

Fatigue Performance Evaluation of Severely Corroded Steel Strands

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Abstract

Recently, one of the external tendons in Jung-reung-cheon Viaduct in Seoul was failed after 17 years of service due to severe corrosion in strands. As a part of the in-depth investigation, fatigue tests for the corroded strands were conducted to check the structural safety and serviceability of the defected tendons. Nine corroded strand specimens were collected from the replaced tendons. All corroded strands demonstrated very poor fatigue performance. All the specimens could not satisfy the minimum requirement of two million cycles at the stress range of 190 MPa recommended by Eurocode. Section loss in each specimen was measured at the fractured section and found that there is little correlation between section loss and fatigue life. It may be little fatigue life remaining once corrosion occurred in strands.

Keywords: fatigue; corrosion; external tendon; strand; durability; section loss; post-tensioning.

1 External tendon failure

One of the external tendon of Jeong-reung-cheon Viaduct in Seoul City was failed in February, 2016 (Figure 1). The bridge was designed in 1991 and completed in 1999. It was the first tendon failure occurred in South Korea. In-depth investigation was conducted after the failure was found. The investigation revealed that corrosion of strands was the main reason of the failure. There were several reasons caused corrosion related to design and quality control in construction phase and those were:

1. From the bridge deck, water with high level of chloride infiltrated through the unsealed and damaged air vents, which were located underneath the bridge deck pavement. Water content in existing tendon was

abnormally high and the maximum chloride content in the grout was about 12,000 ppm.

2. Low gradient of the bridge deck, almost close to zero degree, at the failure location caused drainage problem and accelerated deterioration and damage of the pavement.
3. Grout was not completely filled due to bleeding at the top position of the inclined tendons. It was suspected that the water-cement ratio of the grout was higher than 45%.
4. Only visual inspection had been conducted, so that the large void and corrosion in the tendon was not known, although the bridge was inspected regularly.