

Static Analysis of Shelf to Study the Effect of Different Meshes and Addition of Stifnners on FEA Results

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Abstract:-- Shelves are subjected to uniformly distributed load and concentrated load many times over its life span. Strength of these structures are increased by adding stiffeners to its base plate. This paper deals with the analysis of Shelf with and without stiffener. A comparison of without stiffener shelf and one, two and three stiffeners is done for the same dimensions. In order to continue this analysis various research papers were studied to understand the previous tasks done for stiffened shelf. Hyper mesh is used to do the analysis. Triangular flat plates are used as stiffener at middle, both outer side of shelf. Displacement plot and stress plots are studied for all above cases and comparison table is prepared. On that which case is good or better is found out.

Keywords:-- Stiffener, Static Analysis, FEA,

I. INTRODUCTION

The stiffened structural elements are widely useful in engineering mainly for the application of steel plates for hulls of ships, steel bridges and aircraft structures. These types of structures have wide application in modern industries.

In order to increase the strength of shelf, plates are one of the common option. These plates are usually two dimensional with thickness very low as compared to other two dimensions. Stiffeners mounted on the plate increases the resistance to deformation by increasing the overall stiffness. Modelling was done using CATIA tool. For FEA, meshing was performed using Hyper Mesh. Linear static analysis was performed with the same load cases and in order to find out the reliability of the shelf. Meshing is done using shell elements, element and material property details are shown below in table no. 1

TABLE NO.1

Sr. No.	Type of elements	Number of elements (static analysis)
1	Shell elements	10043
Material Properties: - Elastic Modulus- 2.1E5 N/mm ² , Poisson's Ratio- 0.3, Density of steel- 7.9E-9 Kg/mm ³		

For Analysis of four different Cases HyperMesh software is used. 4 node shell elements were used to discretize the complete shelf structure. After applying the boundary

condition Radioss was used to do the processing and post processing is carried out in Hyper View.

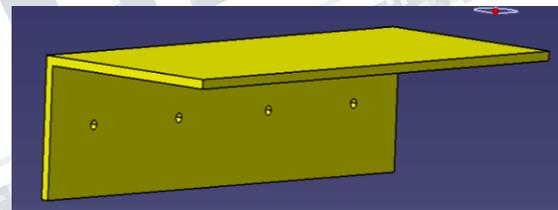


Figure-1 Shelf without stiffener

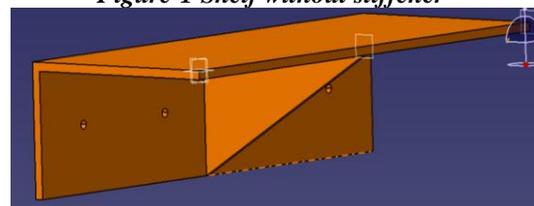


Figure-2 Shelf with stiffener at mid

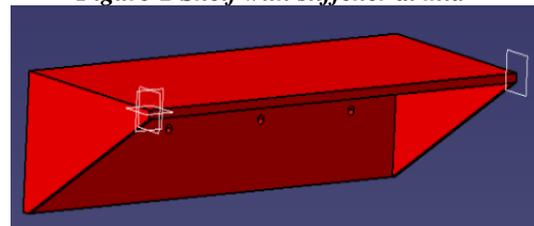


Figure-3 Shelf with twostiffeners which are at the end.

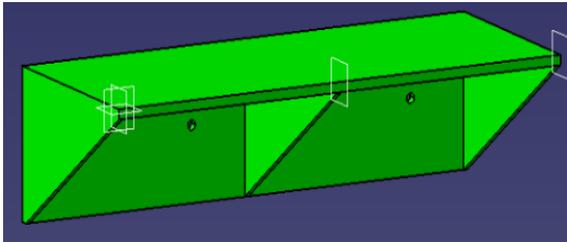
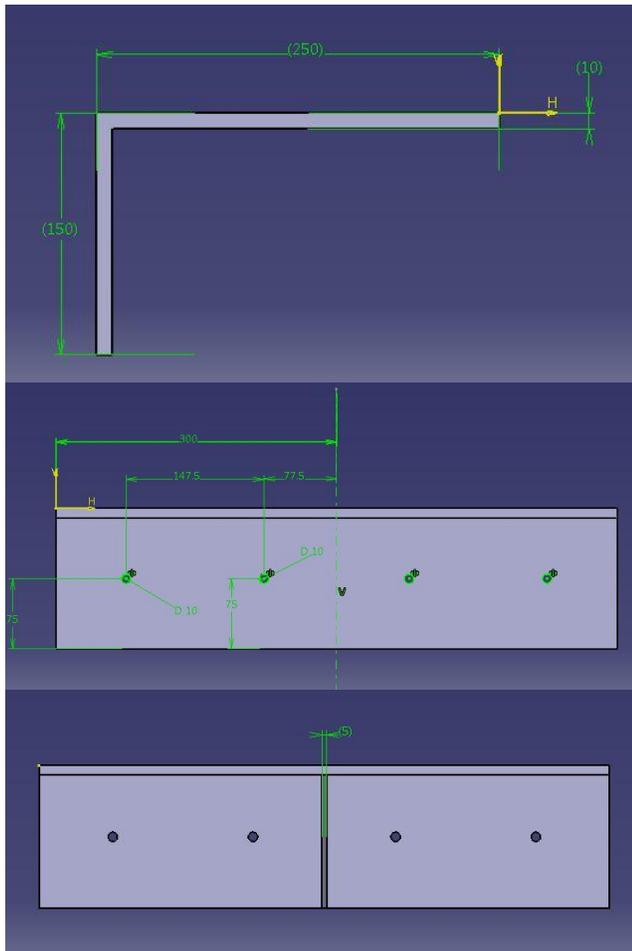


Figure-4 Shelf with three stiffeners, two are at the end and one is at mid

III. PROBLEM STATEMENT

Modal under study shelf of the dimensions as shown below,
DIMENSIONS OF SHELF



Amount of load and type of constraint acting on the modal are the actual load acting on the shelf. Load of 1000N is acting on the top outer edge of the shelf as uniformly distributed load throughout its length and on the other side

at the holes which are fixed on wall is given fixed constraint as shown in Fig.6.

IV. STATIC ANALYSIS

A series of FE modal are generated for the shelf with mesh size 5 mm with four types of meshing

- 1] Mixed mesh
- 2] Quad mesh
- 3] Tria mesh
- 4] R-Trias, using automatic mesh technique.

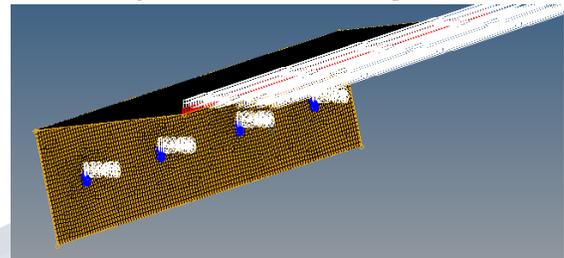


Fig.6. shows the Shelf with mixed mesh type.

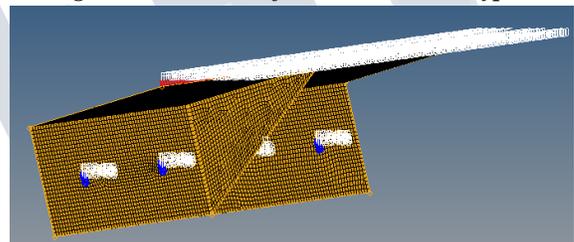


Fig.7. shows the Shelf with quad mesh type.

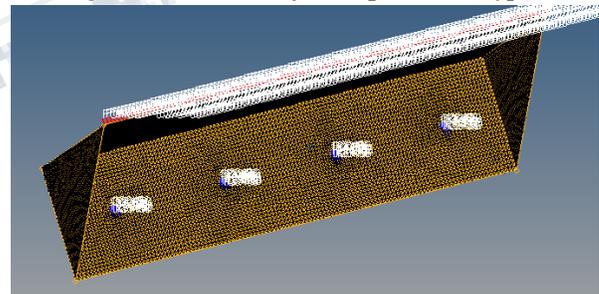


Fig.8. shows the Shelf with R-Trias mesh type.

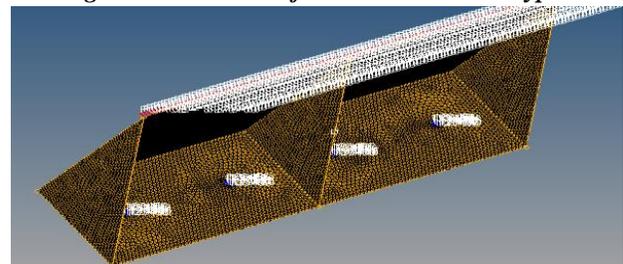


Fig.9. shows the Shelf with Tria mesh type.

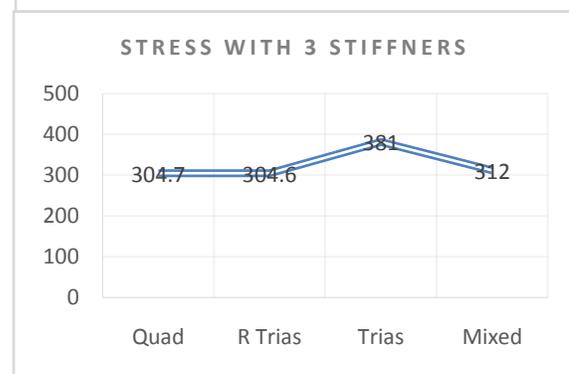
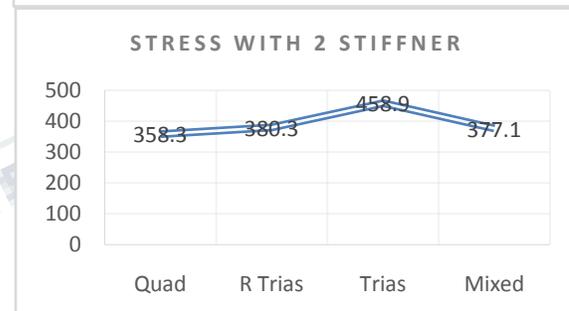
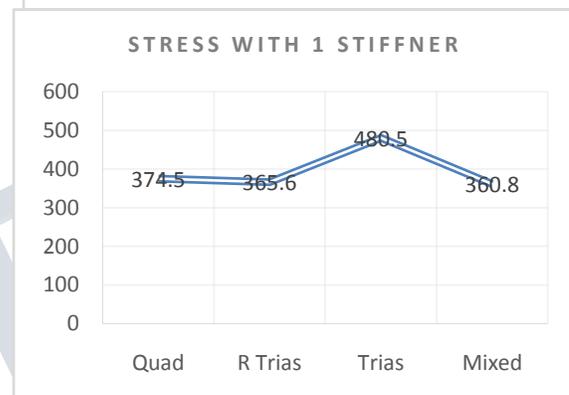
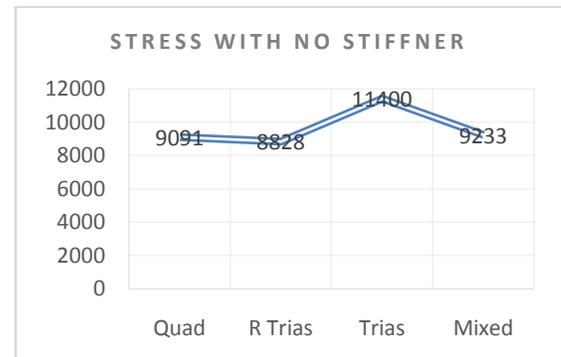
RESULTS AND DISCUSSION

Following table shows the displacement and von misses stress for different types of mesh and the stiffener value

TABLE NO. 2

Sr. No.	Type of Mesh	No. of Stiffeners	Displacement Plot (mm)	Stress Plot (N/mm)
1	Quad	0	870.8	9091
2	R Trias	0	869.3	8828
3	Trias	0	870.1	11400
4	Mixed	0	871.3	9233
5	Quad	1	3.689	374.5
6	R Trias	1	3.687	365.6
7	Trias	1	3.695	480.5
8	Mixed	1	3.699	360.8
9	Quad	2	4.274	358.3
10	R Trias	2	4.273	380.3
11	Trias	2	4.279	458.9
12	Mixed	2	4.287	377.1
13	Quad	3	1.912	304.7
14	R Trias	3	1.913	304.6
15	Trias	3	1.92	381
16	Mixed	3	1.921	312

Graphs of vonmisses stress vs. Type of element



From the table, it is clear that the displacement and von mises stress values are less for R-Trias elements, and more for TRIA ELEMENTS, If the values of stiffeners

is increasing then the stresses developed in the shelf are going to decrease. From this it is proved that Strength of the structures is increased by adding stiffeners to its base plate.

CONCLUSIONS: -

Using HyperMesh linear static analysis has been successfully carried out. Stress levels obtained in analysis are within the acceptable limits. Overall stiffness of the shelf can be effectively increased by addition of stiffener which can yield better result. By taking above all cases in to consideration we came with conclusion mentioned below:

1. Out of above four shelf, the shelf with three ribs seems to be safer than others.
2. From above four meshing types stress concentration is more in R-TRAIS and TRAIS.
3. MIXED and QUAD types of meshing give more accuracy in results.

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