PH.D DEFENSE ON BRIDGE PIER SCOUR DEPTH PREDICTION USING ARTIFICIAL INTELLIGENCE TECHNIQUES HELD AT UET PESHAWAR

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PESHAWAR July 13: Highway bridges play a major role in the economy of a country. Bridge scour poses a serious threat to the integration of bridges and as such is a very critical public issue that needs to be properly addressed to ensure public safety and minimize adverse effects of bridge damages or closures. It is therefore an urgent need to design and maintain bridge foundations to resist the effects of scour and build research tools to minimize future flood damages to the bridges.

This research has two major parts including 1) Experimental analysis of pier scouring for two different bridges in Pakistan and one Bridge in Malaysia and 2) Development of state of the art AI-Based Inductive Modeling Techniques for Bridge Pier scour depth prediction. Experimental analysis was carried out in Malaysia and Pakistan. In Pakistan, Circular pier of Motorway Bridge at Kabul River and Square pier of Khairabad Bridge at Indus River were modeled on small scale in the Open Channel of Hydraulics Laboratory of Civil Engineering Department, UET, Peshawar. Pier scour depth was measured for different conditions of flow, sediment properties and pier geometry and the same was converted to the corresponding field scour depth through Froude's Number Similitude Analysis. The new data has not only enhanced the current data base of bridge pier scour but also important in Pakistan's perspective as there is no data available in this area. This laboratory data was then used for the development of AI-Based models as well to draw Contour maps for different pier shapes under varying flow and sediment conditions.

Two newly developed AI-Based Modeling Tools including Gene Expression Programming (GEP) and Genetic Functions (GF) were used for the development of accurate scour depth prediction models. Both these models (GEP and GF) were used for such an application for the first time, the research also resulted in an enhancement of the GF technique including 1) increasing number of input variables from three to five, and 2) enriching the library of sub functions for use in the genetic algorithm search process. It was concluded that these new techniques (GEP and GF) not only outperformed other conventional and AI methods like (ANN) in model accuracy but also resulted in more compact, simple, and easy to use expressions for pier scour depth prediction as a function of the relevant input parameters under different flow and sediment conditions. These new AI-Based Techniques were then used for the development of Design/Sensitivity Curves for pier scour depth as a function of the relevant input parameters derived from the explicit expressions as an outcome of the GEP and GF-based inductive models.