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Compression of Structure Confined Ferromagnetic High-Strength Concrete's Behavior

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ABSTRACT
Potential plastic hinge zones in reinforced columns intended for seismic regions must be thoroughly studied for ductility in order to ensure that big earthquakes do not cause collapse. When a concrete with reinforcement is subjected to an earthquake or a nuclear bomb, for example, it collapses rapidly. This issue can be avoided if the crucial parts are capable of undergoing massive plastic deformations and absorbing huge quantities of strain energy. The confinement of concrete by appropriate transverse reinforcement results in a substantial improvement in compressed concrete strength and ductility. Confined Fiber Reinforced Concrete is a form of concrete that uses fibres to provide some confinement (CFRC). When we use fibers in large volumes it has the tendency to ball. As a result, the amount of indirect confinement provided by steel fibre is limited. This restriction confinement necessitates the use of further

TEST Engineering & Management

March-April 2019
ISSN:0193-4120 Page No. 78 – 83

confinement in reinforced concrete components at crucial sections. A Ferro cement shell can be used to give further confinement. Confined Ferro Fiber Reinforced Concrete is the name given to this type of concrete (CFFRC). The purpose of this study is to look at the stress strain characteristics and compressive strength of CFFRC and mortar.

Keywords: Sress, Strain, Compressive Strength, Columns, Fiber Reinforced Concrete, mortar

1. Introduction

The seismic resistance of buildings necessitates a high degree of ductility. As a result, concrete ductility is now increased by restricting it in steel binders, ties in compression members, and stirrups in beams. The crucial section, at which the first hinge occurs, is also the section with the greatest shear force in statically indeterminate systems. The offered stirrup reinforcement must take care of shear at that area while also providing confinement.

Therefore it may not be possible to sufficiently confine the structure by providing the laterals ties alone but it would be useful if a supplementary or indirect confinement, in addition to laterals, can be provided at the critical sections or a good alternative for the confinement.

Following were the objectives of the investigation:

- To study the behaviour of Confined Ferro fiber reinforced concrete (CFFRC) under axial compression
- To compare the compressive strength of Plain concrete and Fiber reinforced
- Evaluate the stress and longitudinal strain behaviour of columns

2. Materials used

Steel Bar: Steel bar of diameter 6mm was used as a longitudinal reinforcement and lateral ties for Column.

Galvanized Iron Wire: GI- wire was used as a longitudinal reinforcement and lateral ties. The diameter of GI-wire is 4mm.

Fabric Wire: Galvanized woven wire mesh of a square grid fabric was used. The diameter of meshed wire is 0.43mm and openings of wire mesh are 3mm.

Cement: Cement used in this project was an Ordinary Portland Cement of 53 grade confirming to IS 12269 – 1987.

Coarse Aggregate: Machine cut stone aggregates of 12mm down were used as coarse aggregate throughout the work.

Fine Aggregate: River sand available locally was used for concrete and for the mortar, fine aggregate (passing through 800μ and retained on 600μ sieve was used for Ferro cement).

Mortar: Cement mortar with 1:2 ratio and water-cement ratio of 0.5 was used.

Concrete: The concrete utilised was of the M25 grade.

Concrete Fiber: Volume fractions i.e., 1% of fibers are used in the investigation. In this present investigation, the fibers used are of diameter 0.45 mm and length 36 mm (aspect ratio 80) are used. The steel fibers are uniformly dispersed inside the entire mass of concrete.

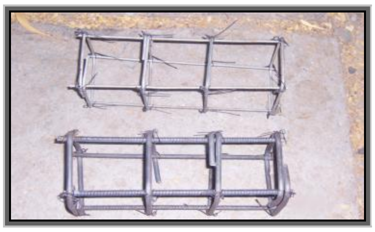
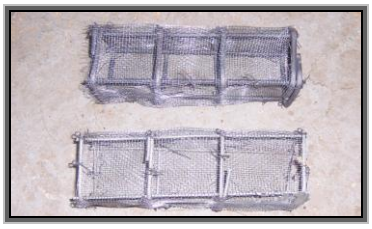
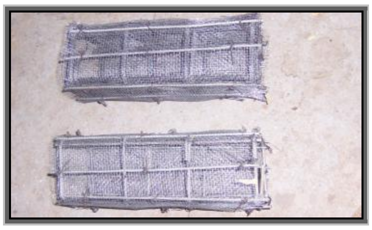
March-April 2019
ISSN:0193-4120 Page No. 78 – 83

Mortar fiber: Synthetic polypropylene fiber, was used in mortar.
Concrete mix for M_{25}: 1: 1.74: 2.29 and w/c = **0.45**

3. Casting

\Plane concrete cubes and fiber reinforced concrete cubes were cast in the standard cubes of size 150x150x150mm, from the same mixes prepared for casting the column specimen of size 150x150x300mm were cast to check the stress-strain behaviour.

Plane mortar cubes and mortar with fibers cubes were cast in the standard cubes of size 7 x 7 x 7cm, to check the compressive strength of mortar.

Zero mesh **Single layer mesh** **Double layer mesh**

The below table explains the experimental program in detail showing the columns casted with diameter of bar, number of mesh layers and the percentage of "Crimped steel fiber" and "Recron 3s" fiber used in the specimen with proper designation.

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March-April 2019
ISSN:0193-4120 Page No. 78 – 83

Table No 1: Details of short columns tested for stress-strain

Sl.No	Series	Designation	Dia of Bar/GI in mm	No of Specimen	No of Mesh Layers	Columns Cast in	
						Crimped steel Fiber %	Recron Fiber %
1	A	PC60	6	3	0	0	0
2		CF60	6	3	0	1	0
3		PC61	6	3	1	0	0
4		CF61	6	3	1	1	0
5		PC62	6	3	2	0	0
6		CF62	6	3	2	1	0
7	B	PC40	4	3	0	0	0
8		CF40	4	3	0	1	0
9		MF40	4	3	0	0	0.25
10		MCF40	4	3	0	1	0.25
11	C	PC41	4	3	1	0	0
12		CF41	4	3	1	1	0
13		MF41	4	3	1	0	0.25
14		MCF41	4	3	1	1	0.25
15	D	PC42	4	3	2	0	0
16		CF42	4	3	2	1	0
17		MF42	4	3	2	0	0.25
18		MCF42	4	3	2	1	0.25

4. Results

Table No 2: Details of concrete Cubes tested after 28 days curing

Sl.No	Specification	% of Fibers	Average Compressive Strength N/mm^2
1	0	0%	33.00
2	F	1%	45.04

Table No 3: Details of Mortar Cubes tested after 28 days curing

Sl.No	Specification	% of Fibers	Average Compressive strength N/mm^2
1	0	0%	22.5
2	F	0.25%	26.15

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March-April 2019
ISSN:0193-4120 Page No. 78 – 83

Table No 4: Ultimate Stress and Strains of Specimens

Sl.No	Series	Designation	SSR	Ultimate Stress F_{fu} N/mm^2	Ultimate Longitudinal Strain ϵ_{fu}	Ultimate Lateral Strain ϵ_{fu}
1	A	PC60	0	26.04	0.00176	0.184
2		CF60	0	29.68	0.00354	0.084
3		PC61	0.0172	27.64	0.0613	0.167
4		CF61	0.0172	30.84	0.0312	0.0814
5		PC62	0.0344	32.57	0.00176	0.082
6		CF62	0.0344	34.26	0.00341	0.115
7	B	PC40	0	26.02	0.00272	0.0425
8		CF40	0	27.2	0.00167	0.0236
9		MF40	0	26.222	0.00865	0.1426
10		MCF40	0	28.267	0.00594	0.075
11	C	PC41	0.0172	28.86	0.00325	0.156
12		CF41	0.0172	30.84	0.00588	0.0678
13		MF41	0.0172	29.54	0.0124	0.135
14		MCF41	0.0172	31	0.0187	0.0953
15	D	PC42	0.0344	30.355	0.00121	0.05
16		CF42	0.0344	32.32	0.0061	0.015
17		MF42	0.0344	31.4	0.00405	0.154
18		MCF42	0.0344	35.34	0.00894	0.14

5. Conclusion

\Compressive strength of concrete and mortar improves with the addition of fibers. Spalling of mortar reduces with the addition of fibers. The confinement of Ferro cement shell improved the stress-strain behaviour for fiber reinforced as compared to plain concrete specimen. Increase of confinement of fibers in columns show improvement in peak stress and strain. Addition of fiber in mortar has improved the strength at higher specific ratio, with the increase in the specific surface factor, the improvement in strain is more pronounced. The strength and ductility of columns increased with the increase in amount of confining steel in both fiber and non-fiber columns though, the enhancement were slightly more pronounced in the presence of fibers.

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