FREE VIBRATION ANALYSIS OF SHELL

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***ABSTRACT*-In generally shells are used for industrial structure as well as for large covering areas. The both singly and doubly curved shell structure gives aesthetical look. Due to its curvature it transfers the loads from number of directions. But there is not much of consideration about the vibration performance in shell structure. The study had been carried out by detailed study of literature review, about the vibrations and behavior of shells and under free vibrations. The Free vibration analysis of the shell both singly and doubly curved shell is done by using FEA software ANSYS the models of shell both created by basis material properties. Finally the results were compared in between the models of singly and doubly curved shell.**

Keywords: singly curved cylindrical shell, doubly curved shell of Dome, ANSYS

1 INTRODUCTION:

Shell is a type of structural_element a thin shell is defined as a shell. Shell roof gives an aesthetical look and it is useful when the inside of the building is open and does not contain walls or pillars in it. This is characterized by its geometry, being a three-dimensional solid whose thickness is very small when compared with other dimensions, and in structural terms. Essentially, a shell can be derived from a plate by two means: by initially forming the middle surface as a singly or doubly curved surface. A thin shell thickness which is small compared to its other dimensions and in which deformations are not large compared to thickness. A primary difference between a shell structure and a plate structure is that, in the unstressed state, the shell structure has curvature as opposed to the plate's structure which is flat. Membrane action in a shell is primarily caused by in-plane forces (plane stress), but there may be secondary forces resulting from flexural deformations. Where a flat plate acts similar to a beam with bending and shear stresses, shells are analogous to a cable which resists loads through tensile stresses. The ideal thin shell must be capable of developing both tension and compression. The effort in design is to make the shell as thin as practical requirements will permit so that dead weight is reduced is to make the shell as thin as practical requirements will permit so that dead weight is reduced and the structure functions as a membrane free from large bending stresses. Shells are broadly classified into two major groups: (i) Single curve shell is nothing but having only one linear axis to form a shell is say as single curve shell. Example of single curve shell is conical and cylindrical shell. (ii) Doubly curve shell is nothing but having a two Individual axis to form a curve is say as double curve shell. Example of double curved shell is circular domes, paraboloid, ellipsoid, hyperbolic paraboloid and elliptic paraboloid.

1.1 VIBRATION:

Vibration is a mechanical phenomenon whereby oscillations occur about an point. The oscillations may be periodic, such as the motion of a pendulum or random, such as the movement of a tire on a gravel road. Vibration can be desirable: for example, the motion of a tuning fork, the reed in a woodwind instrument or harmonica, a mobile phone, or the cone of a loudspeaker. many cases, however, vibration is undesirable, wasting energy and creating unwanted sound. For example, the vibrational motions of engines, electric motors, or any mechanical device in operation are typically unwanted. Such vibrations could be caused by imbalances in the rotating parts, uneven friction, or the meshing of gear teeth. Careful designs usually minimize unwanted vibrations. The studies of sound and vibration are closely related. Sound, or pressure waves, are generated by vibrating structures (e.g. vocal cords); these pressure waves can also induce the vibration of structures (e.g. ear drum). Hence, attempts to reduce noise are often related to issues of vibration.

1.2 FREE VIBRATION:

The Free vibration is nothing but the initial force which is given to the body to oscillate freely. The free vibration in which energy is neither added to nor removed from the vibrating system. It will just keep vibrating forever at the same amplitude.

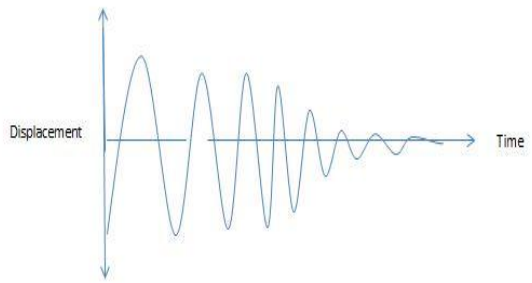

Figure 1.2.1 free vibration

Free vibration occurs when a mechanical system is set in motion with an initial input and allowed to vibrate freely. Examples of this type of vibration are pulling a child back on a swing and letting go, or hitting a tuning fork and letting it ring. The mechanical system vibrates at one or more of its natural frequencies and damps down to motionlessness. Best example is oscillation of pendulum by initial force the pendulum rests in position after some time.

2 LITERATURE REVIEW:

Kim et al (2014) studied an effective p-version two node mixed finite element is newly presented for predicting the free vibration frequencies and mode shapes of isotropic shells of revolution. The present element considering shear strains is based on reissner-miudlin shear deformation shell theory as Hellinger-reissner varitional principle- to improve the accuracy and resolve the numerical difficulties due to the spacious constraints field-consistent stress parameters employed corresponding displacement shape function. With high-order Hierarchical shape function. The elimination of stress parameters and the reduction of the node less degrees by the guyon reduction yield the standard stiffness and mass matrix. Results of the proposed elements are compared with analytical, experimental and numerical solutions. Found in the literature. We Continuous a very satisfactory numerical behavior of the present p-version mixed element.

Koteswara Rao et al (2012) the finite element modeling and analysis of functionally graded (FG) shell structures under different loading such as thermal and mechanical. Free vibration analysis of functionally graded (FG) spherical shell structure has also been presented. In order to study the influences of important parameters on the responses of FG shell structures, different types of shells have been considered. The responses obtained for FG shells are compared with the homogeneous shells of pure ceramic and pure metal (steel) shells and it has been observed that the responses of the FGM shells are in between the responses of the homogeneous shells. Based on the analysis some important results are presented and discussed for thick as well as thin shells.

Salvatore brischetto et al (2016) proposes the study of the approximation of the curvature terms in the 3D equilibrium shell equations used for the free vibration analysis of one layered and multilayered composite and sandwich structures 3D equilibrium equations written for spherical shells degenerate into 3D equations for cylindrical shells and plates considering one of the two radii of curvature or both as infinite, respectively The approximation of curvature terms has been introduced in3D equilibrium equations in order to study its effects in terms of frequency values. These effects depend on the thickness and curvature of the considered structure on the embedded material and laminated sequence on the frequency order and vibration mode. A layer wise approach is considered for multilayered structures. The approximation of the curvature has been introduced in the 3D equilibrium shell equations and not in the interlinear continuity conditions and in the top and bottom boundary and loading conditions. This choice has been made for numerical reasons. The investigation of curvature approximation effects in the equilibrium equations allows an exhaustive analysis to understand the importance of curvature terms in the free vibration problems.

Bandyopadhyay et al (2015) the variation of curvature is the difficult encountered in the analysis of these shells. The finite element method is used here for the analysis of generalized doubly curved shells and is applied to truncated and full conoids of different boundary conditions. Aspects ratios and degrees of truncation. An eight nodes Isoperimetric finite element with five degrees of freedom per node, including three translations and two rotations, is utilized. The accuracy is checked by completing the results obtained by the present analysis with those existing in the literature. Results are presented in different conoidal shells and a set of conclusions are arrived at based on a parametric study. Doubly curved conoidal shells are gradually of curly used for various industrial structures conoidal shells are aesthetically appealing and being ruled surfaces. Provide ease of casting.

Bhiimarsaddi et al (2014) Studied the free and undamped vibration of an isotropic circular cylindrical shell is analysed with higher order displacement model giving rise to a more realistic parabolic variation of transverse shear strains. The method response of cylindrical shells. The frequencies obtained from the present analysis shear deformation theory and flugge theory are compared with the exact elasticity results. It is found that the frequencies predicted by the present analysis are closer to exact values than those predicted by the shear deformations theory especially for cases with shorter wavelengths.

Felix breitschadel et al (2010) The general analytical method is represented for evaluating the free vibration characteristics of a circular cylindrical shell with classical boundary conditions of any type. The solution is detected from direct sandersis shell equations and with the axial Fourier series expressions. An explicit expression of the exact frequency equation can be obtained for any kind of boundary conditions. The accuracy of the method is checked under available data's. The method is used to find the modal characteristics of the thermal linear model of the fast test reactor. The numerical results obtained are compared with finite element method solutions.

3 MATERIAL PROPERTIES:

The modelling of singly and doubly curved shell is created under the basic properties of steel and concrete. The material properties taken with previous References.

Table 1 Material properties.

Material	**Density** (Kg//M^3)	**Young's modulus** *E*	**Poisson's ratio** μ
Concrete	2.4x10^3	2.5x10^4	0.2
Steel	7.68x10^3	2x10^5	0.3

4 ANALYTICAL INVESTIGATION:

4.1 Modeling of Singly curved shell:

The finite element model of singly curve (cylindrical shell) is created by using the basic properties of concrete M25 and Steel Fe 250. The thickness of singly curve shell is 50mm and reinforcements 6mm dia bars used. The finite element (FE) modelling and analysis has been carried out using **ANSYS.** The element chosen for concrete is solid 65 and 2 Node beam 188 for Steel. The points created by co-ordinates system of XYZ to create a model the overall key points is 226. Meshing of Steel and Concrete with basic material properties of Young's modulus, Poisson ratio and Density.

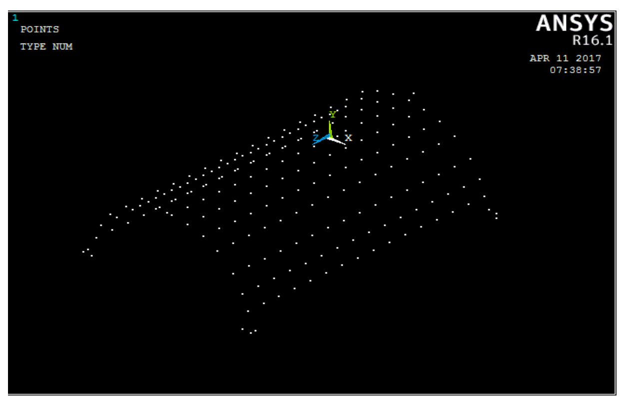

Figure 4.1.1 Key points of cylindrical shell.

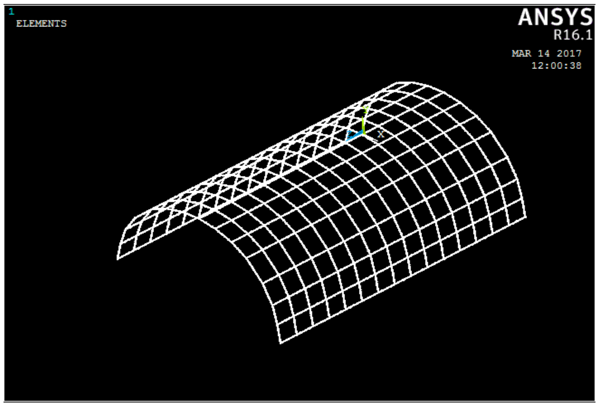

Figure 4.1.2 Reinforcement of cylindrical shell.

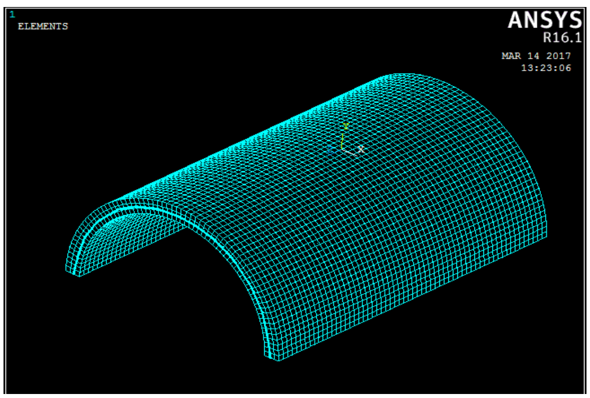

Figure 4.1.3 meshing of steel and concrete.

4.2 Modelling of Doubly curved shell of dome:

The finite element model of doubly curve (Dome) is created by using the basic properties of concrete M25 and Steel Fe 250. The thickness of doubly curve shell is 50mm and reinforcements 6mm dia bars used. The finite element (FE) modelling and analysis has been carried out using **ANSYS.** The element chosen for concrete is solid 65 and 2 Node beam 188 for Steel. The points created by co-ordinates system of XYZ to create a model the overall key points is 280. Meshing of Steel and Concrete with basic material properties of Young's modulus, Poisson ratio and Density.

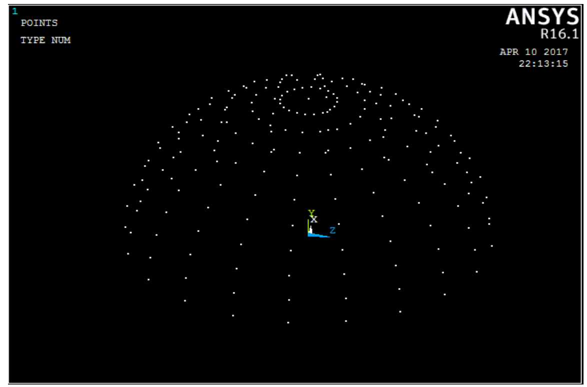

Figure 4.2.1 Key points of doubly curve shell of Dome.

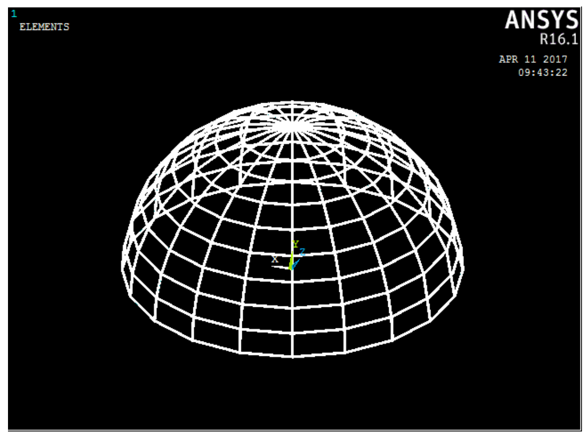

Figure 4.2.2 Reinforcement of Dome.

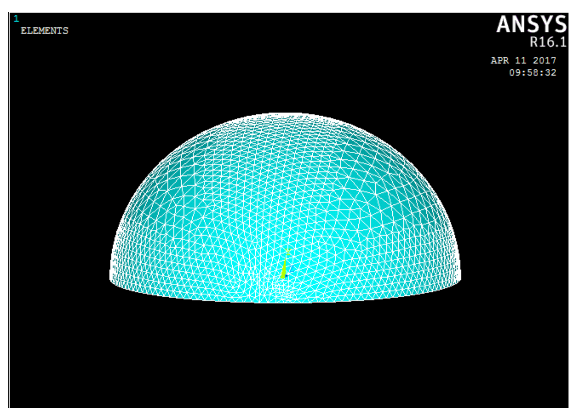

Figure 4.2.3 meshing of steel and concrete

5 RESULTS AND DISCUSSION:

The Analysis of free vibration by using ANSYS. The singly curve cylindrical shell is subject to the vibration of 10 HZ to 0 HZ. The image of deflection and graph of cylindrical shell is shown below.

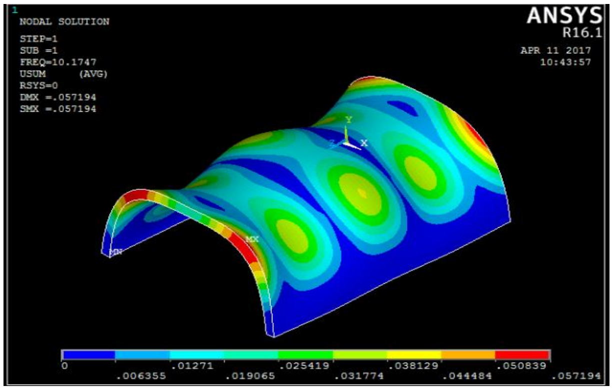

Figure 5.1 Deflection image of cylindrical shell

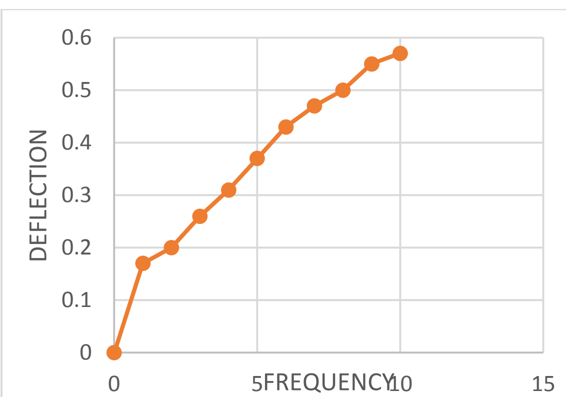

Figure 5.3 Graph of Frequency and Deflection

The Analysis of free vibration by using ANSYS. The doubly curve cylindrical shell is subject to the vibration of 10 HZ to 0 HZ. The image of deflection and graph of doubly curve shell of dome is shown below.

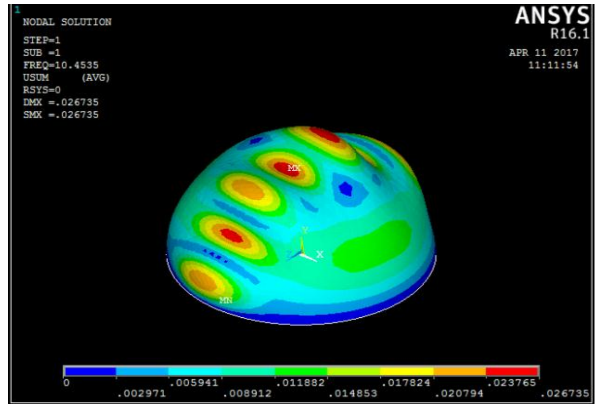

Figure 5.2 Deflection image of dome

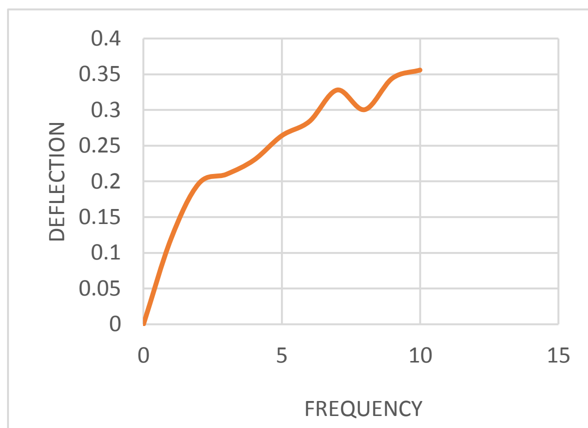

Figure 5.4 Graph of Deflection and frequency.

6 CONCLUSION

In this paper Model of singly curved cylindrical shell and doubly curved dome had been analyzed under free vibration of 10 HZ to 0 Hz by using ANSYS. After the comparison of results between cylindrical shell and dome. The dome gave the better results than cylindrical shell. In Dome the first set of 10 HZ gives the deflection of 0.35mm but cylindrical shell gave the deflection of 0.57mm. Therefore due to closed sections the elements of dome interconnected between each other so it’s subject to minimum deflections. Due to large openings the cylindrical shell vibrates freely and gives little bit deflection higher than dome.

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