USN

CMRIT
CMR INSTITUTE OF TECHNOLOGY, BENGALURU.
ACCREDITED WITH A+ GRADE BY NAAC

Internal Assessment Test 3 – Nov. 2019

Sub:	Design of Bridges					Sub Code:	15CV741	Branch:	Civil
Date:	18/11/2019	Duration:	90 min's	Max Marks:	50	Sem / Sec:	7, A&B		OBE

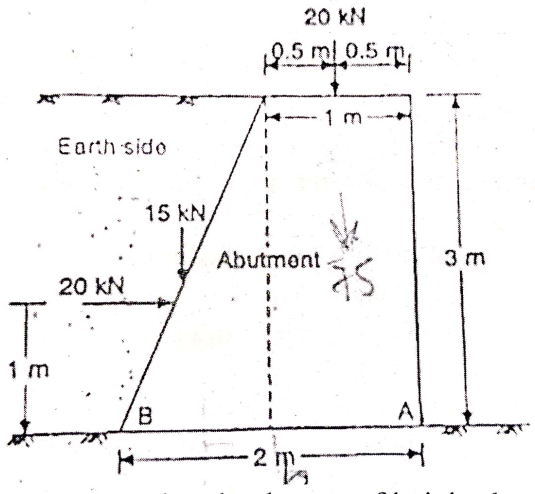
NOTE: 1. IRC – 6, 21 2. IS 458. 3. Moment co-efficient charts

Answer any TWO FULL Questions from Part B, Part A compulsory.

		MARKS	CO	RBT
	Part A			
1	Explain different types of piers and abutment with sketch wherever possible.	[20]	CO5	L2
	Part B			
1	Verify the adequacy of the dimensions for the pier, the following details are available, Top width of the pier: 1.5m, Height of the pier up to springing level: 10m c/c of bearing on either side: 1.00m, side batter: 1in12 high flood level: 1m below the bearing level. Span of the bridge: 16m Loading on span : IRC class AA tracked Loading. Road: two lane road with 1m wide footpath on either side. Superstructure: Consists of three longitudinal girders of 1.4m depth with deck slab of 200mm deep, rib width of girder= 300mm. material of the pier: concrete M15.	[15]	CO5	L3

2 Verify the stability of the abutment shown in fig. the other salient features are given below: [15] CO3 L3

Material of abutment: concrete. Density of the soil: 19kN/m^3. Co-efficient of friction: 0.6Angle of repose of the soil: ϕ=30°. Live load on the bridge: IRC class AA (tracked)



3 Design a pipe culvert through a road embankment of height 6m. the width of the road is 7.5m and the formation level is 10m. the side slope of embankment is 1:1. The maximum discharge is 5m^3/s. the safe velocity of 3m/s. class AA tracked vehicle is to be considered as live load. Assume bell mouthed entry. Given C_e=1.5, C_s=0.010 and the unit weight of soil = 18kN/m^3. [15] CO3 L3

CI CCI HOD

PART-A

1) Types of piers :-
* solid type piers
* circular type piers
* Trestle type piers
* hammered type piers
* framed type piers

* Solid type pier :- This type of piers are mainly built with bricks masonry or using concrete. They are basically build for a bridge which is being constructed on water bodies such as river, lakes etc

* framed type pier :- this type of piers has a high strengths as it is a monolithic structures. this types of piers are interconnected with each other.

* Hammered type pier :- This type of piers are basically constructed to the metro rail where a bed of bridge is laid on the Hammered type piers and which are connected like cantilever rip type connection on the both sides

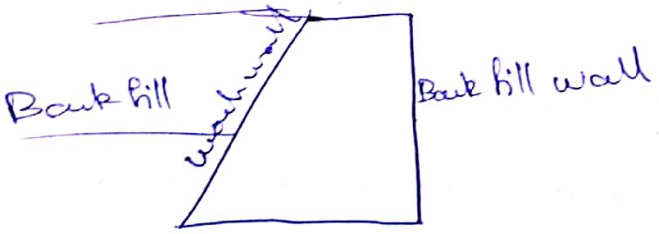
* circular type pier :- this type of pier are same as that of hammer type pier but these are in circular shape so as the cost is reduce by the reduction in area to fill the concrete.

* Trestle type pier :- ~~This type of pier are the one which are~~ constructed from

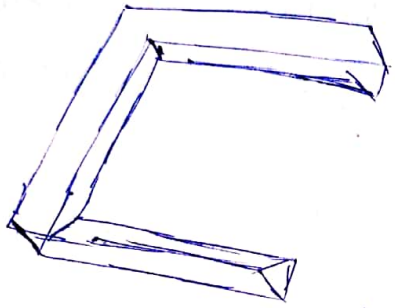
This piers are mainly built with the steel reinforcement and where the bed of the bridge is laid on it. This is mainly contributed for the pedistral bridges etc.

Types of abutment :- * gravity type abutment
* U type abutment
* spill through type abutment
* pile bent abutment :

gravity type abutment :- In this type of abutment the wall is parallel to the back fill wall or inclined to some angle and the bed of the bridge is placed on it and it basically follow the the gravity force on it.



U type abutment :-



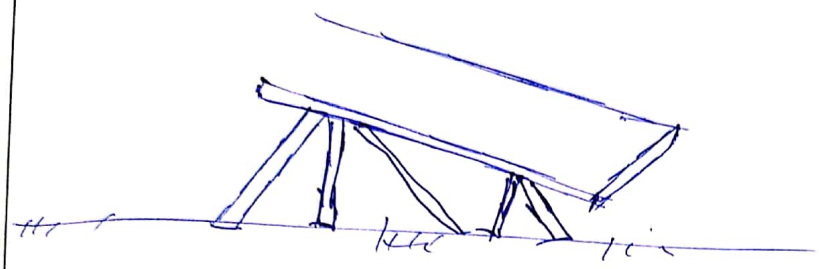
In this the main wall is perpendicular to the bank fill wall. the bed on the bridges is laid on it and it act as the beam surface on it.

Spill through type abutment :-

This type of abutment are built for the short span of bridge at a each span it is built through the bridge and has more strength

pile bent type abutment :-

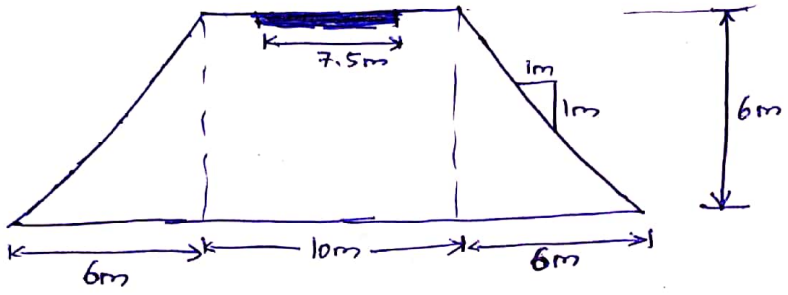
In this type of bridge a piles are built where ever necessary to hold the bridge and to carry a load. in this the pile can be bend and kept at any angle which is required to hold the bridge.



Internal Assessment test - 3

3) Given :- $Q = 5 m^3/s$ $C_c = 1.5$ $\delta = 18 KN/m^3$

$V = 3 m/s$ $C_s = 0.010$



$$Q = KAV$$

$$K = \frac{1}{\sqrt{1 + K_f + K_c}}$$

$K_c = 0.08$ for Bell mouthed Entry

$$K_f = 0.0033 \frac{L}{R^{1.3}}$$

$L = 6 + 10 + 6 = 22m$

$R = \frac{D}{4} = \frac{1}{4} = 0.25m$ assuming dia of pipe as 1m

$$\Rightarrow K_f = 0.0033 \times \frac{22}{0.25^{1.3}}$$

$$K_f = 0.44$$

$$K = \frac{1}{\sqrt{1+0.44+0.08}}$$

$$K = 0.81$$

$$Q = KAV$$

$$5 = 0.81 \times A \times 3$$

$$\Rightarrow \boxed{A = 2.05\ m^2}$$

area of the pipe if dia = 1m $\Rightarrow \frac{\pi}{4} \times D^2 = \frac{\pi}{4} \times 1^2 = 0.78\ m^2$

$$\therefore \text{No of bars} = \frac{\text{Area calculate}}{\text{Area of 1 pipe}} = \frac{2.05}{0.78} = 2.62 \sim 3 \text{ pipes}$$

check for stability factor

$$\frac{\text{3 Edge bearing load}}{\text{FOS}} = \frac{\text{w due of filling materials}}{\text{CF}} + \frac{\text{w due to surface loads}}{\text{Safety factor}}$$

for table No 6 ; Pg 10 of IS 458:2003

3 Edge bearing load = 108.90 KN/m

FOS = 1.5

SF = 1.5

w due to filling materials $(w_1) = C_e w D^2$

$= 1.5 \times 18 \times 1^2$

$= 27$ KN

w due to surface loading $(w_2) = 4 C_s I P$

given tracked vehicle $P = 350$ KN

$I = 1.5$

$\Rightarrow w_2 = 4 \times 0.01 \times 1.5 \times 350$

$w_2 = 21$ KN

$$\Rightarrow \frac{108.90}{1.5} = \frac{27}{CF} + \frac{21}{1.5}$$

$$CF = 0.46 < 1.5$$

Hence safe

Detailing / Designing of section :-

From table No 6 ; Pg No 10 ; Is 458 : 2003

for pipe of dia 1m the longitudinal reinforcement is 6.04 KN/m 35.48 6.04

and the spiral reinforcement is 35.48 KN/m

weight of Each bar $= \frac{D^2}{162} = \frac{12^2}{162} = 0.88$

(assuming the dia of spiral as 12mm)

length of spiral = π x circumference

$= \pi \times$ (dia + thickness of pipe)

$= \pi \times (1 + 0.115)$

$= 3.50\,m$

weight of Each spiral $= 3.50 \times 0.88$

$= 3.08\,KN/m$

No of spiral $= \frac{35.48}{3.08} = 11.51 \simeq 12$

Spacing of Each spiral $= \frac{1000}{12} = 83.33 \simeq 80\,mm$

∴ provide a spiral reinforcent of 12mm ϕ with 80 mm c/c.

Design of longitudinal reinforcent:

weight of Each bar $= \frac{D^2}{162} = \frac{8^2}{162} = 0.39$

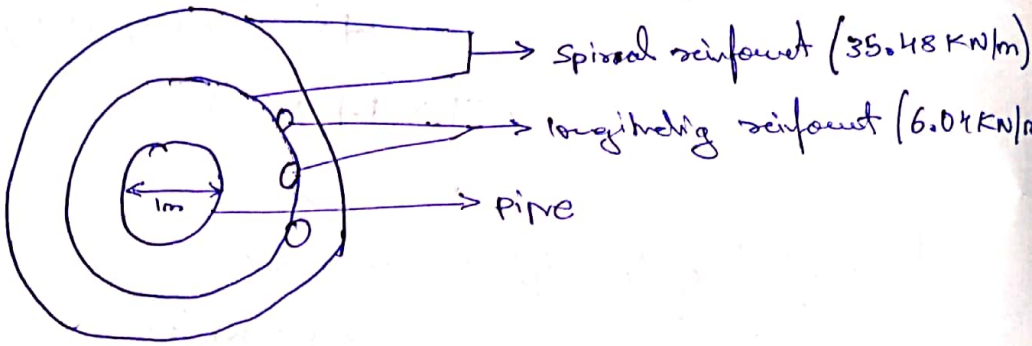
(assuming the dia of bar as 8mm)

No of spiral $= \frac{6.04}{0.39} = 15.48 \simeq 16$

∴ providing 8 bar in innear circumference
and 8 bar in outer circumference

Spacing of ~~Each~~ bar $= \frac{3500}{16} = 218.75 \simeq 210\,mm$

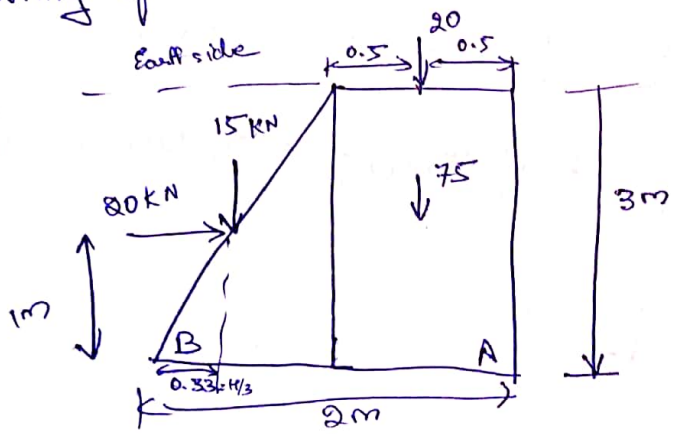
∴ provide 8mmϕ longitudinal reinforcet at 210 mm c/c.



2) Stability of the abutment :

$\frac{M}{b}\left(1 \pm \frac{6e}{b}\right)$

$\gamma_{concrete} = 25\ KN/m^3$ (assume)



weight of ~~Each~~ on abutment $W = W_1 + W_2 + W_3 + W_4$

~~$W_3 = 1m \times 30 \times 175 =$~~ $W_3 = 75\ KN$

$W_4 = \frac{1}{2} \times 1m \times 3m \times$ ~~35.5~~ 25

$W_4 = 37.5\ KN$

$W = 20 + 15 + 75 + 37.5 = 147.5\ KN$

moment calculation : (considering moment from point A)

$= 20\times0.5 - (20\times1) + (75\times0.5) + 15\times(2-0.33) + (37.5\times(1+0.33))$

$M = 102.42\ KNm$

check for stability

stress $\sigma = \frac{W}{b}\left(1 \pm \frac{6e}{b}\right)$

$b = 2m$

$e = \frac{b}{2} - z$

$z = \frac{M}{W} = \frac{102.42}{147.5} = 0.69$

$e = \frac{2}{2} - 0.69 = 0.31$

$\sigma_{max} = \frac{147.5}{2}\left(1 + \frac{6\times0.31}{2}\right)$

$\sigma_{max} = 142.33\ KN/M$

$\sigma_{min} = \frac{147.5}{2}\left(1 - \frac{6\times0.31}{2}\right)$

$\sigma_{min} = 5.16\ KN/M$

check for overturning $= \frac{\text{Anti clockwise moment}}{\text{clockwise moment}}$

$= \frac{102.42 - 20}{20} = 4.12 > 1.5$

Hence safe.

check for sliding $= \frac{0.5 \times \text{load}}{\text{clock wise moment}} = \frac{0.5\times147.5}{20}$

$= 3.68 > 1.5$

Hence safe.