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Figure 1: View of the Kelanisiri Bridge across the Kelani River

Scour Under Bridges: An Invisible Danger

Engineering Approaches to Predict and Prevent Failure

Bridge scour – the erosion of riverbed sediment around bridge supports – is a hidden but serious threat to bridge safety. Scouring alters flow patterns around piers and abutments, increasing shear stress (Dey & Raikar, 2007). Damage from scour can lead to bridge failure, and worldwide it is one of the leading causes. In Sri Lanka, failures have occurred before; the Magalle Bridge, for example, collapsed in 2006 after its foundations were undermined by flood-driven erosion. Several others – Manampitiya, Kotugoda, and Ruwanwella – have also experienced serious scour. These incidents underscore why engineers consider scour one of the most critical threats to bridge safety.

A reliable approach for the estimation of scour depth around bridge piers is an indispensable fact in terms of the safety and integrity of the bridge structures, since implementation of preventive measures based on the scour depths predicted is more cost-effective and less disruptive (Khosronejad et al., 2012).

This study employed a two-dimensional (2D) hydraulic and sediment modeling approach using HEC-RAS software to investigate how floodwaters erode the riverbed at the Kelanisiri Bridge across the Kelani River of Sri Lanka. Previous studies have largely relied on laboratory experiments or simplified modeling approaches, whereas this study is based on a validated 2D model applied to a bridge in a real river environment.

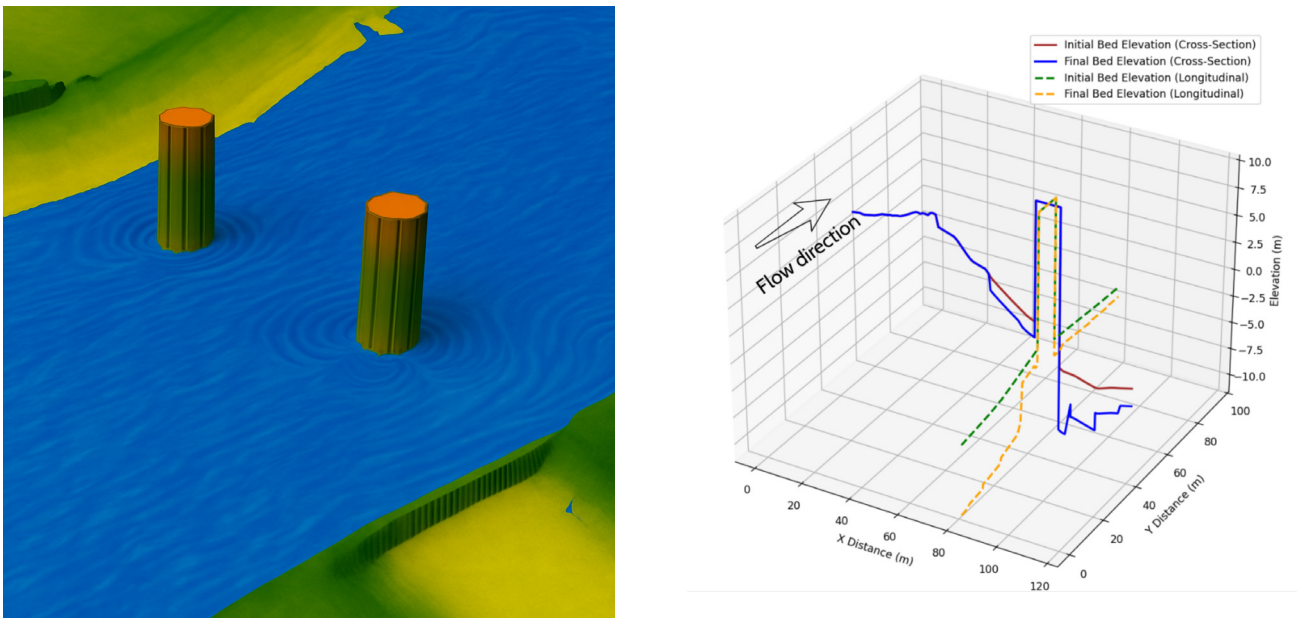

Figure 2: Simulation of bridge piers in the model and the obtained bed level change around a pier

Unlike older one-dimensional methods, 2D modeling can capture swirling currents and sediment transport patterns that cause scour holes around piers. Simulation was performed for the 2016 flood event and validated with field observations. Further, the model accuracy was confirmed through comparison with laboratory-scale physical modeling results.

The study demonstrates the adaptability of advanced numerical modeling in identifying hidden threats due to scouring around bridge piers. Developed model enables the estimation of future scour depths under predicted flood conditions. Through the early detection of high-risk zones, engineers can implement effective protection measures before disaster strikes. As floods intensify, the ability to predict and plan is crucial for maintaining bridge safety and ensuring connectivity. Accordingly, the current study on Kelanisiri Bridge demonstrates the importance of local research for the preservation of existing structures while guiding the design of more resilient bridges for the future.

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