Design And Analysis Of Heavy Vehicle Axle Carrying Frame Structure

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Abstract:– In transportation theory each and every equipment has its own importance. The main aim is only to be safe transport of finished goods. In the transportation many types of pallets are used. Generally the standard pallets are used in all the industry, because they are easily available and ordered from local market. The disposal of this standardize pallet is also easy. The axle transportation is the special case of transport when it comes to export of axles across countries. Before this type of design optimization it is needed to check with the all circumstance related to failures occurring while exporting the product across countries. The pallet design is optimized and simulated for the critical behavior of pallet

1. Introduction

Packaging is one of the main parts of transportation of finished goods. The world becomes faster day by day and due to this time limitation all process to be completed within the customer time demand. In this process packaging is very important to contribute the safe dispatch. Internal and external transportations use different types of pallet like wooden, metal, plastic etc. In the transportation finished goods proper packaging is very important to prevent it from any types of damage the product. As for as the packaging concerned to be the safety transportation of engine packaging design consideration is required. It includes the packaging process and equipment.

In packaging, selection of proper pallet is also important. Olden day's many countries would use the wooden pallets for packaging. The wooden pallet is lighter in weight, easily available and manufactures with the less cost and has many more advantageous. Similarly plastic and metal pallet is alternative to wooden pallet.

2. Problem Statement

The frame structure carrying the goods (manufacture parts) is an important part of logistic department , transportation, while in a breaking, bumping and turning of the vehicle the loads on the frame structure seriously threatens the geometric tolerence of the finished products. Thus, goods carrying frame structure safety and how to design a frame structure with a good stiffness and strength are important task for logistic department. The logislation regulation as per the DNV standards has been enforced for logistic department.

2.1. Objective

The main objective of this project work is as follows

1. To conduct the static analysis on axle carrying frame structure for three worst case for loading condition like-

1.Bumping

2.Breaking

3.Turning.

2. To find the stress and displacement contour plots and predict the factor of safety.

3. Methodology

The objective of a current project is to design amd analysis the axle carrying frame structure. In order to carryout the design following parameters were consider-

1.Bumping load condition

2.Turning load condition

3.Breaking load condition

Design selection has to be selected based on the above worst load cases. The standard tube(box) sections's has to be selected for ease of the manufacturing. The CAD model is created using SOLID WORKS or HYPERWORKS. The 3D CAD model created is exported as a nuetral file format preferably DOT IGES file.

1. The DOT IGES file is imported into a preprocessing tool at Hypermesh for descritization.

2. The FE model created is exported as a DOT DAT solver file to run in a NASTRON

3. The results from the NASTRON are post processed using hyperview

Problem definition

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Creted 3D CAD model

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Creted FE model using Hypermesh

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Export DOT file

⇩

Run in NASTRON software

⇩

Post process results using Hyper view

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Results And Discussion

4. Results and discussion

4.1. Load Case I (Bumping Load)

In load case I study of stress behavior is carried out when Bumping load condition is along the vertical negative Y direction of the axle carrying frame structure. Below Figure shows the von-mises stress plots for the Breaking load condition of the axle carrying frame structure.

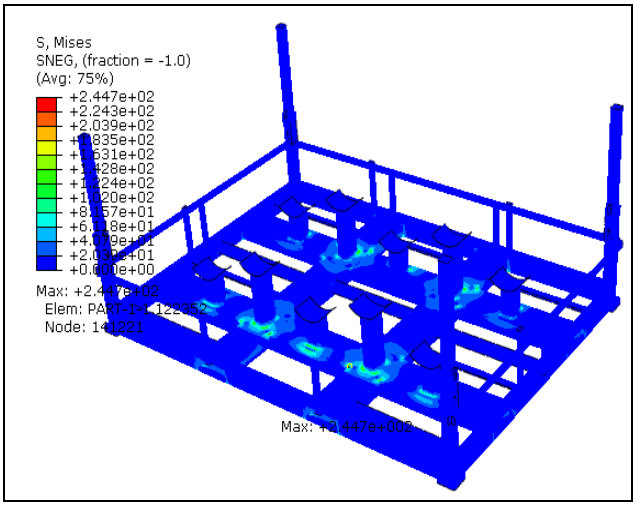

Fig 4.1: Von-mises stress plot, MPa

The maximum von-mises stress at transition region of the vertical member and longitudinal tube is 244.7MPa.

Below Figure shows the maximum and minimum principal stress plots respectively for the Bumping load condition of the axle carrying frame structure

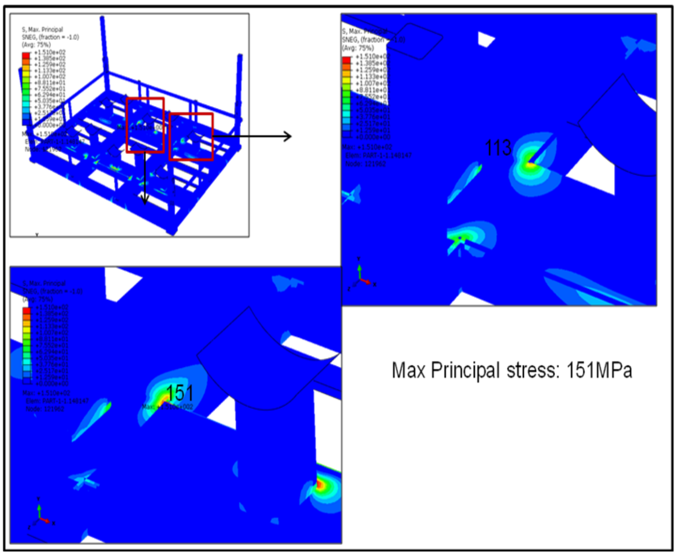

Fig 4.2: Maximum principal (Tensile) stress, MPa

The maximum principal stress refers that the structure is subjected to tensile stress and this occurred at the bottom side of the pocket hole and the maximum value is 151 MPa.

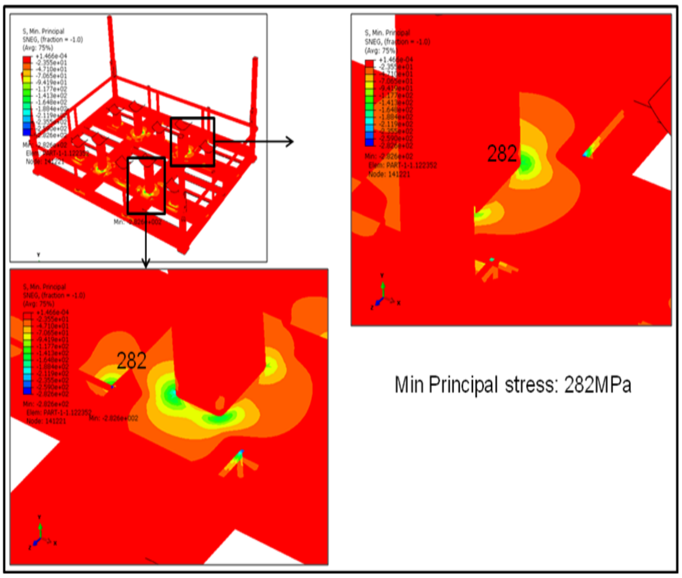

Fig 4.3: Minimum principal (Compressive) stress, MPa

4.2 Load Case II (Breaking Load)

In load case II study of stress behavior is carried out when Breaking load condition is along the longitudinal in negative Y direction of the axle carrying frame structure. Fig 4.4 shows the von-mises stress plots for the Breaking load condition of the axle carrying frame structure.

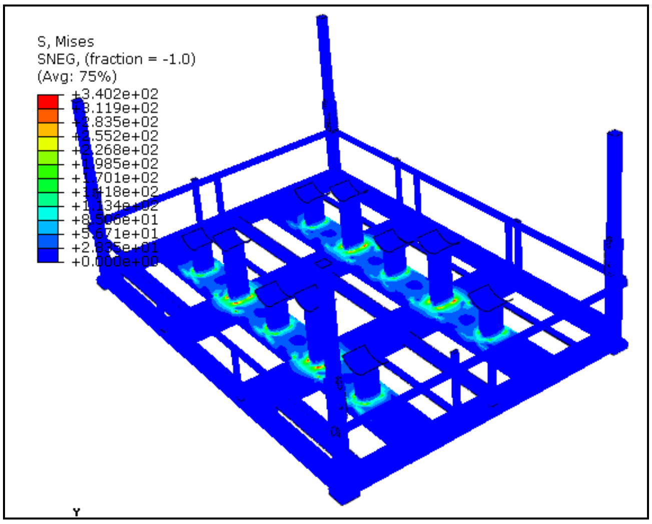

Fig 4.4 Von-mises stress plot, MPa

The maximum von-mises stress at transition region is 340 MPa. This stress value is below the yield stress of 550 Mpa of the material. For designing the Hardox steel component the maximum energy distortion theory will be adopted. As per this theory the yielding will happen if the von-mises stress is more than the yield strength of the material.

Fig 4.5 and 4.6 show the maximum and minimum principal stress plots respectively for Breaking load condition of the axle carrying frame structure.

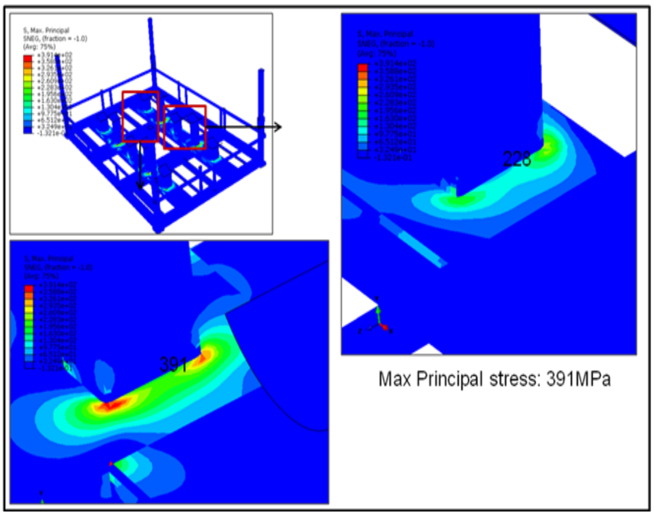

Fig 4.5: Maximum principal (Tensile) stress, MPa.

The maximum principal stress refers to tensile stress and this occurred at the top side of the transition region and the maximum value is 391 MPa.

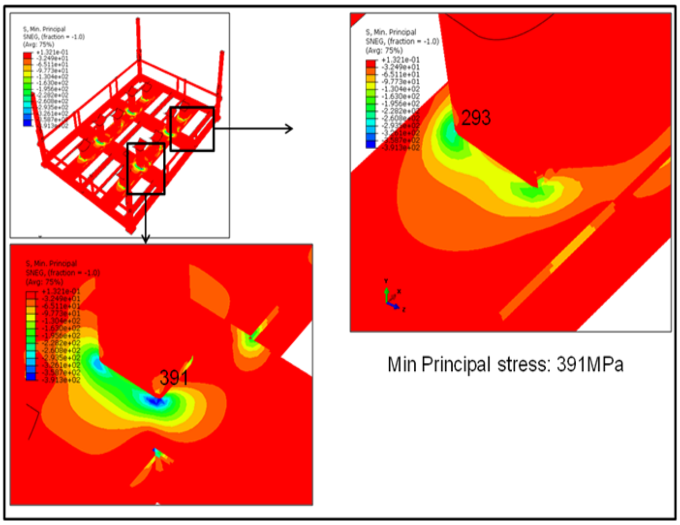

Fig 4.6: Minimum principal (Compressive) stress, MPa.

The minimum principal stress refers to compressive stress and this occurred at the bottom side of the transition region and the corresponding value is 391 MPa. These stresses are plotted to understand the stress level.

4.3 Load Case III (Turning Load)

In load case III study of stress behavior is carried out when Turning load condition is along the transverse in negative Z direction of the axle carrying frame structure. Fig 7.17 shows the von-mises stress plots for the Turning load condition of the axle carrying frame structure.

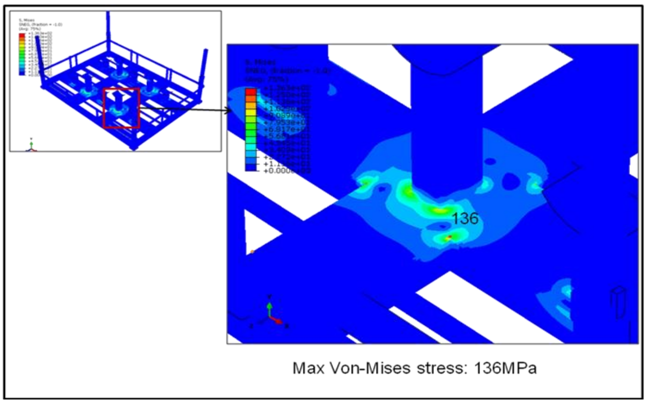

Fig 4.7: Von-mises stress plot, MPa

The maximum von-mises stress at transition region is 136 MPa. This stress value is below the yield stress of 550 MPa of the material. For designing the Hardox steel component the maximum energy distortion theory will be adopted. As per this theory the yielding will happen if thevon-mises stressis more than theyield strengthof the material.

Fig 4.8 and 4.9 show the maximum and minimum principal stress plots respectively for Turning load condition of the axle carrying frame structure.

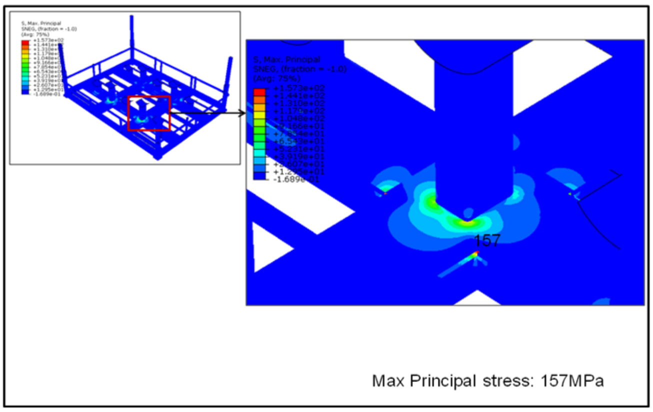

Fig 4.8: Maximum principal (Tensile) stress, MPa

The maximum principal stress refers to tensile stress and this occurred at the bottom side of the transition region and the maximum value is 157 MPa.

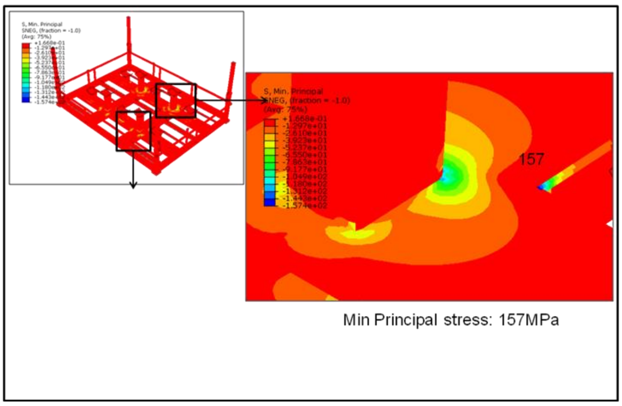

Fig 4.9 : Minimum principal(Compressive)stress,MPa

5. Result Summary Table

Table 5.1 shows the result summary for Factor of Safety (FOS) based on the maximum stress and yield stress of the material.

Table 7.1: Result Summary for FOS.

RESULT SUMMARY							
LC	YS(MPa)	Max Stress(MPa)					FOS
		Von-Mises	Max Principal	Min Principal	Shear stress	Max stress	
LC1	550	244	151	282	282	282	1.95
LC2	550	340	391	391	391	391	1.41
LC3	550	136	157	157	157	157	3.50

Table 5.2 shows the result summary for Displacement in all the three direction

Table 5.2 Summary of Displacement in all 3direction

RESULT SUMMARY				
LC	Displacement(mm)			
	Mag	X	Y	Z
LC1	0.72	0.28	0.68	0.1
LC2	5.88	5.88	1.12	0.04
LC3	0.38	0.007	0.28	0.33

6. Conclusion

To conclude that the results derived from the software are reliable, the software validation is done considering the cantilever beam. The software reliability/validation is explained in the result and discussion section. The results observed in the software are in correlation with the analytical calculation for cantilever beam. Hence based on above evidences the results are concluded as below.

From the above result summary table the stresses in the axle carrying frame structure are well below the yield strength and hence the structure is safe from strength and deflection point of view. Out of 3 load cases the stresses in the load case 2 is maximum and is considered as worst case condition and based on the results of the worst case the factor of safety is predicted which is around 1.41.

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