Doctoral Dissertation Defense Announcement

FRP-CONFINED GROUT SYSTEMS FOR UNDERWATER REHABILITATION OF CORRODED STEEL BRIDGE PILES

Hossein Karagah

Date: Tuesday, July 28th, 2015
Time: 2 PM
Location: CEE Conference Room
Committee: Dr. Mina Dawood (Chair), Dr. Abdeldjelil Belarbi, Dr. Cumaraswamy Vipulanandan, Dr. Ashraf Ayoub, Dr. Sang-Wook Bae

Abstract

This dissertation presents the findings of an experimental and numerical research study that was conducted to study the behavior of corroded steel bridge piles that are repaired using fiber reinforced polymer (FRP)-confined grout-based systems. The objectives of this study were to, (i) quantify the remaining axial capacity of steel piles with different patterns of localized corrosion, and (ii) develop a rational approach for the design of FRP-confined grout-based systems for underwater repair of corroded steel H-piles.

To achieve the first objective, a series of small-scale and full-scale piles with simulate corrosion patterns were tested under concentric compression loading. Thirteen small-scale steel wide flange columns and seven full-scale steel H-piles with simulated deterioration were tested under axial compression. Deterioration was simulated by milling the flanges and webs. The test results indicate that the degree of reduction of the thicknesses of the flanges and webs, presence of through-web corrosion, and length of the corroded region were the major parameters affecting the axial capacity of the corroded columns. Using existing design specifications, including the approach adopted by the American Institute of Steel Construction (AISC) and the American Association of State Highway and Transportation Officials (AASHTO) and those adopted by the American Iron and Steel Institute (AISI) (the effective width and direct strength methods), the remaining axial capacity of the tested piles was predicted and compared with the measured capacities. The findings indicate that among the methods investigated the effective width method resulted in the most accurate but still conservative estimate of the axial capacity.

Subsequently, a rational approach was developed for the design of FRP-confined grout-based repair systems for corroded steel H-piles. Two groups of seven full-scale H-piles with different patterns of simulated corrosion were tested under concentric axial compression. Each group was repaired using a different commercially available FRP jacket system. The fabrication process was implemented underwater to simulate in-situ repairs. The test results indicate that the axial capacity of the repaired piles was successfully restored to the nominal capacity of the uncorroded piles. A complementary numerical study was conducted to further investigate the behavior of the repaired piles. The results of the numerical analysis showed that both the axial capacity and the failure mode were affected by changing the bond characteristics of the interface between the steel pile and the grout core of the repair system. The outcomes of the study provide a rational methodology for predicting the remaining capacity of corroded steel H-piles and for designing FRP-confined grout-based systems to retrofit corroded steel bridge piles.