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Experimental Study of Openings in R.C. Deep Beam

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Abstract- Though wide range of applications of reinforced concrete deep beams application in civil engineering project and lot of research work on this subject, the behavior of these members have not yet been well clarified in various aspects nor well codified for design engineers and professionals who engage in design of such members in practice. The main objective of this dissertation was to study experimental Behavior of R.C.deep beam With Opening and to observe the Load carrying capacity of Deep beam with parameters shape position and number of openings.

Key Words- Deep beam with opening, Squire Openings, circular openings, zone of no crack

I. Introduction

Deep beam has very basic applications such as water tank side wall, pile capes, raft foundations, bunker and silos, shear walls. Beams having large depths compared to spans are called deep beams. The behavior of deep beams is significantly different from that of beams of more normal proportions. Failure of Deep beam is mainly due to Shear. Diagonal cracks that form roughly in a direction parallel to a line from the load to support. Special Design methods are required for the design of RC deep beam such as strut and tie method, Finite element method, and code method. Putting holes in deep beam create further problem and make its analysis critical. Many times opening is necessary in deep beam to provide access in room or to provide ventilation and also opening is provided in deep beam for the purpose of duct electrical fitting firefighting fitting etc. Instead of making opening in casted beam if we put opening at the time of casting without disturbing reinforcement is better option.

Objective

1. Experimental study of Deep beam without and with openings

2. To Fix the Various positions of opening in Deep beam

3. Experimentally find out the ultimate load caring capacity of deep beam with opening

Experimental Investigation

A. Concrete and Reinforcement

Concrete mix proportions chosen should be such that the concrete is of adequate workability for the placing condition of the concrete and can properly be compacted with the means available. In hardened state concrete shall have required strength, surface finish. Concrete mix design is done to get adequate quality concrete. Steel bars we are using in design are of good quality and also checked for desired strength.

Specimens we are using in this investigation are of size 700mmX350mmX150mm .we had casted total twenty one different specimens of seven types. That is each type has three specimens and then average of result of three is taken as final result. Experiment is conducted in two steps. In first step beam without opening is studied and from that we decided the position of opening. IS code method is used for Design of deep beam and following table will give reinforcement details.

Table 1 Reinforcement Details

Sr. no	**Type of Reinforcement**	**Details**
1	Main Reinforcement	10 mm dia – 2 bars
2	Side face reinforcement.	8 mm dia- 2 bars
3	Vertical Reinforcement	8 mm two legged stirrups – 4 no.

B. Casting Work

Casting was done on casting platform near Concrete lab. Code numbers or Beam marks were written on each beam. Names to the beam were given like B1, B2, B3

Fig 1 Casting work

C. Curing Work

Beams were covered by wet gunny bags for 24 Hr after casting. After 24Hr formwork was removed carefully and curing of beam was started. Wet gunny bag were kept surrounding the beam surface and watered so as keep them moist. Beams were cured for 28 days.

IV. Experimental test set up

Beams ware tested on UTM (100KN) in material testing laboratory. One point loading was used for testing.

Fig 2 Experimental test set up

V. Results For Deep Beam Without Opening

Table 2 Results of Deep Beam Without Opening

Sr.No.	Beam without opening	Ultimate Load Taken (kN)
1	B1	220.21

2	B2	225.65
3	B3	201.98
	Average	215.95

VI. Positioning The Opening On The Deep Beam

 Failure of deep beam was mainly due to diagonal cracking and it was along the line joining the load points and supports.

 The types of crack formed in deep beams are Flexure cracks, Shear cracks, Crack due to local failure, Anchorage failure cracks.

 For Providing Opening we reject the area where cracks formed.

 Basically for one point loading we get three different triangular zones where no cracks are developed as shown in figure 3.

 So we can keep opening in this CG of these triangles where no cracks are developed.

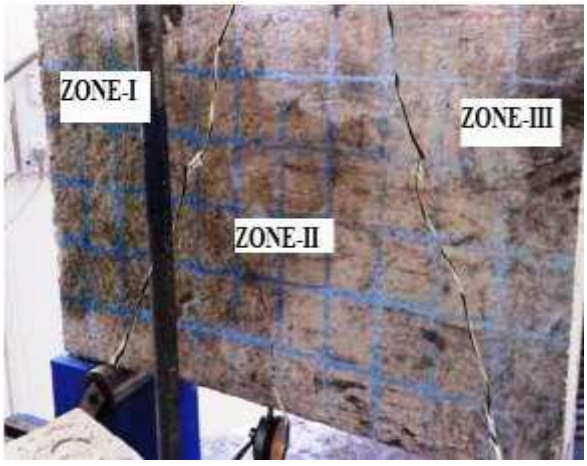

Fig 3 crack pattern

Vii. Experimental investigation on deep beam with openings

A. General

Eighteen Beams of different six type with same size and same reinforcement details were casted only with the difference that either single or double, square and circular opening is created in beam at different position. Material properties are same as that of step 1casting.

B. CASTING OF DEEP BEAM WITH OPENING

Casting was done on casting platform near Concrete lab code to the beam were given like COB1, COB2, COB3, SOB1, SOB2, SOB3. All these codes are mentioned in the observation table.

Fig 4 Shuttering for beam specimen

Fig 5Casting of beam specimens with Circular opening

Fig 6 Casting of beam specimens with Square Opening

VIII. EXPERIMENTAL TEST SETUP

After curing work was over beam were taken for testing purpose. Beam were tested on UTM (1000KN) in material testing laboratory one point loading was used for testing of deep beam

with opening.

Table 3 Test Setup

Sr.no.	Beam Code	Test set up
1	B (avg)	
		
2	COB1 (avg)	
3	COB2 (avg)	

4	COB3	
	(avg)	
		
5	SOB	
	(avg)	

6 SOB2

(avg)

7 SOB3

(avg)

XI. RESULTS

In this experimental study total 21 beams were tested on UTM in laboratory. In this study ultimate load taken by each beam is noted and percentage reduction in load caring capacity with respect to base specimen is calculated.

Table 4 Results for Deep Beam with Opening

Sr. No.	**Beam Code**	**Ultimate Load (kN)**	**% reduction in load caring capacity**

1	B(avg)	215.95	Basic Specimen
2	COB1(avg)	210.12	2.7
3	COB2(avg)	181.40	16
4	COB3(avg)	152.03	29.96
5	SOB1(avg)	209.43	3
6	SOB2(avg)	175.87	18.56
7	SOB3(avg)	103.07	52.27

CONCLUSION

 Reduction in Ultimate load caring capacity of Deep beam with opening is found out by comparing results with Deep beam without opening. We conclude from above result that.

 Circular opening at CG of middle zone II gives least reduction in load carrying capacity. i.e. 2.7%.

 Circular openings are better than Square openings

 Two square holes on CG of Zone I and Zone III Gives max reduction in ultimate load carrying capacity i.e.52.27%.

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