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Review of helical reinforcement in column

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Abstract:

The present work explores the compatibility of normal with helical reinforcement as a whole which can be looked upon as an efficient replacement for normal reinforcement because of its ability to reinforce in all directions. The effectiveness was assessed by performing tests on the beams with respect to the cracking pattern, ductility and load defection diagrams. The advantage of using helical reinforcement can be observed significantly. Therefore, reinforced beam with helical reinforcement has higher ultimate load-bearing capacity than normally reinforced beam. Hence it can be used in places where horizontal loads have higher significance.

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Keywords: RCC beams, RCC columns, Spiral reinforcement

Introduction

Reinforced concrete, as a composite material, has occupied a special place in the modern construction of different types of structures due to its several advantages. Due to its flexibility in form and superiority in performance, it has replaced, to a large extent, the earlier materials like stone, timber and steel. Further, architect's scope and imaginations have widened to a great extent due to its mouldability and monolithicity. Thus, it has helped the architects and engineers to build several attractive shell forms and other curved structures. However, its role in several straight line structural forms like multistoried frames, bridges, foundations etc. is enormous.

Column: Column is a vertical compression member whose unsupported length l shall not exceed sixty times of b (least lateral dimension), if restrained at the two ends. Further, its unsupported length of a cantilever column shall not exceed $100b2/D$, where D is the larger lateral dimension which is also restricted up to four times of b (vide cl. 25.3 of IS 456).

Classification of Columns Based on Types of Reinforcement

Based on the types of reinforcement, the reinforced concrete columns are classified into three groups:

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(i) Tied columns: The main longitudinal reinforcement bars are enclosed within closely spaced lateral ties.

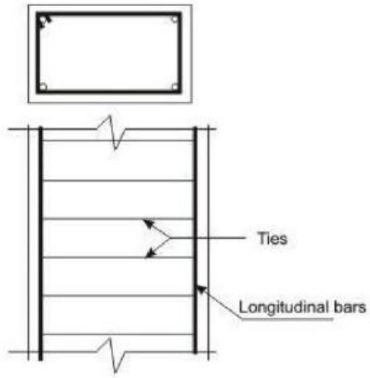


Figure: Tied column

(ii) Columns with helical reinforcement: The main longitudinal reinforcement bars are enclosed within closely spaced and continuously wound spiral reinforcement. Circular and octagonal columns are mostly of this type.

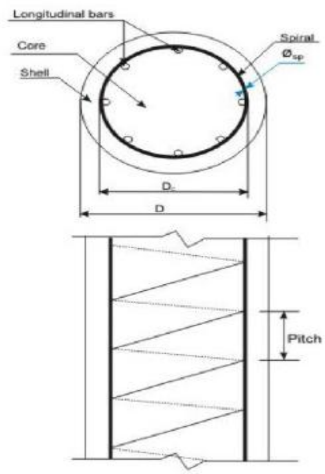
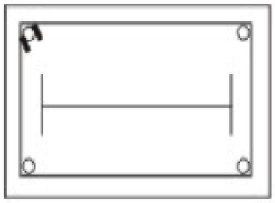


Figure: Column with helical reinforcement

(iii) Composite columns: The main longitudinal reinforcement of the composite columns consists of structural steel sections or pipes with or without longitudinal bars.



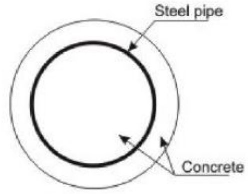


Figure: Composite column (steel selection) figure: Composite column (steel pipe)

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Out of the three types of columns, the tied columns are mostly common with different shapes of the cross-sections viz. square, rectangular etc. Helically bound columns are also used for circular or octagonal shapes of cross-sections.

Review of literature

(Escudé & Sun, 2005) studied "DNA major Groove Binders: Triple helix-forming oligonucleotides, triple helix-specific DNA ligands and cleaving agents" and found that Nucleic acids are polymorphic macromolecules that can adopt a variety of single-, double- and multi-stranded conformations, which in turn may provide important signals for regulating gene expression, and for maintaining genome integrity and stability. The design of tailor-made molecules that recognize specific sequences in the DNA double helix would provide interesting tools to interfere with DNA information processing and to target genome modifications. The ability to specifically manipulate genetic information processing genome-wide offers a variety of applications in experimental biology as well as gene-based biotechnology and therapeutics. It presents an important challenge in biological and biomedical sciences. This chapter will cover the topic of sequence-specific ligands that bind within and recognize the major groove of the DNA double helix. In particular, it will focus on the development of triple helix-forming oligonucleotides as highly sequence-specific DNA major groove binders, the related triple helix structures, examples of triple helix-specific ligands and DNA cleaving agents, as well as their biological relevance, during the last 10-15 years.

(Marini, Levene, Crothers, & Englund, 1982) studied "Bent helical structure in kinetoplast DNA" and found that we have investigated the unusual physical properties of a restriction fragment of Leishmania tarentolae kinetoplast DNA. A gel-purified fragment comprising slightly more than half of a minicircle was determined by Maxam-Gilbert sequence determination to be 490 base pairs (bp) in length. This fragment has dramatically anomalous electrophoretic behavior; it has an apparent size of 450 bp on a 1% agarose gel but migrates as 1,380 bp on a 12% polyacrylamide gel. However, in gel filtration on Sephacryl S-500, the fragment elutes with an apparent size of 375 bp. Finally, it behaves anomalously in electric dichroism experi- ments. Field-free rotational relaxation times from transient elec- tric dichroism studies are highly sensitive to effective molecular dimensions. The rotational relaxation time of the kinetoplast frag- ment is smaller than that of a 309-bp control fragment from pBR322. Because rigorous control experiments rule out the pos- sibility that this fragment is modified, these anomalous properties must be dictated by the sequence itself. Fragment behavior in- dicates that it has an unusually compact configuration; we propose that this molecule contains a region of systematically bent B-DNA. This model accounts for the fragment's difficulty in snaking through the pores ofa polyacrylamide gel, its ease in diffusing into Sephacryl beads, and its smaller rotational relaxation time. Bend- ing of this molecule may be caused by periodicities in the DNA sequence.

(Humakhan & Maharashtra, 2008) studied "Effect of Spiral Reinforcement in Beams and Columns" and found that in reinforced cement concrete the replacement of main reinforcement into spiral form leads to increase the bending moment, torsional moment, shear, ductility with reduced deflection. This also leads to better earthquake performance. The main objective is to carry out the experiments and mathematical modeling on RCC beams and columns having main spiral reinforcement.

(Kaarthik Krishna, Sandeep, & Mini, 2018) studied "Reinforced concrete beams with helical transverse reinforcement" and found that in a Reinforced Concrete (R.C) structure, major reinforcement is used for taking up tensile stresses acting on the structure due to applied loading. The present paper reports the behavior of reinforced concrete beams with helical reinforcement (transverse reinforcement) subjected to monotonous loading by 3-point flexure test. The results were compared with identically similar reinforced concrete beams with rectangular stirrups. During the test crack evolution, load carrying capacity and deflection of the beams were monitored, analyzed and compared. Test results indicate that the use of helical reinforcement provides enhanced load carrying capacity and a lower deflection proving to be more ductile, clearly indicating the advantage in carrying horizontal loads. An analysis was also carried out using ANSYS software in order to compare the test results of both the beams.

(Konijn, Sanderink, & Kruyt, 2013) studied "Behaviour of Spirally Reinforced SCC beams" and found that thirty RCC beams were tested using a static four-point bending set-up to study the effect of using continuous rectangular spiral reinforcement as transverse reinforcement. The behaviour of shear critical beams was studied through monitoring the load-deflection curve, ultimate load values and crack propagation during static tests. The results showed that using rectangular spiral shear reinforcement improved the shear capacity and the ductility of beams compared with traditional individual closed stirrups beams regardless of pitch spacing and inclination angle of stirrups. Beams with spiral reinforcement spacing at 120 mm exhibited 55% increased capacity with respect to the beams with stirrup. Furthermore beams with advanced spiral spacing 120 mm exhibited 65% increased load carrying capacity. The crack pattern for traditional stirrups and spiral beams were identical and the failure mechanism was practically equal.

Moreover, a middle span deflection ductility index has been adopted in order to evaluate the efficiency of the spiral reinforcement in the post-peak part of the tested shear-critical beams. The beams with advanced spirals with spacing 80 mm exhibited higher deformation ductility value of 3, demonstrating this way improved post-peak deformation capacity compared to the beams with equal quantity of commonly used stirrup.

Load deflection in column

The load deflection curve for normal with helical reinforcement. The results show that reinforcing the concrete with steel helix lead to an increase in load bearing capacity of the beams. The effect of helical reinforcement in beams is more attributed at higher load levels only when the ultimate load capacity of the beams is taken into consideration. The cracks were first observed in the mid-lower region and as the load increased, new cracks were found along the beam towards the point of application of load. The mode of failure also changed from brittle to ductile for the normal with helically reinforced beams when compared to the normally reinforced beams.

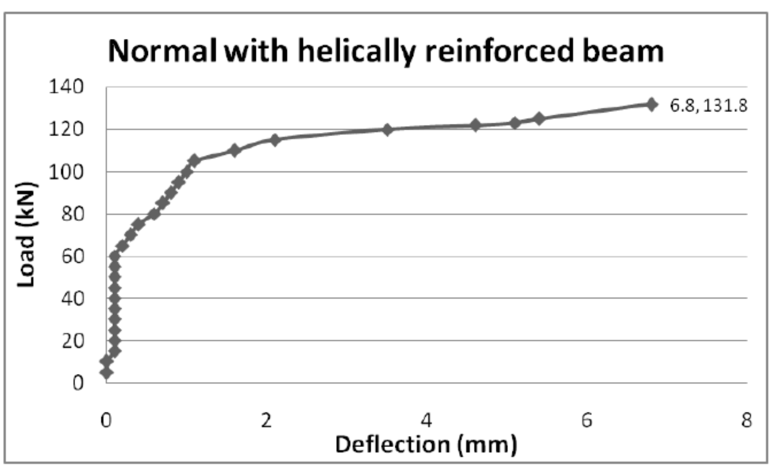

Figure: Load-Deflection curve for normal with helically reinforced beam

Conclusion

A concrete is a mixture of cement, sand, aggregate, and water with or without admixtures. Such concrete is having good compressive strength thereby it resist the compressive forces effectively, but it is very weak to resist the tensile forces and also it is brittle in nature. So the steel reinforcement is used in concrete to take the tensile forces by enhancing the ductility of the structure. Such reinforced concrete is in use for various constructions.

1) Compressive yield strength of conventional RCC beams with minimum shear reinforcement is 29.431MPa

2) Compressive yield strength of RCC beams with spiral shear reinforcement is 33.908MPa

3) Compressive yield strength of RCC columns with main spiral reinforcement is 70.573MPa

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