International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 6 Issue 1, November-December 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Enhancement Properties of Circular Column with the Help of Compression Members Increase Their Ductility

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ABSTRACT

Conventional steel tied reinforcement may not provide superior confinement for reinforced cement concrete columns (RCC). Based on different experimental observations and theoretical literature review many materials like FRP, WWF etc. were used as reinforcements to increase the load bearing capacity and ductility of the structural members. So, one such material welded wire mesh (WWM) we have used in this project work in order to improve the confinement and ductility. This whole project aims to define how confinement and improvement in confinement will help compression members (Circular column) to increase their ductility. So, we used a welded wire mesh in addition to the previous reinforcement. Sample used were categorized in two categories, samples confined using conventional methods and others with improved confinement.

KEYWORDS: *Conventional, steel tied, ductility, wire mesh, confinement, reinforcement*

How to cite this paper: Shubham Shukla | Deeksha Shrotriya | A. K. Jha "Enhancement Properties of Circular Column with the Help of Compression Members Increase Their Ductility" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-1, December 2021, pp.1197-1201, URL: www.ijtsrd.com/papers/ijtsrd47998.pdf

IJTSRD47998

INTRODUCTION:

A compression member is an important component of reinforced concrete structures. Compression member such as column, in general, It can be defined as an element that carries direct axial stresses which result in compressive stress of such amount that these stresses largely have effect on its design. Both column & strut are compressive elements, the effective length of which is more than 3 times the least horizontal dimensions. When an element carries mainly axial stresses is vertical, it's called as a Column, while if it is inclined or horizontal, it's called as a 'Strut'. Depending upon structural or architectural requirements, Columns are mainly seen in shapes, i.e. (circular, rectangular, square, hexagonal, etc.). Concrete as we came to know through various experiments is stronger in compression. Therefore, mains bars or vertical steel rods are always provided in order to assist in carrying the direct loads. And there is set limit to provide that longitudinal steel in different shapes of column, whether it is taken into consideration of the type of load acting or not. And this is done to avoid tensile stresses formed due to some eccentricity of the loads acting longitudinal direction. Different sets of benchmarks that are listed in codes to provide the amount of maximum reinforcement, because reinforcement more than the upper limit may generate difficulties in pouring of concrete and compaction of the concrete. Vertical reinforcing bars are tied horizontally by ties or stirrups or welded joints at certain intervals so that the bars do not shatter or cause bulging.

TYPES OF COLUMNS

Columns on the basis of different arrangement of steel reinforcement and concrete designs are classified into four different types:-

A. **Columns with longitudinal reinforcement and lateral ties: -** when no lateral ties are used with main bars and when load is applied on such a column, the concrete bulges out laterally. The bars themselves act as along slender columns and therefore tend to buckle away from the column's axis. Due to this, tension is caused in the outside shell of the concrete which opens out. The failure usually takes place suddenly. In order to check this tendency, the longitudinal rebars are tied transversely, at a suitable interval, with the help of ties. These ties check the bars from buckling and also restrain the concrete from bulging action.

B. **Columns with longitudinal steel and spirals: -** each of the tie has to be spliced by lapping or By bending its ends around the main bar, which is quite troublesome. In order to overcome this difficulty, the longitudinal bars are tied continuously together with the help of spirals. The spirals so provided serve an additional purpose of laterally supporting the concrete inside and thus has confining effect on it.

C. **Composite columns**: - Reinforced with a centrally placed joist and four or more longitudinal bars. Other steel sections may also be used. However, composite columns are used only for heavy loads.

D. **Braced and unbraced Columns: -** In the greater part of the cases the segments are exposed to level burdens like breeze, seismic tremor and so forth. In the event that sidelong backings are given toward the finish of the segments, the parallel burdens are borne totally by the horizontal backings. Such sections are known as supported segments, different segments, where the sidelong loads must be opposed by them, notwithstanding hub loads and end minutes are named as unbraced segments.

Functions of reinforcements in a column

Longitudinal and transverse reinforcements are provided in a column. Figure 1.1 shows the both type of reinforcements.

Figure 1. reinforcement

Functions of reinforcement are briefly discussed as follows: -

1. **Vertical Reinforcement: -**

A. To distribute the axial compressive stresses in column.
B. To avoid tensile stresses formed in compression member due to: -
1. Whimsical stress.
2. Force acting at some point other than centre.
3. Horizontal load.
C. To avoid sudden shattering of the column.
D. To provide certain amount of malleability to the column.

2. **Horizontal Reinforcement: -**

A. To avoid longitudinal shattering of vertical reinforcement.
B. Avoid inclined stresses formed by horizontal shear formed by moment.
C. Restricting vertical reinforcement in their position at the time of pouring of concrete.
D. Confine the concrete, thereby avoiding vertical bars to shatter.

3. **perrikin (2001)** pivotal conduct of fortified solid segment bound with FRP coats. In these squares, round segments that were bound with FRP composite coats were exposed to monodriven pivotal stacking. Here upgrades or unjacketed solid individuals were contrasted and the jacketed solid individuals and results were produced. Axial stress strain behavior of FRP confined concrete was affected by factors like transverse dilation and effectively confined regions and areas that were confined and their relationships and inter-relationships of jackets of jacket properties were generated.

4. **Shan et al. (2007)** these all learned about the conduct of cementfilled cylinders and kept cement filled cylinders under rapid effect. As we as a whole realize that in everyday developments like development of extension, structures concrete filled tubulars are increasingly used. Specialist named Xiao as of late developed new cement filled cylindrical segment framework that was a short time later named as bound cement filled rounded framework. What's more, increasingly after that he demonstrated those solid filled rounded sections has effective ones by indicating different stacking tests on it thusly basic properties like high burden conveying limit, malleability under static stacking and furthermore under seismic stacking were demonstrated right. Utilizing a gas weapon all the effect tests were continued cement filled steel tubes and the bound cement filled steel tubes. Different testing

parameters were thought about like imprisonment subtleties and effect speed. Results demonstrated that soas to improve the dynamic effect conduct of cement filled sections efective horizontal imprisonment strategies were utilized. All the dynamic and static strain and the disappointment designs were talked about further in the diaries, examination was made in test results and the explanatory outcomes were completed utilizing LS-DYNA. Likewise, the engendering of the pressure designs was roughly same as anticipated before hypothetically

METHODOLOGY

MATERIAL AND SPECIFICATIONS

Material used for experiments are listed below with brief specifications: -

A. **Mould: -** for the experiment we used a circular mould that was having a height of 900mm and diameter 150 mm. Pictorial representations and front view of Auto-cad are shown below in figure 3.1 and 3.2 respectively.

B. **Cement: -** For experimental work we used OPC 43 Grade. Before using it for experimental work we did some basic tests as mentioned below : -

1. **IST & FST: -** consistency test in a cement paste is defined as the minimum amount of water that is required to form the cement paste. And practically if we talk about this test then if it vicat's apparatus needle reaches a depth of 33-35mm from the upper end, then it defines the consistency of the cement at that amount of water. This is also known as Ordinary consistency. Apparatus is shown bellow in Figure 3.4. Through all this experiment we found out the IST and FST of cement. The IST is the time elapsed between adding water to the cement to the time cement paste starts loosing plasticity. It came out be 40 min as per the experiment conducted in lab (As per IS-4031 it should not. And the FST of the cement. Final setting period is the period from adding water to the cement to the time when cement paste completely loses its plasticity. It came out to be 310min (As per Indian standards it should not exceed 600min.

PROBLEM FORMULATION

DESIGN MIX FO CONCRETE AND REINFORCEMENT

Preparation of Design Mix

Here design mix prepared was whole as per the guidelines provided by IS: 10262-2019. Basic material used and some material specifications has been listed below in table.

Table 1 Material specification

Material	Specification
Grade of concrete	M30
W/c Ratio condition	Severe
Grade of cement	OPC 43 Grade
Specific gravity of cement	3.10
Workability	100mm(slump)
Maximum size of CA	20mm
Specific gravity of CA	2.78
Water absorption of CA	1.4%
Aggregate Type used	Crushed stone angular aggregate
Type of fine aggregate used	Zone II Sand
Specific gravity of sand	2.47
Water absorption of fine aggregate	0.6%
Method of pouring	Hand pouring using Trowel

A. Target Strength for Mix Proportioning

Target strength of the M30 grade concrete is denoted as f'_{ck} and after calculating it came out to be 38.25 MPa. Therefore, the target strength of the concrete is 38.25 MPa.

B. Approximate Air Content

As we used maximum size of coarse aggregate 20mm so according to table 3 the expected to be 1% for 20mm ostensible most extreme size of total.

C. Determination of Water-Concrete Proportion

As per table 5 from IS: 456, we assumed severe exposure condition so here we consider w/c ratio of 0.45.

RESULT ANALYSIS

On testing all the samples under axial loading under the universal testing machine we found the compressive strength and deflection of each sample. Compressive strength values of each sample with respect to days has been tabulated below and graphical representation of load with respect to deflection value of each sample on the 28th day has been graphically represented.

Compressive strength values

The compressive strength value in kN of each sample (Case I, Case II and Case III) has been tabulated in table 5.1 with respect to time period. And graphical representation of data is shown in Figure 5.1 in the form of bar graph.

Table 2 Compressive strength Results

Specimen name	Compressive strength (kN)		
	7 DAYS	14 DAYS	28 DAYS
Case I – 5RS	430	597	663
Case II- 4RS	418	579	643
Case III-4RWS	465	644	716

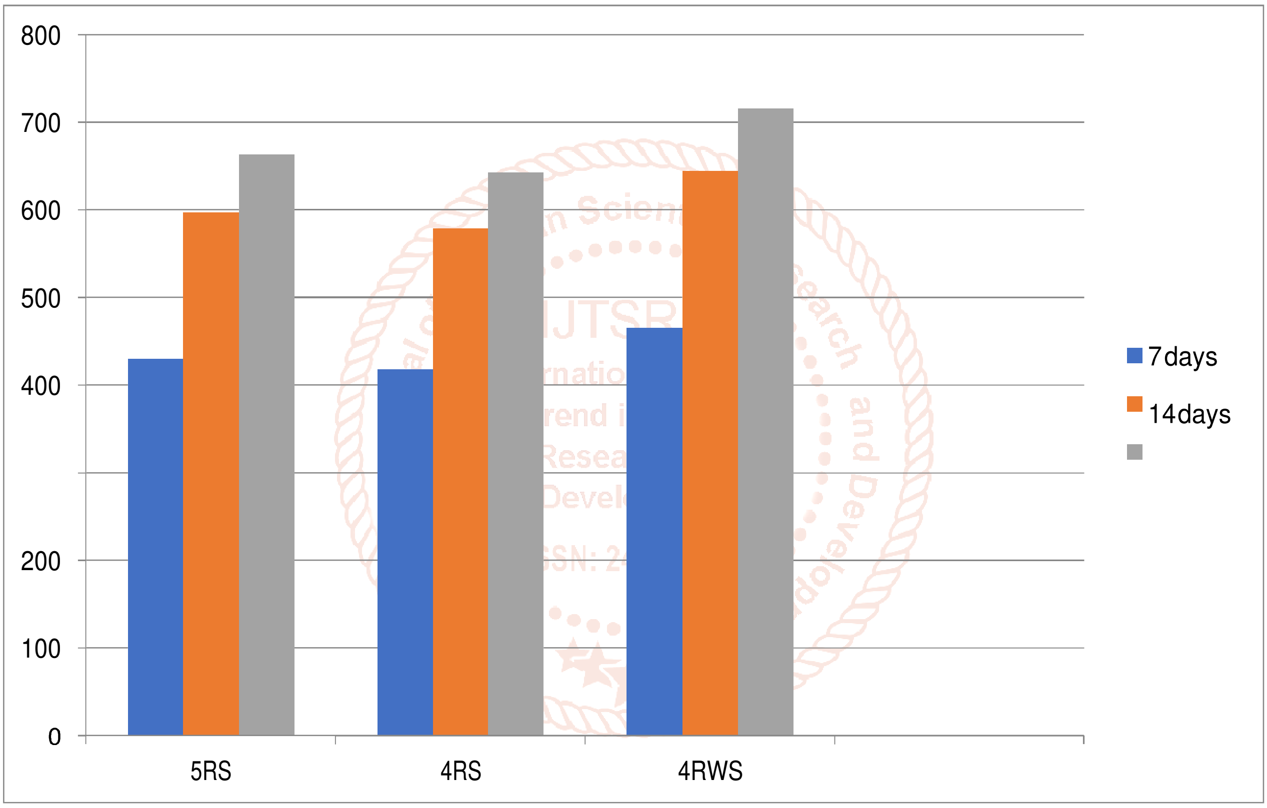

Figure 2 Compressive strength (kN)

REFERENCE

[1] ACI committee 549. Guide for the design, construction and repair of ferrocement. ACI Struct J 1988;85:325-51.

[2] Alcocer, S.M., Ruiz, J., Pineda, J.A. and Zepeda, J.A., 1996, June. Retrofitting of confined masonry walls with welded wire mesh. In *Proceedings of the Eleventh World Conference on Earthquake Engineering*.

[3] Al-Kaseasbeh, Q. and Mamaghani, I.H., 2019. Buckling strength and ductility evaluation of thin-walled steel tubular columns with uniform and graded thickness under cyclic loading. *Journal of Bridge Engineering*, *24*(1), p.04018105.

[4] Ayyub, B.M., Al-Mutairi, N. and Chang, P., 1994. Bond Strength of Welded Wire Fabric in Concrete Bridge Decks. *Journal of Structural Engineering*, *120*(8), pp.2520-2531.

[5] Cusson, D. and Paultre, P., 1995. Stress-strain model for confined high- strength concrete. *Journal of Structural Engineering*, *121*(3), pp.468-477.

[6] Eid, R. and Paultre, P., 2017. Compressive behavior of FRP-confined reinforced concrete columns. Engineering Structures, 132, pp.518-530.

[7] Elhady, I.A. and Elsayed, M., 2018. Jordan University of Science & Technology.

Technology, *12*, p.15.

[8] Fafitis, A. and Shah, S.P., 1985. Lateral reinforcement for high-strength concrete columns. *ACI special publication*, *87*, pp.213-232.

[9] GangaRao, H.V., Taly, N. and Vijay, P.V., 2006. *Reinforced concrete design with FRP composites*. CRC press.

[10] Ghalieh, L., Awwad, E., Saad, G., Khatib, H. and Mabsout, M., 2017. Concrete columns wrapped with hemp fiber reinforced polymer–an experimental study. Procedia engineering, 200, pp.440-447.

[11] Guler, S., Çopur, A. and Aydogan, M., 2013. Axial capacity and ductility of circular UHPC-filled steel tube columns. Magazine of concrete research, 65(15), pp.898-905.

[12] Kent, D.C. and Park, R., 1971. Flexural members with confined concrete.

[13] Mander, J.B., Priestley, M.J. and Park, R., 1988. Theoretical stress-strain model for confined concrete. *Journal of structural engineering*, *114*(8), pp.1804-1826.

[14] Mau, S.T., Holland, J. and Hong, L., 1998. Small-column compression tests on concrete confined by WWF. *Journal of Structural Engineering*, *124*(3), pp.252-261.

[15] Micelli, F., Cascardi, A. and Aiello, M.A., 2018, July. A Study on FRP- Confined Concrete in Presence of Different Preload Levels. In Proceedings of the 9th International Conference on Fibre-Reinforced Polymer (FRP) Composites in Civil Engineering—CICE, Paris, France (pp. 17-19).