The 2019 World Congress on
Advances in Structural Engineering and Mechanics (ASEM19)
Jeju Island, Korea, September 17 - 21, 2019

Machine Learning based Tensile Force Estimation using Embeddable Elasto-magnetic Sensors

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ABSTRACT

The tensile force of pre-stressed tendons of a pre-stressed concrete bridge is one of the important factors for evaluating the performance of PSC girder bridges. To estimate the tension force of the tendons, this study proposed a machine learning based tensile force estimation method using embeddable elasto-magnetic (EM) sensors. The magnetic hysteresis of PS tendons is changed according to the applied tensile force due to the inverse effect of magnetostriction. To measure the magnetic hysteresis of PS tendon of PSC girder, the EM sensor should be embedded in the PSC girder because the PS tendons were located in inside of PSC girder. The radial basis function network(RBFN), one of the machine learning algorithm, was used to estimate the tensile force using the variations in magnetic hysteresis. To verify the proposed method, the in-field tests were performed. The embeddable EM sensors were embedded into PSC girder specimen and the magnetic hysteresis changes due to the variations in tensile forces were measured at different tension state. The tensile forces were estimated using trained RBFN and they compared with reference tensile forces measured by load cells which were installed at the end of girder. According to the measurement results, the proposed method can be a one of the solution to estimate the tensile force of PSC bridges.

Fig. 1 Installation of embeddable EM sensor

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