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Performance Assessment of Behaviour of Spiral Reinforced Concrete Columns

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Abstract: This paper presents an exploratory perception into the way of behaving of twisting built up substantial sections under pivotally concentric stacking. A sum of 6 sections were tried under transient stacking, 3 of which were twisting built up segments, while 3 were with typical ties. The sections were 700 mm high with a size of 230x230 mm. Concentrate on boundaries incorporates the variety of pitch of cross over support. A near report is finished for load conveying limit of winding crossed over and ordinary crossed over with comparative pitched segments. Furthermore, the complete cross over support length and ordinary cross over support length is looked at for comparative pitched segments. The cross over support length is found out by bar twisting timetable with a representation of charts.

Keywords: Load carrying capacity of columns, Spiral reinforced columns, Transverse reinforcement length.

I. Introduction

Concrete columns are fundamental structural elements widely employed in buildings and infrastructure. Ensuring their effective design, detailing, and maintenance is crucial for guaranteeing structural integrity and safety. This article aims to provide an in-depth exploration of the essential aspects associated with the design and upkeep of reinforced concrete columns, with a particular focus on the specialized considerations imperative for their successful implementation. The documentation presented herein encompasses a comprehensive guide covering various facets pertinent to reinforced concrete columns. This includes a detailed elucidation of the critical elements involved in their design and maintenance protocols. Moreover, it delves into the intricacies of column classification based on their slenderness ratio, shedding light on the distinct requirements and challenges associated with different categories. One of the pivotal aspects highlighted within this document is the comparative analysis between two significant reinforcement methodologies: normal ties and spirally reinforced square columns. Through a meticulous examination under short-term axially concentric loading, this analysis aims to unravel the performance disparities, advantages, and limitations of these reinforcement techniques. Such insights will aid in facilitating informed decision-making processes during the design and implementation phases of reinforced concrete columns.

As the structural integrity of columns directly influences the overall stability and safety of structures, understanding the nuances of their design and maintenance becomes paramount. This article serves as a comprehensive resource, catering to engineers, architects, and construction professionals seeking valuable insights and guidance in navigating the complexities associated with reinforced concrete columns. Slenderness Ratio, SR = k lu/r where, lu is unsupported column length; k is effective length factor reflecting end restraint and lateral bracing conditions of a column; and r is the radius of gyration reflecting the size of a column cross-section. Slenderness Ratio, SR = 700/230 = 3.04 < 12 [1]. The column in question is relatively short. The support provided by the winding (spiral) reinforcement should give way before reaching an extremely high level of stress to effectively bind the central concrete core [2]. Through this analysis, it has been observed that even under the highest levels of applied load, the stress induced in the winding support consistently remained well below its yield strength. Only the winding support in the uppermost part of the column yielded, which occurred significantly below the extreme load level. This indicates an insufficiency in the ability of the central concrete core to receive adequate restraint from the horizontal support specifically in the immediate post-top region, leading to an unexpected reduction in load-carrying capacity [3].

This finding highlight that the winding support experienced not only ductile loads from the central concrete but also from the clamping effect of longitudinal bars. Therefore, it becomes crucial to ensure that the longitudinal bars are adequately bundled to prevent excessive clamping when under load. It's important to note that secondary stresses associated with deformations in most columns used in practical applications are typically negligible or very small.

II. Literature Review

This test comprises of 68 concrete columns by fluctuating burden unconventionalities, substantial qualities and how much

support. It was tracked down that rising how much longitudinal reinforcement or potentially diminishing tie spacings will lessen a definitive limit with respect to consolidated bowing and pressure for every single substantial strength, as the support shaped a characteristic plane of partition between the center and cover concrete.They led examinations on eight spirally supported reinforced sections. The investigation discovered that malleability diminished with expanding concrete strength and the sections with higher measures of column kept up with top burden for longer yet showed less flexibility than the segments with less longitudinal support. Effect of varying reinforcement on high-strength concrete columns --They led examinations on eight spirally supported reinforced sections. The investigation discovered that malleability diminished with expanding concrete strength and the sections with higher measures of column kept up with top burden for longer yet showed less flexibility than the segments with less longitudinal support. Effect of cover spalling for high-strength and normal-strength concrete columns --Utilized limited component demonstrating to explore the impact of cover spalling for both high-strength (>60 MPa) and typical strength concentric segments subject to concentric pressure loads. It was viewed as through the model, and checked through trial testing, that as how much tie support expanded, a definitive section strength (or the heap at which early cover spalling occurred) diminished while the flexibility of the segment expanded [4].

They saw that the horizontal displacement or float of a supported cement section at disappointment was subject to and straightforwardly corresponding to the dispersing of support and the stress created inside the segment. Further, it was noticed that the parallel float experienced by the segments at pivotal disappointment was subject to and conversely corresponding to how much axial load applied on the sections. The presentation of sections under seismic stacking is additionally affected by the secondary moment because of concentrated on tentatively the way of behaving of columns under seismic stacking to comprehend the movement of harm and components causing breakdown in shear-basic supported substantial columns. In view of the experimental outcomes, the creators created scientific models to foresee the drift limit of columns. Concentrated on the effect of ideal longitudinal support on the arch malleability limit of segment areas. A methodology for deciding an adequate support through support estimating graph has been depicted. The creators presumed that curvature ductility capacity and flow flexibility limit improved for the instance of ideal longitudinal support comparative with the qualities registered for customarily reinforced columns [5].

Fostered a nonlinear form slope scan technique for tracking down the ideal support of a rectangular reinforced concrete cross section. The creators proposed the utilization of the model for areas exposed to uniaxial or biaxial bending. According to the writing assessed on conduct of segments under cyclic shear stacking, it was reasoned that satisfactory reinforcement support and fitting longitudinal support will give better flexibility, stiffness and strength to the column components of the structures [6].

III. Materials Used

A. Cement

Concrete is a material that has durable and cement properties in the presence of water. Such concretes are called water driven concretes. These comprise fundamentally of silicates and aluminates of lime acquired from limestone [7]. Table I shows the physical properties of cement.

Table I: Properties of Cement

Properties	Value
Specific gravity	3.25
Fineness	2%
Standard consistency	34%
Initial setting time	35 min
Final setting time	6 hours

B. Ordinary Portland Cement

Ordinary portland concrete (OPC) is the fundamental Portland concrete and is the most appropriate for use in everyday substantial development. It is of three sort, 33 grade, 43 grade, 53 grade. One of the significant advantage is the quicker pace of advancement of solidarity [8].

C. Aggregate

Aggregate properties greatly influence the behaviour of concrete, since they occupy about 80% of the total volume of concrete. The aggregate are classified as fine aggregate and coarse aggregate.

D. Fine Aggregate

Fine aggregate is material going through an IS sieve that is under 4.75 mm measure past. The primary framework of the substantial, while fine aggregate structure the filler network between the coarse aggregate. The main capability of the fine total is to give usefulness and consistency in the combination. The fine total additionally assists the concrete with gluing to hold the coarse total molecule in suspension [9].

E. Course Aggragate

According to IS 383:1970, the fine aggregate is classified into four different zones, that is Zone-I, Zone-II, Zone-III, and Zone-IV. Also in the case of coarse aggregate maximum of 20 mm coarse aggregate is suitable for concrete work. But where there is no restriction 40 mm or larger size may be permitted. In case of close reinforcement 10 mm size is also used [10].

IV. Experimental Inestigation and Discussion

A sum of six square columns were tried in this review; three of which were spiral transverse reinforced columns while three were ordinary transverse reinforced columns. They were 700 mm high with a size of 230x230 mm. In view of the slenderness proportion. They were delegated short columns. A similar report was made among columns according to Table II. Segments are axially loaded and compressive strength of those was tried. Table II shows the details of reinforcement in columns.

Table II: Details of Reinforcement in Columns

Ref. No.	Longitudinal Reinforcement		Transverse Reinforcement	
	No. of Bars	Diameter (mm)	Diameter (mm)	Pitch (mm)
C1	4	12	8	300
C2	4	12	8	200
C3	4	12	8	150
C4	4	12	8	300
C5	4	12	8	200
C6	4	12	8	150
C1,C2,C3	Normal Transverse Reinforcement			
C4,C5,C6	Spiral Transverse Reinforcement			

Table III: Comparative Studies Among Columns

Compared Columns	Purpose
C1,C4	Pitch of 300 mm
C2,C5	Pitch of 200 mm
C3,C6	Pitch of 150 mm
To Observe the Influence of Pitch of Transverse Reinforcement.	
To Investigate the Effect of Normal and Spiral Transverse Reinforcement.	

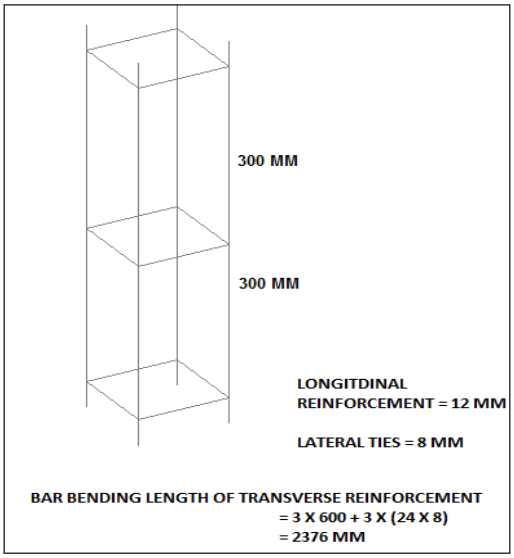


Fig. 1

Table III provides a comparative overview of different sets of columns labeled as C1 through C6, each serving a specific purpose in an experimental investigation focused on reinforced concrete columns. The columns are grouped in pairs (C1 with C4, C2 with C5, and C3 with C6), wherein each pair shares a similar purpose but differs in the configuration of their transverse reinforcement. Fig. 1 shows the reinforcement details of the column.

The purpose of the columns in each pair is as follows:

- C1, C4: Columns designed with a transverse reinforcement pitch of 300 mm.
- C2, C5: Columns designed with a transverse reinforcement pitch of 200 mm.
- C3, C6: Columns designed with a transverse reinforcement pitch of 150 mm.

The main objectives of this experimental setup are twofold:

Observing the Influence of Pitch of Transverse Reinforcement: The different columns in each pair are designed with varying pitches of transverse reinforcement. This aims to analyze and understand how altering the spacing (pitch) between the transverse reinforcements affects the behavior, load-carrying capacity, and structural performance of the columns.

Investigating the Effect of Normal and Spiral Transverse Reinforcement: Each pair of columns is constructed using different types of transverse reinforcements, specifically normal ties in one case and spiral reinforcement in the other. This comparison seeks to explore and assess the impact and effectiveness of these distinct reinforcement methods on the columns' behavior under loading conditions. It aims to determine the differences in structural response, ductility, strength, and overall performance between columns reinforced with normal ties and those with spiral reinforcement [11-12].

By conducting experiments on these different column configurations, the study aims to derive insights into the influence of reinforcement pitch and the comparative effectiveness of normal ties versus spiral reinforcement. These findings are essential in guiding engineers and designers in making informed decisions regarding the selection and design of transverse reinforcements in reinforced concrete columns for optimal structural performance and safety.

V. Conclusion

From this experimental observation, it was inferred that:

- The load conveying limit of spiral-supported concrete sections is bigger than typical built-up substantial segments by 5 to 7% with comparable pitch distance.
- The all-out length of transverse support utilized for spiral built-up substantial sections is relatively different from the typical supported substantial segments.

- Furthermore, subsequently, the spirally built-up sections are more conservative and the heap conveying limit is bigger than the ordinary supported segments.

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