Semicircular Curved Beam Opening Stregtherend by Various Laminates

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***Abstract*-Sandwich beams offer designers a number This research is consecrate to investigate the behavior and performance of reinforced concrete semi-circular curved beams with openings. Four reinforced concrete semi-circular curved beams were tested in the ANSYS, with opening such as circular, rectangular. The variables considered in the program are strengthening of the beam at the opening region strengthening (confinement) by GFRP ,BFRP ,CFRP , laminates. The beams were tested under the action of two point loads at top face of mid spans with three supports at bottom face of the ends and mid span of the beams. The ANSYS software was use to analyze the finite element method (FEM). In this paper, as a preliminary investigation a curved beam is modeled in ANSYS software and its deflection is compared with reference journal. By checking the percentage error in results the ANSYS software is validated.**

Keywords: Semicircular beams, Opening, Various laminates, Finite-element

1.INTRODUCTION

Sandwich beams are composite systems having high Reinforced concrete horizontally semi-circular curved beams are used in many fields, such as in the construction of modern way intersections, circular water tanks, ring beam carrying domes, circular balconies',… etc. In the construction of modern buildings, a network of pipes and ducts is necessary to accommodate essential services like water supply, sewage, air-conditioning, electricity, telephone and computer network. Usually, these pipes and ducts are placed underneath the beam soffit and, for aesthetic reasons, are covered by a suspended ceiling, thus creating a dead space. Passing these ducts through transverse openings in the floor beams will reduce the dead space and result in a more compact design. For small buildings, the saving of dead spaces may not be significant, but for multistory buildings, any saving in storey height multiplied by the number of stories can represent a substantial saving in total height, length of air-conditioning and electrical ducts, plumbing risers, wall and partition surfaces and the overall load on the foundation . A horizontally curved ring beam, loaded transversely to its plane, is subjected to torsion in addition to bending and shear. Furthermore, it is obvious that the inclusion of openings in beams alters the simple beam behavior to a more complex one. Due to abrupt changes in sectional configuration, opening corners are subject to high stress concentration that may lead to unacceptable cracking from aesthetic and durability viewpoints. The reduced stiffness of the beam may also give rise to excessive deflection under service load and result in a considerable redistribution of internal forces and moments in a continuous beam. Unless special reinforcement is provided in sufficient quantity with proper detailing, the strength and serviceability of such a beam may be seriously affected In practice, the most common shapes of openings are circular and rectangular ones.

Fig.1.1 curved beam balconie

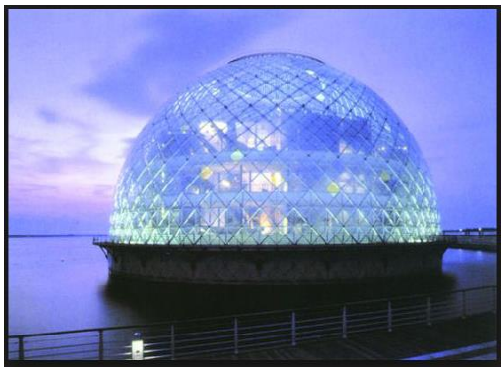

Fig.1.2 curved dome

The application areas of curve beam

- Elevated freeways
- Intersection of highway
- Modern Building Construction
- Curved balconies
- domes
- Curved water tank

II. OBJECTIVES

1. To validate ANSYS software

2.To investigate the behaviour of curved beam with different opening (rectangular ,circular,)

3.To study whether the strengthening of opening with which laminates is effective for curved beam

Table.2.1 Dimensional details of Sandwich Beam

DIMENSIONS OF THE BEAM	VALUES
Outer diameter	2.25m
Inner diameter	2.00m
width	125
depth	250

III.METHODOLOGY

This chapter describes the methodology of the thesis work..The methodology includes study of curved beam and ANSYS software. The whole thesis work is divided into the following sequential steps. The following flowchart represents the methodology of the thesis work to be completed.

A. Modelling

The models are created using ANSYS software. Then obtain the different models should be analysed. Anlysis was performed.After analysis the results obtained are evaluated to find out which type of opening in curved beam is more better for different configuration is most effective in resisting lateral loads. From the literature survey helps to catch the knowledge about the curved beam Here the study is to be carried out for the behaviour of Curved beam .The material properties are selected based on several sources such as literature reviews. Materials used for CFRP,GFRP.BFRP,. beam specimens were made for analysis

B. Dimensional Details

A curved beam is modeled using ANSYS software with the reference journal[3]. Finite element analysis results were used to develop static analysis of beams.:

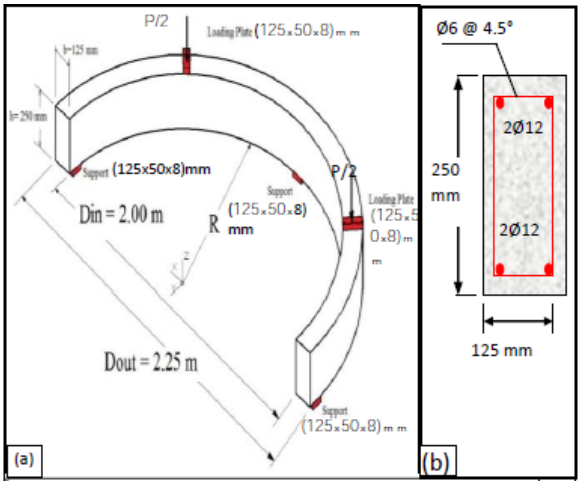

Fig.3.1 Dimensions of Sandwich Beam

C. Material Properties

Curved beam are made up of different materials.The material properties of curved beam are given bellow

Table.3.2 Material Properties of GFRP

Elastic modulus (Mpa)	Major Poisson's ratio	Shear modulus (Mpa)	Thickness of laminates (mm)
E_x =2.1x 10^5	V_{xy}=0.26	G_{xy}=1520	
E_y=7x10^3	V_{xz}=0.26	G_{xz}=1520	
E_z=7x10^3	V_{yz}=0.30	G_{yz}=2650	2

Table 3.3 Material Properties of CFRP

Elastic modulus (Mpa	Major Poisson's ratio	Shear modulus (Mpa)	Thickness of laminates (mm)
E_x=*2.3 x10^5*	0.22	11790	
E_y=*1.79 x10^4*	0.22	11790	2
E_z=*1.79 x10^4*	0.30	6880	

Table.3.4 Material Properties of BFRP

Elastic modulus (Mpa)	Major Poisson's ratio	Shear modulus (Mpa)	Thickness of laminates (mm)
E_x=37700	0.2	2050	2
E_y=5237	0.2	3630	
E_z=5237	0.21	3630	

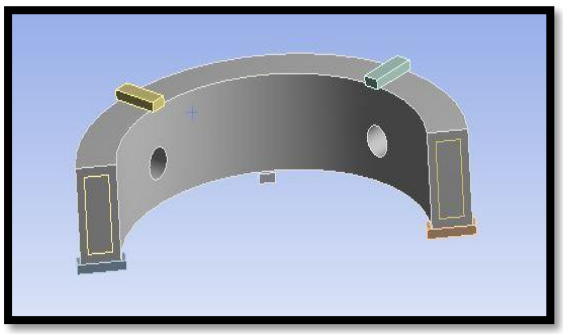

Fig.3.2 circved opening in Beam

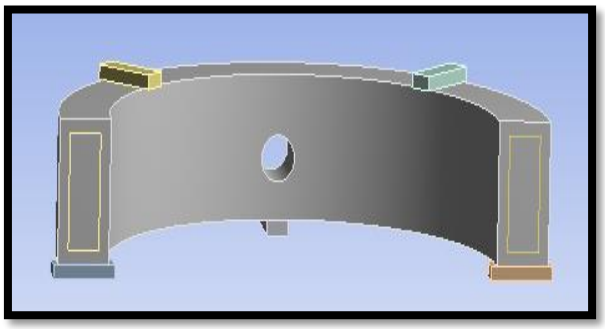

Fig.3.3 curved opening at mid support

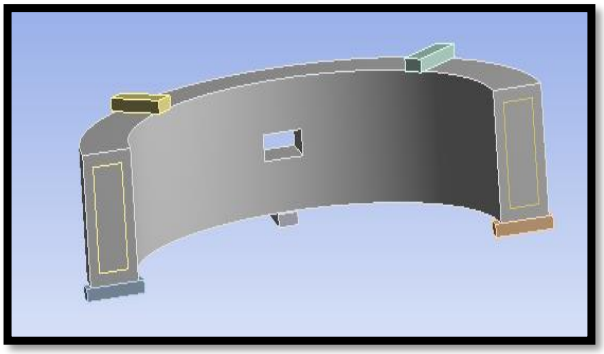

Fig.3.4.rectangular opening at midsupport

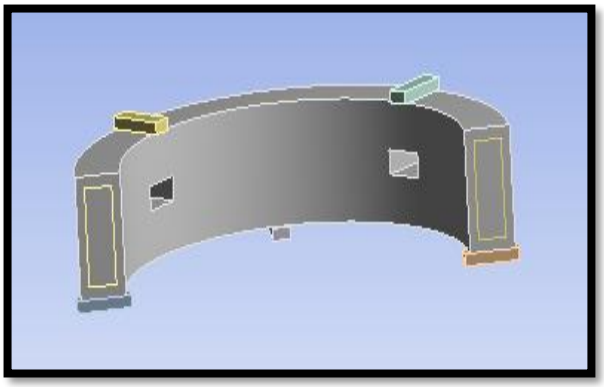

Fig3.5 rectangular opening

D.Meshing and Loading

The beam is modeled using a rectangular mesh which is a 4-node mesh. The element size of the mesh was provided as 25mm. Loading is provided on the top area, as pressure in 10k N. The loading is two point loading.

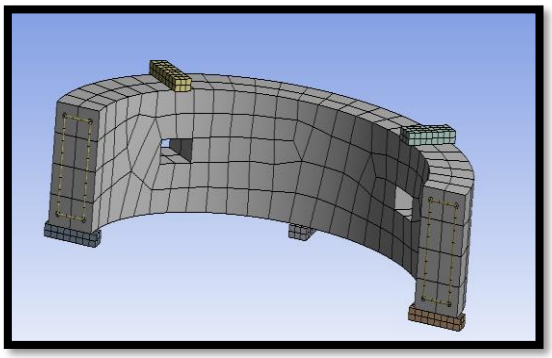

Fig.3.6 Meshing of sandwich beam

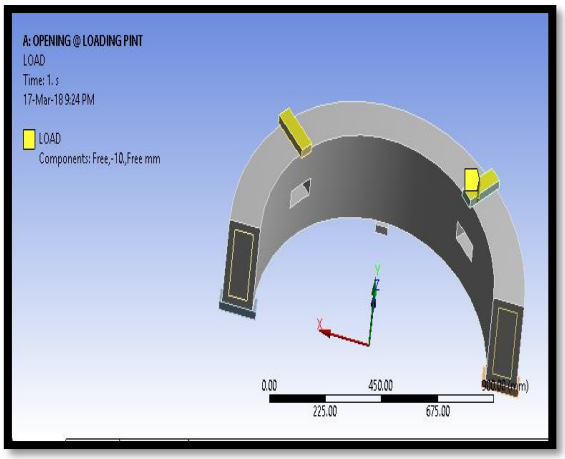

Fig.3.7 Loading of sandwich beam

E. Analysis of Curved Beam

Analysis was done using ANSYS software. Finite element analysis will provide in depth knowledge about the behavior of the member; it performed with proper boundary conditions and material properties. There are different analyses performed in this study. These include the effects of natural frequencys ,mode shapes ,vibration effects damping effects with point load conditions.

Deformation

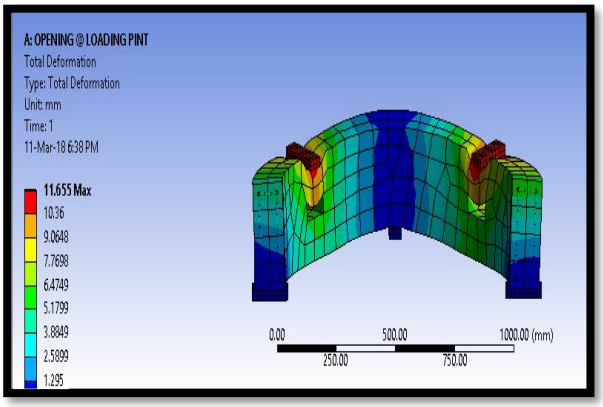

Fig.3.8 Deformation Diagram of Beam

Table.3.5 Force reaction curved of Beam

	OPENING AT MID		OPENING AT LOAD POINT	
	CIRCULAR	RECTANGULAR	CIRCULAR	RECTANGULAR
BFRP	238.57	228.67	245.16	231
CFRP	314.4	247.51	283.16	266.52
GFRP	234.6	225.54	238.3	226.29
WITH OUT WRAPING	188.91	181.67	194.97	189.91

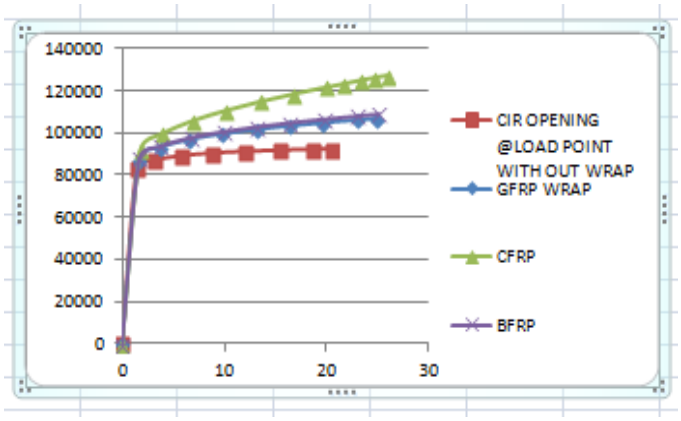

fig.3.9 model frequencies of Beam

IV.CONCLUSIONS

Curved beam is analysed in ANSYS software and the results where compared. The following conclusions are obtained from the study ie, Circular opening is more effective than rectangular type at various postion ,then CFRP external wrapping better result compare with other type of laminates in compare with rectangular & circular opening wrapping.

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REFERENCES

[1] D S Ramakrishna & Rakshith N, Simple Mechanical Model of Curved Beams by a 3D Approach *International Journal of Engineering Inventions*, vol. 3(12), pp. 18-28, 2014.
[2] Haider M. *Alsaeq* Effects of Opening Shape and Location on the Structural Strength of R.C. circular Beams with Opening. (2013) *International Journal of Mechanical Engineering (IJME), IASET, ISSN(P): 2319-2240; ISSN(E): 2319-2259 Vol. 3, Issue 6, Nov 2014, 37-44.*
[3] H M Alsaeq In-Plane Vibrations of Circular Curved Beams with opening *Journal of Construction Steel research*, vol. 100, pp. 221-228, 2014.
[4] Jithinbose K J Effect Of Openings In Beams – A Review *Research Journal of Applied Sciences, Engineering and Technology Vol. 4, No. 9, pp. 1172-1180*,2012
[5] Kijun Kang and Jiwon Han Analysis of a Curved Beam Using Classical and Shear Deformable Beam Theories ACI Structural Journal, Vol 109, 2012
[6] Mansur, M.A Guide for the design and Construction of externally Bonded FRP Systems for Strengthening of Concrete Structures International Journal of Scientific & Technology Research, Vol 3, 2014.
[7] Rakshith , Chethan S fe-investigation of semi circular curved beam subjected to out-of-plane load (2014) *Proceedings of The international Conference on Structural Engineering, Mechanics and Computation, Vol* 1, 2001, pp 311–318
[8] Saffari and R.Tabatabaei-2007 A Finite Circular Arch Element Based on Trigonometric Shape Functions Engineering Structures, Vol 56, 2013, pp 2165–2174.
[9] Somes, N.F. 'Circular openings of continuous beams", using Ansys *International Journal of Civil and Structural Engineering, Vol. 1, No. 3*, pp. 509- 517, 2010.
[10] T E Maaddawy and S Sherif, FRP Composites for Shear Strengthening of Reinforced Concrete Deep Beams with Openings Journal of Construction Steel Research,vol. 60, pp. 1825-1848, 2004.