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Confinement of RCC Circular Columns through Intermittent MS Rings

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ABSTRACT

Strengthening of Reinforced cement concrete (RCC) columns has now become one of the areas of study in construction industry across the world. One of the deficiencies in RCC columns is the lack of lateral confinement and low energy absorption capacity. Researchers are working on the techniques by which such deficiencies can be minimized during construction stage. The strength, ductility and energy absorption capacity of Confined RCC columns during construction can be enhanced by providing external confinement by employing Mild steel rings. This paper deals with determining experimentally. The safe loads for various confining patterns of plain M.S. rings on circular R.C.C. columns and to establish relation between different grades of concrete (M-20,M-25) in circular R.C.C.columns with confining architectural patterns. For this the R.C. concrete circular column specimens of 150 dia. were prepared. 45 no. of specimens were prepared for M-20 grade of concrete & 45 nos. of specimens were also prepared for M-25 grade of concrete. This paper also deals with to evaluate the effect of % of steel in confined circular R.C.C. columns and study of various failure modes.
Keywords: Confinement, Reinforced Cement Concrete, Circular Column, Mild Steel Ring

I. INTRODUCTION

Reinforced concrete is most widely used consumption material. In future too, it will continue to be material of choice for general construction. Congested reinforcement can lead to many problems of placing and compacting concrete. Beam-column joints are frequently areas of congestion in reinforced concrete construction. It has long been recognized that the strength and deformability of concrete substantially increase with the confinement of various types. One of the deficiencies in concrete column is the lack of lateral confinement & low energy absorption capacity. The strength, ductility & energy absorption capacity of new concrete columns during construction can be enhanced by providing external confinement by employing steel, UPVC pipes & welded wire fabric.

Continuous confinement has increased the load carrying capacity of columns. But to provide continuous confinement has various implications like cost, implementation etc. Hence in this work mild steel rings are used as confinement material.

II. METHODS AND MATERIAL

MATERIALS

(i) **Concrete:**The concrete mix used with the following specification of constituting materials-

1. Cement (OPC 43 Grade)
2. Sand-Narmada River sand
3. Coarse aggregate-Maxi. Size of aggregate will be 12 mm.

The two mixes M-20 and M-25 grades are used in the work.

(ii) **Reinforcement:** Deformed reinforcing bars with yield strength (f_y) of 415 Mpa are used.
The three different categories of cages are 6 nos. Of 8 dia., 10 dia. &12 dia. Bars as vertical R/F of column.
(iii) **Mild steel:** Mild steel rings (Fy 250 Mpa) of different thicknesses & of 15 mm width are used in the work.

METHOD

The R.C. concrete circular column specimens of 150 dia. were prepared.45 no. Of specimens were prepares for M-20 grade of concrete & 45 nos. Of specimens were also prepared for M-25 grade of concrete. For each grade of concrete (M-20 & M-25) the different variables were-

(i) Ring thickness (3 mm and 4 mm)
(ii) Different % of steel-The three types of cages were binded. In I CAGE CATEGORY main vertical R/F as 6 nos. Of 8 dia. Bars, in II CATEGORY main vertical R/F as 6 nos. Of 10 dia. Bars, in III CATEGORY main vertical R/F as 6 nos. Of 12 dia. Bars. (These represent different % of steel in column specimens.)
(iii) Different spacing between Mild steel rings-Two types of spacing was used.

Specimens for no confinement case were also cast. These specimens were tested under axial compression loading.

III. RESULTS AND DISCUSSION

The results of every pair of column specimens (three specimens in individual category) varied within 15 % .therefore the average results of each pair of tested circular column specimens were considered. Table 1 summarizes the ultimate load, the maximum axial deflection and maximum lateral deflection for M-20 and M-25 grade of concrete respectively. Fig 1 and Fig 2 shows the failure modes and crack pattern of tested specimens.

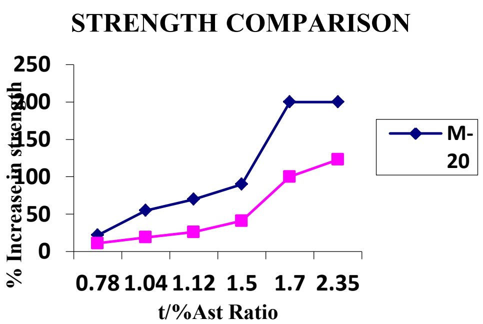

Figure 1. Graph showing strength comparisons for M-20 and M-25

Figure 2. Failure mode for circular RCC Column specimens

Figure 3. ultimate failure mode for RCC circular column

Table 1

CATEGORY		CAGE I			CAGE II			CAGE III		
		A	B	C	A	B	C	A	B	C
CONC M-20	**P (R= 3MM)**	160	477	509	207	356	426	277	339	388
	P (R= 4MM)	160	503	576	207	401	429	277	433	452
CONC M-25	**P (R= 3MM)**	251	501	530	304	386	484	396	443	503
	P (R= 4MM)	251	562	609	304	431	480	396	473	568

A=No confinement, B=Spacing type I, B=Spacing type II
Cage I=8 Dia cage, Cage I=10Dia cage, Cage I=12Dia cage, R=Thickness of MS Rings

Crack Pattern

Vertical longitudinal cracks were seen for most of the specimens of circular RCC columns. The failure started at about 85-90% of ultimate load. The specimens showed significant plastic failure Mostly specimens failed due to crushing of concrete from outer shell and associated further with larger deformations from cage too.

Mostly crack width was in between 1 to 3 mm.
In most of cases the length of cracks was interrupted by the position of MS ring in the vicinity.
It was observed that mostly cracks were seen uniform, both diametrically and longitudinally.

IV. CONCLUSION

For M-20 and M-25 grade of concrete, it is observed from experimental results that

(i) As spacing of rings is reduced, the ultimate load capacity increases.
(ii) The improvement is significant for lesser thickness of MS rings and for lesser % of steel in R.C.C. circular column specimens.
(iii) As thickness of confining MS ring increases, there is observed increase in ultimate load carrying capacity.
(iv) As % of steel increases in column, the lateral displacement increase.
(v) As (t/%Ast) ratio reaches 1.7 and above, the increase in ultimate load carrying capacity is very appreciable .for M-20 grade of concrete it is 200 % and for M-25 it is 100 %. As (t/%Ast) ratio reaches 2.0 and above, the rate of increase in strength becomes stagnant.

V. REFERENCES

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