The Asian Review of Civil Engineering
ISSN: 2249-6203 (P) Vol.7 No.2, 2018, pp.27-29

DOI: https://doi.org/10.51983/tarce-2018.7.2.2262

An Experimental Study on RCC Columns with PVC Tube Confinement with External Link

P. B. Prasanna Kumar[1], S. Kalaiselvi[2] and K. Jagadeesan[3]
[1]Student, [2]Professor, [3]Head (PG), Department of Civil Engineering,
Sona College of Technology, Salem, Tamil Nadu, India
E-Mail: Prasannapbp2@gmail.com, kalai_tptc@yahoo.co.in, Jaganmoorthi24@gmail.com

Abstract - **This paper presents the behavior of RCC columns with PVC tube as external confinement with and without external links. An experimental investigation was carried out to predict the load carrying capacity, energy absorption capacity and confinement of columns with and without external links. The parameters investigated were spacing of the external links of 90 mm c/c and 180 mm c/c. Columns were tested by using loading frame. It is observed that depending upon the spacing of external links along with the PVC tube confinement, the load carrying capacity of the column becomes increased. The spacing of external links along with the PVC tube confinement plays an important role in enhancing the load carrying capacity of the column. Columns with external links spaced at 180 mm apart showed an increase in the ultimate load carrying capacity by 140% to 150%, and columns with 90 mm spacing of external links exhibited an increase in the ultimate load (at which failure occurred) by about 180% to 184%.**
Keywords: **Concrete, PVC tube, Ultimate Load, Energy Absorption Capacity**

I. INTRODUCTION

We studied the following literatures and are inspired by the earlier researcher's works. We present brief literatures relevant to this experimental study. To conduct this study we refer the following literatures to understand the performance of RCC columns with various types of confinements. Gardner and Jacobson *et al.,* carried out experimental tests on CFST short columns under axial compression. Test results showed that the behavior of CFST columns loaded on entire section was significantly affected by the dilation properties of steel tube and concrete [1]. Lee et al introduced a new type of column with composite grids with experimental testing and computational modeling. It was shown that the compressive strength of concrete could be improved by the confinement provided by the composite grids [2]. Prabhu *et al.,* and Sundarraja *et al.,* carried out experimental test on CFST columns with Fibre Reinforced Polymer (FRP) wraps. The test results show that the local buckling of the steel tube was suppressed by the FRP wraps, thus the local buckling resistance increased. Since the FRP wraps could provide additional confining stress to the concrete, the strength and ductility were enhanced. Therefore, the FRP wrap was considered to be highly effective in improving the axial compressive behavior of CFST columns [3]. The load carrying capacity of column with unplasticised polyvinyl chloride tubes filled with concrete was investigated by Usha C. M. *et al.,* It was observed that the strength capacity increased with increase in length [4].

N Balasubramani *et al.,* and R.Thenmozhi *et al.,* conducted experimental studies on six specimens of Double Skinned Hollow Concrete Filled steel Tubular (DSHCFT) columns consisting of PVC inner pipe and mild Steel outer pipes in-filled with Self Compacting Concrete (SCC). The significant feature of this construction was that pvc pipe was employed as an alternative for mild steel pipe. DSHCFST columns were found to be suitable for moderate load conditions [5]. Abhale.R.B *et al.,* and Kandekars.B *et al.,* introduced a new type of column consisting of tube filled with concrete. Experiment results showed that interaction between PVC tube and concrete produced local buckling, the PVC tube delayed the restraint of concrete and the strength of concrete was increased by the confining effect of the PVC tube [6]. Load carrying capacity of R.C.C Columns with different diameters and thickness of PVC tube were investigated by Kumutha *et al.,* and Vijai *et al.* Experimental results showed that the compressive strength, load carrying capacity and energy absorption capacity increased as the thicknesses of PVC pipes increases [7].

II. EXPERIMENTAL INVESTIGATION

A. Materials

Ordinary Portland cement having a consistency of 31%, initial setting time of 25 minutes was used in the casting of specimens. Locally available river sand having a specific gravity of 2.5 and fineness modulus of 2.52 was used. Coarse aggregate of maximum size 20 mm and specific gravity of 2.81 and fineness modulus of 7.45 was used. Potable water was used for the concrete preparation and for the curing of specimens. Mix ratio of 1:1.46:2.79 with a w/c ratio of 0.45 was adopted. RCC columns were confined with PVC tube with and without external links.

B. Details of Test Specimens

Five column specimens of size 190 mm diameters and 1.50 m height were cast and used in the experiments. One specimen was kept as a control specimen. PVC tube of 5 mm thickness was used. The diameter of the longitudinal reinforcing bar was 12 mm and 6 bars were used. Bars of 8mm diameter were used as lateral ties at a spacing of 180 mm c/c. Cross sectional dimensions of column was shown in Figure.1

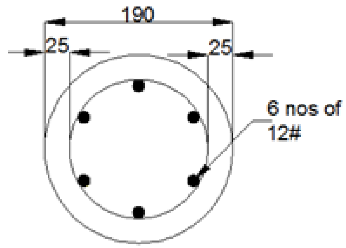


Fig. 1 Reinforcement details of R.C.C column

III. TESTING OF SPECIMEN

A. Experimental Setup

Tests were conducted by using Loading Frame to determine the load carrying capacity of the columns. Experimental setup was depicted in Figure 2. The column specimens were simply supported and axially loaded. A dial gauge was placed at the bottom of the column, and then load was applied by using hydraulic jack 2000 kN capacity. Loading was carried out in gradual increments and deflections in the dial gauge were noted for every load increment. The load at which the column failed was noted and taken as the ultimate load carrying capacity of the column. As soon as the ultimate load was realized the hydraulic jack began to fall.

Fig. 2 Experimental setup

B. Testing of Column Specimens

The effective length of the each column specimen was 1.5m and the diameter was 190mm. Each column specimen was reinforced with 6 pieces of 12mm diameter main bar and 8mm lateral ties placed at 180mm c/c. of the five specimens, one column specimen kept as conventional specimen, two specimens were provided with external ties as confinement at 180mm spacing and tested. In the remaining two specimens external ties as confinement were provided at 90mm spacing. Axial load was gradually applied to the column specimens. Deflection readings were taken at regular intervals of loading. The loading was continued up to ultimate load level.

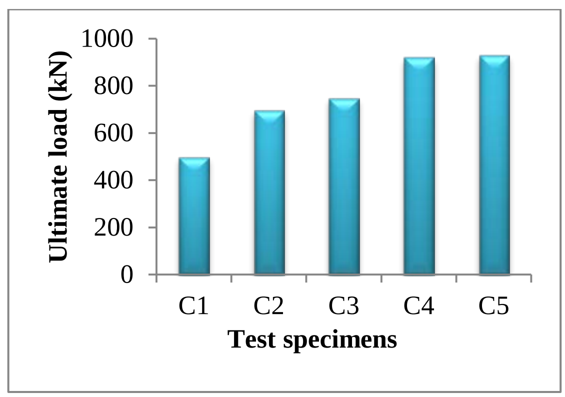
IV. TEST RESULTS

A. Ultimate Load of R.C. Columns

The load carrying capacity of columns is shown in Table I. From the test results it can be seen that the confinement of columns with PVC tube confinement along with external links increases the load carrying capacity of columns. It is observed that depending upon the spacing of external links along with PVC tube confinement, the load carrying capacity increased. Columns with 180 mm spacing of external links increase the ultimate load by 140% to 150% and Columns with 90 mm spacing of external links showed an increase in the ultimate load by 180% and 184%.

TABLE I COLUMN SPECIMEN DETAILS WITH ULTIMATE LOAD

S. No.	Test Specimens	Ultimate Load (kN)
1	C1	500
2	C2	700
3	C3	750
4	C4	920
5	C5	930



C2 & C3 = 180mm spacing of external links,
C4 & C5 = 90mm spacing of external links

Fig. 3 Ultimate load vs. spacing of External Links

B. Energy Absorption Capacity

Energy absorption capacity is determined by calculating the area that fall under the load deflection curve corresponding to ultimate load. Load deflection curves in respect of the five column specimens are depicted in Figure3. From the load deflection curves, it is found that the energy absorption capacity of the PVC confinement columns increases with reduction in spacing of external links.

Column specimens with external links fastened at a spacing of 180mm and 90mm show an increase in their energy absorption capacity by 288% and 485.5% respectively as compared to that of conventional column specimen (C1). It is summarized that lesser the spacing of external links, the greater is the energy absorption capacity.

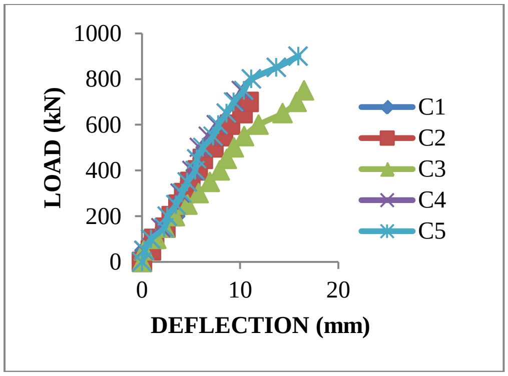


Fig. 4 Load vs. Deflection curve for columns with various external confinement links

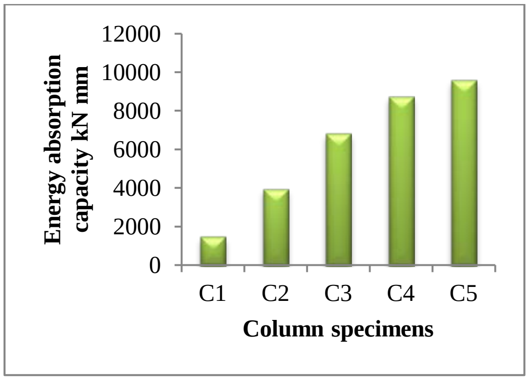


Fig. 5 Energy absorption capacity of columns with external confinement links

V. CONCLUSION

Five specimens of RCC columns with PVC tube as external confinement and with or without external links were experimentally tested for their compressive strength load carrying capacity, and energy absorption capacity. From the experimental test results, the following findings are drawn.

1. RCC column with external PVC tube confinement considerably increases the load carrying capacity as well as energy absorption capacity of the column.
2. Compared to conventional column (C1), values of increase in load carrying capacity of columns with external links and without external links (C4 and C5) are 140%, 150%, 180%, and 184% respectively.
3. Values of increase in energy absorption capacity in respect of columns with external links C2,C3,C4 and C5 are 143%, 288.2%, 356.53%, and 485.53% respectively.
4. Spacing of external ties plays an important role. Columns with external ties spaced at 180 mm showed an increase in energy absorption capacity of about 143% and 288% respectively.
5. Column with external ties spaced at 90mm showed an increase in energy absorption capacity of about 356.53% and 485.53% respectively.
6. There was no buckling and crushing of column will takes with PVC tube confinement.
7. PVC tube can be used as a formwork as well as confinement in the construction of load bearing of R.C.C columns.
8. PVC tube protects the RCC column from corrosion.
9. Since the column is cast within the PVC tube, moisture is retained within the concrete. It facilitates self-curing process. Hence, additional curing may not be required.

REFERENCES

[1] N. J. Gardner and E. R. Jacobson, “Structural Behavior of Concrete Filled Steel Tubes”, *Journal of the American Concrete Institute*, Vol. 64, No. 11, pp. 404-413, 1967.

[2] S. W. R. Lee, Z. Li, L. Q. Cao, M. Chen, P. Tong and S. W. Tsai, “Analysis and Testing for Composite Grid Reinforced Concrete Columns”, *Proceedings of ASCE Structural Engineers World Congress*, San Francisco, CA, July 10-12, ASCE Paper, 1998.

[3] G. G. Prabhu and M. C. Sundarraja, “Behavior of concrete filled tubular (CFST) short columns externally reinforced using CFRP strips composite”, *Construction and Building Materials*, Vol. 47, pp. 1362-1371, 2013.

[4] C. M. Usha, H. Eramma, “Experimental Study on Concrete Filled, Unplasticised Poly Vinyl Chloride (UPVC) tubes”, *International Journal of Advanced Technology in Engineering and Science*, Vol. 2, pp. 331-338, 2014.

[5] N. Balasubramani and R. Thenmozhi, “Strength and deflection of axially loaded DSHCFT column shaving PVC inner - Steel outer pipes annularly in-filled with SCC M35”, *Indian Journal of Science and Technology*, 2015.

[6] R. B. Abhale, S. B. Kandekar and M. B. Satpute, “PVC Confining Effect on Axially Loaded Column”, *Imperial Journal of Interdisciplinary Research*, Vol. 2, pp. 1391-1394.

[7] R. Kumutha and K. Vijai, “External confinement of Plain and Reinforced concrete columns using PVC pipes”, *Proceedings of the 2nd Int. Conf. on Structural Architectural and Civil Engineering*, 2016.