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Research Article

Effect of Concrete Strength on the Size Effect of Reinforced Concrete Circular Column Confined By GFRP Sheet

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Abstract: The finite element analysis by ANSYS finite element software is carried out on the three kinds of concrete strength specimens to explore the influence of concrete strength on the size effect of reinforced concrete circular column confined by GFRP sheet under axial compression. The results show that with the increase of concrete strength, the size effect of reinforced concrete circular column confined by GFRP sheet will be significantly weakened.
Keywords: concrete strength; GFRP sheet; size effect; ANSYS.

INTRODUCTION

Reinforced concrete columns are widely used in practical engineering, but the new composite columns are also developing continuously. In recent ten years, many scholars are put into research work of FRP confined concrete component [1-3], the component of composite columns, effectively reduce the weight of the structure, also slow down the pillars of the concrete aging [4]. Column confined by FRP on force performance is researched by many experimental and theoretical. However the influence of concrete strength on the size effect of reinforced concrete circular column confined by GFRP sheet in the study has yet to be resolved.

In this paper, through the ANSYS finite element analysis software, the size effect of reinforced concrete circular column confined by GFRP sheet is studied, and the effect of concrete strength on the size effect is analyzed.

SIMULATION SPECIMEN DESIGN

In order to study the size effect of reinforced concrete circular column confined by GFRP sheet under the conditions of different strength of concrete, select reinforcement rate was 1.2%, GFRP sheet volume allocation rate was 0.069, 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		Specimen scantling (mm×mm)	Concrete strength	Reinforcement Ratio (%)	Total thickness of GFRP sheet (mm)	GFRP sheet volume allocation rate ρ
A	A1	150×450	C30	1.2	2.601	0.069
	A2	200×600	C30	1.2	3.468	0.069
	A3	250×750	C30	1.2	4.335	0.069
B	B1	150×450	C40	1.2	2.601	0.069
	B2	200×600	C40	1.2	3.468	0.069
	B3	250×750	C40	1.2	4.335	0.069
C	C1	150×450	C50	1.2	2.601	0.069
	C2	200×600	C50	1.2	3.468	0.069
	C3	250×750	C50	1.2	4.335	0.069

$\rho=4n\cdot t/D$; n=layers of GFRP sheets; t=thickness of single layer of GFRP sheet; D=diameter of Specimen.

ESTABLISHMENT OF MODEL

The finite element model established in this paper is a separate model without considering the slippage between the materials. The specific process of geometric model is set up as shown in figure 1. The mechanical parameters are set according to the existing literature with sufficient validity.

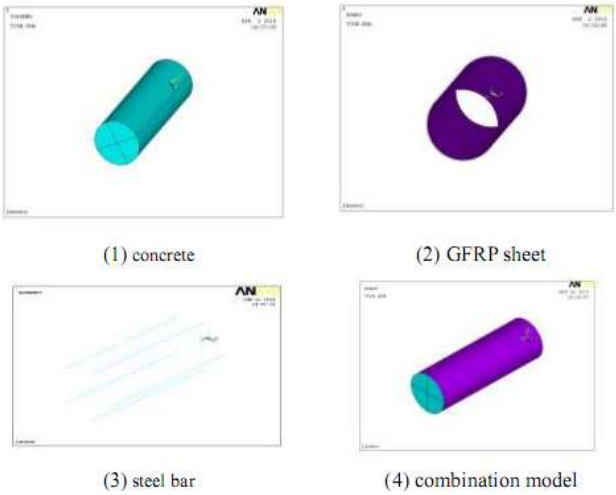


Fig-1: Establishment of geometric model

FINITE ELEMENT ANALYSIS

Ultimate compressive strength analysis

The ultimate compressive strength of specimens with different concrete strength is shown in table 2, and the broken line is shown in Figure 2.

From the table 2 show that the ultimate compressive strength of the specimens in each group is to reduce the law, which shows that the geometric similarity of the specimen, with the increase in size, the ultimate compressive strength decreases, there is a size effect.

Table 2: Ultimate compressive strength of specimens

Specimen number	Specimen scantling (mm×mm)	Concrete strength	Ultimate bearing capacity (KN)	Ultimate compressive strength (MPa)	Decrease amplitude (%)
A1	150×450	C30	521	29.61	—
A2	200×600	C30	878	27.96	5.57
A3	250×750	C30	1325	27.01	8.87
C1	150×450	C40	687	38.89	—
C2	200×600	C40	1179	37.58	3.37
C3	250×750	C40	1792	36.53	6.07
G1	150×450	C50	814	46.09	—
G2	200×600	C50	1408	44.85	2.69
G3	250×750	C50	2173	44.29	3.91

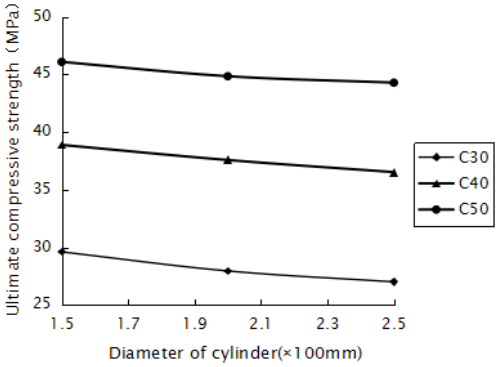


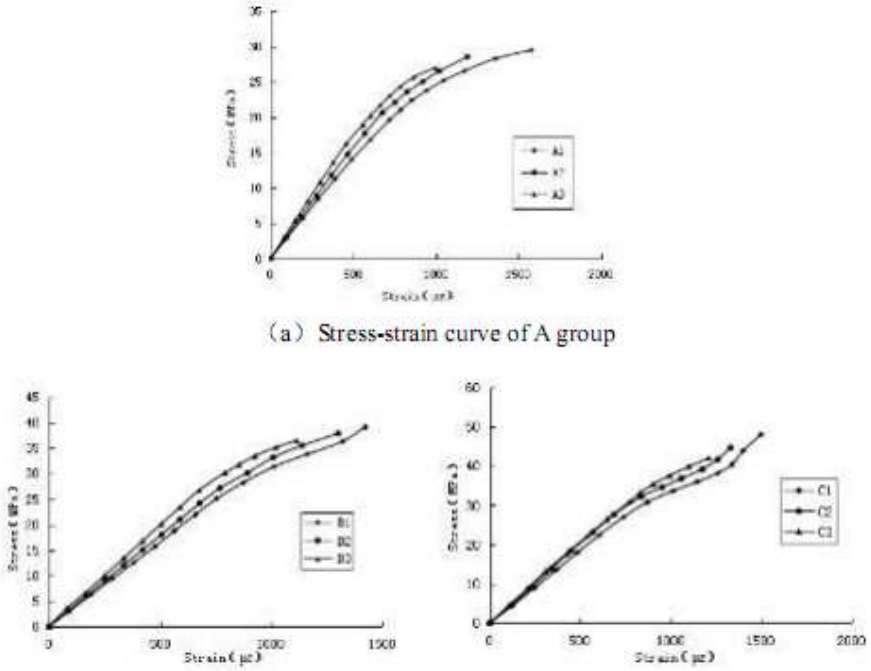
Fig-2: Ultimate compressive strength of specimens

As can be seen from Figure 2 the ultimate strength of the specimens decreases with increasing specimen size and no changes linearly. There are some discrepancies between the ultimate compressive strength of concrete with different concrete strength specimens, with the increase in size, concrete strength

of C50 specimens compressive strength decreases slightly, indicating that the concrete strength is higher, the size effect of reinforced concrete circular column confined by GFRP sheet will be significantly weakened.

Stress-strain curve analysis

C30, C40, C50 of the three groups of concrete strength specimens of the stress-strain diagram as shown in figure 3.



(a) Stress-strain curve of A group

Fig-3: Stress-strain curves of different concrete strength specimens

From figure 3 shows: geometric similar specimens of axial stress-strain curve have a certain difference, the greater the size of the specimens, the curve slope is greater, the strain value corresponding to the same stress is smaller. This shows that the larger the size, the stiffness of the specimen is larger, and the better GFRP sheet restraint effect. The ultimate compressive strength and ultimate strain of the specimen decrease with the increase of the size, which shows that reinforced concrete circular column confined by GFRP sheet with geometric similarity exists size effect, and the larger the size of the specimen, the worse the ductility.

At the same time, compared with A, C, G curve shows that: the higher the concrete strength, the difference of the ultimate compressive strength and the ultimate strain of geometric similar specimens is smaller, indicating that improve the concrete strength, the size effect of the specimen should be weakened.

CONCLUSIONS

In this paper, the numerical simulation of reinforced concrete circular column confined by GFRP sheet under axial compression is carried out, and the ultimate compressive strength and stress-strain curve were analyzed, the main conclusions are as follows:

1. Reinforced concrete circular column confined by GFRP sheet exists size effect, the specimen size is larger, the ultimate compressive strength and ultimate strain decrease, and the ductility is also worse.

2. The increase of concrete strength has a certain degree of improvement on the ultimate compressive strength of reinforced concrete circular column confined by GFRP sheet, but the size effect will obviously decrease.

3. The proposed in the research on mechanical performance of concrete combined component, in order to avoid the size effect on the test results, appropriate to increase the concrete strength, in order to reach the test results in large size component applicability.

REFERENCES

1. Owen LM; Stress-strain behavior of concrete confined by carbon fiber jacketing. Seattle: University of Washington, 1998.
2. Sutherland LS, Shenoi RA, Lewis SM; Size and Scale Effects in Composites: I. Literature Review. Composites Science and Technology, 1999; 59(2): 209-220.
3. Miyauchi K, Inoue S, Kuroda T, Kobayashi A; Strengthening effects of concrete column with carbon fiber sheet. Transactions of the Japan Concrete Institute, 2000; 21:143-50.
4. Lam L, Teng JG; Compressive strength of FRP confined in rectangular columns. Proceedings of the international conference on FRP composite in civil engineering, Hong Kong, 2001; 335-344.