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Structural Behavior of Concrete ENC ASED CFST Column Using Self Compacting Concrete with Polypropylene Fiber

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ABSTRACT *These days, erecting tall structures is necessary due to the growth of metropolitan regions. The massive size of the segments used by the elevated buildings will occupy larger areas and have an unsightly look. The growth of the construction sector inspires a variety of solutions to these problems, one of which is the Concrete Filled Steel Rounded Section. Huge regions can be employed since CFST Sections reduce the vast segment size s. Concretized CFST (concrete filled steel tube) segments are becoming more and more popular in construction, especially for tall and massive range constructions. The current literature is available on the fundamental working of self compacting concrete encased cement encased CFST segment s, but it is not available on self compacting concretes with fiber CFST segments. In this work, cement encased CFST segments are presented using self compacting concrete and polypropylene fibre. In Abaqus Programming 2020, the CFST segment reproduction is complete. The CFST segment underwent trial testing as well, and by examining the outcomes of the exploratory and replication findings, it was discovered that the CFST section enclosed with a square example provides excellent load protection since the weight is dispersed over all pathways.*

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I. INTRODUCTION

In multi celebrated constructions, a sensitive tale of defeating t he rising cost of land space limitation is known. In these situations, the parts are manufactured in larger proportions, requiring additional room. Concrete Filled Rounded Sections (CFTC) are delivered in a form that combines the best qualities of steel and cement. In this postulation, the principal execution on s elf compacting material including fly debris as 25% was explored. Polypropylene (PP) is the first stereo regular polymer to have accomplished modern significance.

The maximum quantity of fibre that may be used in SCC was between 0.75% and 1%. The polypropylene filaments completely increase the strength of SCC without causing any obvious probl ems with the steel strands. The first stereoregular polymer of current relevance is polypropylene (PP). The "large three" fibre classes polyester, nylon, and acrylic take the first three spots today, with polypropylene holding onto the fourth. The main display on self compacting concrete that increases pol ypropylene fibre volume by 1.2% of concrete weight. The advantages of Polypropylene Fibre over Steel Fibre are greater, and Polypropylene Fibre is lighter than Steel Fibre. With a profusion of filaments, the substantial's functioning decreased. The polypropylene filam ents increase the overall strength of SCC without causing any obvious problems with the steel strands.

II. MATERIALS AND ITS PROP ERTIES

Typical Portland cement of grade 53, fine aggregate no larger than 4.75 mm, and coarse aggregate no larger than 20 mm are the materials utilised in the experiment.

I. Cement

The Ordinary Portland Cement that complied with Indian Standard Specifications (BIS 269 1987 & BIS 1987) was the cement that was utilised. Table 1.1 lists the cement's characteristics.

II. Coarse aggregate

Aggregate made of crushed hard granite was utilised. According to Indian Standard Specificati ons (BIS:383 1970), the aggregate utilised was 12 mm in size and degraded. Table 1.2 lists the characteristics of c oarse aggregate as determined by laboratory studies.

III. Fine aggregate
The most common fine aggregate Sand made to Indian Standard Specifications (BIS 383 1970 & BIS 1970) was utilised as the most popular type of fine aggregate. Table 1 .3 lists the characteristics of fine aggregate as determined by laboratory experiments.

IV. Polypropylene Fibre A type of synthetic fibre made from a linear polymer called polypropylene is known as polypropylene fibre (PPF). Its benefits are its light weight, high strength, high toughness, and resistance to corrosion. Table 1.4 lists the PPF's characteristics.

Table1.1: Properties of cement.

Sl. No	Physical properties	Values
1.	Specific gravity	3.15
2.	Normal consistency	32%
3.	Initial setting	37 minutes
4.	Fineness	6%

Table 1.2: Properties of Coarse Aggregate.

Sl.no	Physical properties	Values
1.	Specific gravity	2.74
2.	Fineness modulus	3.39
3.	Maximum size	12 mm

Table 1.3: Properties of Fine Aggregate.

Sl.no	Physical properties	Values
1.	Specific gravity	2.65
2.	Fineness modulus	2.73
3.	Maximum size	4.75mm
4.	Zone confirmed	III

Table 1.4 : Properties of Polypropylene fibre

Sl.no	Physical properties	Values
1.	Tensile Strength	3.5 to 5.5
2.	Elongation	40 to 100
3.	Melting point (°C)	165
4.	Relative density	0.91

MIXTURE PROPORTION AND TEST PREPARATION

a. Mix design proportion

Table 5 provides specifics on the mixing ratios and identifications for grade 30 MPa concrete (M 30). The physical characteristics of the components, such as specific gravity, water absorption, and moisture content, were taken into account throughout the design mix process to give a consistent mixing procedure for the selected ratio. The mix design of concrete utilising Portland cement was carried out manually.

b. Workability test

The mould for the slump test is a 300mm high frustum of a cone. The hole at the top is narrower, measuring 100mm, while the base is 200mm in diameter. The container is filled with three layers of concrete th at have been tested for workability after the foundation has been set up on a flat surface.

c. Compressive Strength

Concrete cubes 150mm in size were used for the cube compression testing. According to the requirements of IS 516 1959, the test was performed. After removing the surface moisture from the specimen, all of the cubes were examined in a saturated state. After the specimen was centred in the testing apparatus, the tests were conducted under a constant stress.

d. Flexural Strength

The material's maximum internal stress at the time of rupture is represented by the flexural strength. The test followed the requirements of IS 516 2002 code. It measures how well a prism, beam, or slab mad e of reinforced concrete can withstand bending failure. Concrete prisms of 100 mm x 100 mm x 500 mm were loaded to determine the flexure strength. The modulus of rupture was used to calculate the flexural strength. The test speci men underwent a maximum load test after curing for 28 days.

e. Split Tensile Strength

The exam followed the IS 5816 1999 code requirement. One of the fundamental and significant characteristics of self compacting concrete is split tensile strength. Due to its low tensile strength and brittleness, c oncrete is often not anticipated to sustain the direct tension. The alternative methods for determining the tensile strength of concrete, aside from flexure, may be roughly divided into direct and indirect approaches. owing to the challenges with direct stress testing. A cylinder with a 150mm diameter and 300mm height was utilised to measure split tensile strength. The cylin der test specimen was created according to protocol. The cast forces were in contact with the testing machine's plates while this specimen was spread down horizontally i n the compression testing apparatus. Up until the sample failed, the load was applied steadily. At a failure, the load was noticed.

III. TEST RESULTS

a. Slump workability test:

The test results are tabulated below 1.5

S.no	Mix proportion	Type of slump	Slump flow diameter (mm)
1	CC	True slump	660
2	CC+1.2%F	True slump	520

b. Compressive Strength of Concrete:

The test results are tabulated below in 1.6

Sl.no	Mix	7 Days	28 Days
1	CC	18.33	32.18
2	CC+1.2%F	18.64	34.79

c. Flexural Strength of concrete:

The test results are tabulated below in 1.7

S.no	Mix	7 Days	28 Days
1	CC	2.9	3.845
2	CC+1.2%F	3.03	4.04

d. Split Tensile Strength of Concrete:

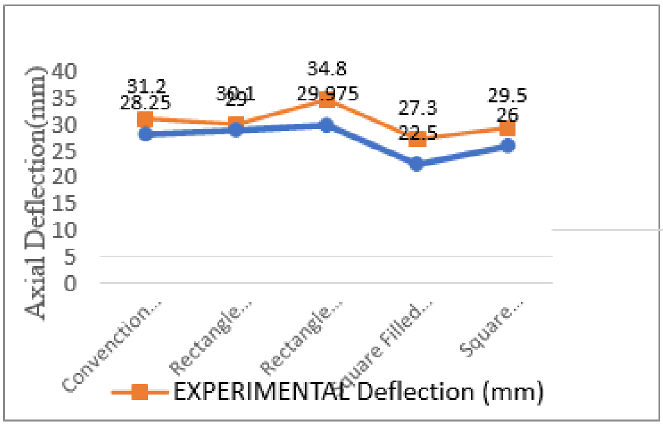
The test results are tabulated below in 1.8

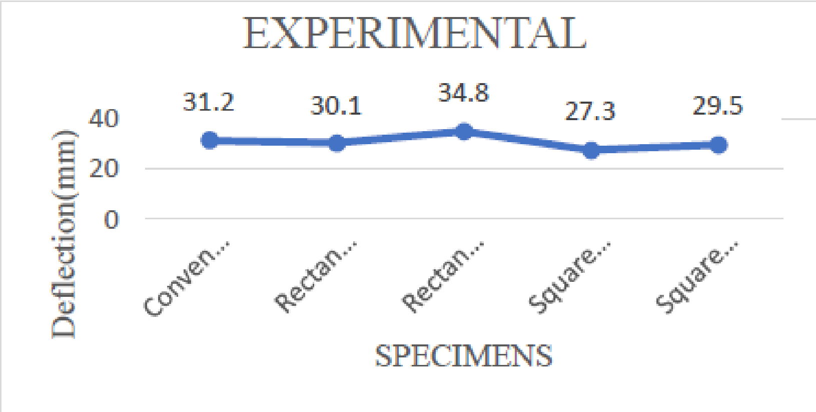
S.no	Mix	7 Days	28 Days
1	CC	1.85	3.11
2	CC+1.2%F	2.12	3.64

COMPARISON OF SPECIMENS

The maximum displacement was recorded in Rectangle Hollow Specimen and minimum displacemen t in square concrete filled column

COMPARISION OF DEFLECTION EXPERIMENTAL WITH ANALYTICAL





IV. DISCUSSION

SCC with Polypropylene Fibre at 1.2% by weight of cement in this study demonstrated greater compressive strength values at 7 and 28 days compared to ordinary concrete. When compared to conventional concrete, it was discovered that the compressive strength values had increased by 8.11%. The split tensile strength of self compacting concrete was discovered to be 17.04% higher than that of traditional concrete. Flexural strength has been improved by 5.07%. In simulation, a square filled column can support a maximum load of 924.678 kN. Rectangle Hollow Specimen had the most displacement, while square concrete filled column showed th e least displacement. Rectangle hollow specimen causes higher deflection because to the uneven surfaces in the column, but the CFST column encased with square specimen offers superior load resistance due to the distribution of stress in all directions.

V. CONCLUSION

The analytical and experimental study on the concr ete filled steel tubular columns tested after 28 days led to the following findings. The addition of polypropylene fibre to self compacting concrete reduces its workability but increases the compressive strength, split tensile strength, and flexural strength by 8.11%, 17.04%, and 5.07%, respectively. Due to the equal distribution of stress on the section's four sides, the square section with concrete filled in it was able to withstand 3.3% greater load than a normal RCC column. Abaqus 2020 simulation of a concrete encased steel tubular column revealed that the core initially becomes weaker, followed by the mild steel tube and then the exterior concrete.

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