International Research Journal of Education and Technology
ISSN 2581-7795

A STUDY ON TORSIONAL BEHAVIOR OF RC FLANGED BEAMS

P Rajesh[1], K Kiran Kumar[2]

[1]*M Tech Student, Dept. of Civil Engineering, Priyadarshini institute of technology and science, Chinthalapudi, Guntur*

[2]*Assistant Professor, Dept. of Civil Engineering, Priyadarshini institute of technology and science, Chinthalapudi, Guntur*

---***---

Abstract - *Environmental degradation, increased service loads, lower capacity due to ageing, degradation due to poor construction materials and workmanship, and the conditional requirement for seismic retrofitting have all necessitated the need for existing structural maintenance and rehabilitation. Fiber reinforced polymers were employed. Because of factors such as low weight, great strength, and durability, it has been used successfully in a variety of such applications. a number of previous Torsion strengthening research has primarily focused on solid rectangular RC beams with varying strip thicknesses. Patterns and various fiber kinds several analytical models have been devised to predict the torsional behavior of reinforced square beams and successfully used for experimental work validation. However, literature the research on torsional strengthening of RC T-beams is limited. In the current work, an experimental study was carried out in in order to have a better knowledge of the torsional strengthening behavior of solid RC flanged T-beams. An RC T-beam is analysed and designed for torsion in the same way that an RC rectangular beam is; codes ignore the effect of concrete on flange. The effect of the flange part in resisting torsion is investigated in this study by varying the flange width of controlled beams. Strengthening configurations and fiber orientations are two more characteristics being investigated.*

Key Words: **Torsional, Strength, Beams Fibre, Reinforced**

1. INTRODUCTION

Modern society is dependent on the continued performance of its civil engineering infrastructure, which includes everything from industrial buildings to power plants and bridges. The necessity for maintenance and strengthening is unavoidable if the present structural system is to work satisfactorily. Almost all engineering structures, from residential buildings to industrial buildings to power plants and bridges, experience degradation or deterioration over their entire life course. Environmental factors such as corrosion of steel, gradual loss of strength with ageing, temperature variation, freeze-thaw cycles, repeated high intensity loading, contact with chemicals and saline water, and exposure to ultra-violet radiations are the primary causes of those deteriorations. In addition to these environmental consequences, earthquakes are a major cause of structural degradation. This issue necessitates the development of successful structural retrofit solutions. As a result, it is critical to keep an eye on the ongoing performance of civil engineering facilities. The structural retrofit issue has been resolved.

2. LITERATURE REVIEW

Ghobarah et al. [1] conducted an experimental investigation on the improvement of the torsional resistance of reinforced concrete beams using fiber-reinforced polymer (FRP) fabric. A total of 11 beams were tested. Three beams were designated as control specimens and eight beams were strengthened by FRP wrapping of different configuration and then tested. Both glass and carbon fibers were used in the torsional resistance upgrade. Different wrapping designs were evaluated. The reinforced concrete beams were subjected to pure torsional moments. The load, twist angle of the beam, and strains were recorded. Improving the torsional resistance of reinforced concrete beams using FRP was demonstrated to be viable. The effectiveness of various wrapping configurations indicated that the fully wrapped beams performed better than using strips. The 45° orientation of the fibers ensures that the material is efficiently utilized

Jing et al. [2] made an experimental investigation on the response of reinforced concrete box beam under combined actions of bending moment, shear and cyclic torque, strengthened with externally bonded carbon fiber reinforced polymer sheets. Three strengthened box beams and one reference box beam were tested. The main parameters of this experiment were the amount of CFS and the wrapping schemes.

Hiiand Al-Mahaidi [3] briefly recounted the experimental work in an overall investigation of torsional strengthening of solid and box-section reinforced concrete beams with externally bonded carbon fiber-reinforced polymer (CFRP).

Zojaji and Kabir [4] developed a new computational procedure to predict the full torsional response of reinforced concrete beams strengthened with Fiber Reinforced Plastics (FRPs), based on the Softened Membrane Model for Torsion (SMMT). To validate the proposedanalytical model, torque-twist curves obtained from the theoretical approaches are compared with experimental ones for both solid and hollow rectangular sections.

3. TORSIONAL STRENGHTENING OF BEAMS

Early research on the behavior of plain concrete to pure torsion found that the material fails in tension rather than shear. Curved in plan structural members, members of a space frame, eccentrically loaded beams, curved box girders in bridges, spandrel beams in buildings, and spiral staircases are typical examples of structural elements subject to torsional moments, and torsion cannot be ignored when designing such members. Torsion-resistant structural members come in a variety of shapes, including T-shapes, inverted L-shapes, double T-shapes, and box sections. These many arrangements make determining torsion in RC members a difficult issue. Furthermore, torsion is commonly connected with bending moments and shearing forces, and the interaction of these forces is critical. Thus, the tensile reaction of the material, particularly its tensile cracking properties, governs the behavior of concrete elements in torsion. Spandrel beams, which are positioned around the perimeter

4. EXPERIMENTAL STUDY

T-shaped beams were evaluated under coupled bending torsion in three groups (T2, T3, and T4). The control specimens were three beams with no torsional reinforcement, and the eight specimens were strengthened with epoxy-bonded glass FRP textiles as external transverse reinforcement. Specimens were cut into cross-sections. One beam was a flanged T-shaped beam with dimensions bw/D/bf/df = 150/270/250/80 mm (beams of series T2). Five beam specimens in the series-B were flanged beams with dimensions of bw/D/bf/df =150/270/350/80. (beams of series T3). In addition, five beam specimens with T-shaped cross-sections with dimensions bw/D/bf/df =150/270/350/80 were used (beams of series T4). All beams' cross-sections. Each group contains one control specimen that does not have transverse reinforcement. T2C was the group-A control specimen, with just longitudinal reinforcement; four deformed bars of diameter 20mm and 10mm in the corners of the cross-section, and T3C was the group-B control specimen.

5. RESULT AND DISCUSSION

5.1 Torsional Moment and Angle of Twist Analysis

Torsional second and Angle of turn Analysis, all things considered, : Here the point of spot of each bar is examined. Point of touch of each shaft is contrasted and the point of bit of control pillar. Additionally the torsional practices thought about between various wrapping plans having a similar support. Same sort of burden course of action was ruined every one of the bars. Every one of the bars were reinforced by utilization of GFRP in four layers over the radiates. It was noticed that the conduct of the pillars reinforce with GFRP sheets are superior to the control radiates. The diversions are lower when bar was wrapped remotely with GFRP strips. The utilization of GFRP strips had impact in postponing the development of break arrangement. At the point when all the wrapping plans are viewed as it was observed that the Beam with GFRP strips completely folded and 45º direction around full a length of 0.8m in the center part had a superior impervious to torsional conduct when contrasted with the others reinforced shafts with GFRP

Fig - 1 A View of Crack

5.2 Torsional Moment vs. Angle of Twist Curves

In this experiment load was applied on the two moment arm of the beams which is 0.35m away from the main beam and at the each increment of the load, deflection at L/3, L/2 and 2L/3 is taken with the help of dial gauges. Using this load and deflection data, the corresponding torsion moment and the twisting angle were calculated and the above graph was plotted. In this group, also the maximum ultimate strength was contributed by fully wrapped pattern of GFRP (T4SF). In addition, complete wrapping scheme provided an efficient confinement and in turn a significant increase in ultimate strength was observed, the increase in strength was 107.23% as compared with the control beam (T4C). T4S45 also giving the increase in ultimate strength of 95.39% as compared with T4C. The U-wrapped beam T4SU showed increase in ultimate strength by 36.84 % with respect to control beam T4C whereas the beam with anchor bolts T4SUA showed 61.83% increase in ultimate strength. The bolts provide continuity to shear flow path hence more capacity to resist the torsion. The beam T4SUA indicated more ductile behavior compared with T4SU.

6. CONCLUSIONS

The experimental program of this study consists of eleven numbers of reinforced concrete T- beams with different flange widths tested under torsion. The main objective of this study is to investigate the effectiveness of the use of epoxy-bonded FRP fabrics as external transverse reinforcement. Based on presented experimental measurements and analytical predictions, the following conclusions were reached Experimental results shows that the effect of flange width on torsional capacity of GFRP strengthened RC T-beams are significant. Torsional strength increases with increase in flange area irrespective of beam strengthening with GFRP The cracking and ultimate torque of all strengthen beams were greater than those of the control beams. The increase in magnitude depends on the FRP strengthening configurations.

REFERENCES

[1] Gobarah,A., Ghorbel, M., and Chidiac, S. 2002. "Upgrading torsional resistance of RC beams using FRP." Journal of Composites for Construction ,6,257–263..

[2] Jing and Pantazopoulou, S.J. 2005 Experimental evaluation of FRP jackets in upgrading RC corroded columns with substandard detailing", Engineering Structures, 26, 817.

[3] Hiiand Al-Mahaidi 2011 Torsional behaviour of prestressed concrete beam strengthened with CFRP sheets" 16th International Conference on Composite Structures, ICCS 16.

[4] Zojaji A.R. and Kabir M.Z. 2011 "Analytical approach for predicting full torsional behavior of reinforced concrete beams strengthened with FRP materials". Scientia Iranica A.19 (1), 51–63.

[5] Zhang, J. W., Lu, T. Z., and Zhu, H.2018 "Experimental study on the behavior of RC torsional members externally bonded with CFRP".FRP composites in civil engineering, I, Elsevier Science, New York

[6] Tastani, S.P. and Pantazopoulou, S.J.2019 "Experimental evaluation of FRP jackets in upgrading RC corroded columns with substandard detailing", Engineering Structures, 26, 817