

## HYDRAULIC CALCULATION

**Introduction:** The Ansal Buildwell group is developing an integrated township of 27 acres named as Florence City at Pathankot (Punjab) near Abrol Nagar posh area. Ansal site is located along Khadi Khad. A flexible pavement is laid along the left side of Khad. The average height of road from the avg bed level is about 2.5 m. The side of khad is not defined and the height from average bed level varies from 1m to 2m. It is noted the discharge 16025 cusec d/s and 12000cused u/s could not be pass through the existing cross section of khad. At present while calculating the width of khad so that Max. height of water could not raise more than 2.5m, a discharge of 16025 cusec is taken. The bridge proposed is of single span and the existing width is not altered at any point. Outcome from calculation is tabulated as below. It is noted that as width of khad is not altered at any point, the effect at u/s and d/s is not considered.

Description	Value
<b>Average bed Level</b>	<b>320.69 Mtrs</b>
<b>Max. height of water surface</b>	<b>2.5 Mtrs</b>
<b>HSL</b>	<b>323.19 Mtrs</b>
<b>Bed width</b>	<b>39.8 Mtrs</b> upto Drang Khad outfall in Khadi Kahd
<b>Length of protection work at u/s</b>	<b>300' u/s</b> upto Drang Khad outfall in Khadi Kahd and 150' beyond this point
<b>Length of protection work at u/s</b>	<b>150'</b>

- 1.) At 300 meter u/s of proposed (incomplete) bridge at conflux of khadi khad and canal by P.W.D. :-

### **Data taken from PWD/ Irrigation Deptt.**

- 1.) Bed Width of KhadiKhad = 35 Meters
- 2.) H.F.L. =321.31 Meters
- 3.) Average bed level = 319.595 Meters
- 4.) Average Depth = 1.715 Meters
- 5.) Bed Slope = 1 IN 359

6.) Discharge( in Khadi Khad) = 10894 Cusecs

**(This discharge is taken at u/s of PWD proposed Bridge, i.e. it is at d/s of proposed Bridge site by Ansal Group. Hence this includes all discharge from Kaddi Khad, Drang Khad and discharge from whole of its catchment area)**

2.) AT SITE OF PURPOSED BRIDGE : -

**Data from field Survey**

1.) Available Bed Width (clear waterway) = 39.8 Meters

Total width available = 43.00m

2.) Average Bed Level =  $(1053.14 + 1050.67 + 1049.67 + 1050.70 + 1053.82 + 1054.82) / 6$   
= 1052.136 Feet  
= 320.69 Mtrs

3.) Available Depth of Khadi Khad = 2.5 Meters (from right bank)

**CALCULATION OF H.F.L. AT PURPOSED BRIDGE SITE :-**

At 300 Meters u/s of P.W.D. Bridge in KhadiKhad Discharge (Q) = 16025 Cusecs  
= 453.8 Cumecs

Bed Width = 35 m

Discharge intensity ( $q_1$ ) =  $453.8/35$   
= 12.965 cumecs per meter width

Total Energy at this section ( $E_1$ ) =  $y_1 + (q_1^2 \div (2 \times g \times Y_1^2))$   
= 4.627

At site of purposed Bridge Discharge ( $Q_2$ ) = 16025 Cusecs  
= 453.8 Cumecs

Bed width = 39.8 Mtrs

Discharge intensity ( $q_2$ ) =  $453.8/38.9$   
= 11.401 Cumecs per meter width

$$\text{Energy (E}_2) = Y_2 + (q_2^2 \div (2 \times g \times Y_2^2))$$

$$E_1.H_F = E_2$$

$$Y_2 = 2.1 \text{ Mtrs} < 2.5 \text{ Mtrs} \quad (\text{available depth})$$

$$\begin{aligned} \text{Thus , H.F.L at the proposed site of bridge.} &= \text{Avg. Bed Level} + \text{Depth of water} \\ &= 320.69 + 2.1 \\ &= 322.71 \text{ Mtrs} \end{aligned}$$

**CALCULATION OF MAXIMUM DISCHARGE POSSIBLE AT PURPOSED BRIDGE SITE:-**

$$\text{Available Depth} = 2.5 \text{ Mtrs}$$

$$\text{Available Bed width(clear waterway)} = \mathbf{39.8 \text{ Mtrs}}$$

$$\begin{aligned} \text{Area of cross-section (A)} &= 39.8 \times 2.5 \text{ ( let Rectangular Section)} \\ &= 99.8 \text{ Square Mtrs} \end{aligned}$$

$$\begin{aligned} \text{Wetted Perimeter (P)} &= 39.8 + 2.5 + 2.5 \\ &= 44.8 \text{ Mtrs} \end{aligned}$$

$$\begin{aligned} \text{Hydraulic Mean Depth (R)} &= A/P \\ &= 99.8/44.8 \\ &= 2.221 \dots \dots \dots \text{ (a)} \end{aligned}$$

$$\text{Bed Slope (S)} = 4.78 \times 10^{-3} \text{ ( Average slope from proposed Bridge site to 1000' d/s)}$$

$$\text{Co-efficient of Rugosity( n)} = 0.025$$

$$\begin{aligned} \text{Velocity (V)} &= (R^{(2/3)} \times \sqrt{S}) \div n \\ &= 4.7046 \text{ Mtrs/Sec.} \dots \dots \dots \text{ (b)} \end{aligned}$$

$$\begin{aligned} \text{Discharge} &= A \times V \\ &= 99.5 \times 4.7076 \\ &= 468.41 \text{ Cumecs} \\ &= \mathbf{16529 \text{ Cusecs}} > 16025 \text{ Cusec calculated at d/ s of} \\ &\quad \text{proposed site} \end{aligned}$$

Therefore if max discharge at d/s of proposed site is taken ( As given by department at 300 u/s of proposed bridge site of department at khadi khad and canal), HFL calculated at bridge site ( Proposed by Ansal Group) is 322.71 m i.e. depth required at this section is 2.1 m while 2.5 m depth is available . If the HFL is calculated based on 2.5m depth, **HFL will be 323.19 m** hence it is safe. It is also calculated that a max of **16529** cusecs discharge may pass easily under bridge of 39.8 m wide which is sufficiently more than **16025** cusecs ( observed by PWD/ irrigation department)

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