International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in; editorijoer@gmail.com

Vol.5., Issue.5, 2017
Sept-Oct

RESEARCH ARTICLE

ISSN: 2321-7758

EFFECT OF RC HOLLOW BEAMS UNDER PURE CYCLIC TORSION

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ABSTRACT

Environmental degradation, increased service loads, reduced capacity due to aging, degradation owing to poor construction materials and workmanships and conditional need for seismic retrofitting have demanded the necessity for repair and rehabilitation of existing structures. Fibre reinforced polymers has been used successfully in many such applications for reasons like low weight, high strength and durability. Many previous research works on torsional strengthening were focused on solid rectangular RC beams with different strip layouts and different types of fibres. Various analytical models were developed to predict torsional behavior of strengthened rectangular beams and successfully used for validation of the experimental works. But literature on torsional strengthening of RC T- beam is limited.

In the present work experimental study was conducted in order to have a better understanding the behavior of torsional strengthening of solid RC flanged T-beams. An RC T-beam is analyzed and designed for torsion like an RC rectangular beam; the effect of concrete on flange is neglected by codes. In the present study effect of flange part in resisting torsion is studied by changing flange width of controlled beams. The other parameters studied are strengthening configurations and fiber orientations.

The objective of present study is to evaluate the effectiveness of the use of epoxy-bonded GFRP fabrics as external transverse reinforced to reinforced concrete beams with flanged cross sections (T-beam) subjected to torsion. Torsional results from strengthened beams are compared with the experimental result of the control beams without FRP application. The study shows remarkable improvement in torsional behavior of all the GFRP strengthen beams. The experimentally obtained results are validated with analytical model presented by A.Deifalla and A. Ghobarah and found in good agreement

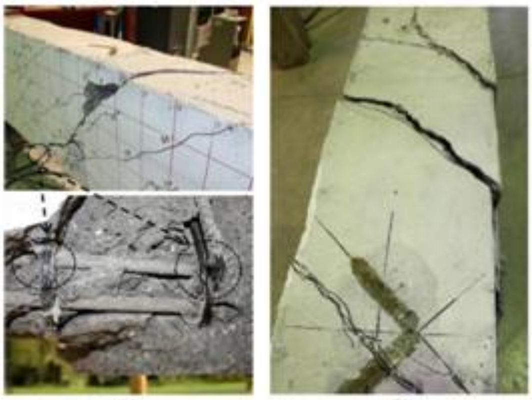
INTRODUCTION

Modern civilization relies upon the continuing performance of its civil engineering infrastructure ranging from industrial buildings to power stations and bridges. For the satisfactory performance of the existing structural system, the need for maintenance and strengthening is inevitable. During its whole life span, nearly all engineering structures ranging from residential buildings, an industrial building to power stations and bridges faces degradation or deteriorations. The main causes for those deteriorations are environmental effects including corrosion of steel, gradual loss of strength with ageing, variation in temperature, freeze-thaw cycles, repeated high intensity loading, contact with chemicals and saline water and exposure to ultra-violet radiations. Addition to these environmental effects earthquakes is also a major cause of deterioration of any structure. This problem needs development of successful structural retrofit technologies. So it is very important to have a check upon the continuing performance of the civil engineering infrastructures. The structural retrofit problem has two options, repair/retrofit or demolition/reconstruction. Demolition or reconstruction means complete replacement of an existing structure may not be a cost-effective solution and it is likely to become an increasing financial burden if upgrading is a viable alternative. Therefore, repair and rehabilitation of bridges, buildings, and other civil engineering structures is very often chosen over reconstruction for the damage caused due to degradation, aging, lack of maintenance, and severe earthquakes and changes in the current design requirements. Previously, the retrofitting of reinforced concrete structures, such as columns, beams another structural elements, was done by removing and replacing the low quality or damaged concrete or/and steel reinforcements

TORSIONAL STRENGHTENING OF BEAMS

Early efforts for understanding the response of plain concrete subjected to pure torsion revealed that the material fails in tension rather than shear. Structural members curved in plan, members of a space frame, eccentrically loaded beams, curved box girders in bridges, spandrel beams in buildings, and spiral stair-cases are typical examples of the structural elements subjected to torsional moments and torsion cannot be neglected while designing such members. Structural members subjected to torsion are of different shapes such as T-shape, inverted L–shape, double T-shapes and box sections. These different configurations make the understanding of torsion in RC members of complex task. In addition, torsion is usually associated with bending moments and shearing forces, and the interaction among these forces is important. Thus, the behaviour of concrete elements in torsion is primarily governed by the tensile response of the material, particularly its tensile cracking characteristics. Spandrel beams, located at the perimeter of buildings, carry loads from slabs, joists, and beams from one side of the member only. This loading mechanism generates torsional forces that are transferred from the spandrel beams to the columns.

Reinforced concrete (RC) beams have been found to be deficient in torsional capacity and in need of strengthening. These deficiencies occur for several reasons, such as insufficient stirrups resulting from construction errors or inadequate design, reduction in the effective steel area due to corrosion, or increased demand due to a change in occupancy. Similar to the flexure and shear strengthening, the HRB fabric is bonded to the tension surface of the RC members for torsion strengthening.



(a) (b)

In the case of torsion, all sides of the member are subjected to diagonal tension and therefore the HRB sheets should be applied to all the faces of the member cross section. However, it is not always possible to provide external reinforcement for all the surfaces of the member cross section. In cases of inaccessible sides of the cross section, additional means

Material and Beam Specification

To understand the behavior of hollow RC beam under pure cyclic torsion total six beams were casted and tested under pure cyclic torsion using the Torsion Frame. To create hollow section in the beam PVC pipe was inserted at the time of the casting on the center line of section and supported on the hollow ply wood side panels in the formwork. The beam was cured with jute bags for 28 days and then tasted under pure cyclic torsion. Reinforcement details are shown below in Table 1 of test beams. All beams having same grade of concrete having characteristic compressive strength after 28 days as 25N/mm2. Stirrups in all beams are of same 8-mm diameter with yield strength of

415N/mm2. w/c ratio was 0.45 and OPC grade 53 cement was used in casting. Concrete mix proportion was 1:1.68:2.7 (Cement: Fine Aggregate: Coarse aggregate) as per IS: 10262– 2009.

Notation for the beam is given as B for beam, and the digits shown after L is diameter of longitudinal steel, S-stirrup spacing. For example BL8S100 means beam having 8 mm longitudinal steel and stirrup @ 100 mm spacing. FACTORS

INFLUENCING THE CHLORIDE DIFFUSION RATE

The main issue that controls the diffusion of chloride ions in geo chemical compound geo chemical compound concrete is geo polymer geo polymer concrete permeableness. Geo chemical compound geo polymer concrete permeableness is reduced by:

- Reducing the water-cement magnitude relation of the geo chemical compoundgeo polymer concrete.
- Adding pozzolanic and pozzolanic /cementitious materials to the geo chemical compoundgeo polymer concrete.
- Adding chemical compound modifiers to the geo chemical compoundgeo polymer concrete. Aggregate gradation.
- Some other factors influencing the diffusion of chloride ions in geo chemical compoundgeo polymer concrete include:(8) Surface charge on the hydrous cement paste.
- Formation of porous transition zones at the aggregate/cement paste interface. Microcracking.

An increase in micro cracking will increase the speed of chloride particle permeableness for structures subjected to cyclic loadings. Static compressive stresses don't seem to possess any important result on chloride particle permeableness. However, geo chemical compoundgeo polymer concrete exhibits a big increase in permeableness once loaded with cyclic compressive hundreds that area unit sixty to eighty % of its final strength. the speed of chloride particle permeableness will increase as residual strength decreases.

The prediction/calculation of chloride penetration into geo chemical compoundgeo polymer concrete is usually done mistreatment Fick's Second Law. However, the applying of Fick's Second Law to predict chloride penetration yields results that area unit terribly conservative. this is often principally because of the outline of geo chemical compoundgeo polymer concrete as a consistent medium to model the transport of dissolved ions (i.e., it's too straightforward a model and isn't because of any elementary drawback with Fick's Law). additionally, the prediction of chloride particle penetration mistreatment diffusivity could also be unsure because the assumption of a relentless chloride particle diffusivity is rarely seen in real structures.

STRENGTHENING OF BEAMS

At the time of bonding of fiber, the concrete surface is made rough using a coarse sand paper texture and then cleaned with an air blower to remove all dirt and debris. After that the epoxy resin is mixed in accordance with manufacturer's instructions. The mixing is carried out in a plastic container (100 parts by weight of Araldite LY 556 to 10 parts by weight of Hardener HY 951). After their uniform mixing, the fabrics are cut according to the size then the epoxy resin is applied to the concrete surface. Then the HRB sheet is placed on top of an epoxy resin coating and the resin is squeezed through the roving of the fabric with the roller. Air bubbles entrapped at the epoxy/concrete or an epoxy / fabric interface are eliminated. During hardening of the epoxy, a constant

To implement equation 7 above, find each of Zs and As in terms of yield stress fy st and Moment M. Express Zc only in geometric form

CONCLUSION

The hitherto sought single model to aid in the design of reinforced concrete (flexural members) is herein formulated. The extensive application of it to solid and hollow geometrical sections of all shapes with the striking results, show some promises for another perspective in the design of reinforced concrete. The limit state method is not in any way undermined in this work; rather it is the basis upon which the basic principles in the formulation of the model are founded. There is hardly any known single design model that can handle the design of flexural members with different geometrical sections. Different material strengths can be imputed in the proposed method unlike other methods which will restrict the designer to certain material strengths and pre-fixing of the

Ratio together with other parameters. Practicing Engineers would want a model as flexible as this, using a hand calculator for design

Cracking Torque in all six beams BL8S100, BL10S100, BL12S100, BL8S150, BL10S150, and BL12S150 was observed to be almost same that means steel does not affect the cracking torque and it only depends on the grade of concrete. All six beams BL8S100, BL10S100, BL12S100, BL8S150, BL10S150, and BL12S150 were cracked at par torsional moment. At full cracked condition the elongation and buckling of main steel was observed but the stirrups were intact with minor deformation that means at ultimate stage the main reinforcement alone resist the torsional moment. In all type of beams having stirrups @ 150 mm c/c exhibited more energy dissipation compared to beams having stirrups @ 100 mm c/c. It implies that the shear reinforcement affects the torsional capacity of RC hollow beam under pure cyclic torsion. In all type of beams having stirrups @ 100 mm c/c exhibited less twist compared to beams having stirrups @ 150 mm c/c. It shows that the shear reinforcement does not affect the torsional flexibility of the RC hollow beam under pure cyclic torsion and depends on longitudinal reinforcement only. Energy dissipation range for same longitudinal steel and different spacing is less than the same transverse reinforcement and different longitudinal reinforcement. Main reinforcement is more influencing in torsional behavior of RC hollow beam under pure cyclic torsion then shear reinforcement. Post-cracking behavior of RC hollow beams under pure cyclic torsion is purely governed by longitudinal and shear reinforcement.

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