Static Load Analysis Of Tata Ace Ex Chassis And Stress Optimisation Using Reinforcement Technique

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***ABSTRACT*-Chassis is a major component in a vehicle system. This work involved static analysis to determine key characteristics of a chassis. The static characteristics include identifying location of high stress area. Mathematical calculations were carried out to validate the static analysis. This paper presents the static load analysis of the chassis of TATA ace ex using ANSYS workbench and stress optimization using reinforcement technique of optimization. This has been carried out with limited modifications by adding stiffeners. The necessary design changes required to enhance the load carrying capacity of the vehicle has been recommended successfully.**

I. INTRODUCTION

Chassis usually denotes the basic frame that decides the overall shape of the vehicle. The chassis is the framework that is everything attached to it in a vehicle. chassis of TATA ace ex is of ladder frame type which has two side members and five transverse members called cross members of box cross section. The chassis has been modeled in PRO-E software using actual dimensions. FEM analysis was done using ANSYS 14.5 workbench.

II. BASIC CALCULATION

Model- TATA ace ex
Length of vehicle = 4340 mm
Width of vehicle = 1565 mm
Height of vehicle = 1858 mm
Wheelbase = 2380 mm
Track width = 1320 mm
Material of chassis = structural steel
Young's modulus = 2 e+5
Poisson's ratio = 0.3
Length of chassis = 4201 mm
Width of chassis = 808 mm
Dimensions of side bar = 100mm x 36mm x 5 mm
Dimensions of cross bar = 90 mm x 90 mm
Gross vehicle weight (G.V.W) = 2180 kg
Ker weight = 1180 kg
The above load (G.V.W) is applied in the form of pressure.

Hence the total area of application of load as calculated from chassis dimensions = 1182600 mm^2.
Total load to be applied = 2150 x 9.81 = 21091.5 N
Pressure to be applied = 21091.5/1182600 = 0.017834 MPa.

III. MODELING OF CHASSIS

For carrying out the FE analysis of the frame the CAD model is prepared in PRO-E and then the analysis is done in ANSYS workbench. CAD model is prepared as below:-

Figure 1 CAD Model of chassis

IV. MESHING

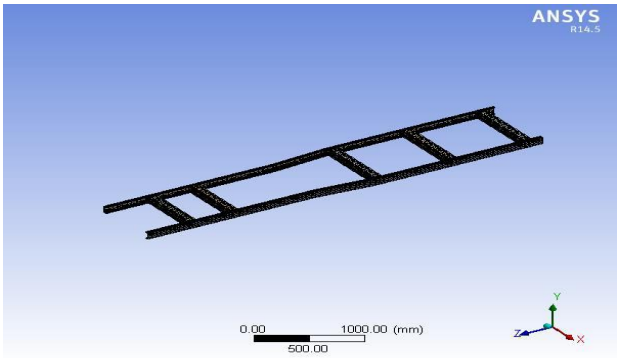

Figure 2 Meshed Model of chassis

Meshing is done using the auto mesh mode of ANSYS workbench. The mesh model has 8112 elements and 20998 nodes.

V. LOAD APPLICATIONS AND BOUNDARY CONDITIONS

Load is applied in the form of pressure of magnitude 0.017834 MPa. There are two boundary conditions which includes fixing the front and the rear axle.

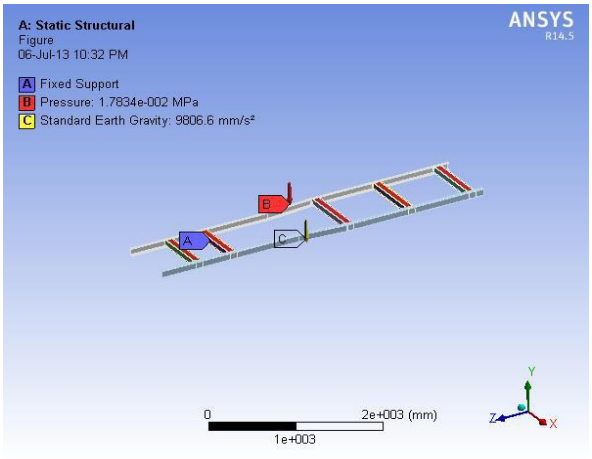

Figure 3 Fixed support and pressure application

VI. RESULTS WITHOUT OPTIMISATION

Load analysis of original chassis gives maximum stress intensity of magnitude 37.09 MPa in close proximity of rear axle at the joint of side member and cross member. The von misses stress magnitude is 37.04MPa. Also the magnitude of total deformation is 1.08 mm.

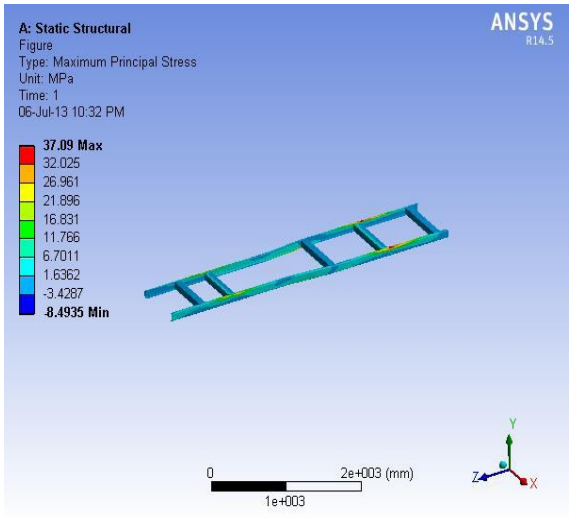

Figure 4 Stress intensity

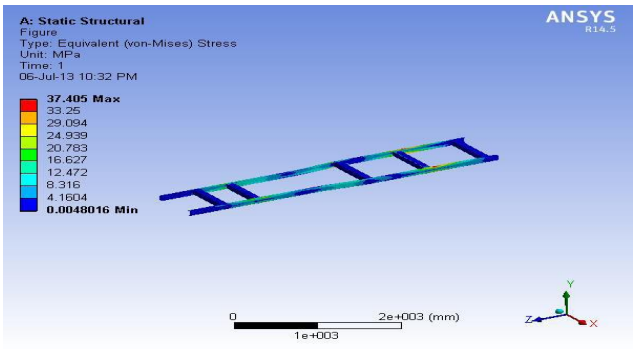

Figure 5 Von Misses stress

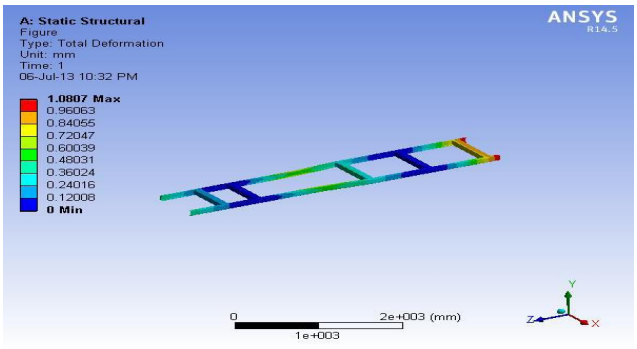

Figure 6 Total deformation

VII. OPTIMISATION OF CHASSIS

Different practices are available for optimization by chassis modification. Here suitable changes are made in the design using reinforcement methods and the analysis is done to observe the reduction in the stress levels. Reinforcement of 5 mm thickness and 130 mm length is provided on the side members where the stress is maximum.

A) Optimization using reinforcement technique

Reinforcement is the practice of providing a cover plates on external on the side members at the highly stressed regions.

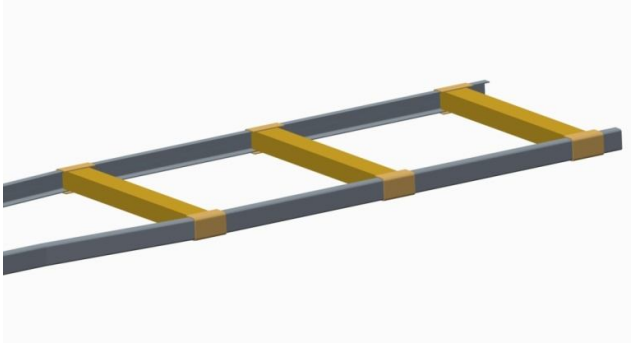

Figure 7 Chassis with reinforcement

B) *Results after optimization using reinforcement technique.*

In this case, stress intensity and von misses stress are reduced to 22.97 MPa and 28.74 MPa respectively. Total deformation is reduced to 0.64 mm

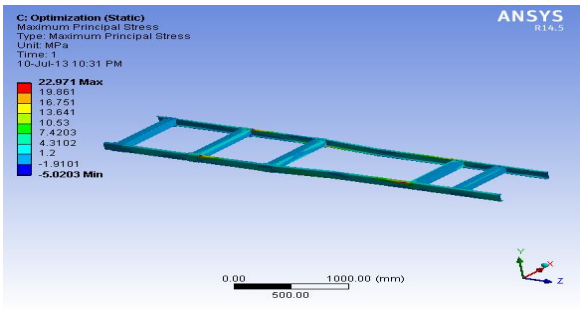

Figure 8 Stress Intensity after reinforcement

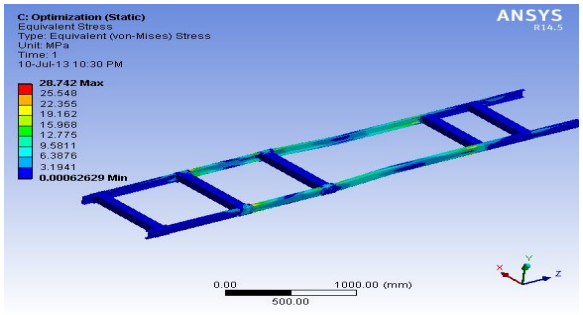

Figure 10 Von Misses stress after reinforcement

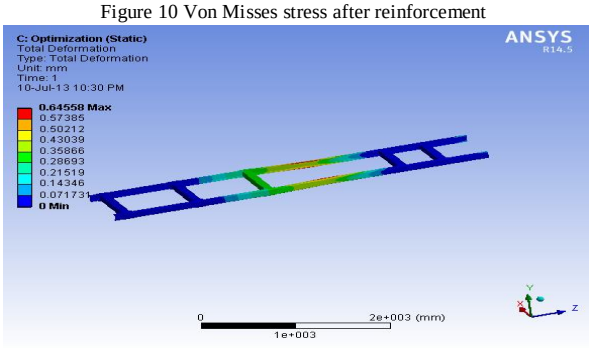

Figure 11 Total deformations after reinforcement

TABLE 1 COMPARISON OF RESULTS

Sr.	TYPE	PRESSURE APPLIED IN MPa	STRESS INTENSITY IN MPa	VON-MISES STRESS IN MPa	TOTAL DEFORMATION IN mm
1	Original chassis	0.017	37.09	37.04	1.08
2	Chassis with reinforcement	0.017	22.97	28.74	0.64

Hence the method of reinforcement is found to be most effective.

VIII. CONCLUSION

The existing chassis was analyzed by the finite element analysis, the stress levels are found to be 37.04 N/mm^2. After modifications, the chassis with suitable reinforcement, increase in thickness, addition of stiffeners, the finite element analysis was carried out, and the stress levels of chassis are found as 22.97 N/mm^2 which demonstrates that the modified chassis is capable to carry the loads beyond the previous payload.

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