JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

"COMPARATIVE STUDY ON CONCRETE FILLED STEELTUBE WITH REINFORCED CONCRETE"

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ABSTRACT

The Concrete filled steel tube (CFST) has many advantages as compared to conventional RCC structure. One of the main advantages is provide high strength to the structure in small section size of column also it gave more stability in seismic behaviour. Also, one of main advantage as compared to conventional system it gave more life span to the structure. Now a days in China the CFST structure are extensively used such as the world High altitude level Railway arch bridge constructed in Tibet province of China and also Japan is the one of the countries research projects on this system over last 37 years the famous program conducted by US-Japan partnership is US-Japan comparative earthquake research program. This paper introduces the merits of CFST structure in new construction trend of CFST and discusses the results of trail design CFST and also finds out the ways to how to be more economical the CFST structure using mild steel in specimens and increase performance of the structure. this paper is based on comparative study of CFST and RC column under an axial compressive stress

[Key Words: CFST, Convectional System, RC, Axial force, Ductility, Mild Steel, Specimens, Economical, buckling, Circular tube]

Introduction

Concrete filled steel tubes (CFST) are Structural member. CFST structure is a type of the composite steel-concrete structures used presently in civil engineering and consists of steel tube and concrete core inside it. In which hollow steel section is filled with high strength concrete. Combining the advantages of both hollow structural steel and concrete gives an advantage of high rigidity. Composite columns are structural members, which are subjected mainly to axial compressive forces and end moments.

The steel tube provides formwork for the concrete, the concrete prolongs local buckling of the steel tube wall, the tube prohibits excessive concrete spalling, and composite columns add significant stiffness to a frame compared to more traditional steel frame construction. Concrete filled steel tubes (CFST) are also used extensively in other modern civil engineering applications. When they are used as structural columns, especially in high-rise buildings, the composite members may be subjected to high shearing force as well as moments under a wind or seismic actions. While many advantages exist, the use of CFTs in building construction has been limited, in part, to a lack of construction experience, a lack of understanding of the design provisions and the complexity of connection detailing. Consequently, a joint was needed that could utilize the favourable strength and stiffness characteristics of the concrete-filled tube column yet be constructible.

1) Literature review

1.1) S.V.V.K. Babu AND Aditya Sai Ram, 2016

S.V.V.K Babu and Aditya Sai ram in there paper they compare the CFST columns and RC columns under the axial compressive force in this study they found that the CFST load carrying capacity increase by 19.3% and 38% for M_{20} and M_{40} ,17.3% and 22.2% for M_{20} and M_{40} , 19.7% and 24.3% for M_{20} and M_{40} and the average ultimate load carrying capacity filled tubular frames was increased by 22.5% and 48% for M_{20} and M_{40} The theoreticalaxial load carrying capacity of Concrete Filled Steel Tubular columns evaluated in accordance with AISC-LRFD 2005 and Eurocode 4 were found to be in best agreement. Maximum percentage variation for experimental results and theoretical results of axial load carrying capacity of CFST columns evaluated in accordance with AISC-LRFD 2005 was around 21%. Eurocode 4 was around 16%. Although there was some variation in the results between the experimental and theoretical results, but the experimental results were on the conservative side. The failure of the CFST columns of height 0.5m was basically due to the local buckling near the mid height compare to the failure of Hollow Steel Tubular columns which failed due to inward local buckling near the ends. The failures of the CFST columns of height 1.0m and 1.5m were basically due to the overall buckling which was very much similar in case of Hollow Steel Tubular columns

1.2) Esra metes Guneyisi, AysegulGultekin, Kasim Mermerdas, March 2016

For best and accurate value of structural load carrying capacity we need a more accurate equation.Esra Mete Güneyisi, Ayşegül Gültekin , and Kasım Mermerdaş paper state that the gene expression programming and the Eurocode 4 are gives the more accurate value than other provisions. They also state that the A new prediction model through explicit formulation of ultimate load carrying capacity (Nu) of the concrete filled steel tubular (CFST) short columns is presented in this study. The proposed formulation is developed by means of gene expression programming which is the development of genetic algorithm. In order to derive the model, the available experimental data presented in the technical literature were used. In accordance with the above mention

ed discussion and comparison of the proposed model with existing formulations, the following conclusions can be drawn (1) It was found out that GEP technique can be efficiently utilized to develop an empirical mathematical formulation for the axial load carrying capacity of CFST column with various geometrical and material properties. All of the obtained prediction results were valid (no zero or negative value). Therefore, it can be concluded that the proposed.

1.3) Stephen P. Schneider, Donald R. Kramer it all, August 2004

In Stephen p. schneider, Donald it all paper based on the stiffness of the Concrete filled Steel Tube (CFST).Construction of a type of moment-resisting joint recently used for two low-rise buildings in Vancouver, Washington U.S.A. The joint consists of a structural steel wide-flange shape penetrating continuously through a composite concrete-filled steel tube (CFT). Examples of two joint types are considered: One in which the girder was attached to the column in the field, and the second consisting of shop fabrication of the critical joint. Each joint configuration was detailed to accommodate the needed tolerances of fabrication and field erection, while minimizing welded joints in critical regions of the connection. This paper discusses an economical connection for a steel girder to a concrete-filled steel tube (CFT) column that has been designed for two recent building projects near Vancouver, WA. The anticipated behaviour during a seismic event, and some critical issues in the design of the connection, were also presented. Some comments regarding this joint behaviour and design are worth noting: 1. Test results indicate that a girder connection continuous through the CFT column core will clearly have the potential to sustain a large seismic event. The continuous connection detail shown in this paper has proven to be reasonably economical and constructible relative to the wide-flange column frame. 2. The flexural capacity computed by the ultimate strength method, as allowed by the AISC/LRFD steel specification, resulted in more capacity than provided by the ACI-318 concrete specification. This strength increase was due to utilizing the full capacity of the CFT cross-section at strength allowed by the AISC/LRFD provision. However, once each strength failure surface is factored for

2) METHODOLOGY OF CFST

In previous study the CFST member's performance as significantly considerable with the different D/t ratio in term diameter to thickness ratio we use the *115 mm* outer diameter with *4mm* wall thickness or thickness of steel tube. The yield stress of steel tube is 250 map (N/mm^2) and the concrete grade we use is m-20 local brand cement and steel tube is purchase from steel industry in Nanded city

The concrete mix designs for CFST are not different. There are no different clauses for concrete mix design for CFST. That's why we use normal concrete mix design. In this paper 8 numbers of CFST samples were tested and 8 number of same circular concrete cylinder were tested as same area of CFST concrete for more accurate strength of concrete

Table no1.1: Concrete mix design

Grade of concrete	Weight of cement	Weight of water	Weight of fine aggregate	Weight of course aggregate
M20	1.28 kg	0.64 kg	2.44 kg	3.305 kg

After the mix design the concrete should properly filled in CFST tubes. This test is taken on 7 days and 21 days curing of concrete

2.1)Dimension of CFST columns

i. The outer diameter of steel tube *115mm*
ii. The inner diameter of steel tube is *107mm*
iii. Thickness of steel tube is *4mm*
iv. The hight of CFST is *300mm*

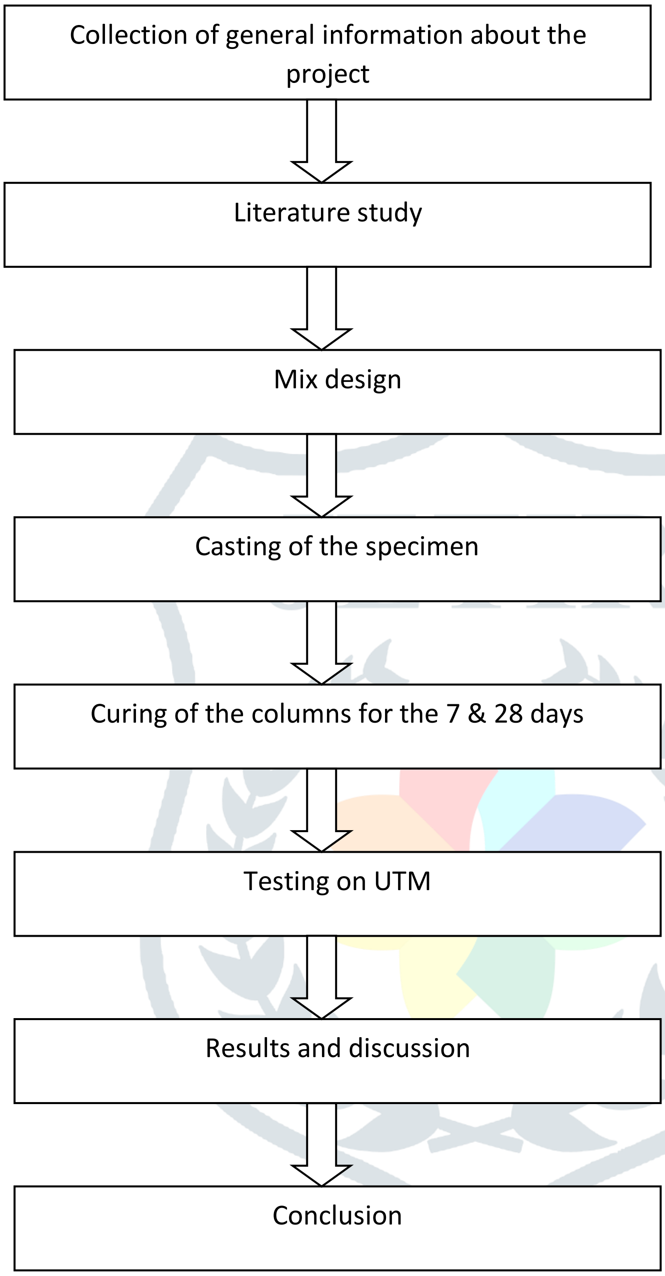
2.2Material used are :

i. Mild steel specimen
ii. Steel
iii. Cement
iv. Fine aggregates
v. Coarse aggregate
vi. Red oxide

2.3) Dimension of RC column

i. The diameter of circular RC is *115mm* X*300mm* height

2.4)Various steps involve in experimental investigation of structure behaviour



3) Experimental Work

All test are carried out on capacity of 2000 KN compressive testing machine. Shown in fig 1. The CFST is placed centrally on plate of compressive testing machine and loads are applied gradually. The reading were taken on dial gauge and tabulated.

3.1) IS 456:2000

Design of RC column as per IS456:2000 provides a proper steel area for reinforcement and compare with CFST column. Indian standard code design has minimum cross sectional area for steel reinforcement

3.2) Review of design codes

There are several codes are available for CFST structure. This code is help to design the CFST composite members. In civil engineering predict the strength of member are indues the more sustainable structure codes like (*AIJ 2001*), (*ACI 138R 2005)* (AISC 2005), EUROCODE 4 These are codes for CFST design and prediction of axial load carrying capacity of column.

But the form resent study on Esra Mete Güneyisi[1] the accurate prediction of the axial loads carrying capacity of CFST columns are GEP (gene expression programming) and Eurocode 4

Resistance of cross-section Eurocode 4 clause no 6.7.3.2

$$Npl = Aa \times fyd + AC \times fcd$$

Aa = cross-sectional area of structural steel section
fyd = Design value of the yield strength of the structural steel
Ac = Cross-sectional area of the concrete
fcd = Compressive Strength of concrete

Table no 3.1: Test result on 7 days curing

CFST Specimens	AXIAL COMPRESSIVE FORCE	CROSS-SECTIONAL ARES	ULTIMATE COMPRESSIVE STRESS
CFST 1	550KN	10386.89mm^2	52N/mm^2
CFST 2	589KN	10386.89mm^2	56.70 N/mm^2
CFST 3	602KN	10386.89mm^2	57.95 N/mm^2
CFST 4	560KN	10386.89mm^2	53.91 N/mm^2
RC Columns			
RC 1	290KN	10386.89mm^2	27.91 N/mm^2
RC2	289KN	10386.89mm^2	27.89 N/mm^2
RC3	310KN	10386.89mm^2	29.84 N/mm^2
RC4	335KN	10386.89mm^2	34.117 N/mm^2

Table no 3.2 .Test result on 28 days curing

CFST Specimens	AXIAL COMPRESSIVE FORCE	CROSS-SECTIONAL ARES	ULTIMATE COMPRESSIVE STRESS
CFST 1	660KN	10386.89mm^2	63.54 N/mm^2
CFST 2	770KN	10386.89mm^2	74.13 N/mm^2
CFST 3	700KN	10386.89mm^2	67.39 N/mm^2
CFST 4	750KN	10386.89mm^2	72.20 N/mm^2
RC Columns			
RC 1	350KN	10386.89mm^2	33.69 N/mm^2
RC2	345KN	10386.89mm^2	33.21 N/mm^2
RC3	400KN	10386.89mm^2	38.510 N/mm^2

RC4	320KN	10386.89mm^2	30.80 N/mm^2
RC5	315KN	10386.89mm^2	30.32 N/mm^2

4) Failure mechanism

In different load condition CFST shows different buckling. The local buckling of all specimen are visible refer fig no 1 the local buckling of steel tube a observed at the top portion of the CFST

Conclusion

- This paper discuss on the comparative study of CFST columns with traditional reinforce columns for reduce the effective length and cross-sectional area.
- It was found that the concrete filled stell tube CFST are provide more strength in less effective area
- CFST member provide more rigid to the structure as compare to RC columns
- CFST are ductile material and it gives a sign before the failure structure.

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