MODELLING AND ANALYSIS OF EXISTING AND MODIFIED CHASSIS IN TATA TRUCK

Darshit Nayak[1], Dr.Pushpendra KumarSharma[2], Ashish parkhe[3]

[1]M.tech Research Scholar, [2]Guide & Head, [3]Co-guide & Assistant Professor,
Mechanical Engineering Department, NRIIST, Bhopal M.P. (India)

ABSTRACT

Truck chassis forms the structural backbone of a commercial vehicle. The main function of the truck chassis is to support the components and load that mounted on it. The chassis is experienced a stress whether when it ismoving or in a static condition. This thesis presents an analysis of the static stress that acting on the upper surface of the truck chassis. These projects study the distributions of the stress that acting on the chassis. Critical parts that will lead to failure are also observed. The method used in this numerical analysis is finite element analysis (FEA). Finite element analysis helps in accelerating design and development process by minimizing number of physical tests, thereby reducing the cost and time for analysis. 3-D model of the truck chassis is made using ProE before analyzed. Modal updating of truck chassis model is prepared adjusting the selective properties such as mass density and Poisson's ratio. Numerical results showed that critical part was at the mounting bracket of the tire and also at the front part of the chassis. Some modifications are also suggested to reduce the stress and to improve the strength of the truck chassis. Finally optimum section is suggested.

Keywords: Modelling, Ansys, Chassis, Frame Work

I INTRODUCTION

The chassis is the framework to which everything is attached in a vehicle. In a modern vehicle, it is expected to fulfill the following functions:

- Provide mounting points for the suspensions, the steering mechanism, the engine and gearbox, the final drive, the fuel tank and the seating for the occupants
- Provide rigidity for accurate handling;
- Protect the occupants against external impact.

While fulfilling these functions, the chassis should be light enough to reduce inertia and offer satisfactory performance. It should also be tough enough to resist fatigue loads that are produced due to the interaction between the driver, the engine and power transmission and the road. The frame consists of various members placed in different orientation and at different location. These members made of cold-rolled steel or heat-treated alloy steel, are as given below.

- longitudinal side member,
- front, rear and intermediate member,
- diagonal member

While fulfilling these functions, the chassis should be light enough to reduce inertia and offer satisfactory performance. Modelling and analysis is carried out for the existing and modified design. The model is prepared in pro-e software and inserted in the ansys software for the static analysis.

II MODELLING AND ANALYSIS OF EXISTING CHASSIS

In Table II.1 represents the unit used in modelling analysis.

TABLE II.I Unit Used In Modelling Analysis

Unit System	Metric (mm, kg, N, °C, s, mV, mA)
Angle	Degrees
Rotational Velocity	rad/s

Table II.2 represents the model geometry of truck chassis.

TABLE II.IIThe model geometry of truck chassis.

Model > Geometry

Object Name	Geometry
State	Fully Defined
Definition	
Source	D:\project\chasis_1613\trial\c section\long_beam.stp
Type	Step
Length Unit	Meters
Element Control	Program Controlled
Display Style	Part Color
Bounding Box	
Length X	7720. mm
Length Y	254. mm
Length Z	900. mm
Properties	
Volume	4.1522e+007 mm³
Mass	324.95 kg
Statistics	
Bodies	1
Active Bodies	1
Nodes	20581
Elements	9738

Table II.III represents the model geometry parts of truck chassis.

TABLE II.III The model geometry parts of truck chassis

Model > Geometry > Parts

Object Name	*LONG_BEAM*
State	Meshed
Graphics Properties	
Visible	Yes

Transparency	1
Definition	
Suppressed	No

Material	St37
Stiffness Behavior	Flexible
Nonlinear Material Effects	Yes
Bounding Box	
Length X	7720. mm
Length Y	254. mm
Length Z	900. mm
Properties	
Volume	4.1522e+007 mm³
Mass	324.95 kg
Centroid X	-3825. mm
Centroid Y	110.06 mm
Centroid Z	-450.01 mm
Moment of Inertia Ip1	4.7337e+007 kg·mm²
Moment of Inertia Ip2	1.7547e+009 kg·mm²
Moment of Inertia Ip3	1.702e+009 kg·mm²
Statistics	
Nodes	20581
Elements	9738

Table II.IV represents the material property of truck chassis.

TABLE II.IVThe material property of truck chassis.

St37 > Constants

Structural	
Young's Modulus	2.1e+005 MPa
Poisson's Ratio	0.29

To carry out of the static analysis themodelling of Tata turbo truck se1613 is prepped in the pro-e software then is inserted in ansys software for static analysis that is show in figure 1.

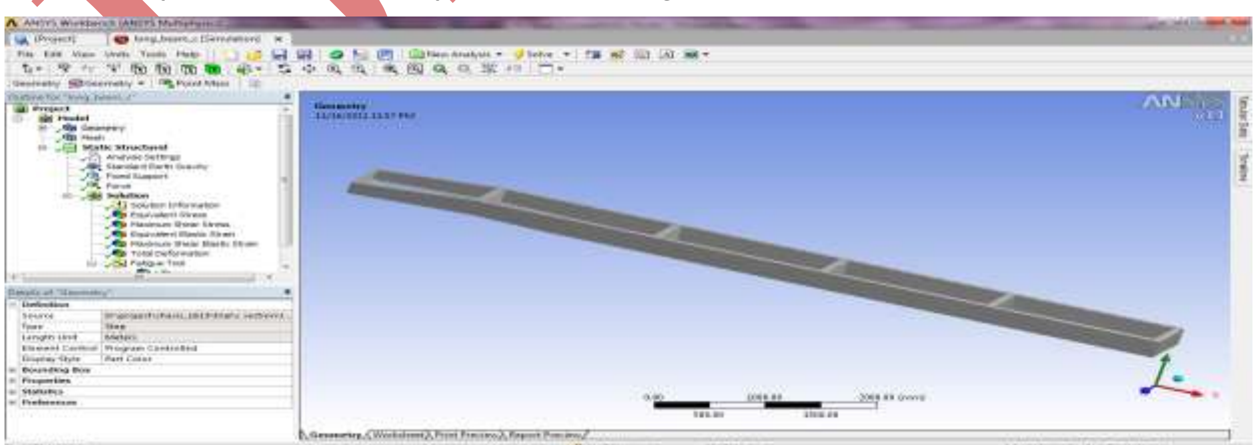

Figure 1 Truck chassis model inserted in ansys.

To carry out the static analysis first of all the meshing of model is to be done that is show in figure 2.

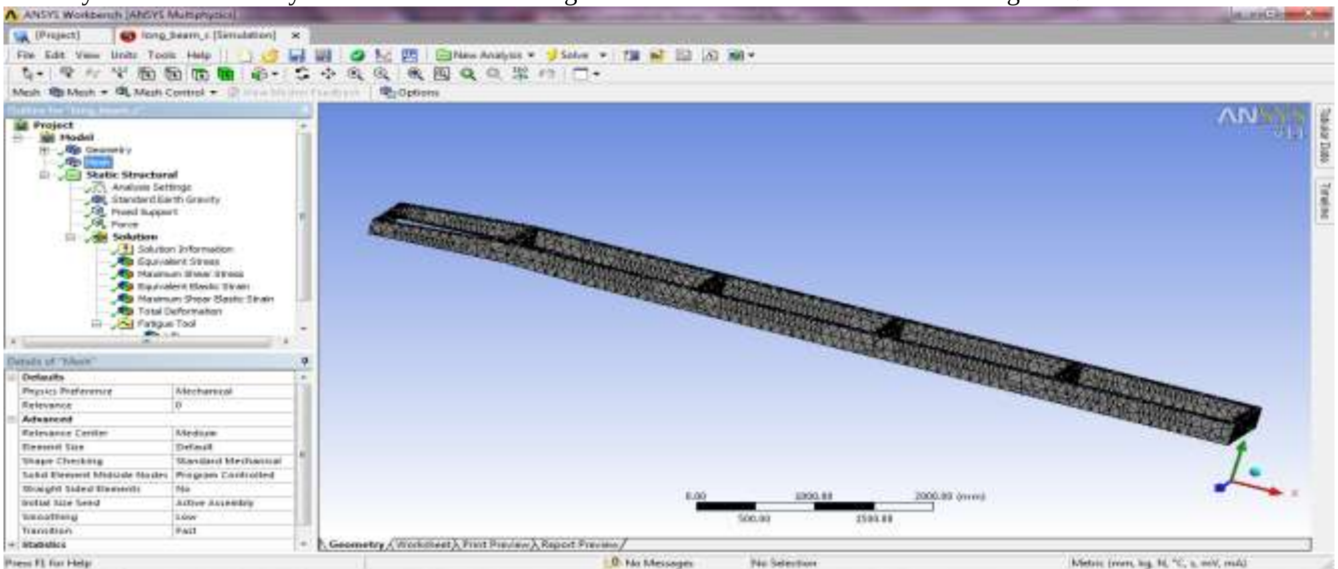

Figure 2 Meshing of truck chassis.

TABLE II.VThe mesh applied to chassis of truck.

Model > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Advanced	
Relevance Center	Medium
Element Size	Default
Shape Checking	Standard Mechanical
Solid Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Initial Size Seed	Active Assembly
Smoothing	Low
Transition	Fast
Statistics	
Nodes	20581
Elements	9738

Now the boundary conditions are applied to this chassis that is shown in figure 3.

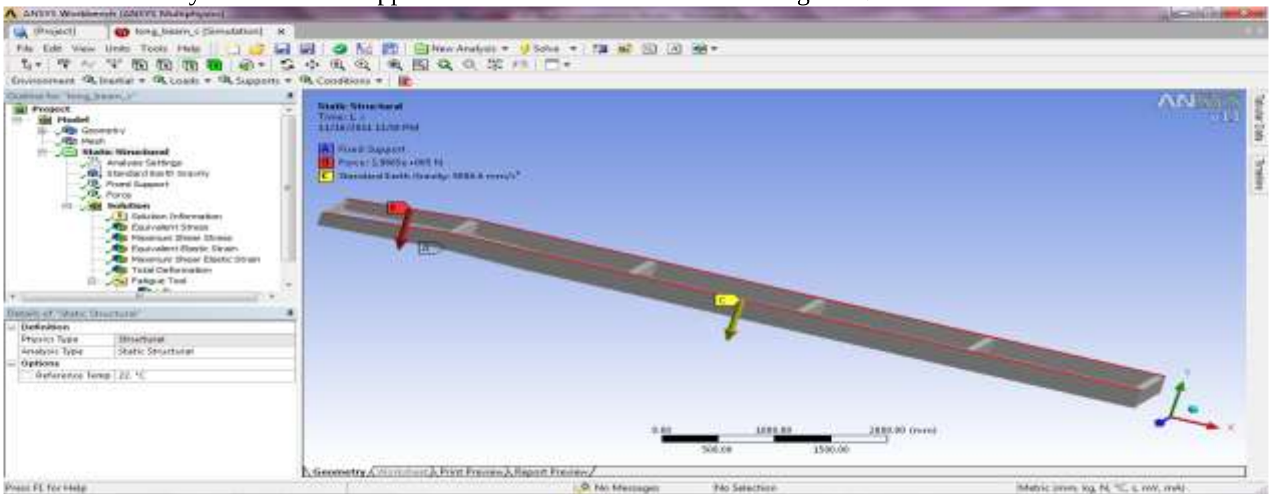

Figure 3 Boundary condition applied on truck chassis model.

The equivalent stresses are checked on the application of load to the chassis that is shown in figure 4.

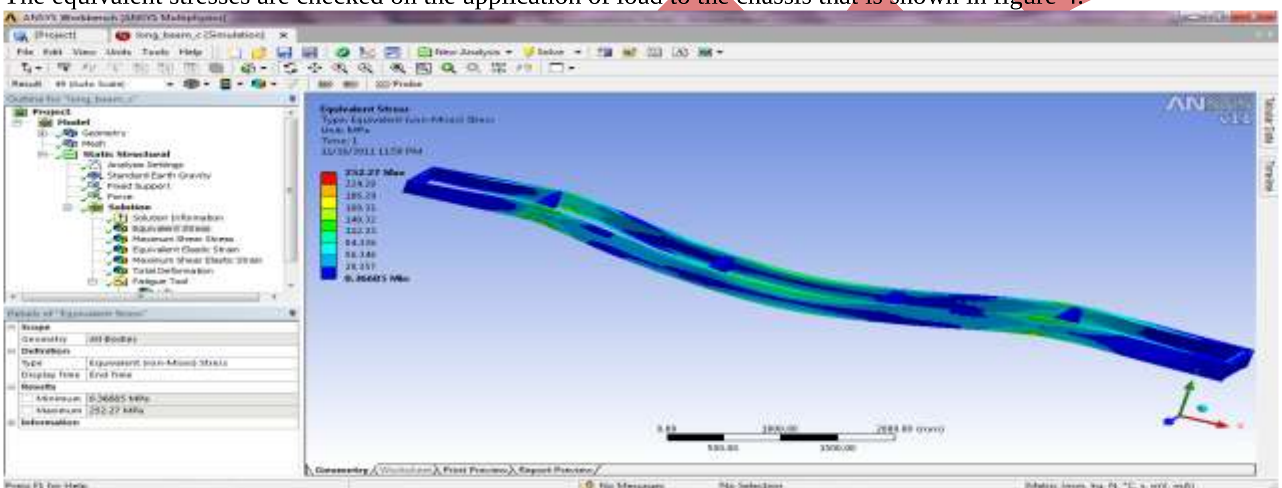

Figure 4 Equivalent stress produced in model.

Now the maximum shear stresses are checked on the application of load to the chassis that is shown in figure 5.

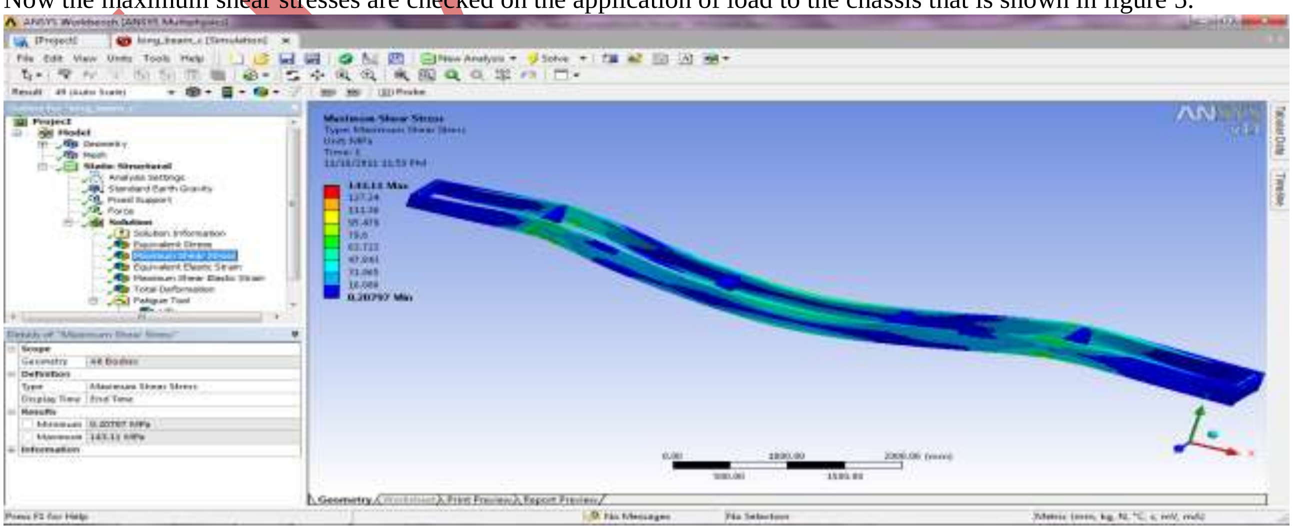

Figure 5 Maximum shear stress produced in model.

Now the maximum equivalent elastic strain is checked on the application of load to the chassis that is shown in figure 6.

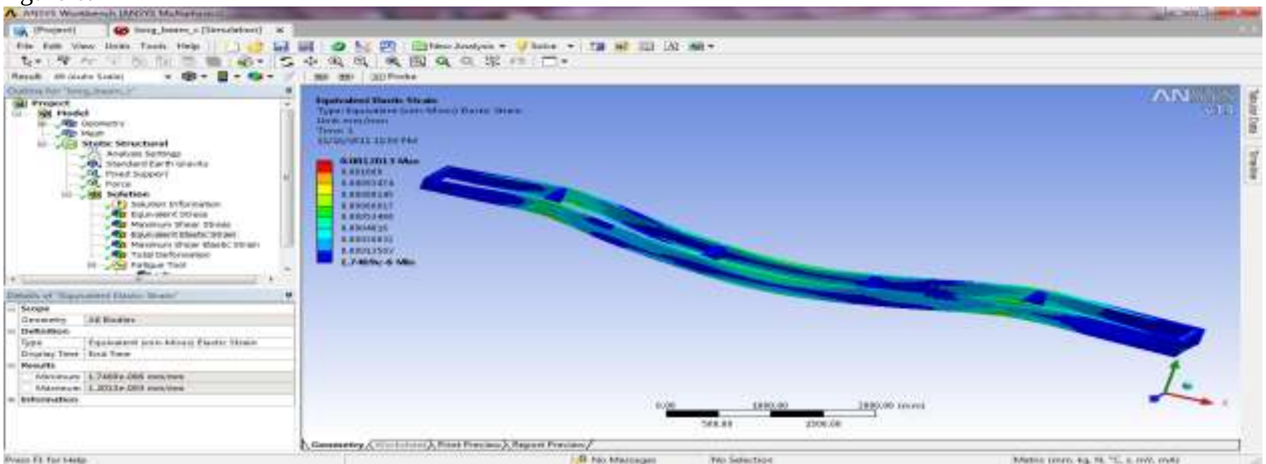

Figure 6 Equivalent elastic strain produced in model.

Now the maximum shear elastic strain is checked on the application of load to the chassis that is shown in figure 7.

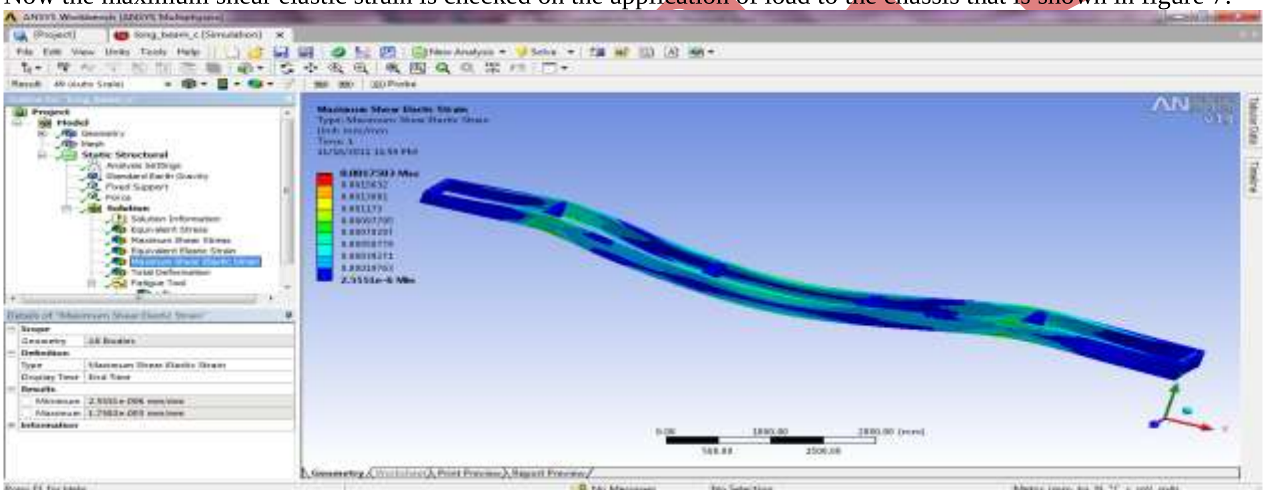

Figure 7 Maximum shear elastic strain produced in model.

Now the total deformation is checked on the application of load to the chassis that is shown in figure 8.

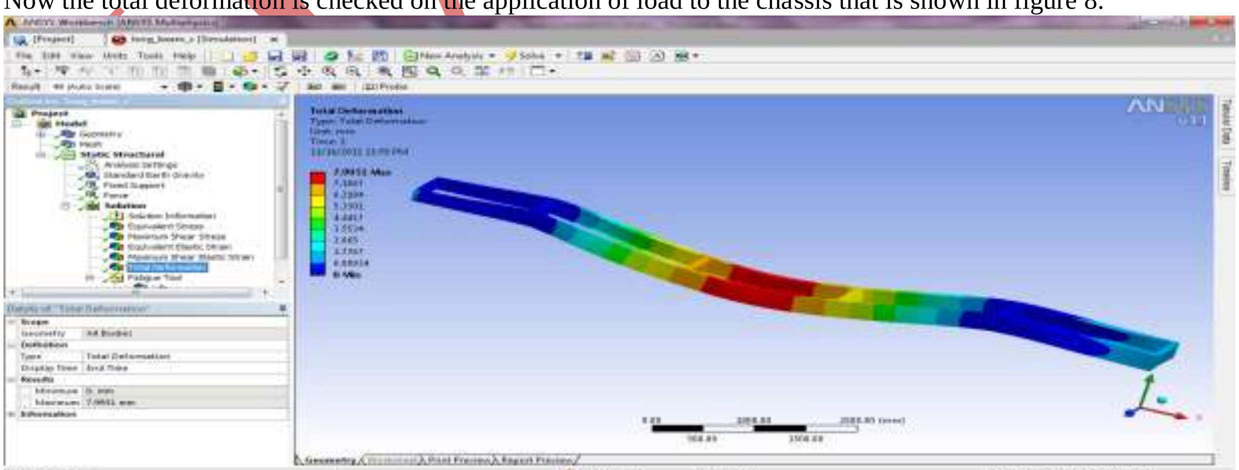

Figure 8 Total deformation produced in model.

Now the equivalent alternating stress produced on the application of load to the chassis that is shown in figure 9.

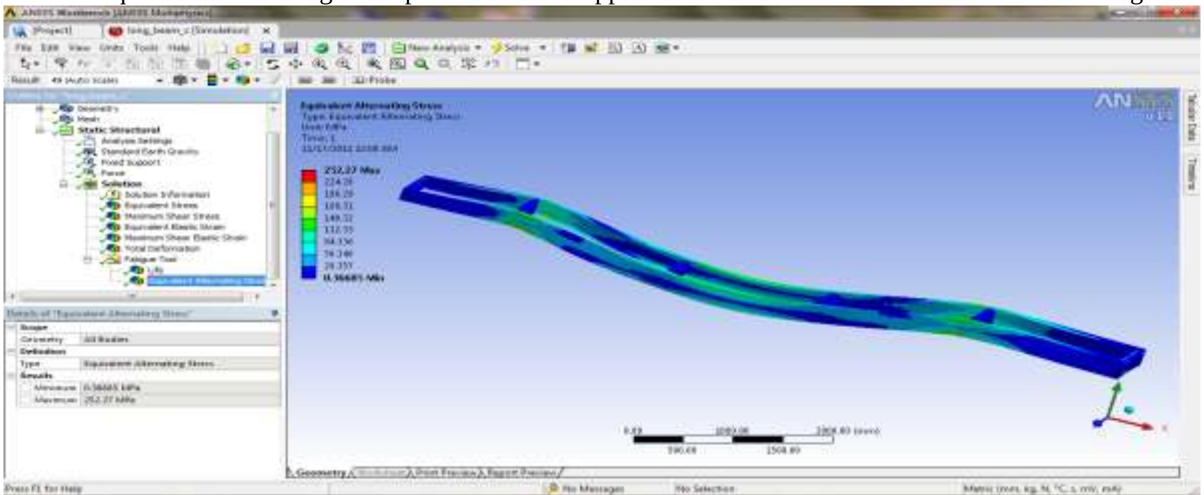

Figure 9 Equivalent alternating stress produced in model.

III MODELLING AND ANALYSIS OF MODIFIED CHASSIS

In Table III.I represents the unit used in modelling analysis.

TABLE III.IThe unit used in modelling analysis

Unit System	Metric (mm, kg, N, °C, s, mV, mA)
Angle	Degrees
Rotational Velocity	rad/s

Table III.II represents the model geometry of truck chassis.

TABLE III.II The model geometry of truck chassis.

Model > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	D:\project\chasis_1613\trial\cm5c\long_beam.stp
Type	Step
Length Unit	Meters
Element Control	Program Controlled
Display Style	Part Color
Bounding Box	
Length X	7720. mm
Length Y	254. mm
Length Z	900. mm
Properties	
Volume	3.4885e+007 mm³
Mass	273.85 kg
Statistics	
Bodies	1
Active Bodies	1
Nodes	29381
Elements	13873

Table III.III represents the model geometry parts of truck chassis.

TABLE III.IIIThe model geometry parts of truck chassis

Model > Geometry > Parts

Object Name	*LONG_BEAM*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Material	St37
Stiffness Behavior	Flexible
Nonlinear Material Effects	Yes
Bounding Box	
Length X	7720. mm
Length Y	254. mm
Length Z	900. mm
Properties	
Volume	3.4885e+007 mm^3
Mass	273.85 kg
Centroid X	-3824.2 mm
Centroid Y	109.65 mm
Centroid Z	-450. Mm
Moment of Inertia Ip1	4.6726e+007 $kg \cdot mm^2$
Moment of Inertia Ip2	1.4781e+009 $kg \cdot mm^2$
Moment of Inertia Ip3	1.4352e+009 $kg \cdot mm^2$
Statistics	
Nodes	29381
Elements	13873

Table III.IV represents the material property of truck chassis.

TABLE III.IVthe material property of truck chassis

St37 > Constants

Structural	
Young's Modulus	2.1e+005 MPa
Poisson's Ratio	0.29

To carry out of the static analysis the modelling of Tata turbo truck se1613 is prepped in the pro-e software then is inserted in ansys software for static analysis that is show in figure 10.

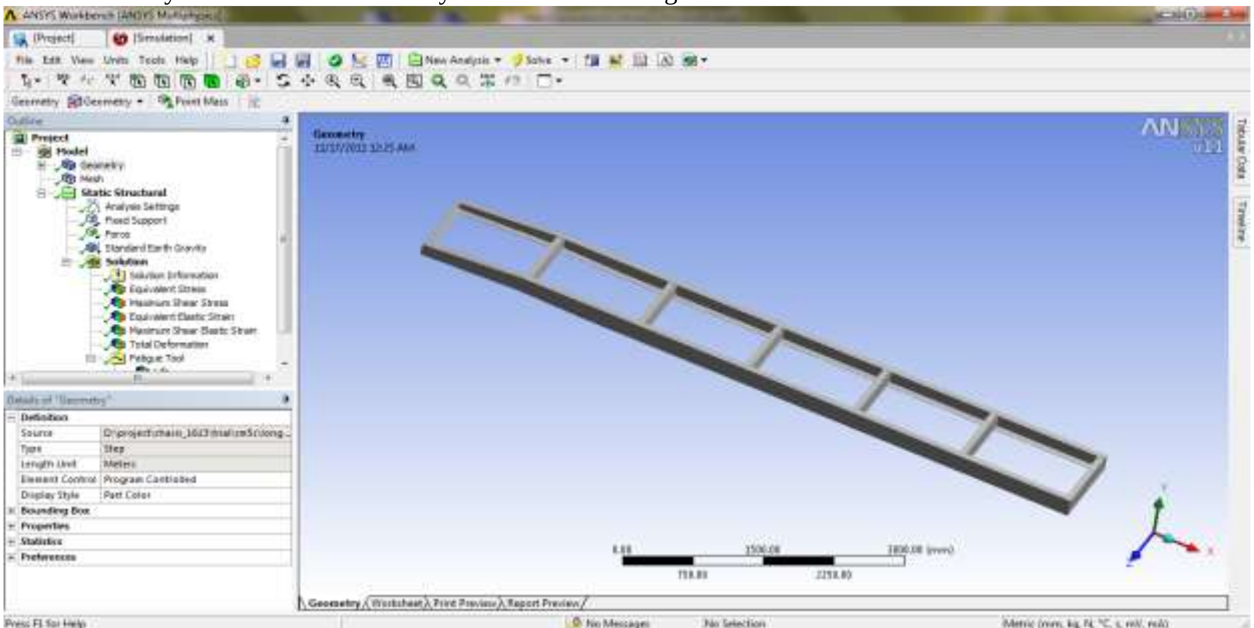

Figure 10 Truck chassis model inserted in ansys.

To carry out the static analysis first of all the meshing of model is to be done that is show in figure 11.

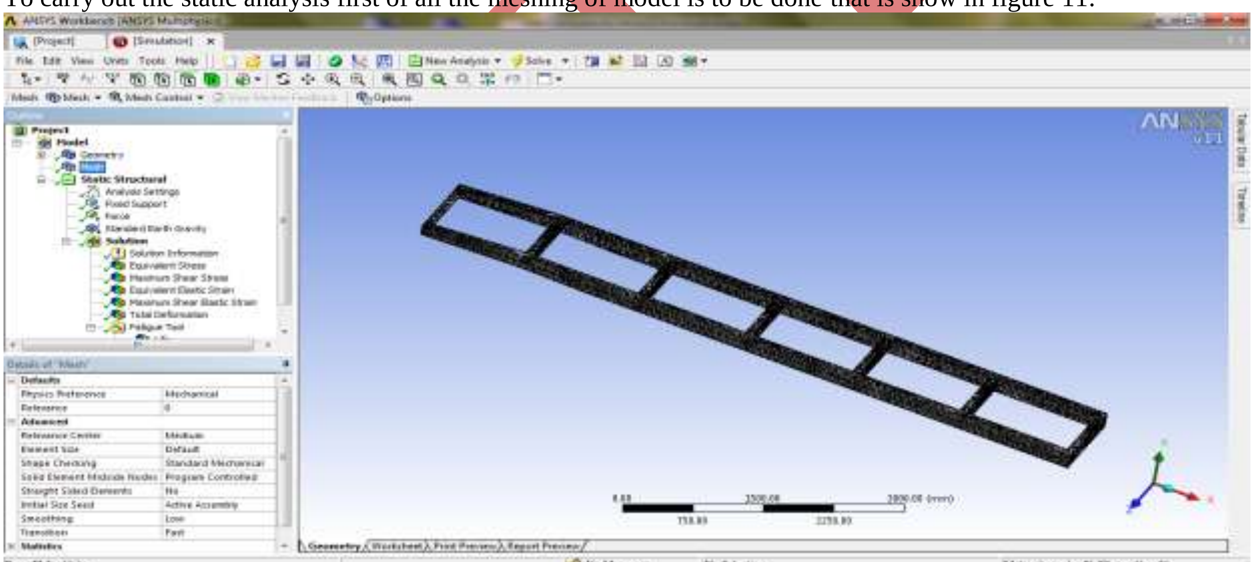

Figure 11 meshing of truck chassis.

Table III.IV represents the mesh applied to chassis of truck.

TABLE III.IVThe mesh applied to chassis of truck.

Model > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Advanced	
Relevance Center	Medium

Element Size	Default
Shape Checking	Standard Mechanical
Solid Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Initial Size Seed	Active Assembly
Smoothing	Low
Transition	Fast
Statistics	
Nodes	29381
Elements	13873

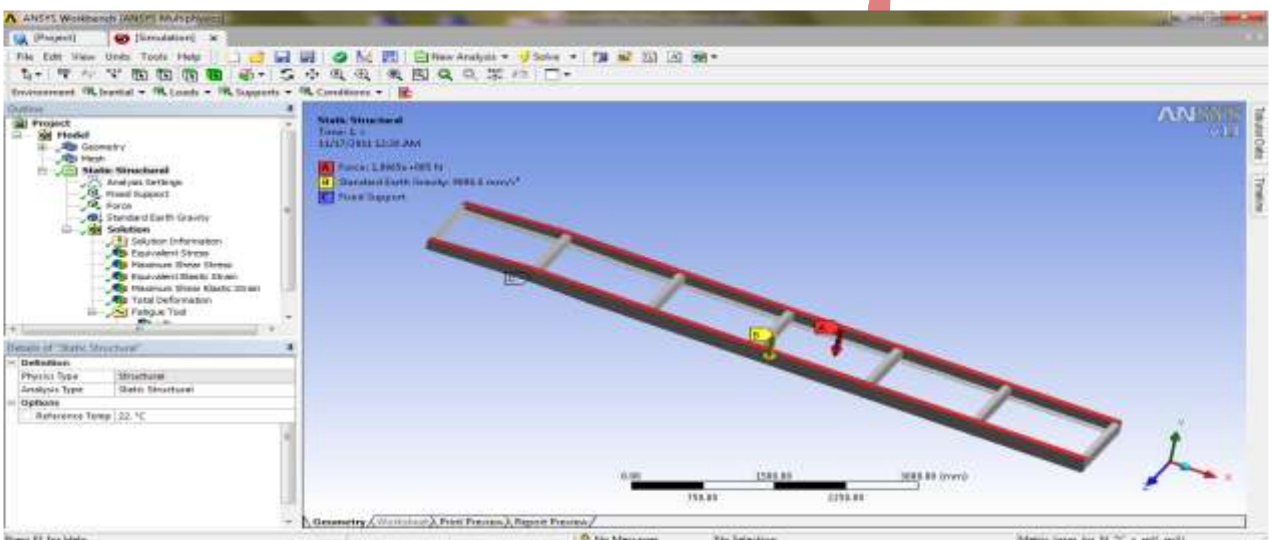

Figure 12 boundary condition applied on truck chassis model.

The equivalent stresses are checked on the application of load to the chassis that is shown in figure 13.

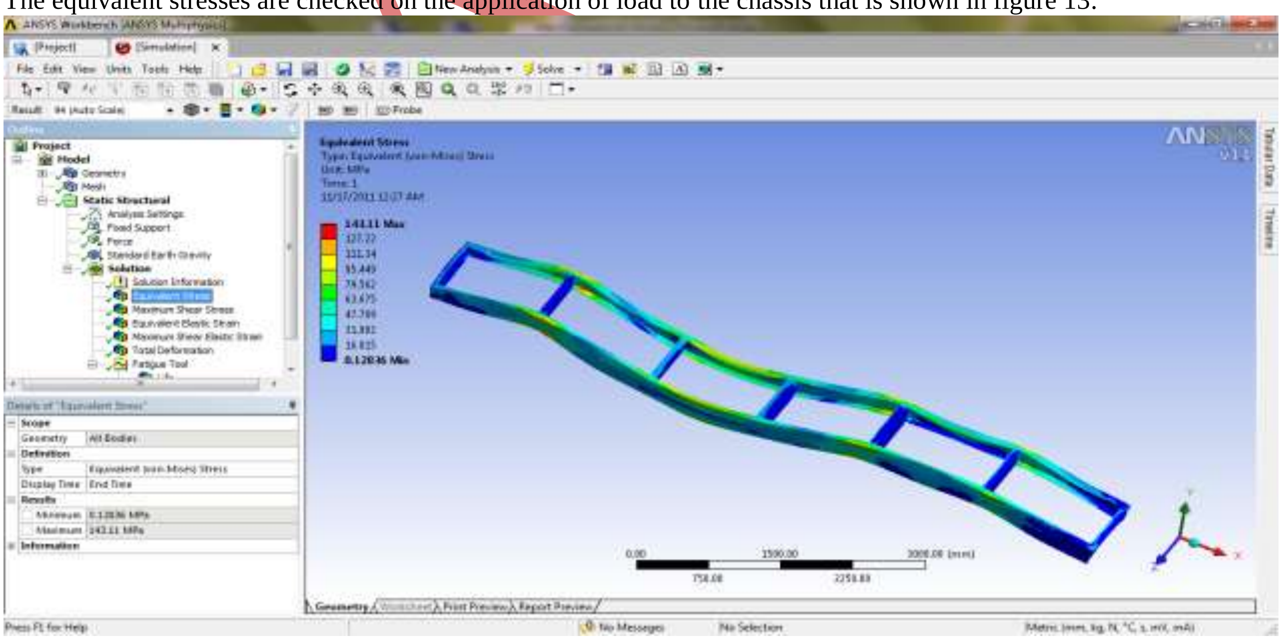

Figure 13 equivalent stress produced in model.

Now the maximum shear stresses are checked on the application of load to the chassis that is shown in figure 14.

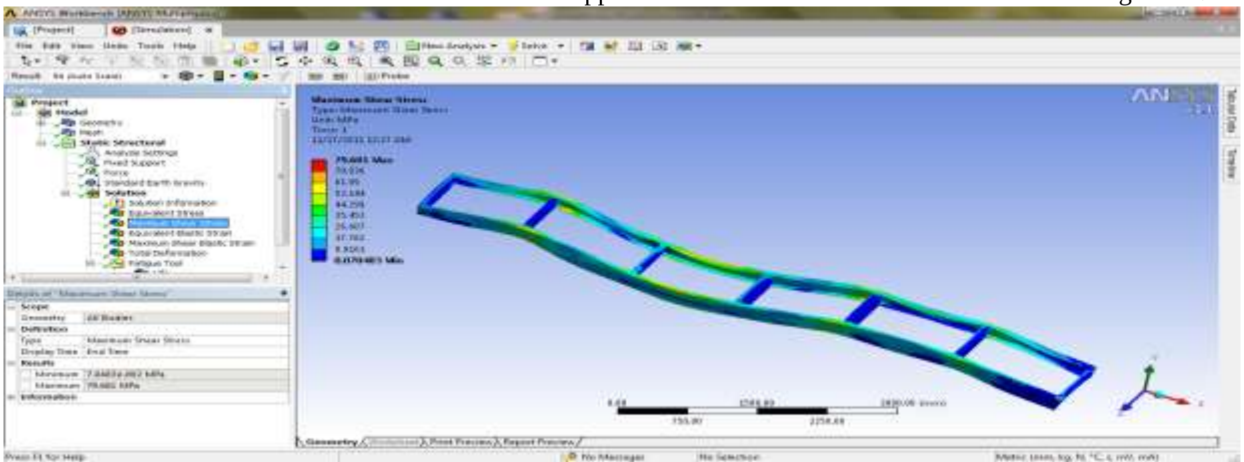

Figure 14 maximum shear stress produced in model.

Now the maximum equivalent elastic strain is checked on the application of load to the chassis that is shown in figure 15.

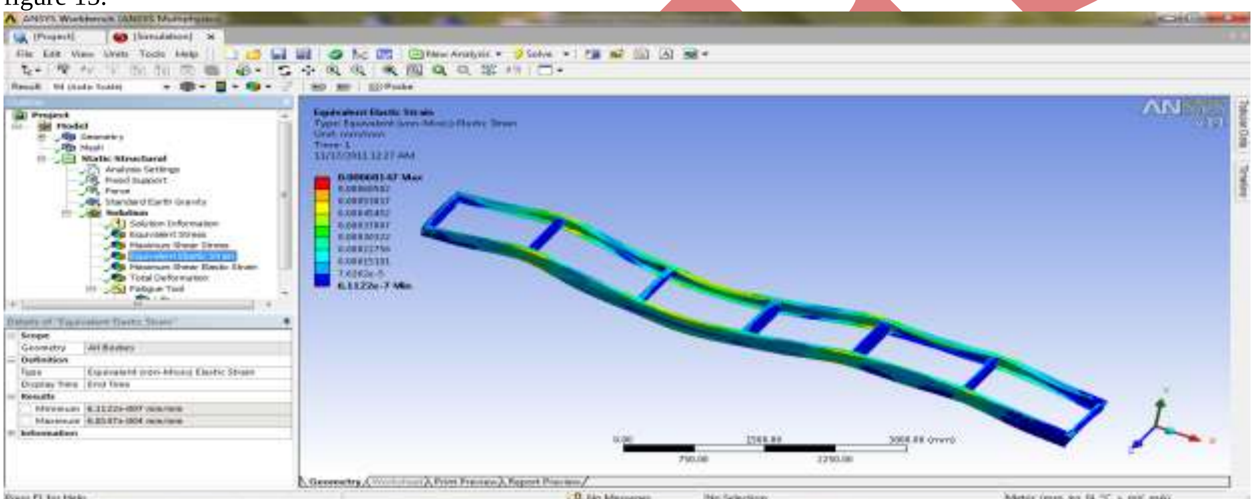

Figure 15 equivalent elastic strain produced in model.

Now the maximum shear elastic strain is checked on the application of load to the chassis that is shown in figure 16.

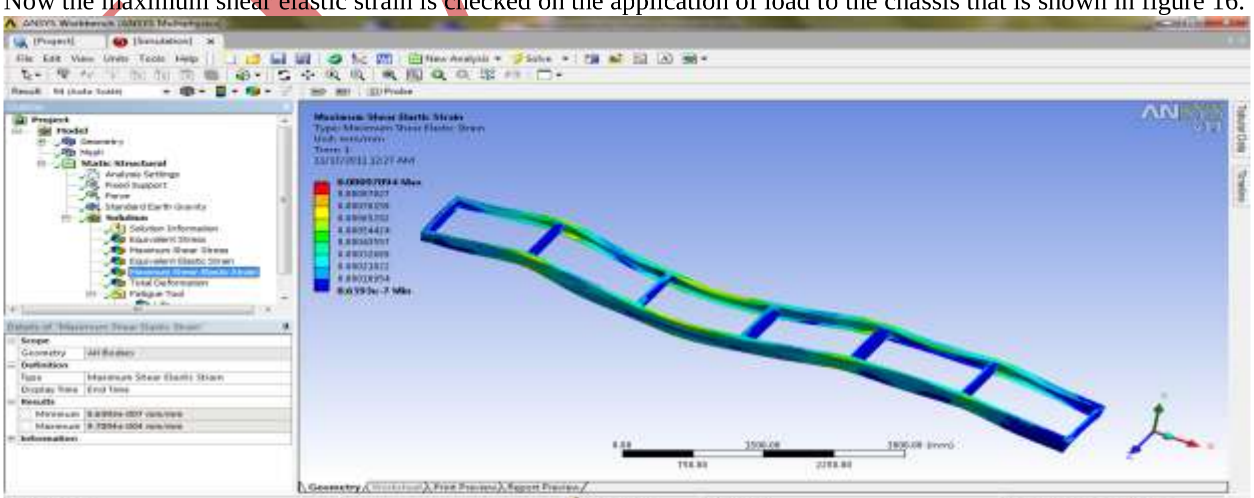

Figure 16 maximum shear elastic strain produced in model.

Now the total deformation is checked on the application of load to the chassis that is shown in figure 17.

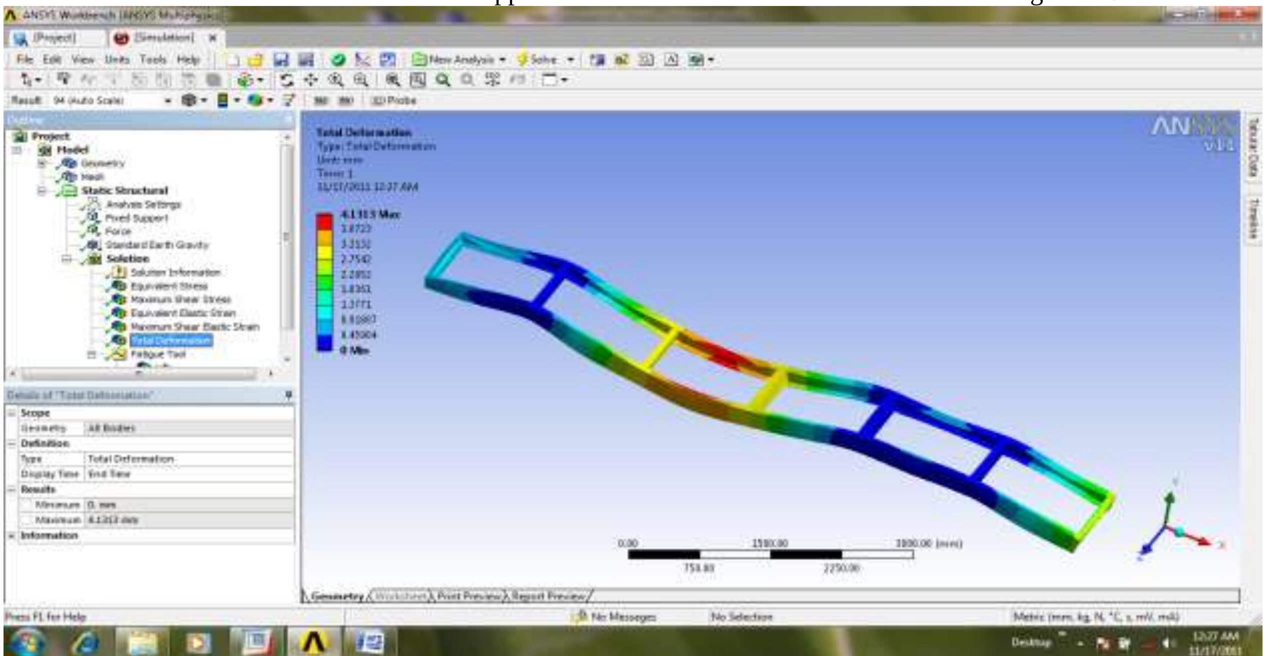

Figure 17 total deformation produced in model.

Now the equivalent alternating stress produced on the application of load to the chassis that is shown in figure 18.

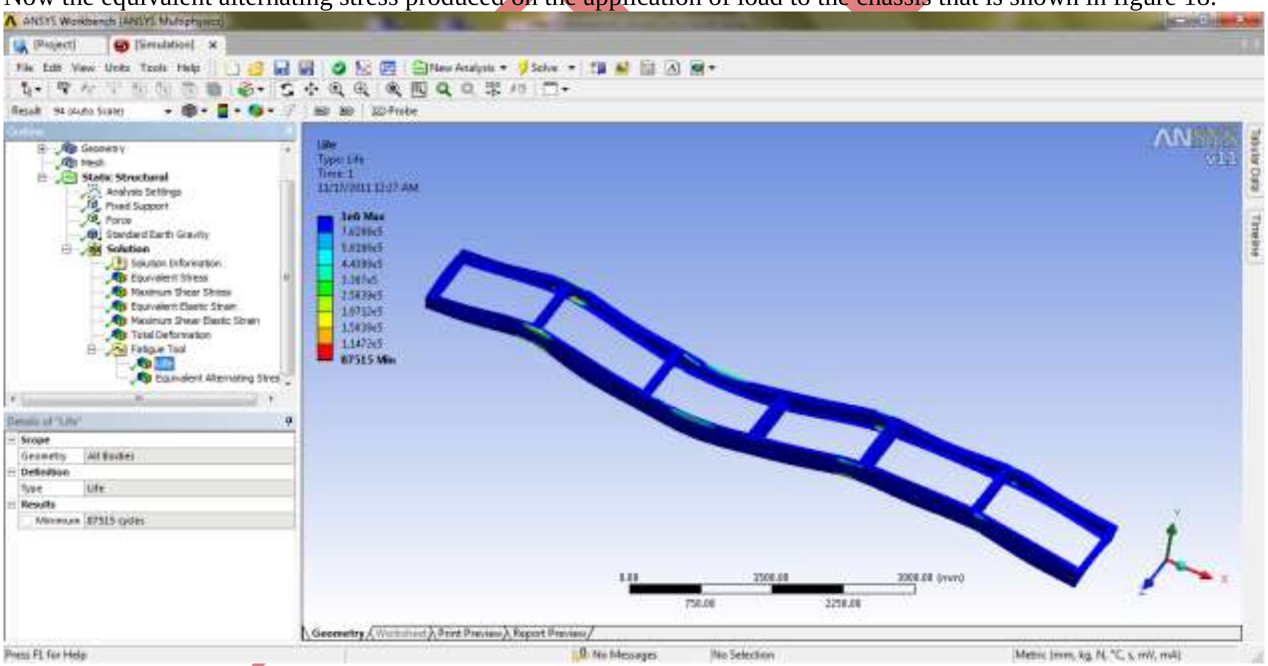

Figure 18 equivalent alternating stress produced in model

IV COMPARISON

In this work two different chassis models are checked for same loading condition of 198652.5 N. To carry out this loading conditions the models are prepared in pro-E and analysis in ansys software. After the analysis the stress values for loading condition are shown in table.

TABLE IV.I Comparisons of different stress value

Sr. No.	Model Type	Von-misses strain	Maximum shear strain	Von-Misses stress	Equivalent stress	Maximum shear stress
1	Existing C section	0.0012	0.001758	252.27	252.77	143.11
2	Modification C section	0.0007	0.000979	143.11	143.11	79.681

TABLE IV.II Comparisons of Different parameter in existing and modified design

Sr. No.	Model Type	Mass	Thickness	cross member	Deformation
1	Existing C section	325.95	6.35	6	7.9951
2	Modification C section	273.85	5	7	4.1313

From the comparison it is clear that after the modification Von-Misses stress, Maximum shear stress, Von-misses strain, Maximum shear strain, Equivalent stress are less than the existing design.

V CONCLUSION

To different model are checked for loading condition 198652.5 N

In the case of existing design when the load of 198652.5 N is applied on the model as the result of that von misses stress 252.27MPa, maximum shear stress 143.11 MPa, von misses strain 0.0012 mm/mm, Maximum shear strain 0.001758 mm/mm, Equivalent stress 252.77 MPa.

In the case of modified design when the load of 198652.5 N is applied on the model as the result of that von misses stress 143.11 MPa, maximum shear stress 79.681 MPa, von misses strain 0.0007 mm/mm, Maximum shear strain 0.000979 mm/mm, Equivalent stress 143.11 MPa.

From the result it is clear that modified design is superior as compare to existing design.

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