

An Experimental Investigation on Flexural Behaviour of FRMC and SFRC¹Mr. Lokesh Kumar Sharma, ²Mr. Anil Kumar Sharma¹M.Tech Scholar, Department of Civil Engineering, Arya College of Engineering & Research Centre, Jaipur²Assistant Professor, Department of Civil Engineering, Arya College of Engineering & Research Centre, Jaipur**Abstract**

Utilization of steel fibers is known to enhance the flexural strength in concrete beams, but the focus of the present study is to investigate experimentally the flexural behavior of the beam section with steel fibers and Metakaolin. Combination of both known as FRMC (Fiber Reinforced Metakaolin Concrete). The focus of the present study to show the variation in flexural strength in SFRC and FRMC. The specimen was prepared with M 40 grade of concrete, with or without Metakaolin. The percentage of Metakaoline used only 10% as a replacement of Cement used. In the present study, there is a variation of fiber depth which is measured from the bottom are taken into consideration which is 0.25d to the full depth of the beam with the difference of 0.25d Beam specimen of 100*100*500 mm were casted and tested respectively for flexural strength at the age of 28 days.

Keywords: SFRC, Steel Fiber, Metakaolin, FRMC, M 40, Flexural Strength Test.

Introduction

Some investigations suggest use of steel fibers only in zone, where tensile stresses are induced in a manner similar to that presently contemplated and used in conventional reinforced concrete. The inclusion of fibers into a matrix over only a partial thickness of the beam is regarded as partially fiber reinforcing a beam [5]. The present study deals with partially steel fiber reinforced M 40 grade of Concrete beams, the FRC in the present study consisted of OPC and OPC with Metakaolin. The present study aimed to evaluate the performance of flexural member with steel fiber and with or without Metakaolin [6].

Materials and Methodology :

Steel fiber reinforced concrete (SFRC): is a composite material whose segments incorporate the conventional constituents of Portland concrete cement (hydraulic cement, fine and coarse aggregates, admixtures) and a scattering of haphazardly arranged short discrete steel fibers. Similarly likewise with all FRC materials, contrasted with plain concrete, the most observable contrasts are improved ductility and post cracking performance.

Steel Fiber: In the experiment–Dramixgluedsteel fiberwereused. Thesteel fibercontentwasvariedas 0%, 0.5%, 1.0%, and 1.5% by weight of cement. The steel fibers were 60mm in length, and the aspect ratio of the fiber was80.

Metakaolin: Metakaolin isn't a byproduct. It's obtained by claiming pure or refined mineral clay at a temperature of 6500 to 8500 ° C so grinding to a fineness of 700 to 900 m two / weight unit. Metakaolin could be a pozzolanic supplement/product that has several specific properties. Metakaolin is obtainable in many alternative varieties and qualities.

IS Code 516: 1959 used for the method of tests for the flexural strength of concrete. The size of the beam 500mm x 100mm x 100mm used in the present study . The specimens were tested after deep curing for 28 days.

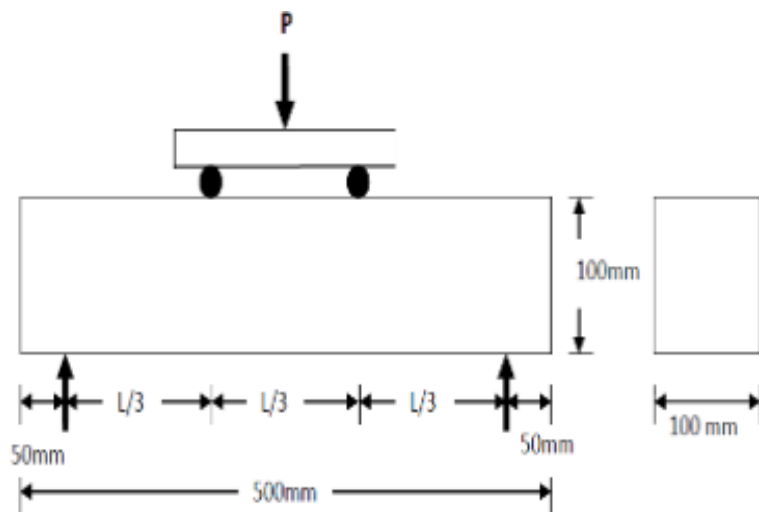


Fig 1: Two Point Loading Setup in flexure test

Results and Discussions

Flexural Strength test results:The flexural strength and deflection test results of beam specimens with Metakaolin and 0.5% fiber content at 28 days age are presented in Table 1

Table 1: Flexural Strength and Deflection of Concrete Mixes with 0.5 % Fiber Content, 10% MK, and Variation of Fiber Depth (at the age of 28 days)

Specimen	Fiber Depth	Deflection	Flexural Strength
Cement + Metakaolin	Measured from bottom	(mm)	(N/mm ²)
90+10	25	0.022	6.3
90+10	50	0.039	6.64
90+10	75	0.050	6.83
90+10	100	0.060	7.16

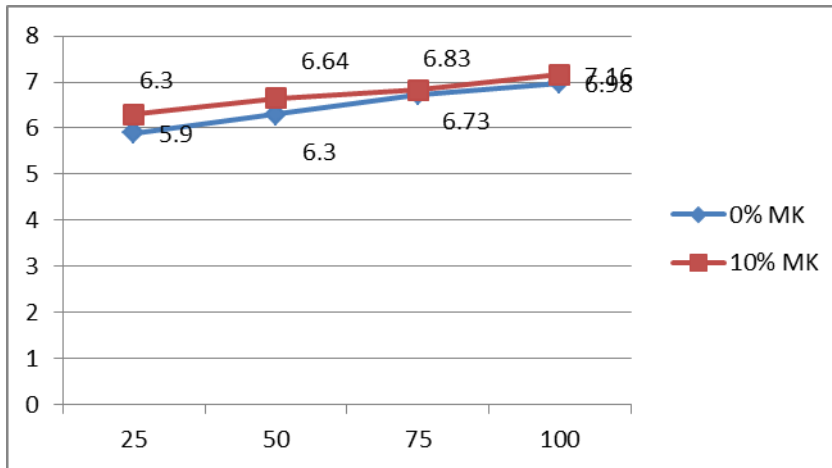
The flexural strength and deflection test results of beam specimens without Metakaolin and 0.5% fiber content at 28 days age are presented in Table 2.

Table 2: Flexural Strength and Deflection of Concrete Mixes with 0.5 % Fiber Content and Variation of Fiber Depth (at the age of 28 days)

Specimen	Fiber Depth	Deflection	Flexural Strength
Cement + Metakaolin	Measured from bottom	(mm)	(N/mm ²)
100 + 0	25	0.018	5.9

100 + 0	50	0.036	6.3
100 + 0	75	0.047	6.73
100 + 0	100	0.051	6.98

Figure 2 : Variations in Flexural Strength with 0.5% Fiber Content at various depth and with or without Metakaolin (At the Age of 28 Days)



The flexural strength and deflection test results of beam specimens with Metakaolin and 1% fiber content at 28 days age are presented in Table 3

Table 3: Flexural Strength and Deflection of Concrete Mixes with 1 % Fiber Content, 10% MK, and Variation of Fiber Depth (at the age of 28 days)

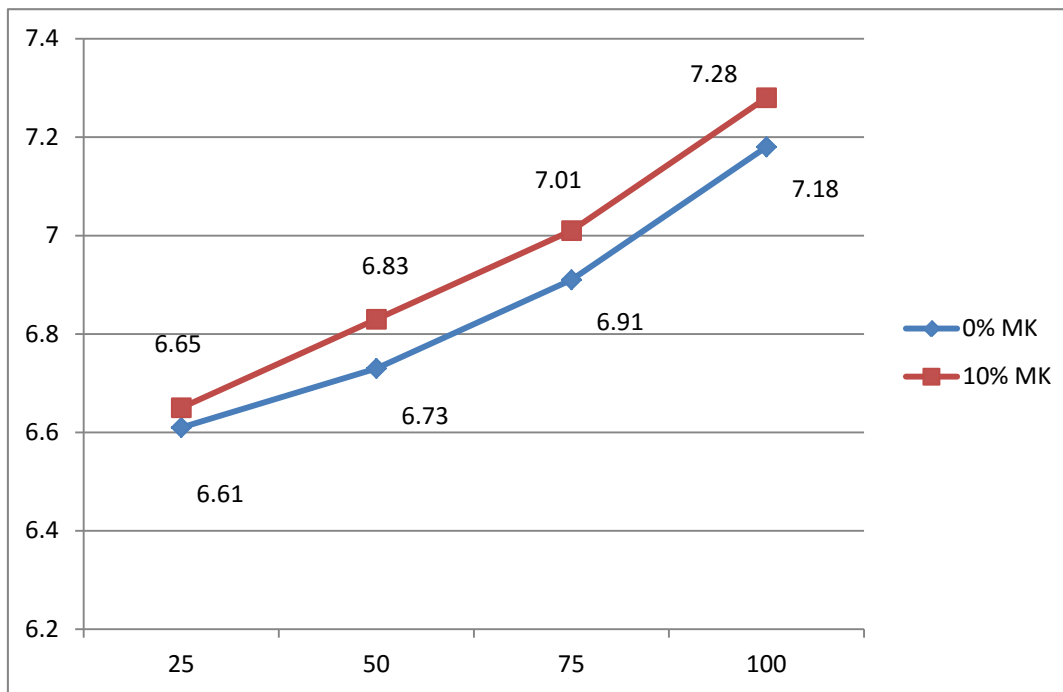
Specimen	Fiber Depth	Deflection	Flexural Strength
Cement + Metakaolin	Measured from bottom	(mm)	(N/mm ²)
90+10	25	0.037	6.65
90+10	50	0.045	6.83
90+10	75	0.053	7.01
90+10	100	0.072	7.28

The flexural strength and deflection test results of beam specimens without Metakaolin and 1% fiber content at 28 days age are presented in Table 4.

Table 4 : Flexural Strength and Deflection of Concrete Mixes with 1 % Fiber Content and Variation of Fiber Depth (at the age of 28 days)

Specimen	Fiber Depth	Deflection	Flexural Strength
Cement + Metakaolin	Measured from bottom	(mm)	(N/mm ²)
100 + 0	25	0.034	6.61
100 + 0	50	0.041	6.73
100 + 0	75	0.052	6.91
100 + 0	100	0.057	7.18

Figure 3: Variations in Deflection with 1% Fiber Content at various depth and with or without Metakaolin (At the Age of 28 Days)



The flexural strength and deflection test results of beam specimens with Metakaolin and 1.5 % fiber content at 28 days age are presented in Table 5

Table 5: Flexural Strength and Deflection of Concrete Mixes with 1.5 % Fiber Content, 10% MK and Variation of Fiber Depth (at the age of 28 days)

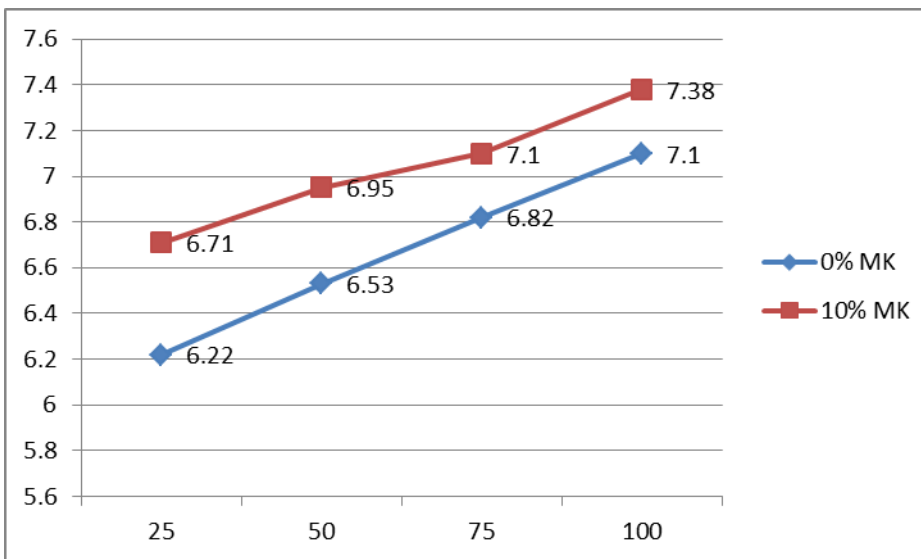
Specimen	Fiber Depth	Deflection	Flexural Strength
Cement + Metakaolin	Measured from bottom	(mm)	(N/mm ²)
90+10	25	0.050	6.71
90+10	50	0.060	6.95
90+10	75	0.072	7.1
90+10	100	0.088	7.38

The flexural strength and deflection test results of beam specimens without Metakaolin and 1.5 % fiber content at 28 days age are presented in Table 6.

Table 6: Flexural Strength and Deflection of Concrete Mixes with 1.5 % Fiber Content and Variation of Fiber Depth (at the age of 28 days)

Specimen	Fiber Depth	Deflection	Flexural Strength
Cement + Metakaolin	Measured from bottom	(mm)	(N/mm ²)
100 + 0	25	0.047	6.22
100 + 0	50	0.059	6.53
100 + 0	75	0.067	6.82
100 + 0	100	0.079	7.1

Figure 4: Variations in Flexural Strength with 1.5 % Fiber Content at various depth and with or without Metakaolin (At the Age of 28 Days)



Variation in flexural strength with respect to different fibers content

The flexural strength test results of beam specimens with Metakaolin and 0.5%, 1% and 1.5% fiber content at 28 days age are presented in Table 7 and figure 5..

Table 7: Flexural Strength of Concrete Mixes with 0.5%, 1% and 1.5 % Fiber Content, 10% MK and Variation of Fiber Depth (at the age of 28 days)

Specimen	Fiber Depth	Flexural Strength		
Cement + Metakaolin	Measured from bottom	0.5% SF	1% SF	1.5% SF
90+10	25	6.3	6.65	6.71
90+10	50	6.64	6.83	6.95
90+10	75	6.83	7.01	7.1
90+10	100	7.16	7.28	7.38

Figure 5: Flexural Strength of Concrete Mixes with 0.5%, 1% and 1.5 % Fiber Content, 10% MK and Variation of Fiber Depth (at the age of 28 days)

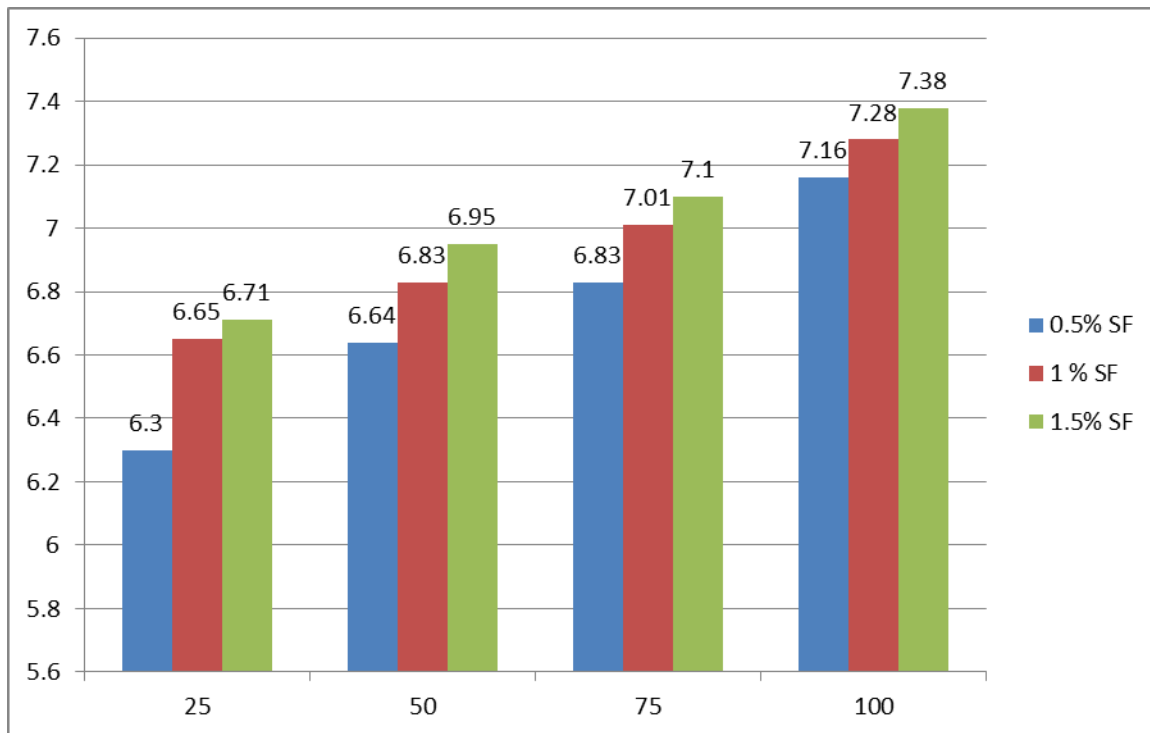


Figure 4 represents the variation of flexural strength at the age of 28 days and Concrete Mixes with 0.5%, 1% and 1.5 % Fiber Content, 10% MK and Variation of Fiber Depth 25mm, 50mm, 75mm and full depth of beam.

The flexural strength test results of beam specimens with Metakaolin and 0.5%, 1% and 1.5% fiber content at 28 days age are presented in Table 8 and figure 6.

Table 8: Flexural Strength of Concrete Mixes with 0.5%, 1% and 1.5 % Fiber Content and Variation of Fiber Depth (at the age of 28 days)

Specimen	Fiber Depth	Flexural Strength		
		0.5% SF	1% SF	1.5% SF
Cement + Metakaolin	Measured from bottom			
100+0	25	5.9	6.61	6.22
100+0	50	6.3	6.73	6.53
100+0	75	6.73	6.91	6.82
100+0	100	6.98	7.18	7.1

Figure 6: Flexural Strength of Concrete Mixes with 0.5%, 1% and 1.5 % Fiber Content and Variation of Fiber Depth (at the age of 28 days)

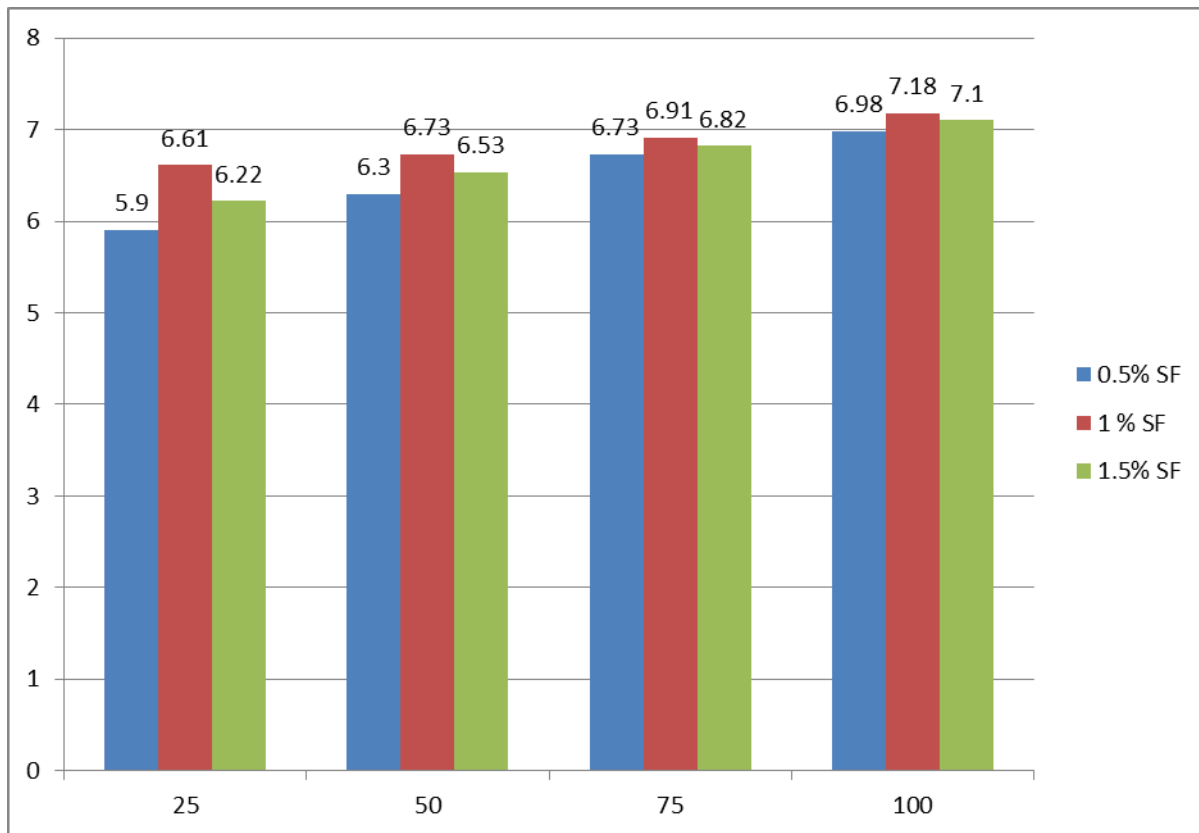


Figure 6 represents the variation of flexural strength at the age of 28 days and Concrete Mixes with 0.5%, 1% and 1.5 % Fiber Content without Mk and Variation of Fiber Depth 25mm, 50mm, 75mm and full depth of beam.

Conclusions

1. For the hardened properties of Fiber Reinforced Metakaolin Concrete, the steel fiber and Metakaolin combination enhance the flexural strength.
2. On increasing depth of the FRC, with 1% and 1.5 % fiber content, the rate of gain in flexural strength increases as well.
3. Above results show that the advantage of adding fiber is more when the volume fraction is 1% or more, both for the flexural strength and deflection.

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