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EXPERIMENTAL STUDY ON STRENGTH OF FIBRE REINFORCED DEEP BEAMS

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ABSTRACT

This experimental study deals with the behaviour and ultimate strength of steel fibre reinforced concrete(SFRC) deep beams with and without openings in web subjected to two point loading, concrete deep beams of dimensions (750×350×75)mm thickness were to be tested to destruction by applying gradually increase load. Simply supported conditions were maintained for all concrete deep beams. The percentage of steel fibre was varied from 0 to 1.0. The influence of fibre content in the concrete deep beams has been studied by measuring the deflection of the deep beams and by observing the crack patterns. The investigation also includes the study of strength of steel fibre reinforced concrete deep beams with web reinforcement with and without openings. The ultimate load obtained by applying the modified Kong and Sharp's formula for deep beams are compared with the experimental values.

1.INTRODUCTION

1.1 . GENERAL:

Deep beams are often used as structural members in civil engineering works. Deep beam can be defined as a beam in which either clear span is equal to or less than four times the overall member depth or concentrated loads are within a distance equal to or less than two times the depth from the face of support (ACI Committee 318, 2008). Also Deep beam define as members loaded on one face and supported on opposite face, so the compression struts can develop between the loads and supports.

As per the Indian code deep (IS456-2000) beam is define as "Beam with the large depth in relation to the span are called as deep beams". The ratio of deep beam as per I.S 456(2000) (clause 29) for simply supported beams L/D<2 and Continuous beam L/D<2.5.

1.2 . WEB OPENING DETAILS:

In many cause web openings required to provide for service or for access. No code provision exists for analysis deep beams with web opening. The code implemented strut and tie models are debatable and no unique solution using these models is available. The opening of the deep can be a shape of square or circle or rectangular. The best shape for the opening, in the deep beam considered, is the narrow rectangular one, with the long sides extended in the horizontal direction. However, this shape may not be suitable in some practical cases.

The use of circular opening has advantage over using square opening regarding the structural strength of the beam. The best location of the opening, regardless its shape, is far from the arching action and the flexure region, which is near the upper corners of the beam. The beam can deform by the openings so the beam should be have high shear resistance by adding fibre in concrete or provide the inclined reinforcement around the openings, the better thing is adding the fibre in concrete.

1.3. APPLICATION OF DEEP BEAM:

It have many useful application in building structures such as transfer girders, wall footings, floor diaphragms, and shear walls. Particularly the use of deep beams at the lower levels in tall buildings for both residential and commercial purpose has increased rapidly because of their convenience and economical efficiency and also application of Water tank side walls (R.R.C),

Pile cap acts as a deep beam in case of smaller span, Short span carrying heavy load; Floor slab under horizontal loads, particularly the use of deep beams at the lower levels in tall buildings for both residential and commercial purpose has increased rapidly because of their convenience and economical efficiency.

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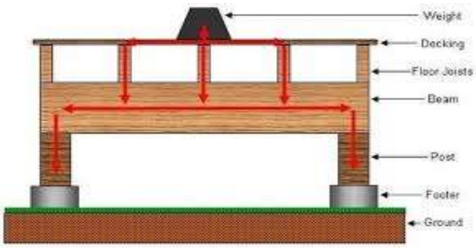

Fig 1: Lower position of high rise buildings

1.4. NEED OF THE PROJECT:

The needs of the project are the following reason:

1. To increase the strength and durability of concrete deep beam.
2. To provide the perfect opening for services and some uses.
3. To increase the compressive and flexural strength of the deep beam.

1.5. SCOPE OF THE PROJECT:

1. To study the experimental investigation of fibre content in deep beam.
2. To analyse the crack pattern of deep beam.
3. To study the position of openings.

2.1. LITERATURE SUMMARY

Web opening may be provided in the compression zone of the beams and fibre content of 0.75%by volume may be added to improve the strength of the structure. Failure of deep beam was mainly due to diagonal cracking and it was along the line joining the load points and supports. The opening in the tension zone weakens the beam. Fibre content of 0.75% by volume of the beam improves the ultimate load and the first crack load of the beam. Additional of the steel fibres increase the tensile strength of the concrete matrix and also increase in the flexural rigidity of the beam. The inclusion of short steel fibres in concrete mix provides effectives shear reinforcement in deep beams and provides better crack control in beams. Shear strength increase with fibre content and decreasing a/d ratio. The inclusion of steel fibres in concrete deep beams resulted in reduced crack width and

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deflection at all stages of loading through to failure. Fibre reinforcement can increase the stiffness of the concrete and spall resistance. All SFRC beams exhibited large deflection at failure, indicating high ductility and energy absorption property. The best location of the opening, regardless its shape, is far from the arching action and the flexure region, which is near the upper corners of the beam.

3.MATERIALS

3.1 ADMIXTURE:

As per IS code 9103, superplasticizer are recommended for M25 concrete. So we have used superplastizer which is known as high range water reducers. These polymers are used as dispersants to avoid particle segregation and improve the flow characteristic of suspensions such as in concrete applications. Their addition to concrete or mortar allows the reduction of the water to cement ratio, not affecting the workability of the mixture, and enables the production of self-consolidation concrete and high performance concrete.

3.2. STEEL FIBRE:

Fibre reinforced concrete is concrete contain fibrous material which increases it structural integrity. steel fibre are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. The specification of fibre: tensile strength 650Mpa, diameter 0.3-0.7mm.

Fig 2: steel fibre

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4. CONCRETE MIX DESIGN

Table 4.2: Mix Proportion Details

Constituents	**Quantity (kg/m^3)**	**Mix proportion**
Cement Content	320	1: 1.15: 2.45: 0.43
Coarse Aggregate	1356	
Fine Aggregate	751	
Water	138	

5. STRENGTH TEST

5.1. Test for Compression Strength:

When added 0% fibre the compression strength for 7days curing

Failure load = 43500 kgf

= 43500 x 9.81 = 426.735 KN

Compression strength = 426.735 / (150x150)

= 18.966 N/mm^2

When added 0% fibre the compression strength for 28days curing

Failure load = 65300 kgf

= 65300 x 9.81 = 640.590 KN

Compression strength = 640.59 / (150x150)

= 28.47 N/mm^2

When added 0.75% fibre the compression strength for 7days curing

Failure load = 44700 kgf

= 44700 x 9.81 = 438.507 KN

Compression strength = 438.507 / (150x150)

= 19.48 N/mm^2

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When added 0% fibre the compression strength for 28days curing

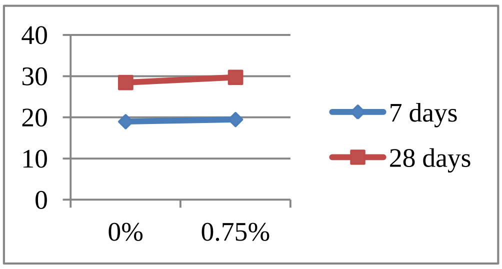
Failure load = 68200 kgf

= 68200 x 9.81 = 669.042 KN

Compression strength = 29.73 N/mm^2

Table 7.1 compression test result

Graph 1: compressive strength

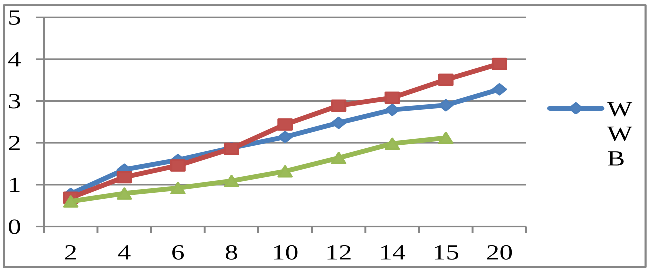


X direction - % of fibre

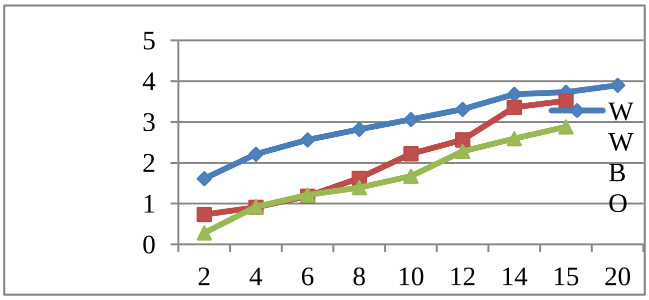
Y direction – compressive stress

Test for Flexural Strength:

Graph 2: deflection at 0.75% fibre



Graph 3: Deflection at 0% Fibre



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X direction – loads (tons)

Y direction – deflection (mm)

Table 7.3: experimental analytical results for deep beam

Opening Position	Fiber 0%		Fiber 0.75%	
	Experimental Load(kg)	Theoretical Load(kg)	Experimental Load(kg)	Theoretical Load(kg)
WWBO	21650	22169	24980	24332
WBOA	18240	18635	25390	19104
WBOB	17250	17348	20920	18162

CONCLUSION

The following conclusions can be drawn from the experimental results:

1. The web opening may be placed in and non shearing area like to top corner of the structure.
2. The fibre content should be not less than 0.75% into the cement to improve the strength.
3. The openings in below to the neutral axis weaken the beam.
4. The steel fibre is cause to high compression strength and flexural rigidity of deep beam.
5. The first crack load was increase the by 0.75% steel fibre.
6. High concrete mix design is increase the strength of deep beam.

Recommendation for further work:

1. The experimental study may be carried out for replacement of fibre with various aspect ratios.
2. The investigation may be carried out adding fibre with coarse and fine aggregate.

3. The openings can be various locations in deep beam.
4. The specimen size can change to investigation.
5. The openings may be covered with stirrups with steel mesh.

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ANNEXURE

PHOTOGRAPHS

Fig 3 Deep beam with opening

Fig 4 Deep beam

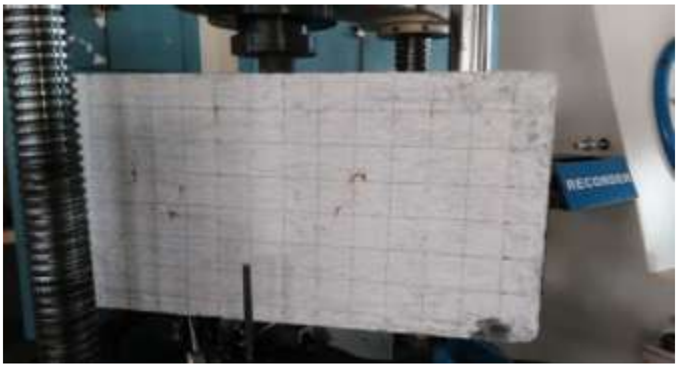

Fig 5 utm testing

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Fig 6 deflection measurment

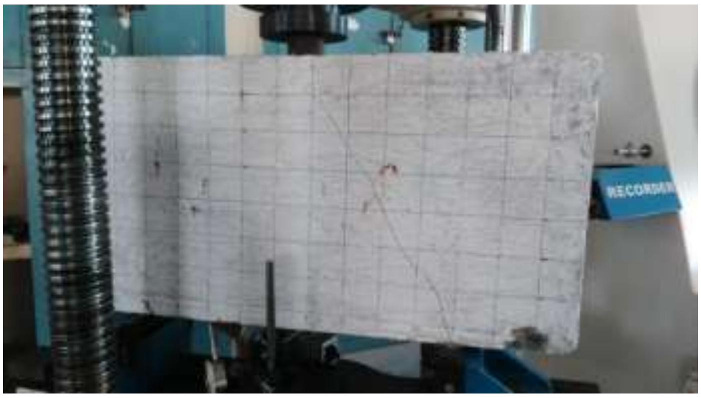

Fig 7 Crack pattern