

## **A Case Study on Pier Scour Monitoring at Incheon Bridge in Korea**

*Jong-Hyun Shin, Jeong-Woo Seok, Dae-Jin Hwang, Zu-Cheol Kim, Jeong-Hwan Kim and Kyung-Soo Bahk*

Geotechnical team, Institute of Technology, Samsung Corporation  
Seongnam-Si, Gyonggi-Do, Korea

Geotechnical team, Institute of Technology, Samsung Corporation  
Seongnam-Si, Gyonggi-Do, Korea

Geotechnical team, Institute of Technology, Samsung Corporation  
Seongnam-Si, Gyonggi-Do, Korea

Incheon Bridge, Civil Engineering Division, Samsung Corporation  
Incheon, Korea

Incheon Bridge, Civil Engineering Division, Samsung Corporation  
Incheon, Korea

Institute of Technology, Advanced Aquatic Technology  
Ansan, Korea

### **ABSTRACT**

The local scour is a critical factor of the bridge stability. Scour depths are usually determined using empirical formulas or numerical studies or physical model tests in more complex cases. But all methods to estimate scour depths always include uncertainties resulting from hydraulic and geology conditions, therefore it is necessary to overcome these by in-situ monitoring for real bridge scour. In this study, the local scour depths were evaluated at a important pier of Incheon Bridge. Generally, local scour is closely related to bottom characteristic and bottom shear stress. If tidal current is strong and ground condition is soft, bottom shear stress is high so the possibility of local scour occurrence is increasing. As the result of bottom shear stress evaluation, W1 pier of cable-stayed bridge section is selected for scour monitoring. Two monitoring methods are applied. One is a periodic scour survey using a boat. The other is a installation of the profiling scour monitoring system which was newly developed, attaching a profiling scan sonar for this study. The measurements of the new system are compared to measurements of the survey using a boat. The results indicate that the survey using a boat is effective in evaluating the maximum scour depth and the profiling scour monitoring using a new system would be more cost-effective than the previous scour monitoring system if the pier foundation consist of many piles with large diameter.

**KEY WORDS:** Local scour; Bottom shear stress; Tidal current; Survey boat; Profiling sonar

### **INTRODUCTION**

Scour is one of the major causes of bridge failures. The estimation and verification of scour depths are certainly necessary to assure the stability of a bridge structure. Scour depths are usually determined using empirical formulas or numerical studies. Additionally model tests are available in more complex cases. If the bridge foundations have a

weakness for Scour problems, the design will be changed so that foundations have more supporting capacities or countermeasures will be installed.

But, there are still many unknowns to judge the scour potential of a specific site. The most troublesome parameter is the bed property because there is normally very scarce information provided. For example, consolidation, gradation, cohesiveness are important parameters but the details are not normally provided. Thus, it is necessary to overcome these shortcomings by an in-situ monitoring. Real-time monitoring of bridge scour process, therefore, is a fulfillment of the comprehensive bridge scour analysis. For this, a continuous bridge scour monitoring tool should be developed (Yeo et. al., 1999). Sensors and a data acquisition system are glued together for the bridge scour monitoring.

In scour monitoring, scour depths cannot be measured directly. It must be determined by interpretation of channel geometry data. The magnitude of scour for a scour data set is the vertical distance between the measured channel geometry and a surface, line, or point that represents the reference channel geometry for the baseline condition, i.e., for conditions in the absence of the bridge structure (Landers and Muellers, 1996). Reference surfaces should be selected so that the local scour may be quantified. The scour measurements could vary according to methods determining the reference surface. Field measurements of local scour which can fatally affect the stability of the structures, have generally used the concurrent ambient bed level as a reference.

In this study, local scour depths were evaluated at a important pier of Incheon Bridge. For the reasonable evaluation, two methods were selected. One is a periodic scour survey using a boat. The other is a installation of the profiling scour monitoring system which was newly developed by combination with a profiling scan sonar and a data logger for this study.