International Journal of Innovative Research in Science and Engineering
Volume 7, Issue 07, 2021
www.ijirse.com
ISSN: 2454-9665

AN EXPERIMENTAL STUDY & ANALYSIS ON ESTIMATION AROUND THE BRIDGE PIER FOUNDATION

ADARSH RAI , KAMALSHANKAR PANDEY , DEVANAND SINGH , ABHISHEK CHAUDHARY

Name of Guide: Mr. ASHISH VERMA

(Assistant professor CIVIL ENGINEERING DEPT.DR. APJ ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW INDIA JUNE 2021.

ABSTRACT

Scour around bridge piers is a challenging problem faced by bridge engineers. Scour is caused by the horseshoe vortex formed due to the presence of the pier obstructing the flow. The behaviour of horseshoe vortex differs according to the arrangement of piers. The flow pattern is different for a group of piers and a solid pier thereby creating different scour patterns. Bridge scour is the removal of sediment such as sand and gravel from around bridge abutments or piers. Scour, caused by swiftly moving water, can scoop out scour holes, compromising the integrity of a structure.In the United States and different countries of world bridge scour is one of the three main causes of bridge failure (the others being collision and overloading). It has been estimated that 60% of all bridge failures result from scour and other hydraulic-related causes. It is the most common cause of highway bridge failure in the unite states, where major bridge failures resulted from scour near piers from years.Man's never-ending search for better materials and construction methods and for techniques of analysis and design has overcome most of the early difficulties of bridge building. Scour of the stream bed, however, has re-maimed a major cause of bridge failures ever since man learned to place piers and abutments in the stream in order to cross wide rivers. The bridge builder's concern with scour in the days of the masonry arch is evidenced by the treatises of that time. The massive piers and short spans typical of old arch bridges resulted in extreme contractions of the flow section and, consequently, severe scour. Moreover, the timber-crib foundations placed at or near the originalstream bed were particularly vulnerable to undermining. Modern steel and concrete bridges can be built with long spans and relatively small piers. Pile and caisson foundations can be sunk far beneath the stream bed. Yet every year additions are made to the list of bridges that have failed because of scour of the stream bed around the piers and abutments. Scour can cause problems with the hydraulic analysis of a bridge. Scour may considerably deepen the channel through a bridge and effectively reduce or even eliminate the backwater. This reduction in

International Journal of Innovative Research in Science and Engineering
Volume 7, Issue 07, 2021
www.ijirse.com
ISSN: 2454-9665

backwater should not be relied on, however, because of the unpredictable nature of the processes involved. Scour around bridge pier located in an erodible bed is a complicated problem and only very limited success has been made to model the local scour computationally. Physical model remains the principal tool employed to estimate local scour depth.

3

ation problems at a structure requires the long-term monitoring of changes in the river for significant distances, both upstream and downstream.

development of clear water scour around a non-uniform cylindrical pier in steady flow. The pier comprised a slender cylinder founded on a large cylinder. This study aimed at investigating the effects of foundation depth on the scour process. Three-dimensional topography of the scour was carefully measured using digital stereo-photogrammetry as a method to level a riverbed. The

spatial distributions of the sediment transport rate were estimated with the variation in the bed elevation. The results show that the process of sediment transport and scour depends on the foundation depth. The retarding and limiting the scour due to the foundation occur when it is placed at an appropriate level below the initial bed level. The scour depth increases with foundation level when the foundation protrudes above the initial bed level.

Experimental Study on Clear Water Scour around Bridge Piers

This study analyzed the characteristics of bridge scoured by clear water according to 14 groups of laboratory experiments. The formulation of critical velocity based on historical equations of clear water scour was concluded for the test circumstances in laboratory. The experimental conditions include the variation of flow velocity, sediment cover depth, and diameter of bridge pier/bases. The erosion status prior to the maximum scour depth was recorded by a pinhole camera, and, in general, the equilibrium scour depth was reached after 24 hours. The maximum scour depth increases as the sand cover depth decreases. As the same sediment depth, the fast flow velocity will induce the deep scour depth with respect to the slow flow velocity. The same result can be observed for the large diameter of pier (or base) versus the small one. The maximum scour depths in the front of the pier are always deeper than that behind the pier. Study of sour bridge piers is extremely important

RIP-RAP METHOD OF SCOURING PREVENTION AT BRIDGE PIER

Although riprap is the most commonly employed countermeasure against scouring around bridge piers, few studies exist of riprap performance under live-bed conditions. In this study, failure mechanisms, stability, and placement level effects for riprap at bridge piers are considered experimentally. Under clear-water conditions, riprap is subject to shear, winnowing, and edge failure. Under live-bed conditions, a fourth failure mechanism, destabilization by bed-form progression, becomes important. Destabilization by bed-form progression is dependent on the destabilizing influence of bed-form

troughs as they pass the pier. Experiments were used to assess the ability of riprap stones to protect bridge piers under a wide range of flow conditions. The effects of placing the riprap layer at depth within the sediment bed, rather than level with the bed surface, were investigated also. The study showed that, as the flow velocity increases, the ability of riprap
stones to protect a pier decreases asymptotically until the scour depth in the riprap layer reaches that of an equivalent unprotected pier.

SCOUR REDUCTION USING SLOTS & COLLAR METHOD

When a collar is installed around the pier, the direct impact of the down flow on the streambed is prevented, which not only causes reduction in the maximum scour depth but also the rate of scouring is also reduced considerably. Reduction in the rate of scouring reduces the risk of pier failure when the duration of flood Reduction of scouring by indirect method can be achieved by using a slot through the pier, which helps to pass most of the flow through it because of a favorable pressure gradient and balance would be left to cause much reduced Scour damage.

The boundary layer in the flow past a bridge element undergoes a three-dimensional separation This separated shear layer rolls up along the obstruction to form a vortex system in front of the element which is swept downstream by the river flow. Viewed from the top, this vortex system has the characteristic shape of a horseshoe and thus
called a horseshoe vortex The formation of the horseshoe vortex and the associated down flow around the bridge element results in increased shear stress and hence a local increase in sediment trans-port capacity of the flow. This leads to the development of a deep hole (scour hole) around the bridge element, which in turn,
changes the flow pattern causing a reduction in shear stress by the flow thus reducing its sediment transport capacity. The temporal variation of scour and the maximum depth of scour at bridge elements therefore mainly depend on the characteristics of flow, pier and river-bed material.