

HYDRAULIC STRUCTURE



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Loads on bridge foundation due to scour:

Scour is one of the greatest reason that leads to bridge failure. In the United States more than 60% of the bridge failure happen due to scour.

Scour causes complex effects on bridge foundation and on the entire bridge structure.

Bridge scour is the removal of sediment such as sand and rock from around bridge abutment or piers, which normally in the range of 0-45m. Scour, losses the soil and reduces the bed level around the pier as well as due erosion phenomena, it erouts the bridge foundation.

Generally bridge is desgin for a fined and estimated bearing capacity of soil, but coz of scouring phenoming which reduces the bearing capacity of soil as a result bridge load ouers on the soil bearing capacity which causes failure of Bridges.

Mainly there's been investigated the load carry capacity of piles, budding risk and additional moment on piles due to increasing water height as effect of scour which destabilisation of foundation which causes failure of Bridge structure.

Mechanism of Scour::

Vertex system formed in front of the obstruction, and has the form of horse shoe. River flow and boundary condition give rise to the energy of the vortices increased shear stress commence local sediment transport.

Problem :-

Selected data

The dimensions of concrete rectangular box culvert are;

$$w = \text{width} = 1.5 \text{ m}$$

$$H = \text{Height} = 0.7 \text{ m}$$

$$L = \text{Length} = 25 \text{ m}$$

$$S = \text{slope} = 1 \text{ in } 600$$

$$\text{Mannings } n = 0.013$$

Range of head water level for investigation = 0-3 m = y_0

Required data :

As we know that

$$Q = A \times V \rightarrow (1)$$

According to Manning equation we have,

Area = $A = \text{width} \times \text{hydraulic depth}$

$$A = w \times y_0$$

$$A = 1.5 \times y_0 \rightarrow (2)$$

$$\text{Wetted parameter} = \text{Width} + 2 (\text{hydraulic depth}) \\ = w + 2(y_0)$$

$$P = 1.5 + 2y_0 \quad - (b)$$

Also;

$$R = A/P = \frac{1.5y_0}{1.5 + 2y_0}$$

$$R = 1.5y_0 / (1.5y_0 + 2y_0) \quad - (c)$$

hence we get velocity which is

$$V = \frac{1}{n} R^{2/3} \sqrt{S}$$

$$V = R^{2/3} \frac{\sqrt{S}}{n}$$

By putting values we get

$$V = \left(\frac{1.5y_0}{1.5 + 2y_0} \right)^{2/3} \frac{(0.00167)^{1/2}}{0.013}$$

$$V = 3.14 \left(\frac{1.5y_0}{1.5 + 2y_0} \right)^{2/3} \quad - (3)$$

By putting eqn (2) and (3) in (1) we get

$$Q = (1.5y_0) \times \left(3.14 \left(\frac{1.5y_0}{1.5 + 2y_0} \right)^{2/3} \right)$$

$$Q = 4.72 y_0 \left(\frac{1.5y_0}{1.5 + 2y_0} \right)^{2/3}$$