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COMAPARATIVE STUDIES OF EFFECT OF ASPECT RATIO ON SHELL STRUCTURE USING ANSYS SOFTWARE

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Abstract—*Shell roof structure have the ability to cover large opening without using column and beam. In the present study, analysis of Shell structure is performed to cover the area of varying aspect ratio1 , 1.5& 2.This study is performed for permissible stress level of material. ANSYS version 14.5 based on finite element method has been used for the design of models as it is a strong computer program for design and analysis of space structure. It is observed that aspect ratio has considerable effect on equivalent Elastic Strain, Equivalent Stress, Maximum Stress, Maximum Principal Stress, Minimum Principal Stress, Safety Factor, Margin and concluding remark are highlighted which shows that as aspect ratio increases , the inaccuracy of the solution increases.*

Keywords-*Shell Structure, Aspect ratio, Finite element method, ANSYS workbench 14.5, Analysis.*

I. INTRODUCTION

Before building a structure, it should be analyzed and designed to decide about its size to resist the possible forces coming on it. The structure should be safe and at the same time its components should be as small as possible. Up to mid-sixties lot of improvements were seen in the classical methods of analysis. Need of tall structure and improvement in computers gave rise to matrix method and finite element method of analysis. Requirement of large column free structures gave rise to analysis and design of shell roofs (curved surfaces), geodetic tower and tension structures.

Shell structure are very important structures from engineering point of view. By analyzing shell structure in ANSYS software calculation and results obtained become fasters than analytical method. In today's world environment, saving of time,cost and material are prime importance. Shell structure are cost and material effective for any building than Flat roof. So, study of thin shell structure are necessary. Using ANSYS accurate analysis result within less time duration can be achieved. Need of study of this project is to learn about shell structure and analysis of them in ANSYS software by taking different aspect ratio which will give idea about stresses at any point in structure and find best structure which can resist all forces and loads without deformation throughout their entire life.

ANSYS is a general-purpose finite-element modelling package for numerically solving a wide variety of mechanical problems. These problem include static/dynamic, structuralanalysis (both linear and nonlinear), heat transfer, and fluid problems, as well as acoustic and electromagnetic problems.

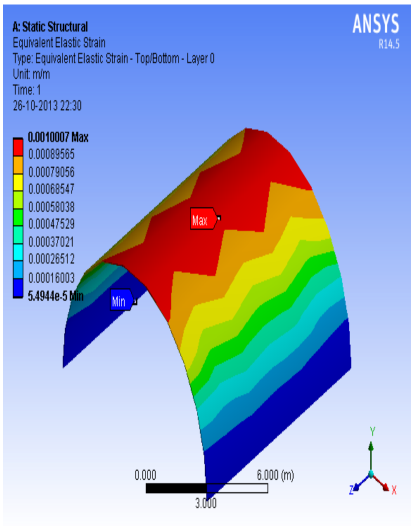
The workbench platform represents a key advantage that differentiates ANSYS technology from that of others in the CAE industry. No other engineering simulation provider offers the same level of integration across such a comprehensive and powerful range of engineering simulation tools. ANSYS workbench is an interface through which the user communicates and interacts with simulation technology. The environment is design to make the process efficient. CAD integration, geometry and meshing tools, and combined physics allow the user to take 3-D based processes through simulation and optimization.

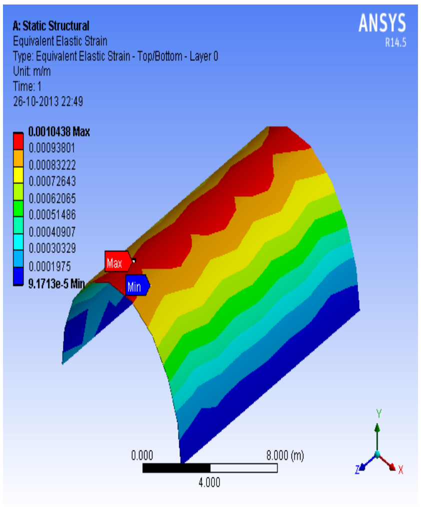
II. DESCRIPTION OF SHELL STRUCTURE

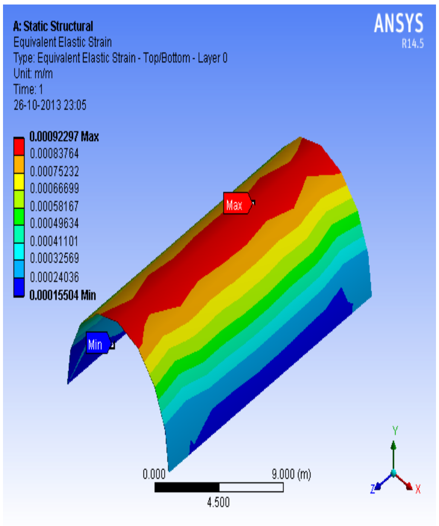
In present study shell structure having length 10m,15m, and 20m i.e.(A.R. 1,1.5,&2) are analyzed. All other dimensions are same for three model. The brief description of the shell structure is give in Table.1.The 3D idealization of shell with different aspect ratio is shown in figure 1, 2 and 3.

Table 1: Preliminary data of shell structure

Material	Steel
Width(m)	10
Height(m)	6
Thickness(m)	0.05
Pressure	10000Pa
Aspect Ratio	1,1.5,2







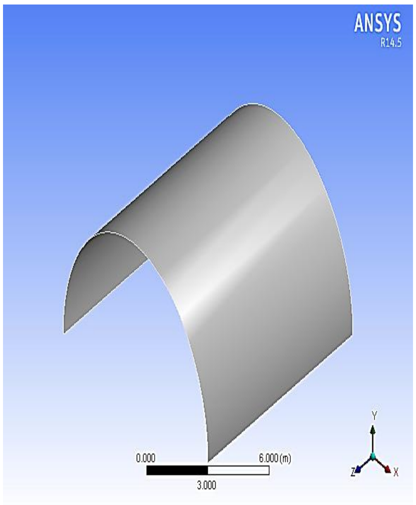


Fig.1: 3D Shell structure with aspect ratio 1

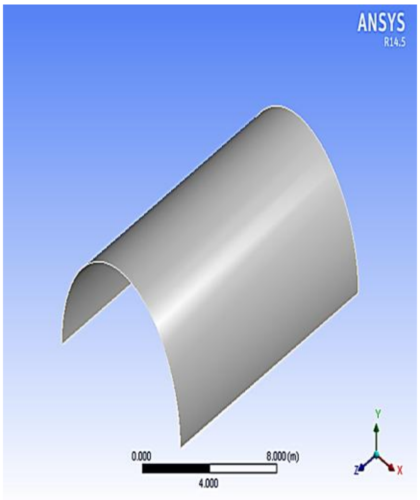


Fig.2: 3D Shell structure with aspect ratio 1.5

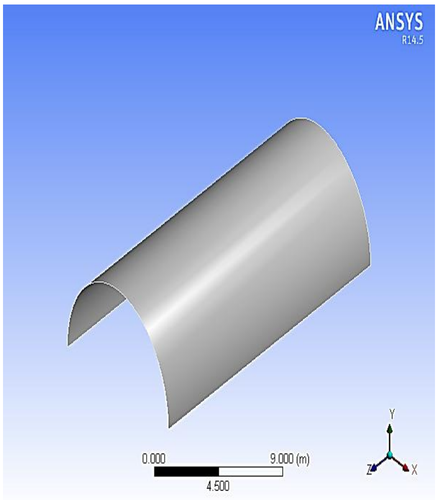


Fig.3:3D Shell structure with aspect ratio 2

III. ANALYSIS AND MODELLING OF SHELL STRUCTURE

ANSYS workbench 14.5 is used to perform static structure analysis of shell of shell structure, three different model are analyzed considering different aspect ratio as shown in figure. Constant pressure are applied and high smoothing fine mesh is provided for analysis of shell structure.

From the analysis, the Equivalent Elastic Strain, Equivalent Stress, Maximum Principal Stress, Minimum Principal Stress, Safety Factor, Safety Margin is obtained and effect of aspect ratio on shell structure is observed by comparing three model with different aspect ratio 1, 1.5, and 2.

IV. RESULTS AND DISCUSSIONS

The considered shell structure is analyzed using the static structure analysis to evaluate Equivalent Elastic Strain, Equivalent Stress, Maximum Principal Stress, Minimum Principal Stress, Safety Factor, and Safety Margin. The shell is subjected to constant pressure. The maximum value of Equivalent Elastic Strain, Equivalent Stress, Maximum Principal Stress, Minimum Principal Stress, Safety Factors, and Safety Margin are taken to observe effect of aspect ratio on shell structure shown in Table 2.

The figure 4 to 6 shows the Equivalent elastic strain. Figure 7 to 9 shows Equivalent strain, figure 10 to 12 shows Maximum Principal Stress, figure 13 to 15 Show Minimum Principal stress, figure 16 To 18 Safety factor and figure 19 to 21 show safety margin for model 1, 2, 3 having aspect ratio 1, 1.5, and 2 respectively.

Fig.4:Equivalent elastic strain for MODEL-1

Fig.5:Equivalent elastic strain for MODEL-2

Fig.6-Equivalent elastic strain for MODEL-3

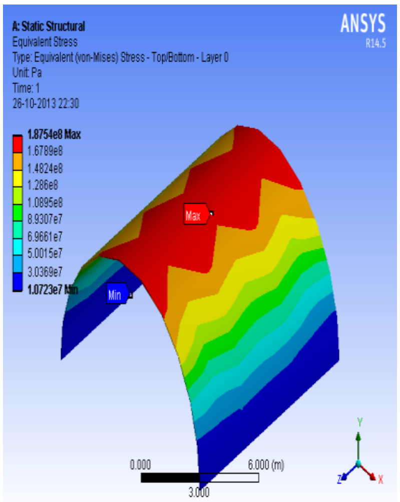


Fig.7:Equivalent stress for MODEL-1

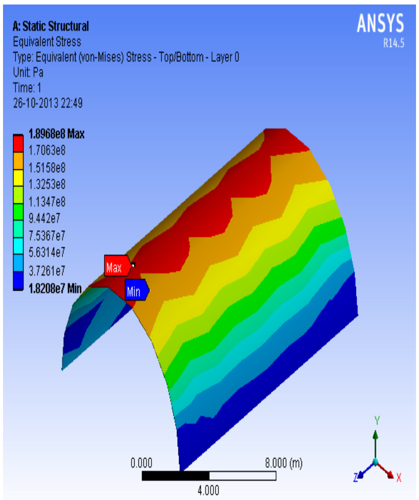


Fig.8:Equivalent stress for MODEL-2

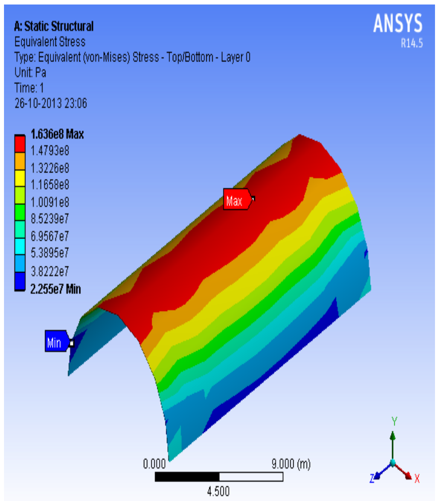


Fig.9:Equivalent stress for MODEL-3

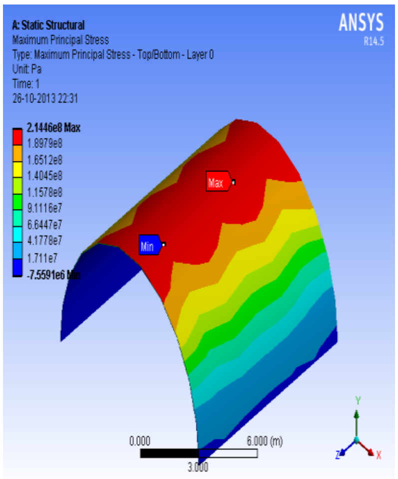


Fig.10:Maximum principal stress for MODEL-1

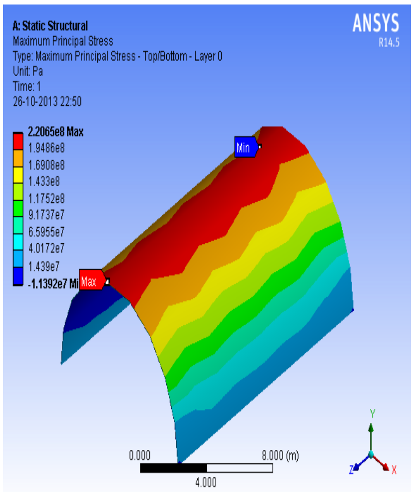


Fig.11:Maximum principal stress for MODEL-2

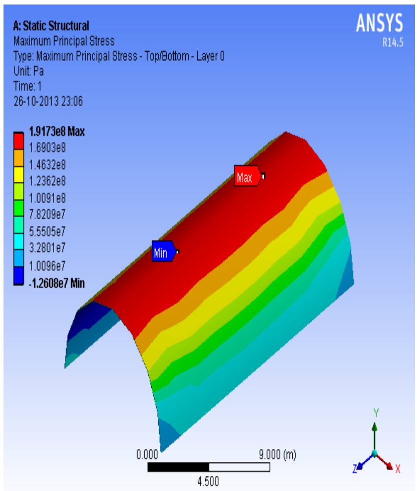


Fig.12:Maximum principal stress for MODEL-3

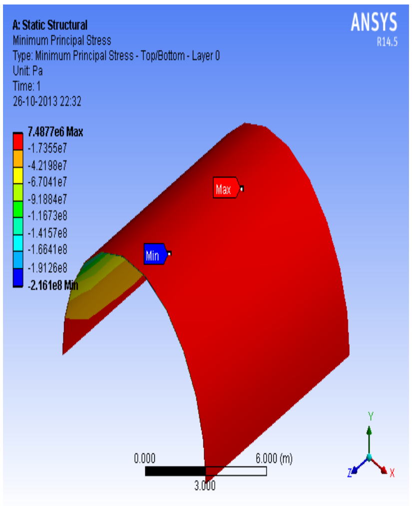


Fig.13:Minimum principal stress for MODEL-1

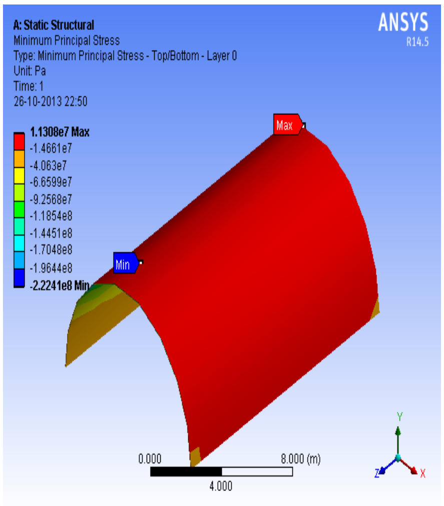


Fig.14:Minimum principal stress for MODEL-2

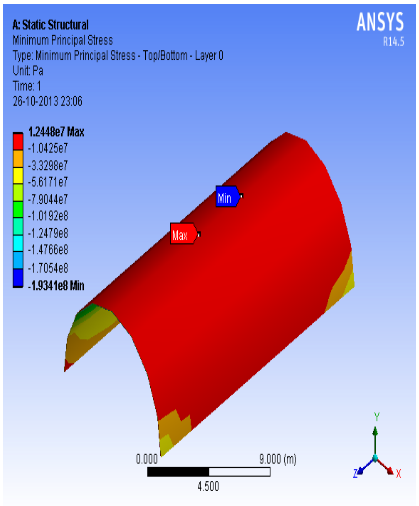


Fig.15:Minimum principal stress for MODEL-3

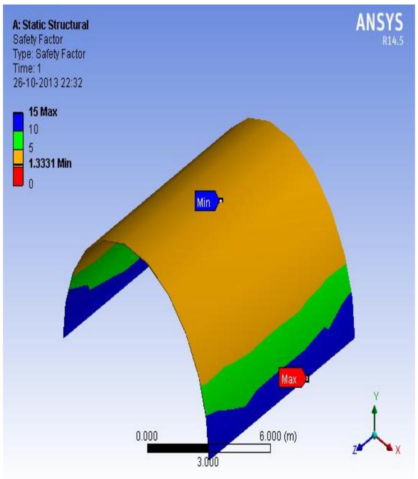


Fig.16:Safety factor for MODEL-1

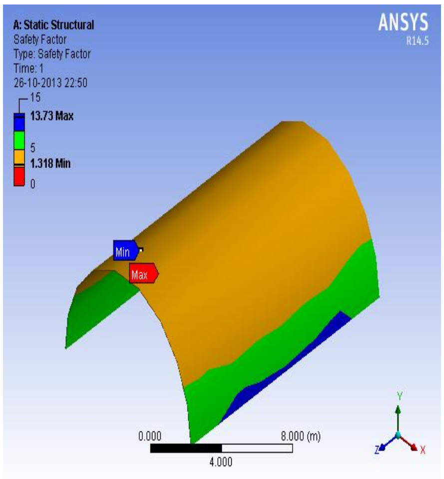


Fig.17:Safety factor for MODEL-2

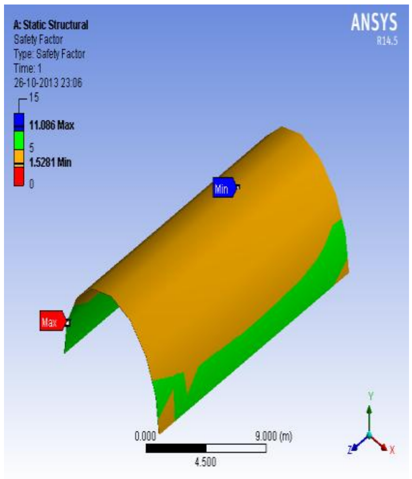


Fig.18:Safety factor for MODEL-3

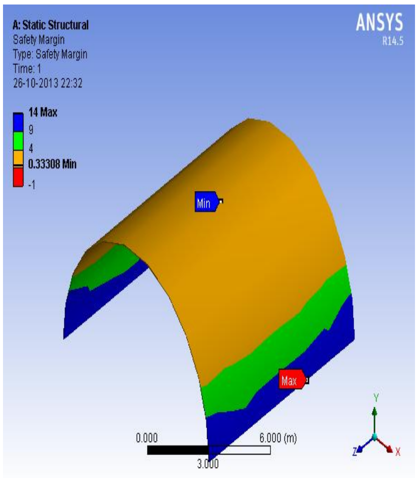


Fig.19:Safety margin for MODEL-1

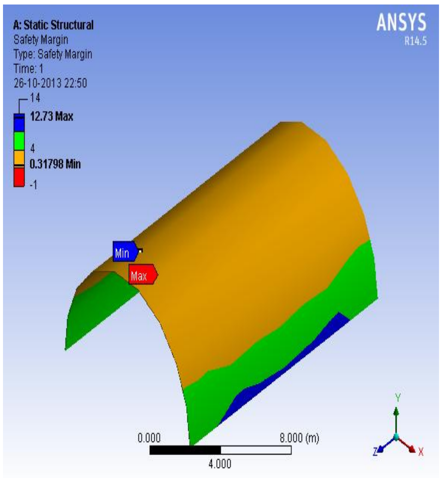


Fig.20:Safety margin for MODEL-2

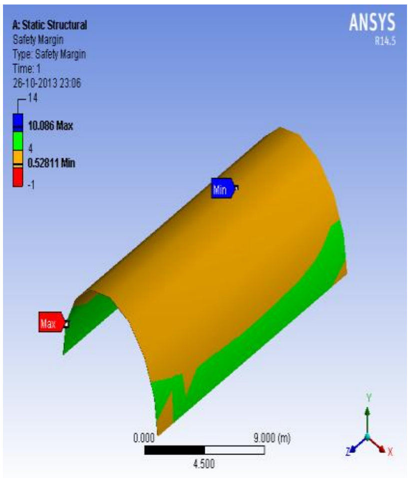


Fig.21:Safety margin for MODEL-3

Table 2: Comparison of results

Properties		**Model-1**	**Model-2**	**Model-3**
Aspect Ratio		1	1.5	2
Pressure		10000Pa	10000Pa	10000Pa
Equivalent Elastic Strain	**Min.**	5.4944e-005m/m	9.1713e-005m/m	1.5504e-004m/m
	Max	1.0007e-003m/m	1.0438-003m/m	9.2297e-004m/m
Equivalent Stress	**Min.**	1.0723e+007Pa	1.8208e+007Pa	2.255e+007Pa
	Max.	1.8754e+008Pa	1.8968e+008Pa	1.636e+008Pa
Maximum Principal Stress	**Min.**	-7.5591e+006Pa	-1.1392e+007Pa	-1.2608e+007Pa
	Max.	2.1446e+008Pa	2.2065e+008Pa	1.9173e+008Pa
Minimum Principal Stress	**Min.**	-2.161e+008Pa	-2.2241e+008Pa	-1.9341e+008Pa
	Max.	7.4877e+006Pa	1.1308e+007Pa	1.2448e+007Pa
Safety Factor	**Min.**	1.3331	1.318	1.5281
	Max	15	3.73	11.086
Safety Margin	**Min.**	0.33308	0.31798	0.52811
	Max	14	12.73	10.086

V. CONCLUSION

In this study the Equivalent Elastic Strain, Equivalent Stress, Maximum Principal Stress, Minimum Principal Stress, Safety Factor, Safety Margin for shell structure having different aspect ratio are evaluated. The significant outcomes of present study are summarized as follows.

By increasing aspect ratio;

- We get max. Strain in less area of shell.
- There is reduction in equivalent stress.
- Maximum principal stress in max. for aspect ratio 1.5.
- There is increase in minimum principal stress with increase in aspect ratio.
- As aspect ratio increasing max. equivalent Elastic Strain and Minimum Principal Stress increasing and Equivalent Stress, Safety Factors , Safety Margin decreasing for aspect ratio 1.5.

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