



Eddy current based evaluation of axial force of high-strength bolts

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Abstract

Many bridges have been in service for over 40 years and face to the repapering or reinforcing period due to deterioration. Particularly, in a high-strength bolts used for joints may be loosened due to co-rotation, corrosion, or vibration caused by the vehicles. Thus, it is important to evaluate an axial force of the high-strength bolts. In this research, an axial force evaluation of high-strength bolt using eddy current that does not require measurement preparation has been investigated. The eddy current method is capable of capturing the change in permeability of steel members due to the stress change. Further, the stress distribution of the bolt head is assumed uniform without directionality. Therefore, a numerical simulation and an experiment that measures the output signal of the eddy current probe while introducing axial force to the high-strength bolt has conducted.

Keywords: high-strength bolt; axial force; bolt head deformation; eddy current; lift-off.

1 Introduction

High-strength bolted joints that enable easy construction, maintenance and replacement are widely used in steel bridges. However, bolts may be loosened due to co-rotation during tightening, corrosion, or vibration caused by the passage of vehicles, so that the designed axial force may not be obtained [1]. Loose bolts affect not only partial damage but also the safety of the entire bridge structure. Therefore, loosening of high-strength bolts such as spliced parts is a report matter in inspection, and many reports have been confirmed.

There have been many studies on the axial force evaluation of high-strength bolts, such as methods using ultrasonic waves [2], strain gauges or

hammering [3]. However, these methods have problems such as cost, need for surface treatment before inspection, and need of skilled engineers for inspection and evaluation respectively. It is considered to be able to apply an eddy current testing method used for detecting surface cracks as another applicable method [4]. The eddy current testing method is a method of evaluating an eddy current obtained by magnetizing an inspection target as a signal. It has an advantage that it can be performed without surface treatment. In addition, it can be easily performed by simply pressing the electromagnetic coil (probe) against the inspection surface.

In this research, a method to evaluate a residual axial force of high-strength bolt by applying the eddy current testing method was investigated with