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THE IMPORTANCE OF SCOUR IN RIVER AND COASTAL ENGINEERING BASED ON THE ENGINEERING APPROACHES TO THE PREDICTION OF SCOUR

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Abstract: **Due to exposure to erratic riverside flows, riverine transport or littoral drift, also known as sedimentation, water salinity, and mass density stratification, riverine flows, storm surges, and astronomical tides affect coastal defenses and riverine through instability of waterway and bridge scour in the region subjected to tidal flow. However, foundation scour may be measured to offset possible negative impacts, and waterway instability can be managed using geomorphology methods and current scour equations.**

Keywords: **riverside flows, riverine transport, storm surges.**

1. INTRODUCTION

How Scour Affects Riverine and Coastal Defences

Riverine flows, storm surges, and astronomical tides affects coastal defenses and riverine through instability of waterway and bridge scour in the region subjected to tidal flow due to exposure to unsteady riverside flows, riverine transport or littoral drift, also known as sedimentation, water salinity, and mass density stratification (Melville and Coleman 2000). Waterway instability, however, can be dealt with using geomorphology techniques and existing scour equations while depths of foundation scour can be determined to counter potential adverse effects. There are fundamental differences in the design of riverine or nontidal streams whereby there are constant annual return flows of 500, 100-, or 50- (Wallingford 2004). The design discharge for a similar flow return period in tidal waterways, on the other hand, may increase since it relies on the elevation of the design storm surge, the mean tide of the waterway area below the bridge, and the bridge's upstream water volume in the prism of the tide (Melville and Coleman 2000). In the event of a constant flow of waterway due to increased astronomical tides that cause erosion, the possibility of an increase in the discharge becomes evident. The use of an existing clear-water scour formula cannot be applied in the prediction of the scour's time history, but rather its magnitude.

Recent studies indicates that there can result into a lasting degradation from this such storm surges and astronomical tides estimated at between 0.2 m/year and 0.9 m/year, a process that involves a combination of geological factors including long-term instability in waterway, local scour, contraction scour, and degradation (Wallingford 2004). The scour mechanisms mentioned above are the primary cause of riverine or tidal streams experienced along the coastal lines (Sumer, Whitehouse, and Tørum 2001). However, despite the fact that most of the tidal waterways are caused by different flow conditions, applicable equations in establishing riverine scour depends on the outcome of a carefully evaluated hydraulic scour. The effect of a coastal region's bridge scour is primarily caused by unsteady semidiurnal and diurnal flows resulting from a combination of tidal and riverine flows as well as from storm surges such as tsunamis, northeasters, and hurricane (Melville and Coleman 2000). Moreover, the tiny size of the material from the bed of the waterway, commonly found in the form of fine sand, clays, and silts with littoral drift and cohesion negatively impacts on the bridge scour's magnitude (Wallingford 2004). Water salinity and stratification of mass density, on the other hand, has a minimal effect on bridge scour. Precisions such as a bridge scour can be used to determine the coastal region's bridge scour and hydraulic variables like depths, velocity, and discharge (Sumer, Whitehouse, and Tørum 2001). Determinations mentioned above are conservative leading to a need for further research on the established cases to enhance evaluation of geological factors contributing to the long-term degradation effects of bridge scour (Melville and Coleman 2000). Notwithstanding the gaps mentioned above, this paper investigates the process and techniques used in the management of flood risk programs.

Proposed Scour Related To the Analysis of the Reliability of Flood Risk Management Schemes

The addition of maximum tidal flow to riverine flood flow can help in defining the scale of the combined flows if assessing a small drainage basin or routing the flows of design riverine to the crossing and tallying the outcome to the storm surge flows. Despite the fact that tidal flows tend to be unstable, the duration of peak flows caused by the effect of storm surges is long enough to make the coastal zones to have fine sand reaching the depths of bridge scour calculated from current scour equations (Melville and Coleman 2000). The twice-daily or daily outflow and inflow of astronomical tides may and do contribute to a lasting degradation impact if at the crossing, there is no foundation of sediment excerpt leading to a permanent dreadful scour conditions annually approximated to range between 0.8 ft. and 3.0 ft. or 0.2 m and 0.9 m without any indication that it will eventually slowdown or stop (Wallingford 2004). For example, In 1938, Delaware experienced scour degradation in the inlet of the Indian River from the initial depth of about 12ft or 3.7 m to approximately 52 ft. or 15.8 m in 1986 (Wallingford 2004).

Saltwater wedges or mass density stratification witnessed when more saline, denser ocean water enters a tidal or estuary inlet with major inflow of freshwater may lead to larger velocities close to the lowest area compared to the vertical area which has an average velocity of water entries (Wallingford 2004). Correct velocity can be determined with careful evaluation for application in the scour equations. The difference in the density between the excerpt of freshwater and saltwater because the proposed degradation process can lead to the formation of saltwater wedges cannot effectively be used to determine the effect on scour equations. In riverine flows, there can be larger viscosity and density differences between sediment-laden and freshwater compared to the variances experienced in freshwater and saltwater. The cohesive sediments' level of erodibility can be affected by salinity. This effect, however, may not be observed in the ultimate scour but rather in the rate of scour. The cause of sediment seen on a tidal water way results from littoral drift and there can be a decreased contraction in its availability, sometimes to the level of local scour leading to an aggravating and stable waterway (Richardson, Richardson, and Edge 1995). The absence of scour sediment from the effect of littoral drift can be associated with a lasting degradation, local scour, and contraction scour. The problem of sediment transport witnessed in the evaluation of littoral drift involves several factors including sources of sediment, coast, or future plans such as jetties and dredging for the waterway and historical information (Sumer, Whitehouse, and Tørum 2001).

Application of Scour Related To the Analysis of the Reliability of Flood Risk Management Schemes

Flood risk management scheme is demonstrated through Source Pathway Other sources Receptors (S-P-R-C) model to measure fragility of material defined by the connection between the possibility of defence response and conditions of different hydraulic loading (Kreibich, Bubeck, Van Vliet, and De Moel 2015). In this regard, the source of the hydraulic loading is the coast, estuary, and river while the pathway denotes the flood plain, defense system, and defence. Other sources include issues of drainage and rainfall. Receptors include people environment and property. The risk of putting excess loads on the source of flooding may result into an increase in the return period indicating how a particular load can frequently be exceeded. Analysis of the reliability of the pathway describes the performance of the systems and structures involved in flood defence, the likelihood of load failure indicated by a fragility curve. These, however, relies on the schemes' condition, failure mechanisms, materials, and structure.

Flood probability, on the other hand, explains the depth and extent of the flood determined by several factors including the topography, overtopping, and breach size. Reliability analysis is combined with flood spreading models to evaluate the probability relationships or depth. The involved consequences of flooding are assessed based on the harm or damage of the condition quantified in terms of the depth. The risk of the flood, on the contrary, is evaluated by the likelihood that certain values of the damage will be exceeded. The fragility curve, therefore, defines the chances of failure by the defence mechanism or structure of the loading. The purpose of calculating the fragility curve of flooding is to understand numerous available responses emanating from a lack of data regarding characteristics of a defence as well as various in the same structures or mechanisms (Cutter et al. 2013). Application of fragility curves in the management of risk caused by flooding includes establishment of rigorous discipline designed to help engineers evaluate the defence mechanisms developed to handle excess flooding and helps in defining the risk of flooding attributable to each installed or built defence structures besides offering reliable and concrete information in the analysis of flood systems (Cutter et al. 2013). Overall, understanding the risk management systems designed to deal with flooding is important because such knowledge can be used to evaluate performance of defences in the process of analyzing the whole mechanism of flood risk. The project provides information about how the flow of water is transported from the source to the receptor.

Techniques Related to the Analysis of the Reliability of Flood Risk Management Schemes

The study on extreme rainfall condition through the stress test scenario that is based on the Exeter flood alleviation system indicate that increasing the depth levels of flood in Exeter by approximately 0.06m leads to a significant difference in the stress test scenario by about 185% increase (Wilby and Keenan 2012). Such a magnitude of flooding represents a large amount of waterway flow likely to break river banks and the flood risk properties can increase if a small quantity of water is added to the channel of water. The findings, however, show that despite the increase in the depth of the flood, the levels of modeled flood shall remain at an average of about 0.5m lower than what is outlined for Exeter by the Environment Agency Extreme Flood (Schelfaut et al. 2011).

2. CONCLUSION

Assessment of bridge scour in waterways that are tidally affected is very complex due to the issue of instability caused by semidiurnal and diurnal flood flows triggered by large tsunami, northeaster, and hurricane storm surges, clays and silts resulting from the combination of tidal flows and riverine, littoral drift, and cohesion as well as from bed materials of sand-size, water salinity, and mass density stratification. The use of flood risk management schemes, however, can help to establish the hydraulic variables such as the depth, velocity, and discharge of the water resulting from the storm surges and tides through calculating the total bridge scours using scour equations.

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