THESIS INFORMATION

INTRODUCTION

Thesis title:	**The influence of some main factors on the shear behavior of unbonded post-tensioned concrete beams shear-strengthened with CFRP/GFRP sheets.**
Major:	Civil & Industrial Construction
Major code:	62.58.02.08
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ABSTRACT

One of the common problems today in the construction field is repairing, restoring, or strengthening the bearing capacity of the degraded, damaged structure after a long time of use or due to changes in usability. With its attractive advantages such as lightweight, high tensile strength, corrosion resistance, non-magnetism, easy handling, retrofitting and/or strengthening RC structures with external fiber reinforced polymer (FRP) sheets are currently an effective and widely used solution in the construction field in recent decades besides traditional solutions. Among the behavior patterns of reinforced members using FRP material, the shear behavior of reinforced concrete (RC) or prestressed concrete (PC) members reinforced with FRP material is really complex and still not well understood. In the case of unbonded post-tensioned concrete (UPC) beams shear-strengthened with FRP sheets, the understanding of their shear behavior becomes even more limited because there are only a few uncomprehensive and inadequate studies available in the literature. Contemporary design guidelines for the shear resistance of PC beams retrofitted with FRP sheets are developed from the results of RC beams. The accuracy of these guidelines for calculating the shear resistance of PC beams wrapped with FRP sheets is still questionable due to the significant difference in the shear behavior of RC vs PC beams, particularly for UPC beams.

This dissertation presents a study on the shear behavior of UPC beams shear-strengthened with CFRP/GFRP U-wraps. Experimentally, the dissertation focuses on evaluating and clarifying the influence of several main factors such as tendon profile (harped or straight), concrete strength (38, 55, and 73 MPa), the shear span-to-depth ratio (1.5, 1.9, and 2.3), ratio and FRP type (GFRP and CFRP), wrapping configurations (installed as continuous and discrete strips), FRP anchors for FRP U-wraps (flat FRP anchor and improved FRP spike anchor) and analyses the interaction effect among these factors to the strengthening efficiency of the CFRP/GFRP sheets for UPC T-beams. The experimental program was conducted on 40 large-scale UPC T-beams shear-strengthened with CFRP/GFRP sheets. Theoretically, the dissertation examines, evaluates, and builds a model and proposes a new formula to predict the shear resistance of UPC beams shear-strengthened with CFRP/GFRP sheets with full consideration of shear resistance mechanisms and their interactions.

The research results show that the shear-strengthening efficiency of CFRP/GFRP sheets in UPC beams is much lower, up to only 27% compared to 75% of RC beams from existing studies. In comparison with the UPC beams with straight tendons, those with harped tendons exhibit a reduction in the shear contribution of CFRP/GFRP sheets (approximately 40%) and show a more ductile failure mode with an improvement of the beam deformation (up to 2.3 times) and energy absorption capacity (average 3.0 times). The use of an improved FRP spike anchor greatly increases the shear resistance of the CFRP/GFRP sheets (up to 118%), the deformation and energy absorption capacity of the beams (up to 28 and 57% respectively). Similarly, increasing concrete strength also significantly improves the above indicators but to a more modest level and CFRP/GFRP sheets are more effective with higher concrete strength. The factors of layer number, wrapping configurations (continuous or discrete strips), and FRP type (GFRP and CFRP) have only a slight influence on the shear resistance of the beams but have a significant effect on the maximum strain of the FPR sheets. The contribution in shear resistance of CFRP/GFRP U-wraps is significantly reduced (approximately 33%) when the shear span-to-depth ratio of the beams decreases. In the context that most of the existing formulas are proposed by using an empirical approach, the proposed formula in this dissertation, which is built by using the analytical method combined with experiments, has more closely reflected the physical nature of shear failure mode, incorporating it the constitutive laws of the materials, the equilibrium and the deformation compatibility as well as taking advantage of the simplicity of the traditional superposition principle. The test results show that the proposed formula gives results closer to the experiments and has better stability than formulas from ACI 440.2R-17 and CNRDT 200R1-13. The proposed formula can be used to design shear resistance for UPC beams for both FRP-strengthened beams and un-strengthened beams.

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