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Monitoring bridge scour using dissolved oxygen probes

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Abstract:

Bridge scour is the predominant cause of overwater bridge failures in North America and around the world. Several sensing systems have been developed over the years to detect the extent of scour so that preventative actions can be performed in a timely manner. These sensing systems have drawbacks, such as signal inaccuracy and discontinuity, installation difficulty, and high cost. Therefore, attempts to develop more efficient monitoring schemes continue. In this study, the viability of using optical dissolved oxygen (DO) probes for monitoring scour depths was explored. DO levels are very low in streambed sediments, as compared to the standard level of oxygen in flowing water. Therefore, scour depths can be determined by installing sensors to monitor DO levels at various depths along the buried length of a bridge pier or abutment. The measured DO is negligible when a sensor is buried but would increase significantly once sour occurs and exposes the sensor to flowing water. A set of experiments was conducted in which four dissolved oxygen probes were embedded at different soil depths in the vicinity of a mock bridge pier inside a laboratory flume simulating scour conditions. The results confirmed that DO levels jumped drastically when sensors became exposed during scour hole evolution, thereby providing discrete measurements of the maximum scour depth. Moreover, the DO probes could detect any subsequent refilling of the sour hole through the deposition of sediments. The effect of soil permeability on the sensing response time was also investigated.

Keywords: Bridge, Dissolved Oxygen Optode, Flood, Hydraulic Structures, Scour, Structural Health Monitoring