DOI: 10.21276/sjet.2017.5.3.4

Scholars Journal of Engineering and Technology (SJET) **ISSN 2321-435X (Online)**
Sch. J. Eng. Tech., 2017; 5(3):96-98 **ISSN 2347-9523 (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Research Article

Effect of Concrete Strength on the Mechanical Properties of GFRP Reinforced Concrete Column

Yun-feng Zhang, Shuo Yang, Jia-nan Chen
Professor, School of Civil Engineering, Northeast Petroleum University, Daqing 163318, China

***Corresponding author**
Yun-feng Zhang
Email: 523762734@qq.com

Abstract: GFRP tube reinforced concrete column is a new type of composite column. In this paper, finite element analysis of three kinds of concrete strength grades is carried out by ANSYS finite element software, the influence of concrete strength grade under axial compression on the mechanical properties of GFRP steel reinforced concrete columns was studied. The results show that with the increase of the concrete strength grade, the bearing capacity of the structure is enhanced, but the ductility is deteriorated.
Keywords: GFRP; concrete strength; ANSYS; bearing capacity.

INTRODUCTION

In recent years, GFRP steel reinforced concrete column are widely used in many practical projects as a new type of composite columns. Compared with the traditional forms of concrete short columns, many aspects have been improved , and once applied to the actual project, it will bring huge economic benefits [1, 2]. At present, there are many experiments and research on the kind of composite column, but we still do not have the same conclusion [3, 5]. In this paper, through the ANSYS finite element analysis software, the effect of concrete strength grade on the mechanical properties of GFRP steel reinforced concrete columns was analyzed.

SIMULATION SPECIMEN DESIGN

In order to study the mechanical properties of GFRP steel reinforced concrete columns under different concrete strength conditions, select concrete strength are C30, C40, C50, three groups of specimens are respectively A, B, C. The design parameters of the simulated specimen are shown in table 1.

Table 1: simulation specimen parameter table

Specimen number	Diameter (mm)	Height (mm)	Thickness of GFRP tube(mm)	Concrete strength	Reinforcement Ratio(%)
A1	100	300	4	C30	7.2
A2	150	450	4	C30	7.2
A3	200	600	4	C30	7.2
B1	100	300	4	C45	7.2
B2	150	450	4	C45	7.2
B3	200	600	4	C45	7.2
C1	100	300	4	C60	7.2
C2	150	450	4	C60	7.2
C3	200	600	4	C60	7.2

ESTABLISHMENT OF MODEL

In the use of Ansys software for finite element analysis, GFRP tube selected Solid45 solid unit, the concrete material is selected Solid65 solid unit, the steel material is selected Solid 45 solid elements. The specific process of geometric model is set up as shown in figure 1.

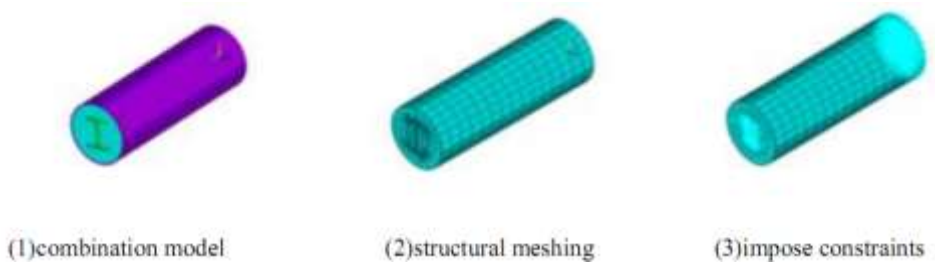

Fig-1: Combined column model

FINITE ELEMENT ANALYSIS

Analysis of bearing capacity and ultimate stress

It can be seen from Table 2 that the bearing capacity of the three sets of composite specimens increases with the increase of the concrete grade. And the ultimate stress of the specimens of group A is 116.39MPa, 92.38MPa and 78.08MPa .The ultimate stress of the specimens of group is 120.9MPa, 98.91MPa and 86.34MPa. The ultimate stress of the specimen is 125.40MPa, 102.89MPa and 90.98MPa. It shows that the geometric similar specimen decreases with the strength grade of the concrete, and the bearing capacity is not linearly changed.

Table 2: Comparison of bearing capacity of different size components

Specimen number	Concrete strength	Thickness of GFRP tube(mm)	Calculate bearing capacity	Actual bearing capacity	Ultimate stress(MPa)
A1	C30	4	729	778	116.39
A2	C30	4	1410	1457	92.38
A3	C30	4	2250	2294	78.08
B1	C45	4	768	808	120.9
B2	C45	4	1507	1555	98.91
B3	C45	4	24326	2478	86.34
C1	C60	4	806	845	125.40
C2	C60	4	1609	1638	102.89
C3	C60	4	2604	2631	90.98

Stress-strain curve analysis

Simulation of concrete strength were C30, C40, C50 three groups of specimens for specimens with axial stress-strain as shown in figure 2.

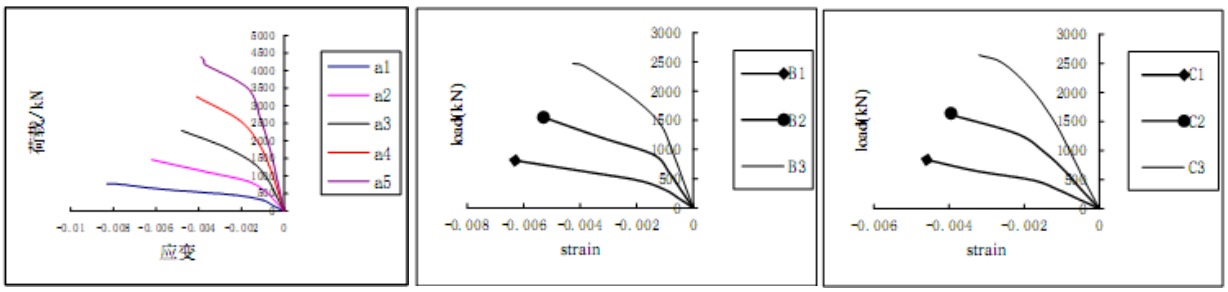

Fig-2: Comparison of load-strain curves of specimens

It can be seen from Fig. 2-2 that the axial load-strain curves of the GFRP steel reinforced concrete columns with similar geometries are different and can be regarded as three stages, namely, straight sections, curve segments and smaller straight lines. As the size of the specimen increases, the strain curve of the structure changes more and more obviously. When the same load, the strain of the small specimen is larger.

Compared with the concrete strength of C30, C45 and C60, we can see that when the concrete strength grade is high, the ultimate strain difference of the geometric similar specimen is small, which means that the concrete will be improved. So that the ductility of the specimen is improved; the same size of the specimen, the higher the strength of concrete, the smaller the ultimate strain, the worse the specimen ductility.

CONCLUSIONS

In this paper, nine kinds of GFRP steel reinforced concrete columns are simulated by axial compression, and the numerical results and load-strain curves are analyzed. The main conclusions are as follows.

1.When the strength grade of concrete is the same, the bearing capacity of GFRP steel reinforced concrete columns increases nonlinearly and the ultimate stress decreases.

2.In the case of the same size of the specimen, the higher the strength of the concrete, the stronger the carrying capacity of the structure, but the worse the ductility.

3.In the case of low concrete strength, the effect of concrete strength on the structure is more significant. When the concrete strength is high, the actual value of bearing capacity is closer to the theoretical value. It is suggested that the concrete strength grade C45 is more reasonable.

REFERENCES

1. Owen LM. Stress-strain behavior of concrete confined by carbon fiber jacketing. Seattle: University of Washington, 1998.
2. Yue QR, Yang YX, Li R. FRP and its application in fiber reinforced composites. The 14th National Symposium on Concrete and Prestressed Concrete. 2007;49-56.
3. Teng JG, Huang YL, Lam L. Theoretical model for fiber reinforced polymer-confined concrete. Journal of Composites for Construction ASCE. 2007;11(2):201-210.
4. Pessiki S, Harries KA, Kestner JT, Sause R, Rides JM. Axial behavior of reinforced concrete columns confined with FRP jackets. Journal of Composites for Construction, 2001;5(4):237-245.
5. Rujikake K, Mindess S, Xu HF. Analytical model for concrete confined with fiber reinforced polymer composite. Journal of composites for construction. 2004;8(4): 341-351.