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Section	A
Subject	hydraulic
structure	

Q1 Given data:-

$$\text{Height} = 0.45 \text{ m}$$

$$\text{Depth} = 0.3 \text{ m}$$

$$\text{Width} = 1.5 \text{ m}$$

$$\text{Length} = 40 \text{ m}$$

$$\text{Slope} = 1 \text{ in } 1000$$

$$\text{Manning} = \eta = 0.013$$

0.3 m neglected the velocity approach.

Required:-

Design of Culvert = ?

Solution:-

$$1) H/D \leq 1.5 \text{ for}$$

open channel

$$H/D = \frac{0.45}{0.3} = 1.5 \leq 1.5$$

Free open channel

2) Critical depth:-

$$y_c = \frac{2}{3} H = \frac{2}{3} (0.1) = 0.06 \text{ m}$$

3) Critical velocity:-

$$V_c = \sqrt{g y_c} \quad \text{which come}$$

from

$$Fr = \frac{V_c}{\sqrt{g y_c}}$$

for Critical flow

$$Fr = 1$$

So,

$$1 = \frac{V_c}{\sqrt{g y_c}}$$

put values

$$V_c = \sqrt{9.81 \times 0.06}$$
$$= 0.24 \text{ m/s}$$

4) Critical slope:-

$$S_c = 0.00427$$

5) Discharge  $Q$   
 AS we know

$$Q = 2.92 Y_0 \left[ \frac{1.2 Y_0}{1.2 + 2 Y_0} \right]^{2/3}$$

$Y_0$	$Q$	$Y_c$
0.1	0.257	0.06
0.2	0.165	0.124
0.3	0.3	0.185

$$Y_c = \left( \frac{Q^2}{g} \right)^{1/3}$$

at the inlet over short  
 reach

$$H = Y_0 + \frac{V^2}{2g} + \frac{K_e V^2}{2g} \quad \text{--- (1)}$$

$K_e$  values

- 1) For square edge  $Y_c = 0.5$
- 2) flat = 0.25
- 3) rounded = 0.25

So we use  $K = 0.5$   
 for Rectangular box  
 Culvert

$Y_0$	$H$	$V_0$
	0.119	0.57
0.1	0.2	0.165
0.2		
0.3	0.3	0.3
	0.4	0.9

The above discharge  
 is find through formula

$$Q = cd (1.2 \times 0.6) [2g (H - 0.57)]^{1/2}$$

$$cd = 0.62$$

$$Q = 2.08 (H - 0.57)^{1/2}$$

Ans<sup>(1)</sup>

Load on bridge foundation due to scour  $\Rightarrow$  the working mechanism:-

Scour of sediments around bridge foundation by the stream is the most significant contributing factor for bridge failure.

The scour failure tend to occur with out proper warning  $\Rightarrow$  have led to facilities  $\Rightarrow$  economic loss every year.

Two Major Categories:-

1) Science driven:-

The Science driven research focuses on understanding the scour mechanism  $\Rightarrow$  aims to explain the cause of scour due to different factors.

ii) Engineering driven:-

Engineering driven focuses on estimation, monitoring  $\Rightarrow$  counter measures of bridge scour.