International Conference on Latest Advancements & Future Trends In Engineering, Science & Management
Sambhram Institute of Technology, Bangalore (India)
03rd - 04th May 2019 www.conferenceworld.in
SAMBHRAM INSTITUTE OF TECHNOLOGY
ISBN : 978-93-87793-86-6

Behaviour of Confined Ferro Fiber Reinforced Concrete under Axial Compression

Manjunath S[1], Shirisha Y C[2], Amitha N R[3]

Assistant Professor[1], Department of Architecture, Acharya's NRV School of Architecture, (India)

Assistant Professor[2], Department of CTM, Acharya Institute of Technology, (India)

Assistant Professor[3], Department of Architecture, Acharya's NRV School of Architecture, (India)

ABSTRACT

In Reinforced columns, designed for seismic regions the potential plastic hinge regions need to be carefully detailed for ductility in order to ensure that the shaking from large earthquakes will not cause collapse. A concrete with reinforcement fails suddenly when subjected to earthquake and nuclear blast etc. This problem can be avoided if the critical sections are able to undergo large plastic deformations and be in a position to absorb large amounts of strain energy. The confinement of concrete by suitable arrangements of transverse reinforcement results in significant increase in both the strength and ductility of compressed concrete. Fibers can give some confinement, such type of concrete is termed as Confined Fiber Reinforced Concrete (CFRC). When we use fibers in large volumes it has the tendency to ball. Therefore, there are limitations to the quantity of indirect confinement offered by steel fiber. This limitation confinement necessities the requirement of additional confinement at critical section in reinforced concrete elements. Additional confinement can be provided in the form of Ferro cement shell. Such concrete can be termed as Confined Ferro Fiber Reinforced Concrete (CFFRC). The present investigation is an attempt to study the stress strain characteristics and compressive strength of CFFRC as well as mortar.

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

1. Introduction

The structures which are designed for seismic resistant demands high ductility. Therefore the ductility of concrete is being improved by confining it in steel binders, as ties in compression members and as stirrups in beams at present. In the structures which are statically indeterminate the critical section, at which first hinge forms are incidentally also the section having maximum shear force. The stirrup reinforcement, which is provided, has to take care of shear at that section and simultaneously provide 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: M25 grade concrete was used.

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.

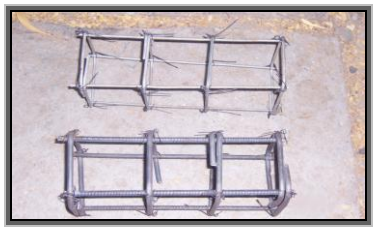
Mortar fiber: Synthetic polypropylene fiber, was used in mortar.

Concrete mix for M_{25}: 1: 1.74: 2.29 and w/c = **0.45**

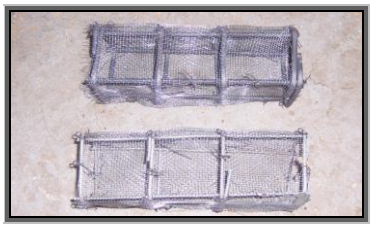
3. Casting

\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.

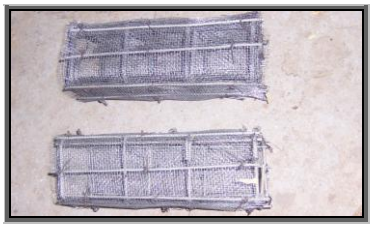
Plane mortar cubes and mortar with fibers cubes were cast in the standard cubes of size 7 x 7 x 7cm, to check the compressive strength of mortar.



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.

ISBN : 978-93-87793-86-6

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

Table No 4: Ultimate Stress and Strains of Specimens

Sl.No	Series	Designation	SSR	Ultimate Stress F_{fu} N/mm^2	Ultimate Longitudinal Strain $\in_{fu}$	Ultimate Lateral Strain $\in_{fu}$
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.

ISBN : 978-93-87793-86-6

Reference

[1]. Nataraja M.C., Dhang N and Gupta AP, "Steel fiber reinforced concrete Under compression" Indian concrete journal, July 1998, pp. 353-356.

[2]. A text book of concrete technology by M. S Shetty.

[3]. D.Logan and S.P.Shah, "Moment Capacity and Cracking Behaviour of Ferro Cement in Flexure", Journal of the ACI Proc. Vo. 170, No. 12, Dec. 1973, pp. 799 – 804.

[4]. "Properties of concrete" by Nevile A.M. Longman Singapore Publisher (1988).

[5]. Ganesan N., and Ramana Murthy, J.V. "Strength and behaviour of confined steel fiber reinforced concrete columns" ACl materials journals, May-June 1990.

[6]. K. Srinivasa Rao, A. Mallika, "A Study of Confined Ferro Fiber Reinforced Concrete under Axial compression", National Conference on Recent Development in Structural Engineering (RDSE-2005).

[7]. K. Ramesh, D.R. Seshu and M. Prabhakar, "A Study of tie confined fiber Reinforced concrete under axial compression", Concrete Science and Engineering, Vol. 2, December 2000, pp. 230-236.