EVALUATING YIELD AND ULTIMATE LOAD CAPACITIES IN M-20 GRADE MS RING CONFINED CIRCULAR RCC COLUMNS

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ABSTRACT

Enhancement of the axial load carrying capacity of reinforced cement concrete (RCC) columns is a big challenge. There have been several efforts in this direction. In the present work, Mild steel (MS) rings in different pattern have been used for enhancement in axial load carrying capacity of circular RCC columns. This paper deals with determining experimentally the enhancement in axial load capacity reservoir. This has come through the difference between ultimate load and first crack load i.e. yield load. The effect of various percentage of steel in RCC columns, thickness of MS rings and spacing of MS rings are studied experimentally. For this the circular RCC specimen columns of 150 dia. were prepared. Total 45 nos. of specimen were prepared for M-20 grade of concrete, covering all different parameters.

Keywords: *M-20, RCC, Circular column, Mild steel ring, Confinement.*

I. INTRODUCTION

Nowadays Reinforced concrete is widely accepted building material. Even in rural areas, concrete is being made with the help of locally available materials.

Usually M-20 grade of concrete is used in building works.M-20 grade of concrete is a moderate strength concrete. In columns, use of M-20 grade concrete limits the load carrying capacity of columns. As percentage of steel is also controlled by IS 456:2000, the load carrying capacityof RCC columns cannot be increased appreciably. Hence developing the need to increase the load capacity with the help of other means like confinement etc.

The use of MS rings will help in producing higher strength using the same cross section. Hence resulting in economy. Use of MS rings as confining material will further restrict the additional cost of additional steel etc for more strength. Comparative lesser use of reinforcing steel for the load will lead to avoidance of congestion of beam-column joints. These MS rings help a lot in enhancing the load carrying capacity of RCC circular columns, ductility & energy absorption capacity of new concrete columns during construction

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. METHOD & 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 mix M-20 grade is 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 (3 mm and 4 mm) & 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. For the grade of concrete (M-20) 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

Figure

Figure 1 Testing of specimen

Figure 2 Cage placement in mould

III. NOMENCLATURE

In the system first two digits depicts grade of concrete i.e. characteristic compressive strength of concrete at 28 days. Here it is M-20 grade of concrete.
After' – ', digit shows dia. of reinforcing column bars i.e. 8, 10 and 12 mm.

After this, if 0 appears it shows that no confinement is used in the specimen. Else further next digit shows thickness of MS ring's thickness. Next digit indicates the no. of MS rings used as confinement in the specimens.

For example 20-8-0 indicates M-20 grade concrete specimens carrying 8 dia. column bars and without MS ring confinement. And 20-10-3-2 indicates M-20 grade concrete specimens carrying 10 dia. column bars and with 3 mm thick MS rings 2 in nos. as confinement.

IV. RESULT & DISCUSSION

The average of the three specimens in each category has been taken. When the first crack was appeared the load was recorded as yield load and load at collapse was recorded as ultimate load.
The observations for different specimens are grouped as below-

Table 1. Comparison table for First crack load and ultimate load

	P_1(First Yield Load) kN	P_{FINAL}(Ultimate Load) kN	Ratio (P_{FINAL}/ P_1)
20-8-0	139	160	1.15
20-8-3-2	323	477	1.47
20-8-3-3	340	509	1.49
20-8-4-2	261	503	1.92
20-8-4-3	384	576	1.50
20-10-0	172	207	1.20
20-10-3-2	231	356	1.54
20-10-3-3	275	426	1.55
20-10-4-2	221	401	1.81
20-10-4-3	269	429	1.59
20-12-0	229	277	1.21
20-12-3-2	248	339	1.36
20-12-3-3	264	388	1.47
20-12-4-2	239	433	1.81
20-12-4-3	276	452	1.63

V. CONCLUSION

- In non confinement specimens only 15 to 20 % increase in ultimate load with reference to first crack load is observed.

- In confinement specimens about 50 to 90 % increase in ultimate load with reference to first crack load is observed.
- The observations clearly show the effectiveness of MS Rings as confining system.
- The Specimens carrying 8mm dia. reinforcements showed unexpectedly higher load capacities. This may be due to ductility of reinforcement and MS Rings.
- As thickness of mild steel rings in RCC columns increases from 3 mm to 4 mm, the ratio ($P_{FINAL}/ P_{1)}$ increases but as spacing for 4 mm thickness MS rings decreases the ratio drops with respect to previous higher spacing

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