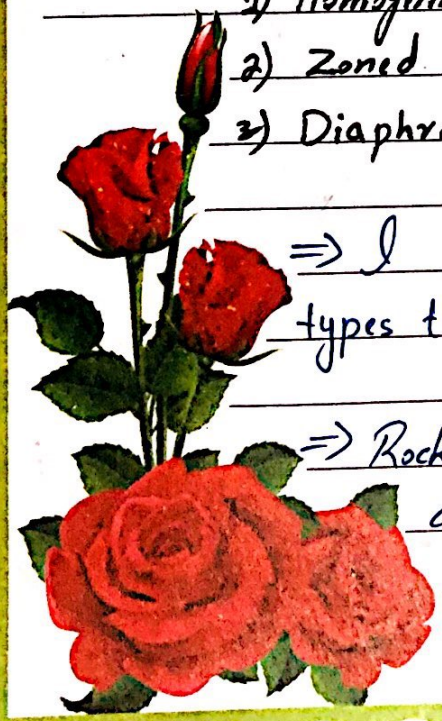
Rock fill dam:

=> Rock fill dam are further distributed in various three types.

1) Homogenous type
2) Zoned type
3) Diaphragm type

=> I suggest the Rockfill dam zoned types to be Constructed over hilly area.

=> Rock-fill dam are embankment of Compact granular Soil in Combination with imperious area.



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⇒ These dams are resistant to damage from earthquakes.

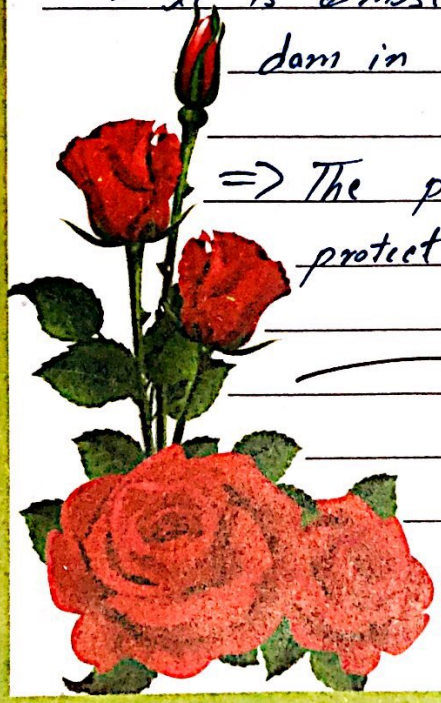
⇒ Due to following factor the Rockfill down is suggested.

1) Nature
2) Particle range
3) Strength
4) Permeability

⇒ Zone embankment dam is composed of more than one kind of material.

⇒ It is most common type of Rolled filled dam in which a central impression core.

⇒ The pervious zone enclose, support and protect the impervious core.



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Question no 2

Spillway

A Spillway is a channel or passageway through which excess water escapes from a reservoirs.

⇒ Discharge the flood water to downstream of river without overtopping the dam.

⇒ A structure which will not let the water rise above the maximum reservoirs level.

⇒ A Spillway is essentially a safety value for a dam.

Types of Spillway

1) Straight drop Spillway
2) Overflow Spillway or ogee Spillway
3) Chute Spillway
4) Side channel Spillway
5) Shaft Spillway
6) Syphon Spillway
7) Labyrinth Spillway

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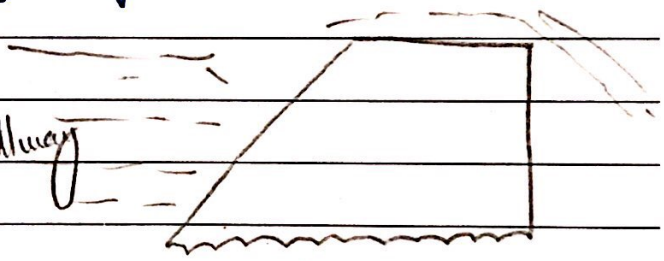
1) Straight drop Spillway

⇒ In this type of Spillway, the water freely drops down from the crest.

⇒ It is a low weir and simple vertical fall type structures.

⇒ The water falls freely the crest under the action of gravity.

⇒ To prevent scoring at the downstream an auxilary dam of artificial pool is to be constructed at the plane of fall of water.



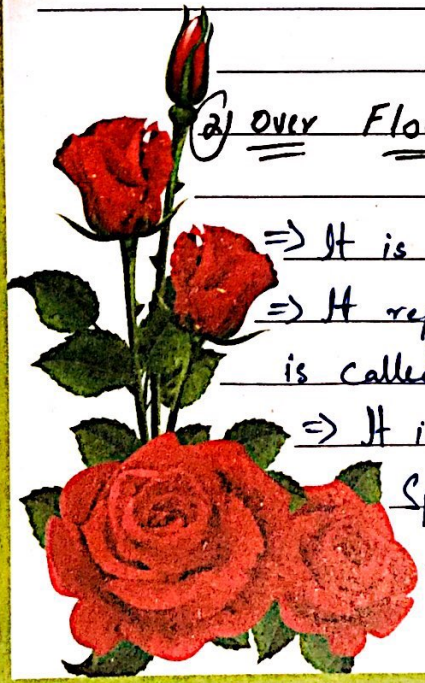
Straight drop Spillway

2) Over Flow Spillway

⇒ It is generally known as "ogee Spillway"

⇒ It represents the S-Shape curve so, it is called ogee Spillway.

⇒ It is an improved from Straight drop Spillway.



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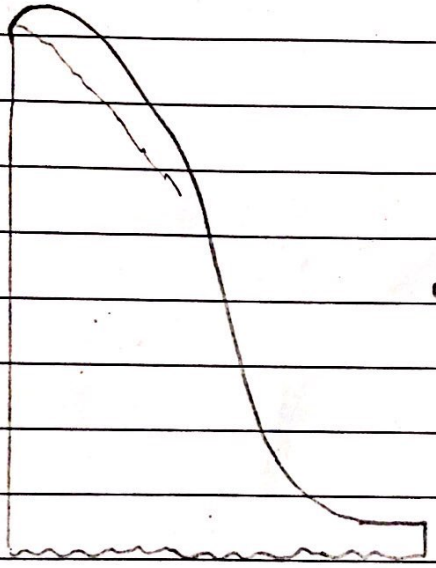
⇒ It is mainly used in gravity dam or buttress dam or Arch dams.

⇒ It has got the advantage over other Spillway for its high discharging efficiency.



ogee shaped Spillway

(3) Chute Spillway

⇒ It is an often called as trough is open channel Spillway.

⇒ For earthen and rockfill dam, Spillway is to be constructed separately away from the main valley.

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⇒ Chute Spillway is a type of Spillway in which excess water from upstream is disposed to the downstream through a steeply sloped open channel.

⇒ Chute Spillway is the simplest types of a Spillway which can be easily provided independently at low cost.

⇒ It is lighter and adoptable to any type of foundation.

(4) Side channel Spillway

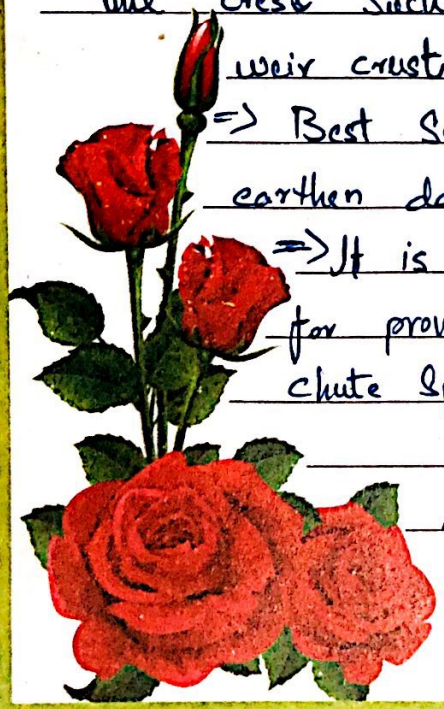
⇒ The flow is this Spillway is turned 90° after passing the crest such that the flow is parallel to the weir crest.

⇒ Best suitable for non regad dam like earthen dams.

⇒ It is preferred where space is not available for providing sufficient crest width for chute Spillway.

Mathematically:

$$\Delta Y = \frac{Q_2 (V_1 + V_2)}{g (Q_1 + Q_2)} \left[(V_2 - V_1) + V_1 \left(\frac{Q_2 - Q_1}{Q_2} \right) \right]$$



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(5) Shaft Spillway

=> The water from the reservoirs enter into a vertical shaft which conveys this water into a horizontal tunnel which finally discharge the water into a river down stream.

=> This type of Spillway is preferred where the space is not available for providing the above type of Spillways.

=> A shaft Spillway is used at the sites where the conditions are not favorable for an overflow or a chute Spillway.

=> It has maximum discharge even at low heads.

6) Siphon Spillway

=> It works on the principle of Syphonic action.

=> In Siphon Spillway the excess water is disposed to downstream through an inverted U shaped conduct. It is generally arranged inside the body or over the crest of the dam.

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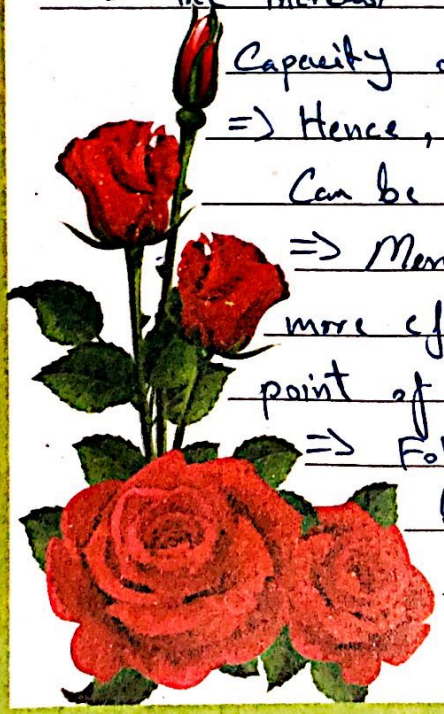
⇒ When the water raises the pool level, Siphonic action starts automatically and the water discharges to downstream side.

⇒ When the water level falls below the pool level air is entered through air vent and the discharging of water stops.

Labyrinth Spillway

⇒ Labyrinth Spillway is a type of Spillway in which the weir wall is Constructed in a zagzag manner.
⇒ Due to zigzag increases the effective length of the weir crest with respect to the channel width.
⇒ The increase in effective length raises the discharge Capacity of the weir.
⇒ Hence, higher water flow at small heads Can be Conveyed to the downstream easily.
⇒ Mention which type of Spillway will more efficient in Condition where freezing point of water than -10° is uncertain.
⇒ Following are the Spillway will be more efficient.



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① Straight Drop Spillway
② Shaft Spillway
③ Side channel Spillway
④ Labyrinth Spillway.

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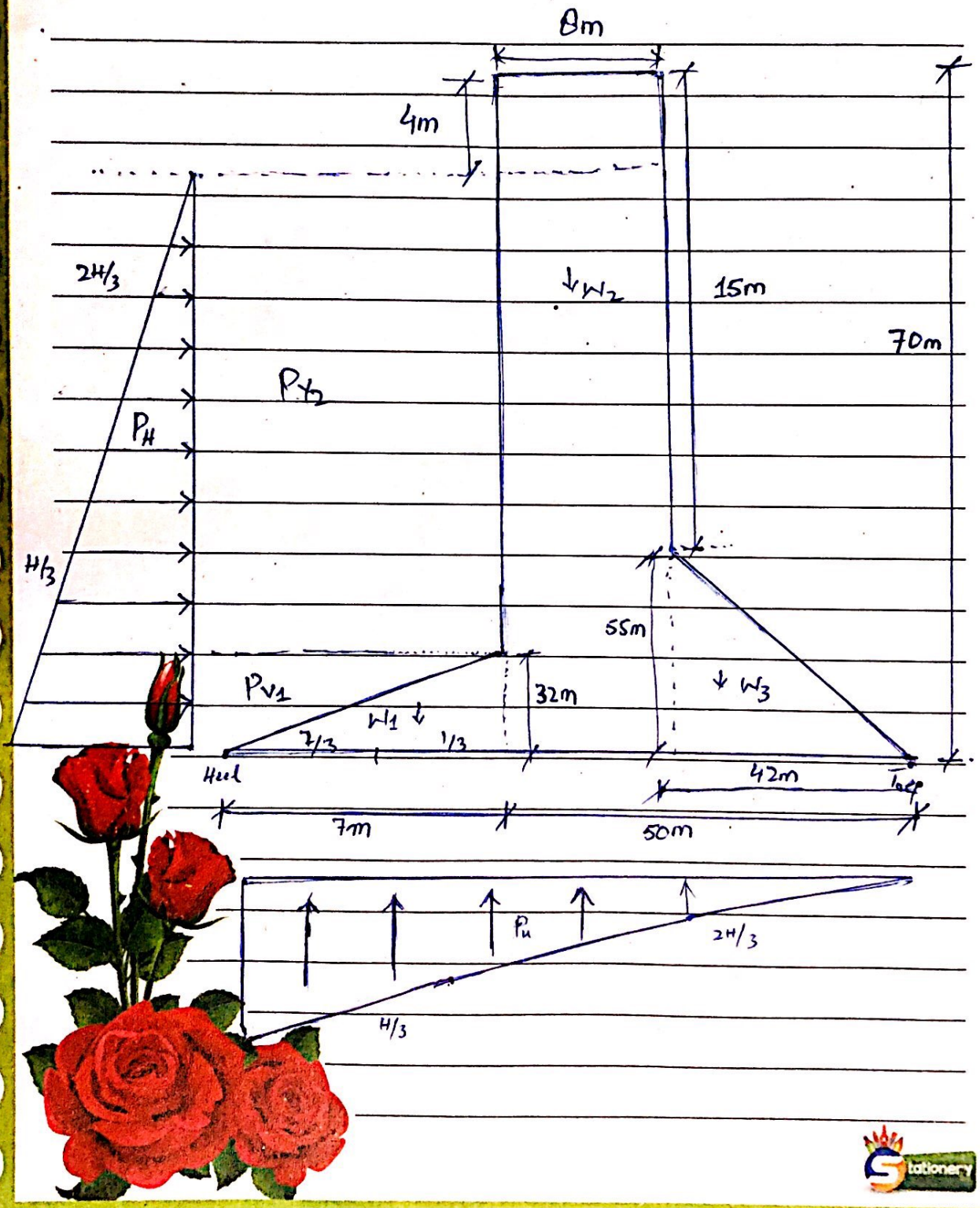
Question no 3



Moment Calculation Assume Unit weight for Concrete = $\gamma_d = 24$ KN

Unit weight for water = $\gamma_w = 10$ KN

Forces	Force Calculation	F_y (kN)	FH	Lever Arm	Mr	M_o
W_1	$1/2 \times 7 \times 32 \times 24$	2688		$50 + (7 \times 1/3) = 52.33$	$2688 \times 52.33 = 140663$	
W_2	$8 \times 70 \times 24$	13440		$42 + 8/2 = 46$	$13440 \times 46 = 618240$	
W_3	$1/2 \times 42 \times 55 \times 24$	27720		$42 \times 2/3 = 28$	$27720 \times 28 = 776160$	
P_{V_1}	$1/2 \times 7 \times 32 \times 10$	1120		$50 + 7 \times 2/3 = 54.66$	$1120 \times 54.66 = 61219.2$	
P_{V_2}	$7 \times 35 \times 10$	2450		$50 \times 7/2 = 53.55$	$2450 \times 53.5 = 131075$	
P_H	$-1/2 \times 57 \times 66 \times 10$	-18810		$57 \times 2/3 = 38$		$18810 \times 38 = 714780$
P_H	$-66^2/2 \times 10$		-21780	$66/3 = 22$		$21780 \times 22 = 479160$
		$\Sigma FV = 28608$	$\Sigma FH = -21780$		$\Sigma Mr = 1727357.24$	$\Sigma Mo = 1193940$

(15)

Eccentricity of the resultant force

$$e = \frac{B}{2} - \bar{x}$$

$\bar{x}$ location of resultant force

$$\bar{x} = \frac{\Sigma M_r - \Sigma M_o}{\Sigma F V}$$

$$\bar{x} = \frac{1727357.24 - 1193940}{28608}$$

$$\bar{x} = \frac{533417.24}{28608}$$

$$\boxed{\bar{x} = 18.65 m}$$

$$e = \frac{B}{2} - \bar{x}$$

$$e = \frac{57}{2} - 18.65$$

$$\boxed{e = 9.85 m}$$

⇒ Fator of Safty Against tension Conditi on

$$e < B/6$$

$$e < \frac{57}{6} = 9.5$$

$\boxed{9.85 \not< 9.5}$ Not oK fail in tension

⇒ Stress heel >0

$$\sigma = \frac{\Sigma fv}{B}\left(1 \pm \frac{6e}{B}\right)$$

σ_{toe} $\frac{28608}{57}\left\{1 + \frac{6e(9.85)}{57}\right\}$

$$\sigma_{toe} = \frac{28608}{57}(2.04)$$

$$\sigma_{toe} = 1023.87 KN/in^2$$

- $\gamma_{Heel} \frac{\Sigma F_V}{B}\left(1-\frac{6e}{B}\right)$

$= \frac{28600}{57}\left(1-\frac{6(9.85)}{57}\right)$

$\gamma_{Heel} = \frac{28608}{57}(-0.04)$

$\gamma_{Heel} = 20.06\ KN/m^3$

$\gamma_{Heel} = 0$

Not Safe

Factor of Safety against overturning

$\frac{\Sigma M_r}{\Sigma M_o} \geq 2$

$= \frac{1727357.24}{119394}$

$= 1.45 \not\geq 2$ Not Safe

$= \Sigma M_r > \Sigma M_o$

$= 1727357.24 > 119394$

Now ok Safe

=> For Against Sliding (0.65 to 0.75)

$\frac{M \Sigma F_V + B \times q}{\Sigma F_H}$

$$\frac{0.72 \times 2.8608 + (57 \times 1400)}{21780}$$

$$= 1.61 > 1$$ Safe ok!!!
