Comparative Study on Conventional Column and Concrete Filled Steel Tube (CFST) Columns under Axial Load – State of Art

Rajeshkumar K[1], Sachin Prabhu P[2], Mohan Kumar N S[3]
[1, 3]PG Student, Department of Civil Engineering, Kumaraguru College of Technology, Coimbatore, India
[2]Assistant Professor, Department of Civil Engineering, Kumaraguru College of Technology, Coimbatore, India

I. INTRODUCTION

Concrete filled steel tube column (CFST) are increasingly used in the world of construction, especially in the construction of the high-rise buildings with increased grid of columns. Presently, these designs are especially demanded in the countries of Eastern and South-East Asia, which are located in areas of high seismic activity. Concrete filled steel tube columns have not only increased bearing capacity, a very large deformability because of the hooped compression that is created by the steel holder for the concrete core. By adopting high-strength concrete (HSC), the column size can be further reduced and higher strength to weight ratio can be achieved without jeopardising the ductility. It provides the quasi-plastic nature of their destruction, even when the high-strength concrete is used. The survivability of buildings during earthquakes significantly increases as a result of using such columns in the building frames.

*V. Kvocaka et al "Composite steel concrete filled tubes"*focused on rectangular composite members subjected to compression and verified by experimental program. Properties of steel and concrete complements each other, which becomes more advantageous for CFST. Highly dependable and economical structures can be designed more efficiently using CFST. Filling hollow steel section with concrete enhances the load-bearing capacity of the structure. Encasing steel section fully in concrete dramatically increases the fire resistance of the structure. Filling hollow steel section with concrete or encasing steel tube fully in concrete both has positive effect on compressive strength of the member, global stability and stiffness of the member.

*A.L. Krishana et al (Jan 2005)"Calculating the Strength of Concrete Filled Steel Tube Columns of Solid and Ring Cross-Section"*conducted Theoritical and experimental test with CFST column with pressed concrete core. Bearing capacity was hugely increased in centrally compressed CFST element. Three major effects that contributed for the increase in the concrete strength are long-term compression in concrete, lateral compression in concrete core, volume compression conditions. Non-linear deformation model should be generated to study the strength of the CFST column.

Ruslan Kanishcheva et al"Stability and Carrying Capacity of the Steel Tubes", Presented information about research related to stability of rectangular CFST in terms of their resistance. It also deals with imperfections on local buckling and load carrying capacity of the member. Models with different support conditions of local edges of the steel section are considered. Results of the model were obtained using ABAQUS and compared with calculations made according to Eurocode 3. Cross-section of CFST element can be greatly reduced because of their significant resistance to loss of global and local stability makes them more economical than cold-formed Hollow steel sections.

*Antanas sapalasaet al"Behaviour of hollow composite steel-concrete members under long term axial compression",*Conducted research related to the performance of hollow composite members made of steel-concrete under short-term loading. Hollow composite steel-concrete members consist of two materials with very different properties. Steel and concrete have different rheological behaviour. Rheological behaviour is neglected for steel at normal temperature, but deformations are substantial for concrete creep. The phenomenon of concrete creep is well investigated, but such knowledge cannot be directly applied to a composite member. Large portion of external forces acting on compressed structural members are due to permanent action. Many investigation are needed for composite members under long-term actions to ensure the reliable design of the structure.

*S.Seangatitha et al "Behaviors of Square Thin-Walled Steel Tubed RC Columns under Direct Axial Compression on RC Core",*presented an experimental study on modes of failure of square thin-walled steel tube Reinforced Concrete columns subjected to axial load applied directly to the RC core and its behaviour. The primary variables found have an impact were the concrete compressive strength, the wall thickness of the steel tube and the spacing of ties. 36 column specimens of size 150mm x 750mm including 24 tubed Reinforced Concrete specimens and 12 Reinforced concrete specimens, were tested. It was founded that the tubed RC columns initially had linear elastic behaviour and gradually became non-linear. Strain hardening, elasto-plastic and strain softening are classified non-linear behaviour of the column. Very large axial deformation mode of failure progressed in the columns. It was noted that there was no full interaction and restriction between the RC core and the steel tube. The design equations over-estimated the axial compressive strength of the column.

Pamuda Pudjisuryadi et al "Performance of square reinforced concrete columns externally confined by steel angle collars under combined axial and lateral load" Studied performance of retrofitting experimentally using five specimens two controlled specimens with conventional stirrups and the other specimens confined externally with the angle steel collars. Al the specimens are tested under constant axial load which is 30% of axial capacity of plain concrete to model gravity load and lateral load is given according to ACI 374.1-05. Lateral load is plotted against corresponding lateral displacement and it was found that the specimens with low confinement ratio suffered brittle failure and the specimens with adequate confinement show good deformability and ductile failure. It was concluded that Retrofitting by providing steel angle collar is very effective.

A.Silva et alinvestigated the flexural behaviour of column with rubberized concrete. Behavioural difference between standard CFST and composite CFST, in terms of energy dissipation capacity and ductility. It was found that cross-section slenderness does not have a significant influence on monotonic and cyclic behaviour of the specimen. No significant loss of bending capacity was observed in the monotonic tests. In the cyclic tests, some load degradation was detected due to pronounced local buckling developing on the specimens. Specimens tested in simple bending and with cyclic lateral loading showed failure of the steel tube due to very prominent local buckling in the specimen's base. The concrete type has not a relevant influence on specimen behaviour. Loading type effect in simple bending tests shows an influence of more pronounced base local buckling in cyclic loading, as the observed peak lateral load is lower than in the monotonic counterpart.

Finite element analysis on concrete-encased CFST stub columns Yu-Feng An, Lin-Hai Han and Xiao-Ling Zhao et al Developed finite element modelling of concrete-encased CFST stub columns under axial compression. Three different kinds of concrete are considered with concrete in CFST, outer confined concrete and outer unconfined concrete. The predicted and measured results were in good agreement. When the outer RC component reaches the ultimate strength, the whole composite column also reaches its ultimate strength. The peak load of the composite column approaches to the ultimate strength and strength of CFST component does not decrease in the whole loading procedure. Outer RC component bears the most of the applied axial load before reaching peak load and after reaching peak load the inner CFST component bears most of the applied load.

II. CONCLUSION

1. Rheological behaviour is neglected for steel at normal temperature.
2. These types of column can be used for retrofitting.
3. Adequate confinement shows good deformability & ductile failure.
4. When cold formed steel is used for CFST columns it optimises and economical when compared to conventional column.

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