# Analysis of Concrete-Filled Steel Tube Column


## ABSTRACT

In this project, work has been done on square and circular types of concrete filled steel column. The concrete filled steel column is becoming popular for the earthquake resistant structure because of good ductility and high axial strength. It has been observed that structure with concrete filled steel column performs well during strong earthquake. In this project work are carried out in three parts, study of design code i.e. IS-456 specification has been made. And compare experimental result of load carrying of CFTC with codal provisions. The second part consists of experimental work that has been carried out on M25 concrete grade and both ends fixed condition of steel tubes. The third part consists of the analytical work with the help of software STAAD-Pro for getting the axial force diagram and the deflected shape.


## INTRODUCTION

The Concrete-Filled Steel Tube (CFST) structural system is a system based on filling steel tubes with concrete. The CFST Structural system has characteristics such as rigidity, strength, deformation capacity, and fire resistance. Composite columns composed of concrete-filled steel tubes have become increasingly popular in structural applications. This type of columns can offer many advantages like high strength, ductility and large energy absorption capacity. In this project we have studied circular and squared shaped CFST columns. By definition, columns are structural members, which are subjected to axial forces. Structural members are generally made up of either steel or concrete or both steel and concrete as composite. The steel members show high tensile strength and ductility on the other hand, concrete members have the advantages of high compressive strength and stiffness.

### Definition

Composite column is a compression member comprising of concrete and steel in the form of other than reinforcing bars, composite column can be of two types.

### Types of Concrete Filled Steel Column

There are two main categories of composite columns, namely the concrete encased and the concrete filled columns. Encased composite column consist of structural shapes surrounded by concrete. Filled composite columns may be the most efficient application of materials for column cross sections. It provides inexpensive concrete core and increases the strength and the stiffness of the column.

1. **Concrete filled steel column**

Figure 1.2: Section of concrete filled steel columns.

2. **Encased column**

Figure 1.3: Section of encased column

### Advantages of Steel Column

1. Steel column are tough, that is, they have both strength and ductility. Thus, steel members subjected to large deformation during fabrication and erection will not fracture.
2. Due to the ductile nature of steel member does not failure suddenly, but gives visible evidence of impending failure by large deflection. Also, the ductile nature of the usual structural steel member enables them to yield locally at the points of high stress concentrations.
3. Being light, steel columns can be conveniently handled and transported. For this reason, prefabricated members can be frequently provided.

4. The properties of steel column mostly do not change with time. This makes steel the most suitable material for a structure.
5. Addition and alterations can be made easily to steel structures.
6. Steel has the highest scrap value amongst all building materials. Also, the steel can be reused after a structure is disassembled.

**Experimental Work**

The ultimate strength of composite has been evaluated and discussed by many researchers. In calculating the capacity of composite member, the strength of the cross section, which is usually expressed in terms of the squash load and the ultimate moment of resistance, is a basic requirement. The selection of an engineering material for a particular application has to take into account its ability and there is no doubt that structure is dependent on the properties of selected material.

**Grades of Concrete**

For this project work the following grades of concrete are selected:
M-25 grade of concrete

**Compaction of Concrete**

After concreting there may be presence of air voids, due to which there may be formation of honey combing, voids, etc. This may give rise to various problems and will reduce the strength of concrete, hence after concreting compaction is necessary. So we used tamping rod.

**Result of Concrete Strength**

Average compressive strength of M25 concrete after 28-Days

| SN | Specimen | Date of casting | Grade of concrete | Strength 28-days ( MPa ) | Average Strength ( MPa ) |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| 1 | 1 | 24/02/2018 | M-25 | 26.3 | 27.6 |
| 2 | 2 | | | 28.8 | |
| 3 | 3 | | | 27.9 | |

**Material Properties**

For design of concrete filled steel column analytically with the help of codes, required material properties of steel and to find out the material properties of steel section like yield strength, ultimate strength, modulus of elasticity.

**Experimental Setup**

For getting the idea of ultimate load carrying capacity of the prepared CFT models the experimental set up consisting of UTM of 1000 kN capacity at RMC Plant near Cathedral School was used.

**Experimental Procedure**

The specimens were set in the testing machine between flat bearings plates included in machine body. These plates were thick enough to ensure a uniform well prepared under the applied load with high of accuracy to ensure the load application to the required positions. The loading was applied from the top plate only keeping bottom support rigid. Loss of load during the test was ensured by preventing slight movement of the specimen's ends by setting the specimen exactly at the center; and initial load was applied to the test specimens and then released prior to testing. In all tests the load was increased gradually throughout the test until failure.

**Test Results**

Three samples of each type of specimens were tested for the ultimate axial loads in UTM. Following tables shows the test results and theoretical values calculated as per IS-456 for both ends fixed condition.

**Results of circular shape sample testing**

| SN | Grade of concrete | One end fixed | | | | |
|---|---|---|---|---|---|---|
| | | Tested load (kN) | | | | Theoret-ical load (kN) |
| | | Sample | | | Avg. load | |
| | | 1 | 2 | 3 | | |
| 1 | M25 | 75.5 | 77.1 | 76.8 | 76.5 | 43.29 |

| SN | Grade of concrete | Both end fixed | | | | |
|---|---|---|---|---|---|---|
| | | Tested load (kN) | | | | Theore-tical load (kN) |
| | | Sample | | | Avg. load | |
| | | 1 | 2 | 3 | | |
| 1 | M25 | 82.8 | 77.6 | 80 | 80.13 | 43.29 |

**Results of Square Shape Sample Testing**

| SN | Grade of concrete | One end fixed | | | | |
|---|---|---|---|---|---|---|
| | | Tested load (kN) | | | | Theoretical load(kN) |
| | | Sample | | | Avg. load | |
| | | 1 | 2 | 3 | | |
| 1 | M25 | 98.3 | 97.8 | 99.1 | 98.4 | 43.19 |

| SN | Grade of concrete | Both end fixed | | | | |
|---|---|---|---|---|---|---|
| | | Tested load (kN) | | | | There-tical load (kN) |
| | | Sample | | | Avg load | |
| | | 1 | 2 | 3 | | |
| 1 | M25 | 101.1 | 99.9 | 100.3 | 100.4 | 45.46 |

**CONCULSION**

In the present study of different types of concrete filled steel column the behavior has been studied for different end condition.

1. It is observed that the different types concrete filled steel column of different end condition the square shape column of both end fixed have 0.05% more capacity than the one end fixed square column for same le/D ratio.

2. Both end fixed circular shape column have 0.08% more capacity than the one end fixed circular column for same le/D ratio.

3. It is also observed that the experimental result of both end fixed square shape column have 4% more capacity than the one end fixed square shape

4. It is also observed that the experimental result of both end fixed circular shape column have 6% more capacity than the one end fixed circular shape column

5. It is concluded that from theoretical and experimental result the square column concrete filled column has more capacity than the circular shape concrete filled column.

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