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A Review on Conventional Spiral Helix DNA-Helically Reinforced Columns with Mixing of Rubber

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ABSTRACTS: Columns support slabs structurally. If a column can't carry beams, those beams can't support walls and slabs, causing the building to collapse. Columns are vulnerable to axial loads and moments because they carry loads from the superstructure to the foundation. Therefore, their design should be prioritised. More ductile columns break less catastrophically and present warning indications before they do. RC column ductility affects seismicity. Strong ductility can absorb and distribute seismic energy. Spiral reinforcement in the compression zone of circular reinforced concrete columns improves their ductility. This has been noticed in global research programmes. DNA helix with rubber at the ends was more flexible than with rubber in the middle. The flexible specimen may have utilised more rubber ties. Spiral helix columns are between a basic DNA helix and one bonded with rubber ties in stiffness. In DNA-helical columns with rubber in the middle, there were two 6-mm rubber ties. In DNA-helical columns with rubber, there were eight sizes of steel ties. This size difference was visible in DNA-helical columns with rubber in the middle. Larger steel ties and more rubber connections increase column ductility. Despite using just two rubber links and eight-millimetre ties, DNA helical columns with rubber at ends had ductility values between basic DNA and DNA specimens with rubber in the centre. In the DNA helix column with rubber connections, the specimen was 720 millimetres long, whereas in other samples it was 600 millimetres long. The DNA helical reinforcement had superior compressive strength, ductility, stiffness, and flexibility than the other specimen, despite being longer. We found that using DNA helical reinforcement instead of spiral reinforcement may increase column performance.

I. INTRODUCTION

A column or pillar is a structural part in architecture and structural engineering that conveys the weight of the structure above to other structural members below through compression. Consequently, column serves as a compression device. There are many other types of columns, but the most common is the spherical support (the shaft of the column) with a capital and base (the pedestal) constructed of stone or any other material. Non-round supports with non-round components, such as square posts and rectangular piers, are the difference between them. When used in bridges, piers may take on a round shape. Wind and earthquake engineering may both benefit from the use of lateral force-resisting columns. Supporting beams or arches on top of ceilings or walls is a frequent use for columns. In architecture, the word "column" refers to a structural element having proportional and decorative features. Many columns are "engaged," meaning they form part of a wall, and they may be used as a decorative feature.

1.1 BACKGROUND

There was some type of column usage by all major Iron Age civilizations in the Near East and the Mediterranean. Stone columns etched to mimic bundled reeds' organic structure were utilised by Egyptian builder Imhotep as early as 2600 BC, and subsequently faceted cylinders were prevalent in Egyptian architecture. Some of the most elaborate columns were discovered in the ancient world. Ancient Greece, followed by the Romans, preferred the use of columns on both the inside and outside of a building, whilst the Egyptians, Persians, and other civilizations preferred reliefs or paintings on the outer walls. Classical architecture is known for its widespread use of columns, which may be seen both inside and outside structures like the Parthenon. The classical architectural orders were developed by the Greeks, and they may be recognised by the column's form and the pieces that make up the column. The Romans added the Tuscan and Composite orders to the Doric, Ionic, and Corinthian orders.

A column is an essential part of any construction. The columns' primary job is to provide structural support for the slabs. If a column fails to support beams, those beams in turn fail to support walls and slabs, therefore the whole

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building falls apart. Because they are the principal load-transmitting components from the superstructure to the substructure, columns are susceptible to large axial loads and moments, making their design a priority. Due to the considerable axial loads and moments that columns are exposed to; the design of a column should be given particular consideration. Those columns that collapse less catastrophically and provide notice before failure are those that have a higher degree of ductility. Reinforced concrete columns' ductility is an important factor in determining their seismicity since a column with strong ductility is capable of absorbing and dispersing seismic energy. The ductility of circular reinforced concrete columns has been shown to increase greatly when spiral reinforcement is used to restrain the concrete in the compressive zone, and this has been observed in research programmes all over the globe.

R.C.C. columns may be made more flexible by substituting the typical spiral helix reinforcement with DNA double helix reinforcement, which is designed to work as both longitudinal and transverse reinforcement in the same column. Rubber is utilised to improve column flexibility in critical places such as beam column connections and the mid-portion in the form of transverse connections in order to boost the column's seismic performance. Furthermore, the impact of relocating rubber connections on the stiffness and flexibility of thin columns should be studied. Spiral-helix models will be compared to each other in terms of stress-strain variables, stiffness and flexibility, and buckling properties.

1.2 IMPORTANCE AND FEASIBILITY

The column is an essential part of any building. The slabs are mostly supported by the columns. It is critical to realise that a column's failure leads in the building collapsing since columns support beams, which in turn support walls and slabs. This means that columns should be designed with care. It is possible to detect failures before they become catastrophic in columns with more ductile behaviour. A column's ductility is also important in defining its seismic behaviour since a column with strong ductility is able to absorb and disperse seismic energy. DNA helical reinforcement mixed with steel and rubber ties has been determined to be a preferable alternative for traditional spiral helical reinforcement in this project work because of the improvements in many column properties. There are several aspects of DNA helically reinforced columns that may be fully explored for future testing and improvisations, which adds to their relevance.

DNA helical reinforcement in columns has the potential to be a viable alternative to spirally reinforced circular columns, at least in the short term. There is just one practical stumbling point to this form of reinforcement: creating the cage for it, which may be easily solved by mechanical mechanisms.

II. LITERATURE REVIEW

2.1. REINFORCED CONCRETE COLUMNS

An embedded steel frame provides strength to a concrete column built of reinforced concrete. Compressive pressures are intended to be carried by this material. A column is a need in any reinforced concrete building. Using this, the superstructure's weight is securely transferred to the foundation. In both man-made and natural structures, the column is the most critical component in avoiding collapse under gravity. Some additional types of compression members are struts, inclined struts, and rigid frame struts. The terms "column" and "compression member" are frequently used interchangeably since the column may represent any kind of compression member. If the column's effective length exceeds three times its smallest lateral dimension, it is a compression member, according to IS code 456. (Cl.25.1.1).

2.1.1 CLASSIFICATION OF COLUMNS

Columns are classified on different criteria such as:

2.1.1.1 Shapes of cross-section.
2.1.1.2 Type of loading.
2.1.1.3 Slenderness ratio.
2.1.1.4 Type of lateral reinforcement

2.1.1.1 Shapes of cross-section

The cross-section of a column can be classified as square, rectangular, circular, pentagonal, hexagonal, octagonal, T-shape, or L-shape based on the cross-section.

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2.1.1.2 Type of loading

There are three sorts of columns depending on the loads they can handle:

(a) Columns subjected to axial loads only (concentric).

(b) Columns subjected to combined axial load and uniaxial bending.

(c) Columns subjected to combined axial load and bi-axial bending.

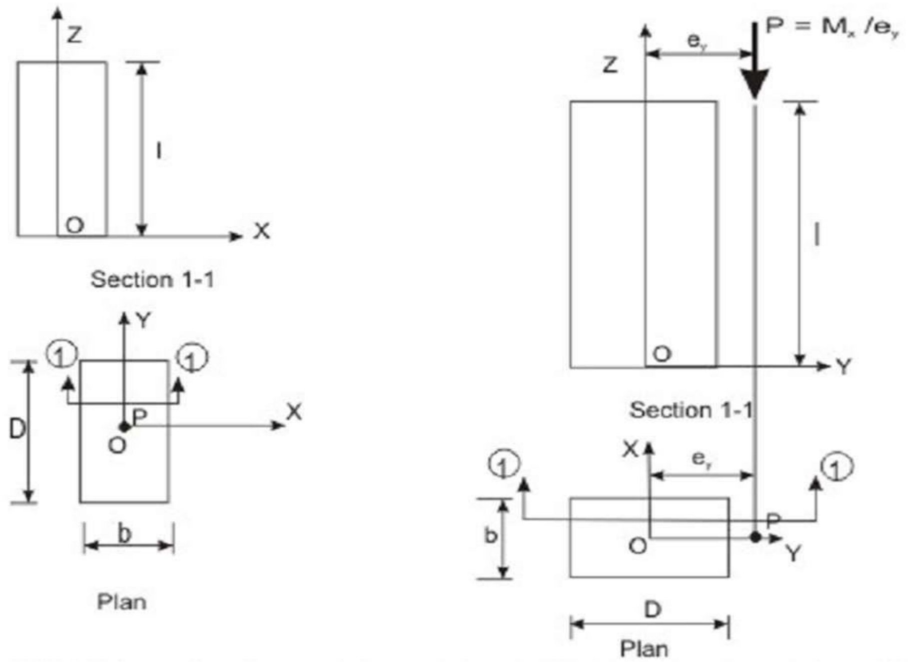

Figure Axial loading concentric and axial loading with uniaxial bending

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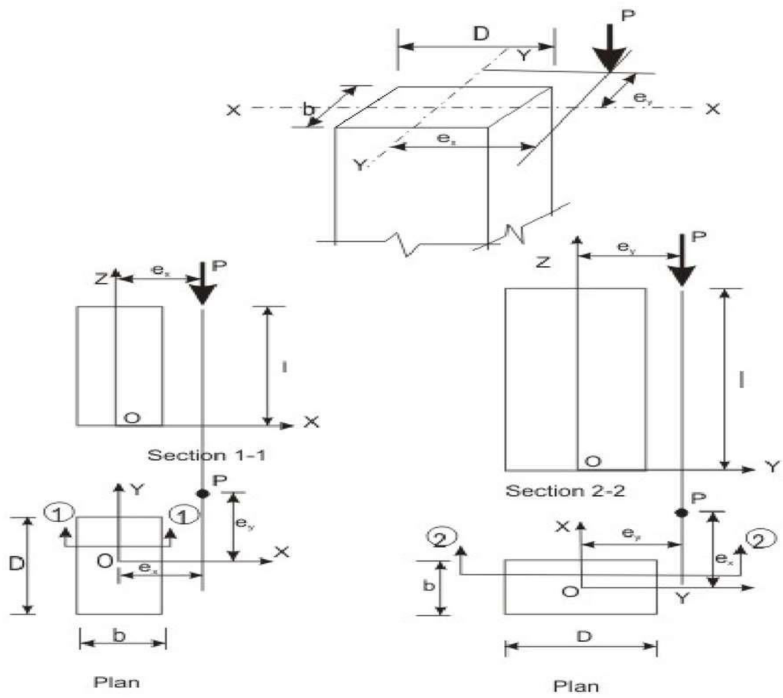

Figure Axial loading with bi axial bending

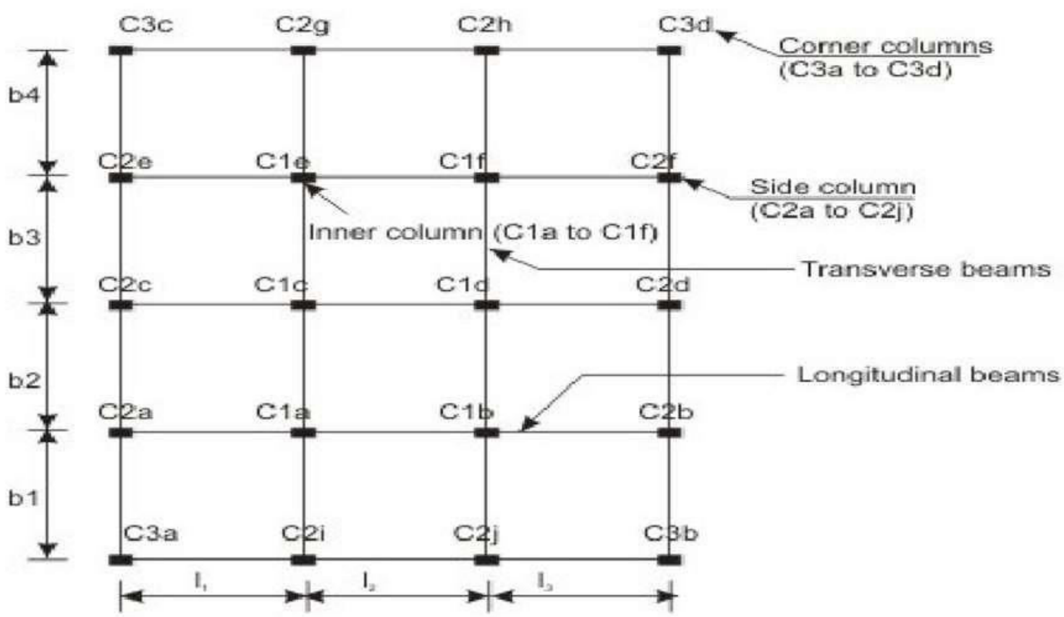

Figure Grid of beams and columns

Reinforced concrete rigid frames with columns and beams in longitudinal and transverse dimensions are depicted in Figure 3 (see Fig. 3). The bending moments on the left and right columns of columns for every continuous longitudinal beam are equal, according to a solid grasp of structural analysis. For each continuous transverse beam, bending moments at the column's two ends may be compared (neglecting small amounts due to differences of l1, l2, l3 and b1, b2, b3, b4). Interior columns C1a to C1f are the only ones that will be subject to axial force. Columns C2a to C2j are

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projected to have unidirectional axial forces, while columns C3a to C3d are expected to have bidirectional axial forces. To put it another way, there is just one type I column in the table, followed by two others, then the third and final one (C1d to C1f) (C3a to C3d). Pure axial forces are quite uncommon in the interior columns. There will be bending moments and shears in all of the inner columns because of the rigid frame action, lateral loads, and other design factors. Similarly, the same types of column shear, axial force, and bending moments may occur in both side and corner columns. It's easy to overlook the minuscule effects of shearing. With longitudinal and transverse reinforcement, even a tiny quantity of column shear is not enough to endanger the structure's stability. In spite of its axial load, a column should be designed with some bending moment in mind. As a result, IS 456 Cl.39.2 and Cl.25.4 specifies the minimal eccentricity for all column designs. Eccentricity should be taken into account while creating a product.

2.1.1.3 Slenderness ratio

(a) Based on the slenderness ratios, columns may be divided into two categories.

(b) Minimalist articles.

(c) Columns that are long or slender.

When the ratios lex/D and ley/b, which measure effective length along the major axis, depth along the major axis, and minor axis length, are both less than 12, compression members are considered short. Aside than that, it's not much.

compression member.

2.1.1.4 Type of lateral reinforcement

Reinforced concrete columns may be divided into three classes based on the type of reinforcement used.

(a) Longitudinal reinforcing bars are contained in closely spaced lateral ties in Tied columns..

(b) This kind of column reinforcement uses spiral reinforcement that is tightly spaced and continuously wrapped around the principal longitudinal reinforcing bars. Octagonal and round columns are the most prevalent..

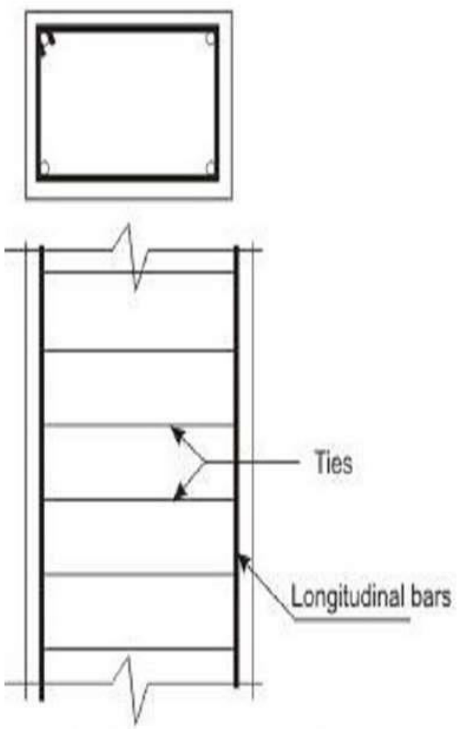

Figure 6 Placement of ties in column

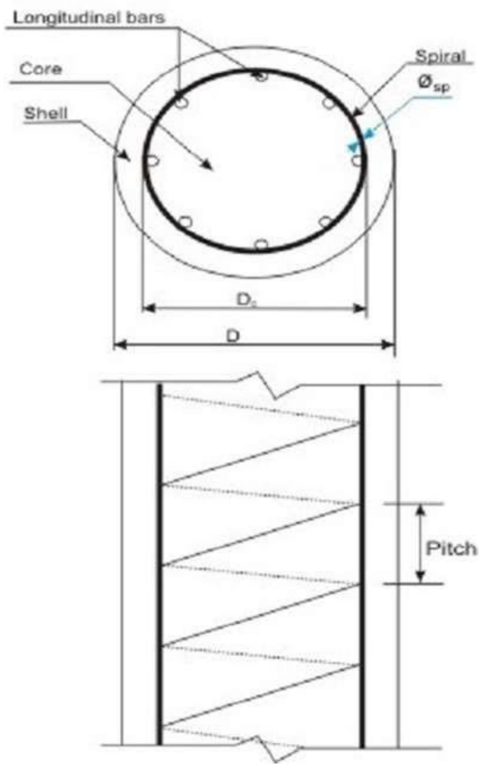

Figure 7 Column with helical reinforcement

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(c). Composite columns: The main longitudinal reinforcement of the composite columns consists of structural steel sections or pipes with or without longitudinal bars.The most common cross-sectional form of a tied column is a square or rectangle, although there are also T, L, cross, and other variations. Circular or octagonal cross-sections may also benefit from the use of helically connected columns. Due to a practical need, some architects use round columns.

III. CONCLUSIONS AND RECOMMENDATIONS

3.1 CONCLUSIONS

The following conclusions were drawn from the experimental results (as tabulated below) obtained from tests conducted on the conventional spiral helix and DNA helically reinforced columns:

Parameters	Spiral helix	DNA helix(simple)	DNA helix(rubber at middle)	DNA helix(rubber at ends)
Ultimate compressive Strength (KN)	233.5	249.5	249	240.5
Young's modulus (E) MPa	2328.34	2666	2282.05	2326.25
Poisson's ratio(μ)	0.244	0.159	0.258	0.202
Shear modulus (G) MPa	933.09	1153.55	907.86	967.6
Bulk modulus (K) MPa	1615.80	1287.7	1573.14	1301.3
Axial Stiffness (k) N/mm	55734.84	63731.65	45337.74	54861.72
Flexibility (δ) mm/N	$1.82\text{x}10^{-5}$	$1.60\ \text{x}10^{-5}$	$2.21\ \text{x}10^{-5}$	$1.83\ \text{x}10^{-5}$
Ductility (%)	53.55	29.04	88.57	75.88

3.1.1 Ultimate compressive strength

With the mean ultimate compressive strength of DNA-helically reinforced columns exceeding conventional spiral helix reinforced columns by 5.496 percentage points.

3.1.2 Modulus of elasticity

While DNA rubber columns had lower elastic modulus values, which were equivalent to the values found in basic spiral helix columns, the elastic modulus of DNA helical columns without rubber connections was greater, successfully resisting elastic deformations.

3.1.3 Axial stiffness and flexibility

Simple DNA helix columns without rubber showed maximum stiffness and hence least flexible behaviour. The increasing order of stiffness in columns was found as

Rubber at middle < Rubber at ends < Spiral helix < Simple DNA helix

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The DNA helix with rubber at the ends was found to be more flexible than the DNA helix with rubber in the centre, which may be ascribed to the specimen's usage of the most rubber ties (4#). Spiral helix columns were discovered to have a rigidity somewhere between that of a basic DNA helix and that of a DNA helix tied together with rubber ties.

3.1.4 Ductility

The increasing order of ductility is as

DNA helix $<$ Spiral helix $<$ Rubber at ends $<$ Rubber at middle

This difference in the steel tie sizes was evident when it came to basic DNA-helical columns with rubber in the centre, where the rubber ties utilised were 6mm in diameter and there were only two, but in DNA-helical columns with rubber in the centre there were eight steel tie sizes. Steel tie diameter and rubber link number have an enormous influence on column ductility, with bigger steel ties and more rubber links resulting in greater ductility values for the columns. The ductility values of DNA helical columns with rubber at ends were found to be in the centre of simple DNA and DNA rubber at middle specimens, despite the usage of 8mm ties and just two rubber links.

REFERENCES

1.Reinforced Concrete Design by S.Unnikrishna Pillai, Devdas Menon 2. IS 456:2000

3. Journal of building Sciences --Shear Mechanism and capacity calculation of steel, Reinforced Concrete SpecialShaped columns. Authors: XueJianyang, Chen Zongping, Zhao Hongtie

4.Elsevier Science Ltd. Paper No 1361—An experimental study on reinforced concrete circular columns heavily confined by spiral reinforcement

5. A study of combined bending and axial load in reinforced concrete members by EivindHognestad, University of Illinois Bulletin

6.www.nptel.ac.in-- Module 10 Compression Members, Lesson 21 &22, Version 2 CE IIT, Kharagpur.