A REVIEW ON "EXPERIMENTAL STUDY ON FLEXURAL BEHAVIOR OF CONCRETE FILLED STEEL TUBE SECTION"

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Abstract - Concrete filled steel tubes (CFST) member have many advantages compared with the ordinary structural member made of steel or reinforced concrete. One of the main advantages is the interaction between the steel tube and concrete. Concrete delays the steel tube's local buckling, whereas the steel tube confines the concrete and thereby increases the concrete's strength. CFSTs are economical and permit rapid construction because the steel tube serves as formwork and reinforcement to the concrete fill, negating the need for either. The deformation capacity of the system is increased by the combined action of the concrete fill with the thin, ductile steel tube. The concrete fill significantly increases inelastic deformation capacity and the compressive stiffness and load capacity of the CFST member. In building construction concrete filled steel tubes are very widely used for columns in combination with steel or reinforced concrete beam. In this work totally 9 specimens will tested out of which 3 specimens were empty steel tubes and remaining 6 specimens were concrete filled with different bonding techniques. Comparison of experimental flexural stiffness with existing codes, such as AIJ-1997, BS5400-1979, EC4-1994, and LRFD-AISC-1999

Keyword:- Concrete fill Steel Section, flexural Behavior, different bonding techniques.

I. INTRODUCTION:-

Concrete-filled steel hollow section (CFSHS) columns are widely used in the construction industry for the past few years owing to advantages of combining two constituent materials. The steel hollow section in-filled with concrete has higher strength and larger stiffness than the conventional structural steel section and reinforced concrete. It can be more economical to use CFSHS columns for the construction of building structures because of the ease of fabrication and lightweight [1].

Concrete-filed steel tubes -CFSTs are used in many structural applications including columns, supporting platforms of offshore structures, roofs of storage tanks, bridge piers, piles, and columns in seismic zones. Concrete-filed steel box columns offer excellent structural performance, such as high strength, high ductility and large energy absorption capacity and have been widely used as primary axial load carrying members in high-rise buildings, bridges and offshore structures. Application of the CFST concept can lead to overall savings of steel in comparison with conventional structural steel systems. In CFST composite construction steel tubes are also used as permanent formwork and to provide well-distributed reinforcement [2]

Composite members consisting of circular steel tubes filled with concrete are extensively used in structures involving very large applied moments, particularly in zones of high seismicity. Composite circular concrete filled tubes (CFT) have been used increasingly as columns and beam-columns in braced and unbraced frame structures. Their use worldwide has ranged from compression members in low-rise, open floor plan construction using cold-formed steel circular or rectangular tubes filled with precast or cast-in-place concrete, to large diameter cast-in-place members used as the primary lateral resistance columns in multi-story buildings. In addition, concrete filling is widely used in retrofitting of damaged steel bridge piers after the earthquake in Japan and the Northridge earthquake in the USA. The CFT structural members have a number of distinctive advantages over conventional steel reinforced concrete members. CFT members provide excellent seismic resistance in two orthogonal directions as well as good damping characteristics. These members also have excellent hysteresis behavior under cyclic loading, compared with hollow tubes [5]

.II. OBJECTIVES:-

The objectives of present study are:

- To find out the ultimate flexural strengths of empty and concrete filled steel tube beam.
- To check effect of different bonding technique on flexural strength of concrete filled steel tube beam.
- To check the behavior, failure and crack pattern of in filled concrete.
- Validate experiment result with AIJ-1997, BS5400-1979, EC4-1994, LRFD-AISC-1999.

III. LITERATURE REVIEW:-

1] wie-Min Gho et.al. (2004) :-

Wie-Min Gho et.al. (2004) presented 'Flexural behavior of high-strength rectangular concrete-filled steel hollow sections'. In this experimental work the behavior of concrete filled steel tubes under pure bending was studied. Twelve rectangular hollow tubes with different sizes 150x150; 200x150 and 250x150 mm were used. High strength concrete (56.3MPa to 90.9MPa) was used as infill for the hollow tubes for composite action. Yield stresses of hollow tubes were 438Mpa, 495Mpa and 409Mpa respectively. They concluded that the post yielding behaviour was good enough with ductility performance. A comparison of the experimental values and values calculated from design formulas in EC4, ACI and AISC were made. The codes underrated moment capacities of the specimens considered. EC4 provides better moment carrying capacity than ACI and AISC and the difference is about 11%. THE ACI and AISC codes underrated the flexural strength of the specimens by 15 and 18%, respectively. On evaluating the codes with the collected data, test results show an increase in flexural strengths by 9, 12 and 15%, respectively

2] **Arivalagan et.al. (2009):-**

Arivalagan et.al. (2009) presented the study of 'Energy Absorption Capacity of Composite Beams Ultimate strength capacity of a square hollow section filled with fibrous foamed concrete'. A brief experimental research was conducted in the experimental work, the moment capacity and the behaviour of unfilled and concrete filled hollow sections were noted down. The sections were subjected to cyclic reversible loading. Here the filler materials were of two types, normal concrete and fly ash concrete. The effect of filler materials used, slenderness of section, load vs deflection, momentstrain curve, ductility, stiffness degradation and energy absorption of concrete –filled RHS beams were studied. Totally 9 specimens were considered. 3 were rectangular hollow sections, 3 were concrete filled steel tubes and the other six were fly ash filled steel tubes. The sizes of RHS section was 100x50x3.2 mm. They concluded that the increase in ultimate moment capacity was due to the filler material strength. The ultimate moment capacity for concrete-filled RHS members based on CIDECT standard was found to be in good agreement with the experimental moment capacity of Rectangular hollow steel beams filled with normal concrete and fly ash concrete. Experimental results prove that void filling increases energy absorption capacity of the section and also reduces the stiffness degradation. It also increases the ductility factor. The study showed that fly ash concrete could be used as infill material for a satisfactory mechanism

3] Andrew Wheeler et.al. (2015) –

Andrew Wheeler et.al. (2015) present Flexure Behavior of Concrete Filled Thin-Walled Steel Tubes with Longitudinal Reinforcement. Tests were carried on the tube specimens and the flexural stiffness of specimens were measured. Additionally in the experimental work, the change in flexural stiffness decreases with increase in diameter of the section. The concrete filled tubes which had larger depth to span ratios, there was cracking on tension side of the specimens and multiple cracks at the mid span. This effect was noted down by Wheeler and Bridge in their work. Both the issues emphasises that size of the specimens effect on flexural behaviour of concrete filled tubular members

4] Manojkumar V. Chitawadagi et.al. (2009) -

Manojkumar V. Chitawadagi et.al. (2009) - The strength deformation behaviour of circular steel tubes filled with different grades of concrete under flexure is presented. The effects of steel tube thickness, the cross sectional area of concrete, strength of in-filled concrete and the confinement of concrete on moment capacity and curvature of Concrete Filled steel Tubes (CFTs) are examined he conclude that A substantial increase in the moment of resistance and the corresponding curvature of all the hollow sections used in the experimental investigation are observed due to concrete filling and the CFT specimens exhibited a higher ductility than the hollow sections. An increase in the wall thickness of the steel tube increases the moment of resistance and ductility of both the hollow and CFT samples. An increase in strength of in-filled concrete for a given wall thickness of a CFT specimen, does not help in increasing the moment carrying capacity to a great extent.

5] M. Elchalakani et.al. (2001) -

M. Elchalakani et.al. (2001) presents an experimental investigation of the flexural behaviour of circular CFT subjected to large deformation pure bending. In general, void filling of the steel tube enhances strength, ductility and energy absorption especially for thinner sections.

6**] Lin-Hai Han et.al. (2003) –**

Lin-Hai Han (2003) develop a mechanics model that can predict the behaviour of concrete-filled hollow structural section beams. To develop formulas for the calculation of the moment capacity of the concrete-filled HSS beams, such formulas should be suitable for incorporation into building codes.

7] Naveena Treesa et.al. (2016) –

Naveena Treesa (2016) From the studies conducted on three different beams it can be seen that a concrete filled steel tubular section with reinforcement resists tension, bending moments and also increases load carrying capacity when compared to a normal reinforced concrete and steel section of similar dimensions.

8] Bharathi.K.M et.al. (2015) –

Bharathi.K.M et.al. (2015) This paper describes the properties and behavior of RC beams with composite reinforcement. The need for a replacement of the conventional reinforcement and the comparative resulting advantages by the in-filled steel pipes.

9] E K Mohanraj et.al. (2010) –

E K Mohanraj et.al. (2010) From results it can be observed that the partial replacements are a very attractive proposition for composite sections. However, the success of the method depends on several factors. The ultimate load of steel tubular beams in-filled with concrete is about 49 to 94 % of hollow beams. The strength of CFSTs with partial replacement of fine and coarse aggregate by waste materials is almost same as that of plain concrete.

10] Dr. Ali I. Tayeh et.al. (2014) –

Dr. Ali I. Tayeh et.al. (2014) The results show that the flexural capacity of the Concrete-Filled Steel Hollow Sections CFSHS beams is actually greater than the hollow beam which was about 70 to 90%.

11] Arivalagan Soundararajan et.al. (2010) –

Arivalagan Soundararajan et.al. (2010) this investigation confirm that normal mix concrete, fly ash concrete and quarry waste concrete can be used as infill material in composite construction to increase the flexural capacity of steel sections.

12] Samer Ahmad et.al. (2017)

Samer Ahmad et.al. (2017) was carry experimental investigation on the flexural behavior of partially encased composite beams. He was found that partially encased steel beam is an efficient technique for the enhancing its flexural capacity, with and without web openings.

13] et.al. (2010)

IV. CONCLUSIONS

- The deformation capacity of the system is increased by the combined action of the concrete fill with the thin, ductile steel tube.
- Concrete filled steel tube permit rapid construction because the steel tube serves as formwork and reinforcement to the concrete fill, negating the need for either.
- The concrete fill significantly increases inelastic deformation capacity and the compressive stiffness and load capacity of the CFST member.
- In building construction concrete filled steel tubes are very widely used for columns in combination with steel or reinforced concrete beam.

V. REFERENCES

1. Wie-Min Gho, Dalin Liu, "Flexural Behaviour of High-Strength Rectangular Concrete-Filled Steel Hollow Sections", Journal of Constructional Steel Research, 60, (2004), 1681 –1696.
2. Arivalagan and Kandasamy,"Energy Absorption Capacity of Composite Beams, Journal of Engineering Science and Technology Review", 2 (1), (2009), 145 150.
3. Dr. Andrew Wheeler, Prof. Russell Bridge, "Flexure Behaviour of Concrete Filled Thin-Walled Steel Tubes with Longitudinal Reinforcement", School of Engineering; University of Western Sydney Locked Bag (2003), 99-130.
4. Manojkumar V. Chitawadagi, Mattur C. Narasimhan., "Strength deformation behaviour of circular concrete filled steel tubes subjected to pure bending" Journal of Constructional Steel Research 65 (2009) 1836–1845
5. M. Elchalakani, X.L. Zhao, R.H. Grzebieta, "Concrete-filled circular steel tubes subjected to pure bending" Journal of Constructional Steel Research 57 (2001) 1141–1168
6. Lin-Hai Han, "Flexural behavior of concrete-filled steel tubes", Journal of Constructional Steel Research 60 (2004) 313–337.
7. Naveena Treesa Joseph," Flexural Performance of Concrete Filled Steel Tube Beams", International Journal of Engineering Research & Technology (IJERT) ISSN:2278-0181 Vol. 5 Issue 07, July-2016

8. Bharathi.K.M, “Flexural Behaviour Of Concrete Beams With Composite Reinforcement”, International Journal of Science and Engineering Research (IJ0SER), Vol 3 Issue 10 October-2015 3221 5687, (P) 3221 568X
9. E K Mohanraj, “SEISMIC BEHAVIOUR OF CONCRETE FILLED STEEL TUBULAR BEAMS” 35th Conference on OUR WORLD IN CONCRETE & STRUCTURES: 25 - 27 August 2010, Singapore Article Online Id: 100035039
10. Dr. Ali I. Tayeh “Flexural Behavior of Concrete-Filled Steel Hollow Sections Beams” Dean of College of Applied Engineering and Urban Planning PhD Mechanics and Deformable Solid University of Palestine – Gaza2014.
11. Arivalagan Soundararajan, “Flexural behaviour of concrete -filled steel hollow sections beams” Journal of Civil Engineering and Management ISSN: 1392-3730 (Print) 1822-3605 (Online) Journal homepage: http://www.tandfonline.com/loi/tcem20
12. Samer Ahmad, “Analytical and experimental investigation on the flexural behavior of partially encased composite beams” Alexandria Engineering Journal (2017) xxx, xxx–xxx.