Proceedings of the 7th International Conference on Mechanics and Materials in Design
Albufeira/Portugal 11-15 June 2017. Editors J.F. Silva Gomes and S.A. Meguid.
Publ. INEGI/FEUP (2017)

PAPER REF: 6419

A STUDY ON PSEUDO-STATIC BEHAVIOUR OF DOUBLE STEEL COLUMN FILLED BY UHPC

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ABSTRACT

Recent experimental studies have been showed that double I-section steel column system has many benefits in combination with concrete. Usually, double columns are constructed as spaced or closed. Filling the columns with concrete can improve the frame performance according to weak beam-strong column principle. Ultra High Performance Concrete (UHPC) that is a concrete with strength more than 150 MPa can be used in the spaced and closed columns for increasing the stiffness. So, in this research, numerical finite element models that can consider the behaviour of this combined UHPC and spaced column system are proposed. Also, cyclic performance of this system is investigated by study the energy absorption. Results showed that by changing the plain concrete inside the space columns to UHPC, ultimate bearing capacity of the columns increases significantly.

Keywords: UHPC, FEM, Double spaced columns, Energy absorption.

INTRODUCTION

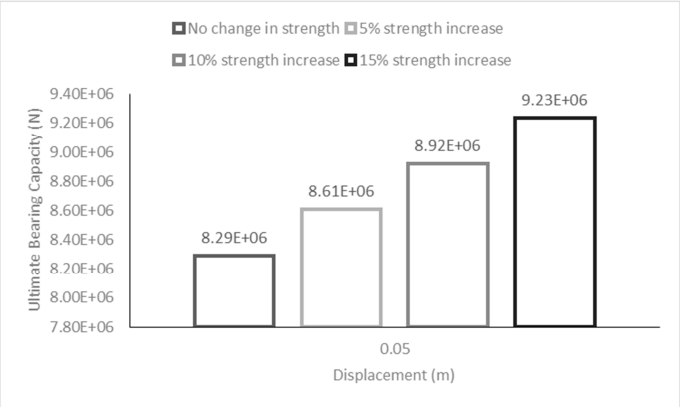
Composite steel-concrete construction has been widely used in many structures such as buildings. The concrete-encased composite column is one of the common composite structural elements (Wang, 2002). A method for estimation the ultimate strength of rectangular concrete-filled steel tubular stub columns under axial compression is proposed in recent researches and the ultimate strength of concrete core is determined considering a failure criterion of concrete under triaxial compression (Huang et al., 2008). Also, Example material constitutive models for concrete-filled tube columns of circular cross section are proposed in (Hu et al., 2010). Different column lengths, sectional sizes and infill concrete strength are used to quantify the effect of member geometry and constituent material properties on the structural behaviour of columns in recent researches and new equations were proposed and used to predict the capacities of elliptical CFT columns (Jamaluddin et al, 2013). Also, Tests on concrete-filled elliptical hollow section beam-columns have been directed to examine their important structural behaviour. The results of experiments and the provisions of the European Standard for determining the ultimate load of concrete-filled circular and rectangular hollow section columns have been compared. It was concluded that for designing concrete-filled elliptical hollow section columns the predicted resistances are safe (McCann et al., 2015).

In this paper, numerical models of UHPC filled double spaced columns have been proposed by finite element program ABAQUS and the results has been verified by recent experimental researches. Parameters like ultimate bearing capacity under monotonic and cyclic load and energy absorption of the column are investigated and the effects of changing the concrete strength and the space between the battens of double spaced column are studied.

RESULTS AND CONCLUSIONS

The results of investigating the effect of changing UHPC strength on the ultimate bearing capacity of double spaced column are shown in Fig. 1. As shown in this figure, with 15 % increase in UHPC strength, ultimate bearing capacity of column is increased by 11 %.

The effect of changing the number of battens of double column is proposed in the associated table. As shown in this table, with increasing 3 numbers of battens, ultimate bearing capacity of columns is increased by 2 percent.



Strength Changes of UHPC	Ultimate Bearing Capacity (MN)
No change	8.29
5 percent increase	8.61
10 percent increase	8.92
15 percent increase	9.23

Fig. 1 - Effect of changing UHPC strength

This study shows that ultimate bearing capacity of concrete filled double spaced columns is significantly increased in cyclic loading with changing the type of concrete from plain to ultra-high performance concrete.

REFERENCES

[1]-Wang, Y. C. (2002). Steel and composite structures: Behaviour and design for fire safety. Spon Press, Tylor & Francis Group, London and New York. 352 p.

[2]-Hu, H. T., Su, F. C., & Elchalakani, M. (2010). Finite element analysis of CFT columns subjected to pure bending moment. Steel and Composite Structures, 10(5), 415-428.

[3]-Huang, Y. S., Long, Y. L., & Cai, J. (2008). Ultimate strength of rectangular concrete-filled steel tubular (CFT) stub columns under axial compression. Steel and Composite Structures, 8(2), 115-128.

[4]-Jamaluddin, N., Lam, D., Dai, X. H., & Ye, J. (2013). An experimental study on elliptical concrete filled columns under axial compression. Journal of Constructional Steel Research, 87, 6-16.

[5]-McCann, F., Gardner, L., & Qiu, W. (2015). Experimental study of slender concrete-filled elliptical hollow section beam-columns. Journal of Constructional Steel Research, 113, 185-194.