Shear Strength Improvement of Deep Beams by using Hooked End Steel Fibers

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Abstract— This document presents the Effect of steel fibers in performance of Deep Beams. Various steel fibers are available to improve the strength of Reinforced concrete members. The aim of present work is to study the suitability of use of steel fibers in deep beams. The present work includes the study of Hooked end Steel fibers used in Reinforced concrete deep beams. Hooked end steel fibers are added in Reinforced concrete deep beams by 0%, 0.5%, 1%, 1.5%, 2% and 3% of volume. For each percentage three samples are prepared and tested by two Point loading method. In this study, the practical difficulties also will be observed for testing the samples of Deep Beams in which steel fibers are used.

Keywords: Deep Beams, Steel Fibers, Hooked End Steel Fibers, Reinforced Concrete, Two Point Loading Method

I. INTRODUCTION

The deep beams now days are widely used as transfer girders in multistory buildings to avoid columns for providing free space at different floor levels for parking. As per IS: 456 (2000) deep beams are defined as the beams having clear span-to-depth ratio less than 2 for simply supported end condition. Greater depth of beams ensures the good moment of resistance. However increased depth hinders the shear strength of beams. The shear strength of beam section can be improved by using high Grade of Concrete, high grade steel and by using fibers. As the members are subjected to loading the microcracks which are already present in concrete turns into macrocracks. The cracks are formed within the shear span when the principal tensile stress exceeds the tensile strength of concrete. The addition of steel fibers into concrete mix improves the post-cracking tensile strength of RC beams. The addition of fibers in concrete helps to reduce crack formation and their propagation. The high-strength concrete has is more brittle and less ductile than normal strength concrete. Various scientists have done study on enhancing the shear strength of the deep beam. One of the solutions is introduction of fibers in concrete. In the present work to the effect of addition of hooked end steel fibers in concrete for deep beam is studied with respect to shear strength, of deep beams.

II. METHODOLOGY

In order to achieve the stated objectives, the study was carried in following stages.

1) The literature review is done for deciding the percentage of addition of Steel fibers
2) Concrete mix design is done for M25 concrete
3) The samples of beams are casted having size 150 mm x350 mm in cross section are
4) The span of beam is kept as 700 mm
5) The Shear Strength assessment is done by conducting two point loading method for simply supported beams on UTM

A. Concrete Mix Proportion:

The Mix design of Concrete of Grade M25 has been done. Table No. 1 Gives the mix proportion considered for the study.

Sr. No	% steel Fiber	W/C ratio	Mix Proportion (Kg/m3)				
			cement	sand	Aggregate	water	Steel Fiber (gm)
1	00	0.44	45	75	106	19	00
2	0.5%	0.44	44.75	75	106	19	225
3	1%	0.44	44.55	75	106	19	450
4	1.5%	0.44	44.325	75	106	19	675
5	2%	0.44	44.10	75	106	19	900
6	3%	0.44	43.875	75	106	19	1125

Table 1: Concrete Mix Proportion

B. Specimen Details:

The samples of beams are casted with above mentioned mix proportion. The details of the same are as given below: Specimen details:

1) Total no of Samples casted: 18
2) Materials:
- M25 Concrete
- Fe 500 Steel

3) Size of Sample
- Length : 900 mm (for Getting clear span 700 mm)
- Width: 150 mm
- Depth: 350 mm

4) Reinforcement: 2 bars of 12 mm diameter at top and bottom
5) Steel Fiber
- Hooked End Steel Fiber
- Length 60mm
- Diameter 0.75mm
- Formation Glued
- Anchorage Hooked

III. RESULTS AND DISCUSSIONS

A. Shear Strength variation for various percentage of Deep Beams:

The Beam samples are tested by two point loading method on UTM after 28 days curing. The observations are presented in table No. 2.

Sr. No.	Beam Designation	% Fiber Content	Shear Force (KN)	Average Shear Force	Average Shear Strength (N/mm2)	% INCREASE IN Strength
1	A	0	171.43	170.9233	3.52	-
2	B		166.47			
3	C		174.87			
4	A	0.5	222.27	221.1733	4.55	29.40
5	B		221.51			
6	C		219.74			
7	A	1	238.45	233.9767	4.81	5.78
8	B		232.7			
9	C		230.78			
10	A	1.5	248.87	248.015	5.10	6.00
11	B		245.58			
12	C		250.45			
13	A	2	261.54	264.96	5.45	6.83
14	B		263.25			
15	C		266.67			
16	A	3	289.32	284.085	5.85	7.22
17	B		285.56			
18	C		282.61			

Table 2: Shear strength of Beams

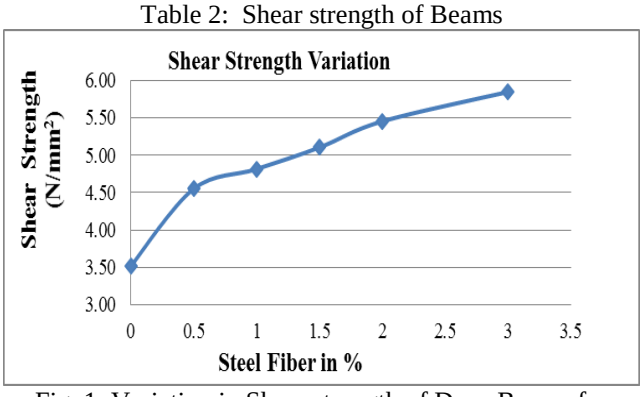

Fig. 1: Variation in Shear strength of Deep Beams for various % of steel fibers

Fig No 1 shows the variation in Shear strength of Deep Beams for various % of steel fibers. From above graph it can be observed that as the percentage of steel fibers increases the shear strength of deep beams also increases.

For 0.5% steel fibers, the Increase in strength is drastic, i.e. 29% than samples with no steel fibers. Thus this makes clear inclusion of steel fibers enhances the shear strength of beams drastically.

Further, for addition of each 0.5%, the percentage increase in shear strength of deep beams increases but with same percentage.

B. General Observation Regarding Handling the Samples

While casting the beams, during the compacting of concrete the shape of steel fibers may change.

1) The beam samples became huge, and hence more no of labor required to handle the beams. This can be overcome by reducing the sample dimensions.
2) The steel fibers may appear on the surface of beams, can be harmful to handling persons. To avoid this difficulty, sample can be covered with jute or similar material.
3) The actual members need a special finishing to cover the surface intrusion of steel fibers

IV. CONCLUSION

Following conclusions can be drawn from above Study:

1) Hooked End Steel fibers can be effectively used to enhance shear strength of Deep beams.
2) In practice, the members with steel fibers need to be finished superiorly to cover the surface intrusion of steel fibers, to avoid any harm to users.

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