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INVESTIGATION OF THE EFFECT OF PIPEHOLES IN THE COMPRESSION ZONE OF BEAMS SUSCEPTIBLE TO SHEAR FAILURE

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***Abstract* - The goal of this study is to experimentally evaluate the influence of circular openings in reinforced concrete beams. Seven reinforced concrete beams with or without openings were tested . The specimens had different opening positions with or without pipes. The load was transmitted to the specimen with bearing plates having the same side length as the beam. A dial gauge was connected to the beam to find the deflection exerted by the beam. Comparative analysis of the experimental results shows that the effect of the hole depends on its position in the beam influenced by the change in moment of inertia with respect to their position in the beam cross section.**

***Keywords* – beam, openings, pipe, design, strength.**

I. INTRODUCTION

Infrastructure development forms an important part in the evolution of mankind. This experimental study involves the effect of pipelines running perpendicular to the beam in the compression zone. It also involves the comparison of failure loads at flexure of normal beams and pipe fitted beams. So for this study, normal beams are cast and the failure load under flexure is found out and the results are compared with the beams with openings in the compression zone with and without pipes.

Usually holes in beams are avoided. However, under certain situations it becomes necessary to take the pipelines through them. Research has been carried out mostly in the deep beams. This project helps us to study the effect of the pipe holes in the compression zone of a beam normally encountered in a typical building.

Pipelines form an integral part of a building. But sometimes, the pipeline has to pass through the compression region of the beam. Keeping that in mind, this project is being carried out. The results obtained can be used for future use in construction of buildings.

II. RESEARCH SIGNIFICANCE

Usually while providing the openings in the beams, the distance at which the openings to be provided are not considered. But by this research it can be found that the point at which the failure loads increase. Another important aspect is that, most of the research has been carried out at the shear region of the beam; on the other hand this project is carried out with openings at the compression zone of the beams. Hence this experimental work is expected to have research significance.

III. OBJECTIVE

The experimental investigation is aimed at evaluating the structural behaviour of beams in flexure when pipelines pierce through the compression zone at different depths from top compression fibre.

IV. SCOPE

- The experimental investigation consists of testing 7 RCC test beams.
- One beam is cast solid, without any holes, which serves as a reference beam.
- 2 beams with single pipe-holes at distances D/2 and D/3 and one beam with two pipe-holes from the top compression fibre with the pipes remaining in the hole are tested to failure in flexure.
- The remaining 3 beams are tested only with the pipe-holes without pipes left in them.

V. EXPERIMENTAL PROGRAMME

(a) Preliminary Tests

The various preliminary tests like specific gravity tests for fine aggregate, coarse aggregate and cement, water absorption test for fine aggregate and coarse aggregate and the test for determining the grading of fine aggregate. Finally, the slump value of concrete is also calculated.

(b) Mix Design

The mix design is obtained and it is carried out in accordance with IS 10262: 2009 Concrete Mix Proportioning – Guidelines code book and the mix ratio is derived as 1:1.8:2.5.

(c) Beam Design

Beam design and the failure load has been estimated using limit state method of design as per IS 456:2000. The total failure load works out to 6 tonnes, considering two point loading. The length of the beam is 1.2 m. the depth of the beam is 150 mm and the breadth is also 150 mm.

(d) Casting

The casting of beams is carried out.

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Fig. 1 Reference Beam

Fig. 2 Beams with pipes

Here, the reference beam is a solid square beam. The test specimens are the remaining beams with or without pipe-holes at distances D/2 and D/3 from the compression zone in the beams.

(e) Testing

The beam thus cast is tested under flexure. The results of the tested beams are denoted in the graphs given below. The reference beam failed under flexure and the collapse load is obtained as 7.6 tonnes. But the beam with holes in D/2 has a collapse load of 3.4 tonnes and the beam with opening at D/3 fails completely at 5.6 tonnes. The load-deflection curve and the load-stiffness curve are given below.

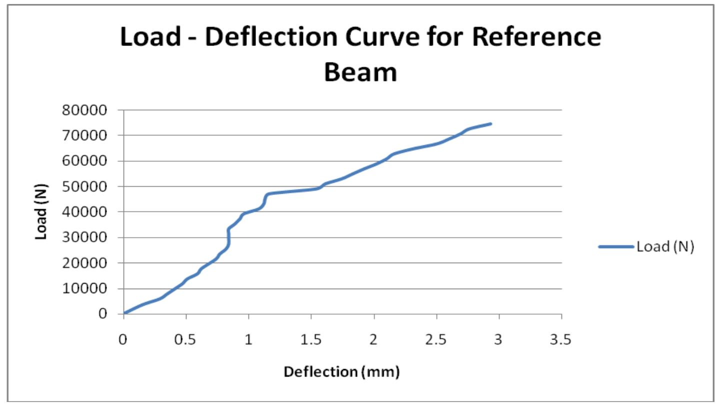

Fig. 3 Load deflection curve for reference beam

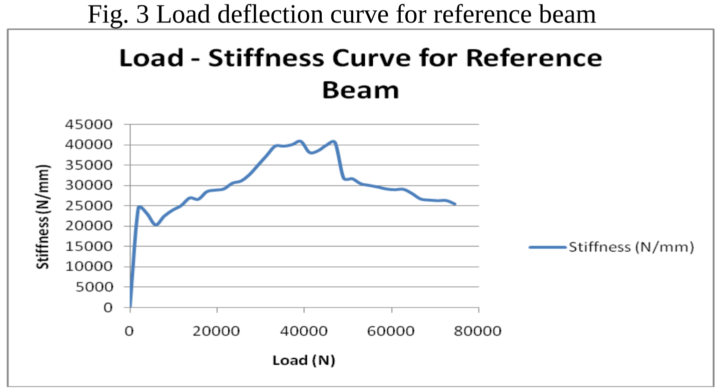

Fig. 4 Load-Stiffness curve for reference beam

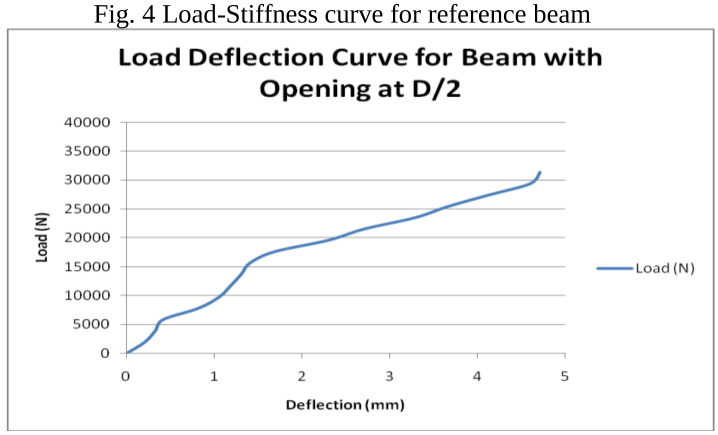

Fig.5 Load-Deflection curve for beam with opening at D/2

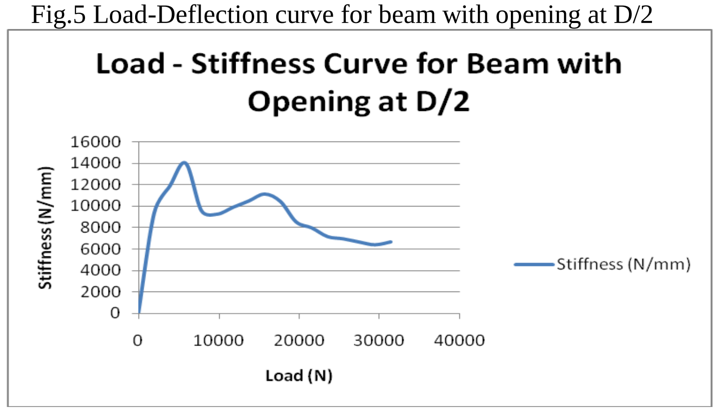

Fig. 6 Load-Stiffness curve for beam with opening at D/2

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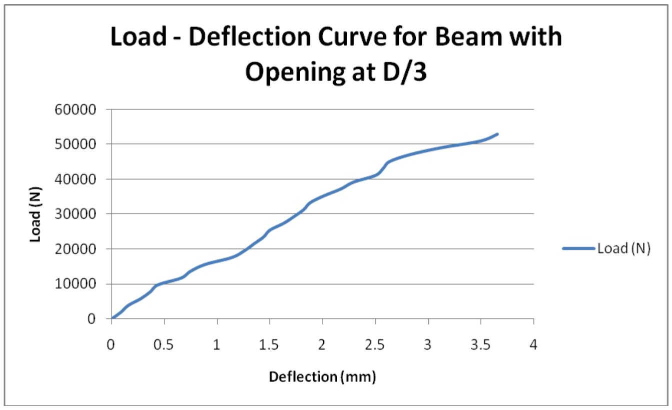

Fig. 7 Load–Deflection Curve for Beam with Opening at D/3

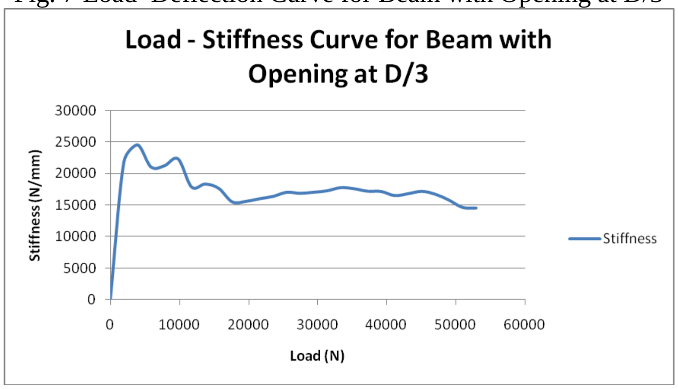

Fig. 8 Load–Stiffness Curve for Beam with Opening at D/3

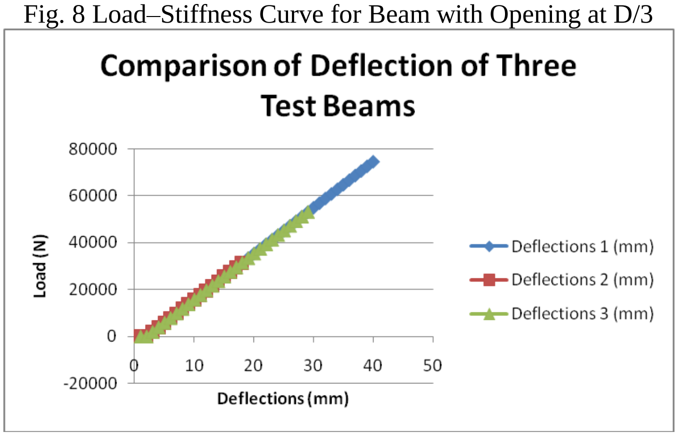

Fig. 9 Comparison of Deflection in Three Beams

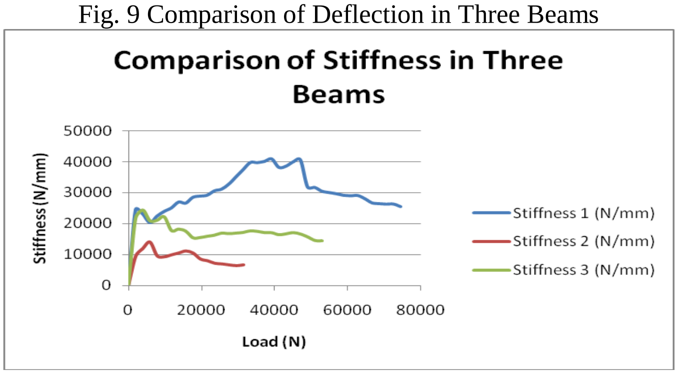

Fig. 10 Comparison of Stiffness in Three Beams

VI. MOMENT AREA INDEX

The moment of inertia for the reference beam and the beams with holes are calculated. The moment area index is calculated by dividing the moment of inertia of the beams with holes by the moment of inertia of the test beams. For beam with opening at D/2, the index is 1 and for the beam with opening at D/3 the index is 0.95.

VII. CONCLUSION

Since this beam is susceptible to shear, the load carrying capacity is much affected when a small portion is removed from the neutral axis in the case of beam with opening at D/2 and in the case of beam with opening at D/3, the load carrying capacity is not much affected when compared to the other case due to the fact that the fact that the neutral axis is not affected.

VIII. REFERENCE

[1] Giuseppe Campione., Giovanni Minafò (2011), 'Behaviour of concrete deep beams with openings and low shear span-to-depth ratio', Dipartimento di Ingegneria Civile Ambientale e Aerospaziale (dica), Università di Palermo, Viale Delle Scienze, I90128 Palermo, Italy.

[2] Keun-Hyeok Yang., Hee-Chang Eun., Heon-Soo Chung(2005), 'The influence of web openings on the structural behavior of reinforced high-strength concrete deep beams', Department of Architectural Engineering, Mokpo National University, Mokpo, Jeonnam, South Korea, Department of Architectural Engineering, Kangwon National University, Chuncheon, Kangwon, South Korea, Department of Architectural Engineering, Chungang University, Seoul, South Korea.

[3] Mansur, M. A (1998), 'Effect of Openings on the Behaviour and Strength of RC +Beams in Shear,' Department of Civil Engineering, National University of Singapore, 10 Kent Ridge Crescent, 119260 Singapore, Singapore.

[4] Javad Vaseghiamiri., Morteza Hosseinalibygie (2004), 'Effect Of Small Circular Opening on the Shear and Flextural Behavior and Ultimate Strength of Reinforced Concrete Beams Using Normal and High Strength Concrete',13th World Conference on Earthquake Engineering,Vancouver, B.C., Canada.

[5] Mansur, M. A., Kiang-Hwee Tan and Weng,W (2006), 'Analysis of Concrete Beams with Circular Web Openings Using Strut and Tie Models, Department of Structures and Materials, Faculty of Civil Engineering', Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor Department of Civil Engineering, National University of Singapore, Planning Engineer, Paul Y(S) Construction Pte Ltd., Singapore.

[6] Nie, J. G.,Cai, C.S., Wu, H., Fan, J.S (2005), 'Experimental and Theoretical Study of Steel Concrete Composite Beams with Openings in Concrete Flange', Department of Civil Engineering, Laboratory of Structural Engineering and Vibration of China Education Ministry, Tsinghua University, Beijing, 100084, China, Department of Civil and Environmental Engineering, Louisiana State University, Baton Rouge, LA 70803, USA.

[7] Jalal Ahmed Saeed, Ali Ramadhan Yousif (2013), 'Concrete Continuous Deep Beams with Web Openings', Dept. of Civil Engineering, Faculty of Engineering, University of Sulaimani, Kurdistan Region, Iraq, Dept. of Civil Engineering, College of Engineering, University of Salahaddin, Kurdistan Region, Iraq.

[8] Said Allam, M (2005), 'Strengthening of RC beams with large openings in the shear zone', Structural Eng. Dept., Faculty of Eng., Alexandria University, Alexandria, Egypt.

[9] Nilesh Saksena, H., Prof. Patel, P. G (2013), 'Experimental Study of Reinforced Concrete Beam with Web Openings', Applied Mechanics Department, L. D. College of Engineering Ahmedabad, Gujarat, India.