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Development a Forecasting System and Reliable Sensors for River Bed Degradation and Bridge Pier Scouring

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Abstract : In recent years, climate change is a major factor to increase rainfall intensity and extreme rainfall frequency. The increased rainfall intensity and extreme rainfall frequency will increase the probability of flash flood with abundant sediment transport in a river basin. The floods caused by heavy rainfall may cause damages to the bridge, embankment, hydraulic works, and the other disasters. Therefore, the foundation scouring of bridge pier, embankment and spur dike caused by floods has been a severe problem in the worldwide. This severe problem has happened in many East Asian countries such as Taiwan and Japan because of these areas are suffered in typhoons, earthquakes, and flood events every year. Results from the complex interaction between fluid flow patterns caused by hydraulic works and the sediment transportation leading to the formation of river morphology, it is extremely difficult to develop a reliable and durable sensor to measure river bed degradation and bridge pier scouring. Therefore, an innovative scour monitoring sensor using vibration-based Micro-Electro Mechanical Systems (MEMS) was developed. This vibration-based MEMS sensor was packaged inside a stainless sphere with the proper protection of the full-filled resin, which can measure free vibration signals to detect scouring/deposition processes at the bridge pier. In addition, a friendly operational system includes rainfall runoff model, one-dimensional and two-dimensional numerical model, and the applicability of sediment transport equation and local scour formulas of bridge pier are included in this research. The friendly operational system carries out the simulation results of flood events that includes the elevation changes of river bed erosion near the specified bridge pier and the erosion depth around bridge piers. In addition, the system is developed with easy operation and integrated interface, the system can supplies users to calibrate and verify numerical model and display simulation results through the interface comparing to the scour monitoring sensors. To achieve the forecast of the erosion depth of river bed and main bridge pier in the study area, the system also connects the rainfall forecast data from Taiwan Typhoon and Flood Research Institute. The results can be provided available information for the management unit of river and bridge engineering in advance.

Keywords : flash flood, river bed degradation, bridge pier scouring, a friendly operational system
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