THESIS INFORMATION

INTRODUCTION

Thesis title:	**The compressive behavior of damaged reinforced concrete columns confined with CFRP and BFRP sheets**
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Major code:	9580201
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ABSTRACT

This study presents an experimental investigation on the effect of degraded concrete due to sulfate attacks and corroded longitudinal/transverse reinforcement on the behavior of reinforced concrete (RC) columns strengthened by CFRP and BFRP sheets. The main aims of this study include: (1) experimentally investigating and quantitatively evaluating the effect of sodium sulfate solution on the axial compressive behavior of CFRP-confined RC columns; (2) experimentally studying the effect of steel corrosion on the behavior of CFRP/BFRP-confined eccentrically-loaded RC columns; (3) analyzing the correlation between stirrups, longitudinal reinforcement, CFRP/BFRP sheets, as well as eccentricity and the behavior and loading capacity of columns; and (4) proposing a semi-empirical model to predict the load-carrying capacity of corroded RC columns strengthened with CFRP/BFRP under eccentric loading, which considers the corrosion level, eccentricity, and confining pressure. Two experimental programs are designed to fulfill the main aims of the study. The first program is carried out to study the effect of wet-dry cycles of sodium sulfate solution on the behavior of twenty-four CFRP-confined mid-scale square RC columns. The second program investigates the effect of corrosion level of longitudinal and transverse reinforcement, relative eccentricity, type of FRP sheets (CFRP and BFRP), and thickness of FRP sheets on the behavior of forty mid-scale square RC columns.

The experimental results on the effect of wet-dry cycles in a sodium sulfate solution showed that the sulfate attack significantly reduced the initial axial stiffness of the column by up to 36%. As a result, its ultimate axial displacement increased by up to 40%, and this increase tended to increase with the number of cycles and decrease with the increase of concrete strength and the number of CFRP layers. The sulfate attack considerably reduced the strength of the unstrengthened columns (up to 29.4%), but it only slightly affected the capacity of the strengthened columns with a 3.7% reduction. The strength reduction increased with the number of wet-dry cycles. CFRP confinement effectively mitigated the penetration of sulfate ions into the concrete core and slowed the degradation of strength by up to 90%; as a result, the capacity of the strengthened columns considerably increased (from 1.24 to 2.38 times), and this increase tended to decrease with the increase of concrete strength and the number of wet-dry cycles. CFRP sheets improved axial displacement (from 3 to 5 times), and this improvement was proportional to the number of CFRP layers. The experimental results show that the contribution of the CFRP sheet is from 18% to 46% of the total bearing capacity of the column; it tends to decrease with the increase of concrete strength, increases with the number of reinforcement layers, and is not significantly affected by the number of wet-dry cycles. Meanwhile, the contribution of the concrete core to the total bearing capacity of the column accounts for 54% to 82%.

Steel corrosion significantly reduced the load-carrying capacity of unstrengthened columns under eccentric loading (up to 23%), while it only slightly decreased the capacity of the strengthened columns (up to 11%) due to the excellent confinement effect of FRP sheets. CFRP/BFRP sheets have proven to have excellent strengthening efficiency, as the capacity of the FRP-strengthened corroded RC columns increased by up to 47%. However, the increase of the relative eccentricity from e/h=0.125 to e/h=0.375 reduced the strengthening efficiency of FRP.

A semi-empirical model, considering the effect of eccentricity, corrosion level, and FRP thickness, was proposed to predict the capacity of corroded RC columns strengthened with FRP sheets under eccentric loading. The predictions matched well with the experimental results, with a small coefficient of variation. It is worth mentioning that the number of experimental results of corroded reinforcement concrete columns is very limited. Therefore, more studies on this topic are deemed necessary to provide more useful data

and analysis so that CFRP/BFRP confinement can be applied to corroded reinforcement RC columns with high confidence.

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