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RESEARCH ARTICLE

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EXPERIMENTAL ANALYSIS OF DEEP BEAM

TUSHAR PAWAR[1], AMOL JHAMBLE[2], ABHIJIT TAKBHATE[3], PRATIKSHA PAWAR[4], GIRISH JOSHI[5]

[1,2,3,4] U.G STUDENT, DEPARTMENT OF CIVIL ENGIEERING, G.H.RAISONI INSTITUTE OF ENGINEERING ANG MANAGMENT, WAGHOLI, PUNE

[5] ASSISTANT PROFESSOR, DEPARTMENT OF CIVIL ENGIEERING, G.H.RAISONI INSTITUTE OF ENGINEERING ANG MANAGMENT, WAGHOLI, PUNE

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ABSTRACT

Study was mainly carried out to compare analytical and experimental flexure and shear of deep beam and to observe the Load vs. Deflection with varying the percentage of steel in the deep beam.

This report consist of both the experimental and analytical work. Experimentally work which was carried consist of four deep beams which consist of the varying steel in it. And All the Deep beams were having l/D ratio less than 2 were tested under two point static loading condition. All deep beams were designed by I.S.code method which was having conventional steel reinforcement as per design. The variables in study are varying percentage of steel (vertical steel: 0.80%,0.64%,0.43%,0.32% & horizontal steel: 0.16%,0.16%0.071%,0.071%) of 20Mpa concrete grade were tested under two point loading condition. The load deflection responses under loading and crack patterns were studied.

From the results of this study, it was found that the modes of failure of deep beams were influenced by the varying percentage of steel

Keywords: Deep beam, steel, flexure , crack , stresses


TUSHAR PAWAR


AMOL JHAMBLE


ABHIJIT TAKBHATE


PRATIKSHA PAWAR


GIRISH JOSHI

1. INTRODUCTION

1.1 GENERAL

Beams with large depths in relation to spans are called deep beams. In IS-456 (2000) Clause 29, a simply supported beam is classified as deep when the ratio of its effective span L to overall depth D is less than 2. Continuous beams are considered as deep when the ratio L/D is less than 2.5. The effective span is defined as the centre-to-centre distance between the supports or 1.15 times the clear span whichever is less.

1.2 SCOPE

Testing of more number of beams is required to confirm the above results and to convert to guide line for design of deep beam. For simply supported beams, other than two points load cases may also be studied. This study can be continued for

a) For various shear span.
b) For various transverse reinforcement.
c) For various longitudinal reinforcement.
d) For various size.
e) For various fibers.

1.3 OBJECTIVES

The objectives of the project were as follows:

1. Experimental and analytical study of shear and flexural behavior of deep beam.
2. To study the behavior of beam having steel varying in it with span and depth constant.
3. To compare experimental and analytical results of beam for different span to depth ratio.

2.METHODOLOGY AND INVESTIGATION

Following steps were involved in methodology of the completed work

Literature survey: This was made through National International Journals, Reference books and through E- Library.

Simply supported rectangular reinforced concrete beams were casted from a regular to deep beam.

All beams were tested on UTM , hydraulic jack and all measuring instruments like strain gauges, strain indicator etc.

2.1 Literature Survey:

1." TALBOT (YEAR 1990)'' : Studied and give a clear way to analysis the shear and designing concrete structure.

2."NILSON AND WINTER (YEAR 1991)"studied and gave info that shear transfer across a crack is due to aggregate interlocking.

3.KANI (YEAR 1967) size effect in the concrete deep beam

4.G.Appa Rao and K. Kunal (2010) studied "effect of size on strength and ductility of RC deep beams"

2.2 Methodology:

While accumulating the information concerned with flexure and shear of deep beam, various problems were studied in detail.

2.3 Deep Beam :

"Beam with the large depth in relation to the span are called as deep beams".

As per I.S 456(2000), clause 29, beams are called as deep if following conditions occur:-

1. Simply supported beams- L/D<2
2.Continous beam- L/D<2.5

Where,
L=Effective span ,
D=Overall depth

2.4 Application of deep Beam

- 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.
- Transfer girder.
- They have a significant role in design of mega as well as small structure

2.5 Design By IS CODE method-

Step 1:-Thickness of beam
Step 2:-Check for bearing stresses
Step 3:-Effective span
Step 4:-Check for deep beam action
Step 5:-Lever arm
Step 6:-Factored load
Step 7:-Flexural reinforcement
Step 8:-Detailing tension steel
Step 9:-Check for shear
Step 10:-Side face reinforcement

6 Proportion used -

Cement	Water	Sand	Coarse aggregate
0.03917 cub meter	0.070875 cub meter	0.0588 cub meter	0.1175 cub meter
1	0.5	1.5	3

3. RESULT

3.1 TEST RESULTS OF DEEP BEAM:

Following are the results of deflection of beam 1

Table 3.1. Results of beam 1

Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)
0	0	130	04.83	260	05.45
10	02.30	140	04.85	270	05.55
20	03.08	150	04.88	280	05.65
30	03.86	160	04.89	290	05.70

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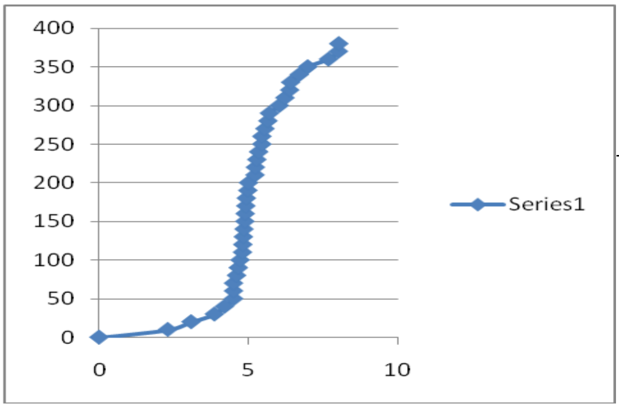
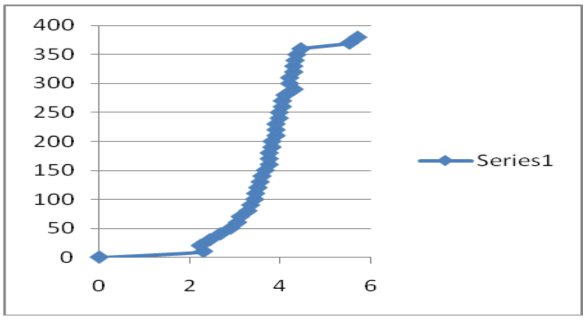
40	04.20	170	04.91	300	06.03
50	04.50	180	04.93	310	06.22
60	04.50	190	04.98	320	06.38
70	04.50	200	05.00	330	06.41
80	04.60	210	05.22	340	06.70
90	04.66	220	05.23	350	06.98
100	04.72	230	05.28	360	07.68
110	04.80	240	05.34	370	08.01
120	04.81	250	05.45	380	08.02



Graph 3.1.1 Load vs deflection (B1)

Table 3.2. Results of beam 2

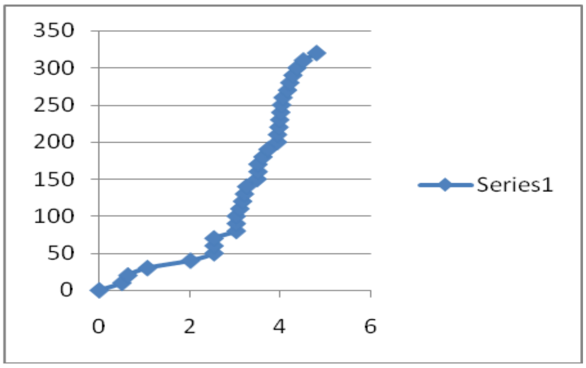
Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)
0	0	130	03.55	260	04.04
10	02.3	140	03.59	270	04.04
20	02.23	150	03.66	280	04.10
30	02.44	160	03.75	290	04.30
40	02.67	170	03.75	300	04.20
50	02.90	180	03.75	310	04.20
60	03.05	190	03.81	320	04.29
70	03.11	200	03.81	330	04.29
80	03.28	210	03.90	340	04.32
90	03.34	220	03.90	350	04.36
100	03.43	230	03.90	360	04.45
110	03.45	240	03.97	370	05.52
120	03.50	250	03.97	380	05.7



Graph 3.1.2 Load vs deflection (B2)

Table 3.3. Results of beam 3

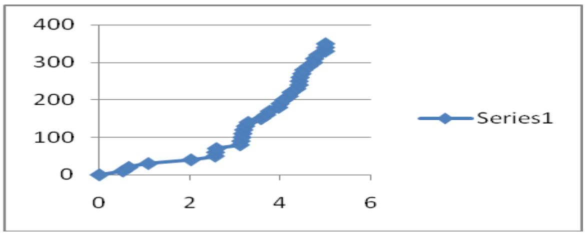
Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)
0	0	110	03.10	220	03.96
10	0.50	120	03.16	230	03.98
20	0.63	130	03.20	240	04.00
30	01.06	140	03.25	250	04.02
40	02.01	150	03.48	260	04.05
50	02.53	160	03.50	270	04.15
60	02.53	170	03.50	280	04.20
70	02.53	180	03.61	290	04.27
80	03.02	190	03.72	300	04.36
90	03.02	200	03.93	310	04.50
100	03.02	210	03.93	320	04.79



Graph 3.1.3 Load vs deflection (B3)

Table 3.4. Results of beam 4

Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)	Load (KN)	Deflection (mm)
0	0	120	03.18	240	04.40
10	0.52	130	03.22	250	04.40
20	0.65	140	03.28	260	04.42
30	01.08	150	03.56	270	04.46
40	02.02	160	03.68	280	04.50
50	02.55	170	03.75	290	04.61
60	02.56	180	03.95	300	04.72
70	02.58	190	03.98	310	04.74
80	03.10	200	04.06	320	04.81
90	03.12	210	04.18	330	04.98
100	03.14	220	04.22	340	04.98
110	03.16	230	04.35	350	04.98



Graph 3.1.4 Load vs deflection (B4)

4. CONCLUSION

From result-

From the test conducted we came to the conclusion that varying the percentage of steel horizontally and vertically results in flexure and shear failure as per variations.

Beam 1,2,4 resulted in shear failure as percentage of steel horizontally was varied as compared to vertical

Beam 3 resulted in flexure failure because steel content was varied vertically as compared to horizontally.

1. Failure of deep beam was mainly due to diagonal cracking and it was along the line joining the load points and supports.
2. As percentage of steel increases inclination of crack decreases.
3. Deflection of beam increases as percent of steel decreases.
4. Ductility of beam increases as percentage of steel decreases.
5. In shear failure of deep beams the deflections are low as compared to flexural failure of normal beams.

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