



Experimental study on PVC-CFRP confined concrete columns under low cyclic loading

Feng Yu^a, Guoshi Xu^a, Ditao Niu^b, Anchun Cheng^a, Ping Wu^a, Zhengyi Kong^{a,*}

^a Dept. of Civil Engineering and Architecture, Anhui University of Technology, China

^b Dept. of Civil Engineering, Xi'an University of Architecture and Technology, China

HIGHLIGHTS

- Different failure modes of PVC-CFRP confined concrete columns under low cyclic loading were found.
- The effect of the axial compression ratio, shear span ratio, and hoop spacing of CFRP strips on the ultimate bearing capacity was established.
- The effect of the axial compression ratio, shear span ratio, and hoop spacing of CFRP strips on the strain evolution was established.
- The effect of the axial compression ratio, shear span ratio, and hoop spacing of CFRP strips on the ductility capacity was established.

ARTICLE INFO

Article history:

Received 15 October 2017

Received in revised form 26 March 2018

Accepted 12 May 2018

Keywords:

PVC-FRP confined concrete
Cyclic behavior
Axial compression ratio
Shear span ratio
Hoop spacing of CFRP strips
Failure mode
Ultimate bearing capacity
Ultimate strain
Ductility capacity

ABSTRACT

This paper presented an experimental study on the failure mode, ultimate bearing capacity and ductility capacity of PVC-CFRP confined reinforced concrete columns subject to low cyclic loading. Several parameters, such as the axial compression ratio, shear span ratio, and hoop spacing of CFRP strips were considered in the analysis. The results showed that all columns at low axial compression ratio failed by bending. The long and short columns with large hoop spacing at high axial compression ratio failed by flexural shear while the short columns with small hoop spacing at high axial compression ratio failed by shear. The ultimate bearing capacity increased as the axial compression ratio increased or the shear span ratio decreased while the ultimate bearing capacity decreased as the hoop spacing of CFRP strips increased. The ultimate strains located at the bottom of the column increased as the axial compression ratio increased while the ultimate strains decreased as the shear span ratio increased. The confining effect of CFRP strips increased gradually as the hoop spacing of CFRP strips decreased. The ductility capacity decreases as the axial compression ratio or the shear span ratio increased while the ductility capacity increases as the hoop spacing of CFRP strips increased.

© 2018 Elsevier Ltd. All rights reserved.

1. Introduction

Fiber reinforced polymer (FRP) materials, such as Carbon Fiber Reinforced Polymer (CFRP), Glass Fiber Reinforced Polymer (GFRP), and Aramid Fiber Reinforced Polymer (AFRP), have been widely used in repairs and rehabilitation works as they have some advantages: high strength, light weight, corrosion resistance, and convenient construction [1–6]. With the development of FRP, FRP composites, a new type of hybrid structure, have been proposed and explored by several researchers for the possible application

on the construction of new building [4,7–12]. PVC-CFRP confined reinforced concrete column consisted of a PVC-CFRP tube, steel bar and concrete is such a new type of hybrid structure [13,14]. The PVC tube is formed by winding CFRP strips around a PVC tube with certain spacing. Steel bars are embed in the PVC-CFRP tube, which is finally filled with concrete. For this new type of column, the PVC tube effectively avoiding the early crush of concrete can be used as a formwork for construction due to its rigidity. As pointed out by Kurt and Wang et al., PVC confined concrete columns can improve the ductility, but the increment of carrying capacity is not obvious due to weaker strength of PVC [15,16]. The intermittent CFRP strips winding the PVC tube will effectively strengthen the PVC tube. As a result, the PVC-CFRP confined reinforced concrete column shows excellent mechanical and durability

* Corresponding author.

E-mail addresses: yufeng2007@126.com (F. Yu), niuditao@163.com (D. Niu), zsh2007@ahut.edu.cn (Z. Kong).

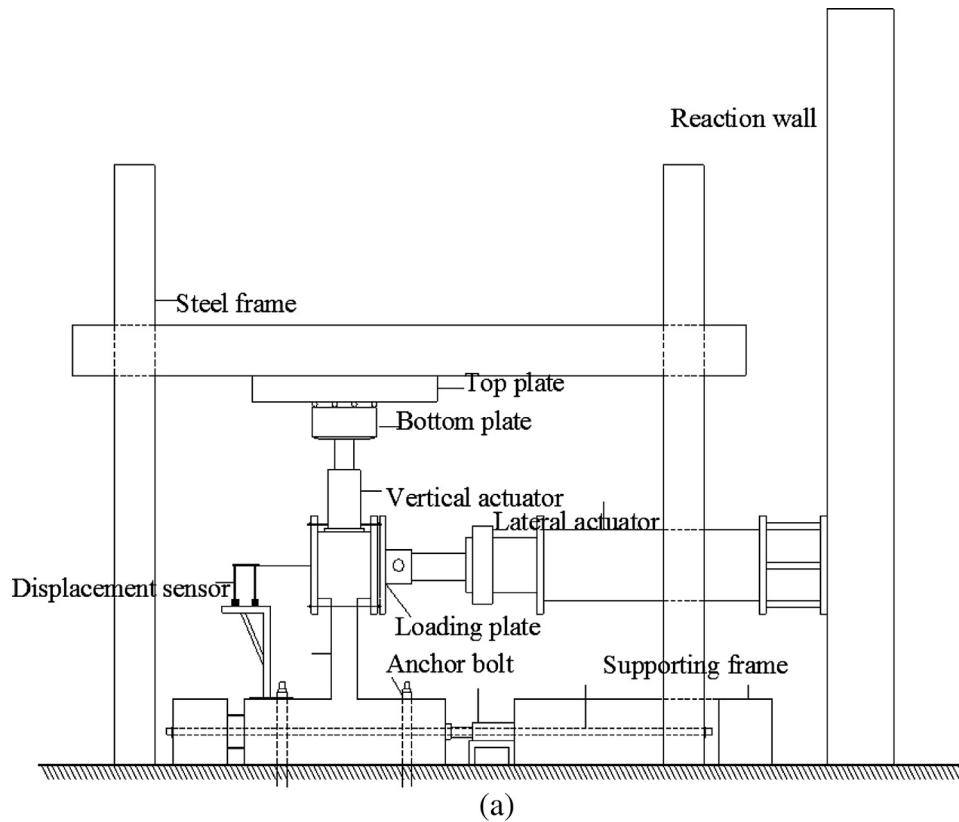


Fig. 1. Test set up.

performance due to the combination of four different materials, such as steel, concrete, PVC and CFRP. The improvement of ductility and carrying capacity for PVC-CFRP confined reinforced concrete column has been confirmed by Yu's experiments [14,17–19].

Saafi, Yu et al., Jiang et al., Fakharifar et al., and Toutanji et al. have carried out experiment to investigate the effect of several parameters (i.e., the hoop spacing of FRP strips, type of FRP, layers of CFRP, slenderness ratio, reinforcement ratio, and eccentricity) on the mechanical behavior of PVC-CFRP confined reinforced concrete columns under static loading [13,14,17–23]. The experimental

results show the core concrete of the column can be effectively confined by the PVC-CFRP tube, and the bearing capacity and ductility capacity are greatly improved.

However, few studies of mechanical behavior of PVC-CFRP confined reinforced concrete columns under cyclic loading have been performed. To the best of the authors' knowledge, only Jiang investigates the effect of the axial compression ratio and FRP types on the behavior of PVC-CFRP confined concrete columns under low cyclic loading [24]. The experimental results show the columns have excellent seismic resistance. However, the other important parameters, such as the shear span ratio and

Download English Version:

<https://daneshyari.com/en/article/6712977>

Download Persian Version:

<https://daneshyari.com/article/6712977>

[Daneshyari.com](https://daneshyari.com)