Prediction of Breakage Position and Remaining Fatigue Life of Corroded Bridge Wires using 3D Scanner

Kazuhiro Miyachi

Gifu University, Gifu, Japan

Shunichi Nakamura

Tokai University, Kanagawa, Japan

Contact: kmiyachi@gifu-u.ac.jp

Abstract

Cables and stays of suspension bridges and cable-stayed bridges have been heavily corroded and broken all over the world. Although cable corrosion can be found by visual observation, it is difficult to find the dimension and distribution of corrosion pits. Therefore, there is no established method to predict fatigue failure, the breakage position and remaining fatigue life of the existing wires. In this study, the risk assessment system of corroded bridge wires using a 3D scanner was established. The surface roughness of corroded wire was measured by 3D scanner and the dimension and corroded area of corrosion pits were obtained. It was found that the most corroded part corresponded with the actual broken position, which makes possible to predict the breakage position. In addition, by comparing the fatigue strength with the S-N curves, the remaining life of corroded wires can be predicted considering the dimension of corrosion pits.

Keywords: bridge wires; corrosion; 3D scanner; fatigue failure; cable breakage; life prediction.

1 Introduction

Cables and hanger ropes of old suspension bridges and stays of old cable-stayed bridges have been severely corroded and fractured all over the world [1]. For risk assessment of corroded wires, information on corrosion Is essential: such as depth, width, length and distribution of corrosion pits. This information would be very useful in assessing the risk of cable breakage. However, there is not an established technology so far to obtain sufficient data on the development and assessment of corrosion. This study targets the corroded bridge wires of the main cables and the hangers of suspension bridges and stays of cable-stayed bridges and was conducted in 4 steps. 1st step, the corroded wires were produced by the accelerated corrosion test. 2nd step, the surface roughness of the corroded wires was measured by 3D scanner. The measured data was analyzed in the circumferential and longitudinal directions to obtain the distribution of surface roughness, diameters, pit shapes and so on. 3rd step, cyclic tests were conducted with the corroded wires, the breakage position and the fatigue strength were obtained. Then, the breakage position was compared with the measured surface roughness data. It was found that the actual breakage position agreed with the severest corrosion part which was measured by 3D scanner. 4th step, the fatigue strength of the test wires was compared with the past S-N curves. Then, the method to

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