

# Hydraulic Mechanism for Bridge Operation

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**Abstract:** *This study discusses hydrologic and hydraulic bridge/culvert studies to estimate the 100-year water surface elevation at a given project site. Bridges (and sometimes very large culverts) are very expensive hydraulic structures that typically have a design life of 100 years. Most of the bridges are collapsing due to overflowing flood water. In Pakistan, this important study is usually neglected, resulting in bridges collapsing before the design deadline. In the present scenario, no one can deny the importance of this study, especially after the destruction of bridges due to the recent flood (July 2010) in Pakistan. This study focuses on various hydrologic and hydraulic procedures to calculate the 100-year flood discharge at the Long Branch culvert site located under Guinea Road in Virginia, USA. To do this, we used Anderson's method to estimate the discounts for different payback periods. The bridge engineer can then correct the road level for the culvert by taking into account the corresponding freeboard value. Such a structure will not block a flood with a periodicity of 100 years*

**Keywords:** Hydrological modeling, hydraulic bridge, bridge

## I. INTRODUCTION

Bridges are very expensive structures. Millions of rupees are spent on bridges in Pakistan, but most of them will not last much longer because either hydrological and hydraulic studies are not done at all or even if the study is done, it is not done properly. Therefore, the free board provided is not sufficient to calculate the floods of different period. Therefore, the bridge overturns and the structural integrity of the bridge is compromised. A hydrological and hydraulic study should be done for the bridge/culvert and then apply all the findings from the study to a real world scenario. The project involves carrying out hydrological and hydrotechnical studies of bridges and culverts. Different hydrological and hydraulic procedures are used to determine the water surface elevation for floods of different recurrence periods at the site of a bridge or culvert. The study ensures that the structure will not collapse during its entire service life and will remain intact and secure during its use. Each bridge must be designed to ensure that a 100- year flood will pass without compromising the integrity of the structure. In most cases, bridges collapse due to overflowing flood water. Therefore, bridges must be designed to allow enough space for floodwaters to pass safely without overturning the bridge.

## II. STUDY AREA

### 2.1 BRIDGE INFORMATION

“A structure that carrying a pathway or roadways or railways over a depression or obstacles (such as a river, valley, road or railway.) a bridge connecting the island to mainland.”

Types of Bridge: 1) Truss Bridge 2) Beam Bridge 3) Suspension Bridge 4) Arch Bridge 5) Cantilever Bridge 6) Cable Stayed Bridge

### 2.2 Hydrological impact on Bridge

#### 2.2.1 Action Mechanism of the Water Current Loads on the Bridge Piers

When a bridge abutment is affected by a flood, another research topic is the calculation of the dynamic response and pressure of the flow stream taking into account the fluidstructure interaction. Mikel and Buanani [19] proposed a practical formulation for studying the dynamic response of structures vibrating



When a flood impacts a bridge abutment, the abutment impact process caused by the flow can be divided into two parts: the moment of flood impact on the bridge abutment and the movement of water flowing around the abutment after the moment of impact.

### 2.2.2 Influence of Fluid –Structure on the Dynamic Water Pressure after the Moment Impact

To further investigate the effect of fluid-structure interaction on the water flow pressure applied to the bridge abutment when the flood acts on the abutment in a steady state, the maximum displacement at the top of the bridge abutment and the maximum stress at the bottom of the bridge abutment are considered as investigation volumes. variation of the fluid-structure interaction effect coefficient (F-Sc) as a function of flow velocity, where F-Sc is defined as the ratio of the numerical response of the bridge abutment under the pressure of flowing water to bridge abutment responses under water pressure excluding the effect of fluid-structure coupling.

### III. DATA COLLECTION

Sr No		At Defined c/s ( 130 m u/s )	At Existing c/s
1	Catchment area		1.74 Curas mail
2	Hydralur Gradient	1.223.73	
3	H.F.L Talled at side	98.250	97.670
4	L.B.L @ Site	96.220	95.815
5	Proposed RTL	99.205	98.685
6	Bed width @ Site	10.00 m	12.00 m
7	Bank width @ Site	15.00 m	28.00 m
8	Foundation	Open	Open
9	% obstruction at H.F.L	28.65 %	-
10	% obstruction at 0.FL	16.35 %	-
11	Required water way at H.F.L	13.06 m	-
12	Waterway Provided	14.00 m	-
13	Angle of site	30*	-
14	Proposal		7.00 m che 2 gale

### IV. RESULT

(i) DISCHARGE BY ENGLISH FORMULA  $Q = C X A A + 4 A = C.A$  in sq. miles 1.740 For C.A upto 20 sqmiles  
 $Q = C X A A + 4 C = 4200 + 0.74(4600 - 4200) C = \text{Constant } 4496.00 Q = 3265.274 \text{ Cuses } 92.533 \text{ Cumec i.e } 92.533 \text{ Cumec}$

### V. CONCLUSION

Based on the results of this study, the following conclusions were drawn:

1. From this study, it can be assumed that if waterways become narrower, more expected bank erosion and erosion may occur. To avoid such a drastic situation, river preparation works from 1 km upstream to 1 km downstream may be



recommended and continuous monitoring should be carried out during and after the construction of this type of structure in the stated situation.

2. The result of the study was only a change in the level of the bottom and erosion of the shore. There were differences in the water level, as well as in the speed of the current. The result of the study is based on the existing condition of the Nala River. The approach may be the same for all rivers, but there is the possibility of deviations in case of other baseline conditions and other rivers. The result also varied depending on the condition of the soil, the speed of the current, the effect of waves, tides, surface runoff and so on.

3. This project found that many river bridges that are more than 40 years old are subject to collapse during floods and sudden increases in contraction and local erosion.

4. The results showed that the bridge abutment narrowed the flow cross-section and caused an increase in support in the upper sections. This increase in underflow caused a decrease in the longitudinal velocity in the upper reaches. Also, the results showed that the position of the maximum layer shear stress moved from the separation zone to the edge of the bridge support. 5. In addition, the results showed that for the cross-section of the downstream bridge abutment, the secondary flow pattern is completely different from the normal secondary flow in the case of an open channel incident without a bridge abutment.

6.1) Recommendations: 1. Hydrological and hydraulic surveys of all existing bridges in India should be properly carried out. 2. The bridge engineer should carry out these studies before providing sufficient free board at the new bridge location. 3. The level of the bridge deck should be at least 150 mm above the maximum height of the water surface.

#### REFERENCES

- [1]. AASHTO, Drainage Manual, Chapter 10, "Bridges," AASHTO Technical Committee on Hydrology and Hydraulics, 2009 (draft).
- [2]. AASHTO, Highway Drainage Guidelines, Chapter 7, Hydraulic Analysis for the Location and Design of Bridges, AASHTO Technical Committee on Hydrology and Hydraulics, 4th Edition, 2005.
- [3]. Clarkin, Kim; Keller, Gordon; Warhol, Terry; Hixson, Suzan, Low-Water Crossings: Geomorphic, Biological, and Engineering Design Considerations, 0625 1808P, San Dimas, CA: US Department of Agriculture, US Forest Service, San Dimas Technology and Development Center, 366 p., 2006.
- [4]. Corry, M.L., Jones, J.S. and Thompson, P.L., Design of Encroachments on Floodplains Using Risk Analysis, Hydraulic Engineering Circular No. 17, Federal Highway Administration, Washington DC, 1981.
- [5]. Federal Highway Administration, River Engineering for Highway Encroachments — Highways in the River Environment, Hydraulic Design Series No. 6, FHWA-NHI- 01- 004, December 2001.
- [6]. Federal Highway Administration, Stream Stability at Highway Structures, Hydraulic Engineering Circular No. 20, Third Edition, FHWA-NHI-01-002, 2001

