Eddy current-based post-tensioning tendon tensile force estimation under varying temperature conditions

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In this study, an eddy current-based tensile force estimation technique was developed for a post-tensioning (PT) tendon under varying temperature conditions. The tensile force in the internal PT tendon was indirectly estimated using the strain level on the external anchor head surface. Based on the piezoresistive effect, a dual-coil probe consisting of two identical eddy current coils measuring the unidirectional loading levels in longitudinal and circumferential directions was designed and fabricated using a flexible printed circuit board (PCB). The relative phase variations on the eddy current signal induced by the external temperature were eliminated using identical signal alternations in both coils under temperature variation. The performance of the proposed technique was experimentally evaluated using a real scale 3.3 m-long mono-strand PT tendon with two anchor heads under varying loading and temperature conditions. In addition, the strain level estimated by the eddy current measurement was validated by installing conventional strain gauges on the anchor head surface. The distinctiveness of this study is reflected in the following aspects: (1) design and fabrication of a dual-coil probe for unidirectional loading level estimation in orthogonal directions, (2) elimination of the temperature effect on eddy current-based tensile force estimation, and (3) real-scale experimental validation under various loading and temperature conditions.