

Chassis Design & Analysis

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Abstract - Chassis is a major component of a vehicle system. It consists of internal framework that supports man-made object. It is the under part of the vehicle which consists of frame and running gear like engine, transmission system, suspension system etc. The type of chassis used in the project is ladder frame chassis. Modeling And Design of the chassis is done through a advanced CAD (AutoCAD, Catia, & Analysis software). The design and analysis of the chassis is done by identifying the location of high stress areas. Ladder frame chassis consists of two symmetrical rails and cross members connecting them to provide strength to different components of vehicle system. This type of chassis is mostly used in heavy duty vehicles like trucks. It provides a good beam resistance because of its continuous rail from front to rear. The reason for using this type of chassis is that here it is easier to change the design without having to change the chassis thereby saving overall design time. The disadvantage with using this type of chassis is that it has poor torsion stiffness, higher fuel consumption and also heavier than a unibody. As a result chassis has been designed in a way to reduce vibration, increase strength and optimize the weight of the chassis.

Key Words: Chassis Design,& Analysis, AutoCAD, Catia, Ansys

1. INTRODUCTION

Basically chassis is considered as a framework to support the body, engine and other parts which make up the vehicle. Chassis lends the whole vehicle support and rigidity. Chassis usually includes a pair of longitudinally extending channels and multiple transverse cross members that intersect the channels. The transverse members have a reduced cross section in order to allow for a longitudinally extending storage space. The safety of the chassis is a major aspect in the design, and should be considered through all stages. The automotive chassis is tasked with holding all the components together while driving, and transferring vertical and lateral loads, caused by accelerations, on the chassis through the suspension and two the wheels. Chassis is a major component of a vehicle system. It consists of internal framework that supports man-made object. It is the under part of the vehicle which consists of frame and Running gear like engine, transmission system, suspension system etc. The automotive chassis is tasked with keeping all components together while driving and transferring vertical and lateral loads caused by acceleration, on the chassis through suspension and the wheels

The key to good chassis design is that further the mass is away from the neutral axis the more rigid it is. The reason for ladder frame type of chassis is that here it is easier to change the design without having to change the chassis thereby saving overall design time. It also provides a good beam resistance because of its continuous rail from front to rear. The disadvantage with using this type of chassis is that it has poor torsion stiffness, higher fuel consumption and also heavier than a unibody. The design of a vehicle structure is of fundamental importance to the overall vehicle performance. The vehicle structure plays an important role in the reliability of the vehicle. Generally, truck is a heavy motor vehicle which is designed for carrying the attached weights, such as the engine, transmission and suspension as well as the passengers and payload. The major focus in the truck manufacturing industries is to design vehicles with more payload capacity. Using high strength steels than the conventional ones are possible with corresponding increase in payload capacity.

1.1 Objective

- The following are the objectives of the study
- To study basic principle of working of chassis.
- To investigate the problems occurs in the chassis.
- To prepare 3D CAD model of chassis geometry (Data Available from Ashok Leyland Akola)
- To perform Finite element analysis of chassis geometry with natural boundary conditions.
- To suggests the remedial actions, new material, and different shapes for chassis geometry to solve the failures.

2. METHODOLOGY

Required parts are first modeled in CATIA V5 which is excellent CAD software's, which makes the modeling easy and user friendly. The model is then transferred in IGES format and exported into the Analysis software Ansys 11.0. The assembly is analyzed in Ansys in three steps. Pre-processing: The geometry (physical bounds) of the problem is defined. The mesh may be uniform or non-uniform. The physical modelling is defined. Boundary conditions are defined. This involves specifying the chassis behavior and properties at the boundaries of the problem. For transient problems, the initial conditions are also defined. The simulation is started and the equations are solved iteratively

as a steady-state or transient. Finally a postprocessor is used for the analysis and visualization of the resulting solution.

3. PROCESS IN CATIA

First go to sketcher for making the sketch of the parts we will make the profile first by using the above tools. To making sketch of part enter the sketcher workbench then create the profile fully constraint with the dimension .In this we didn't have any constraint so we sketched a rough outer shape which will be refined in the parts coming after. First we make the long member sketch of the chassis.

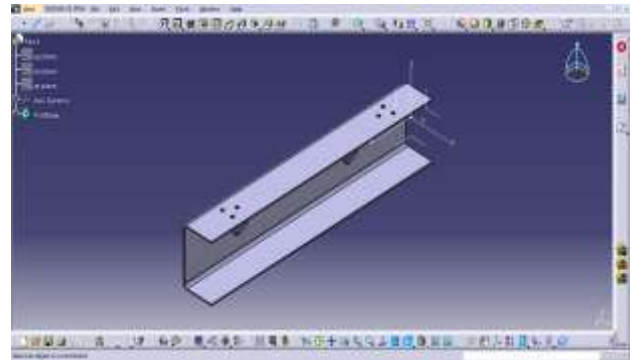


Figure: - cross member part design

Next for making the nut go into sketcher workbench draw circular profile as required diameter make it pad after making pad select the side which side you want extrude as shank of the nut select sketcher workbench make profile exit workbench give it pad after that make head is as rivet select head corner go to dress up feature select variable radius fillet give radius ok.

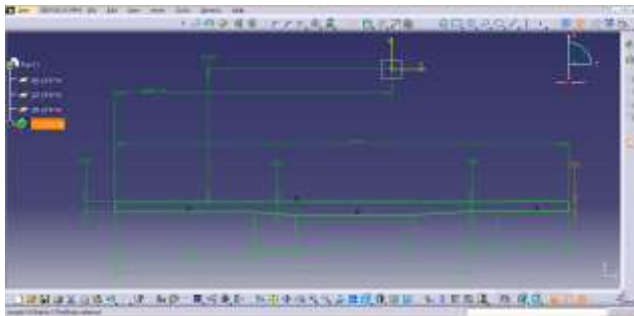


Figure: - sketch of long member

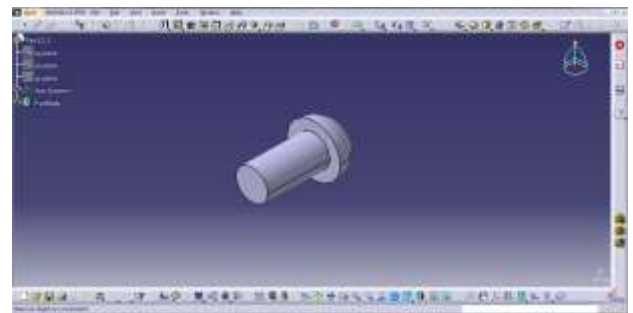


Figure: - Nut in part design

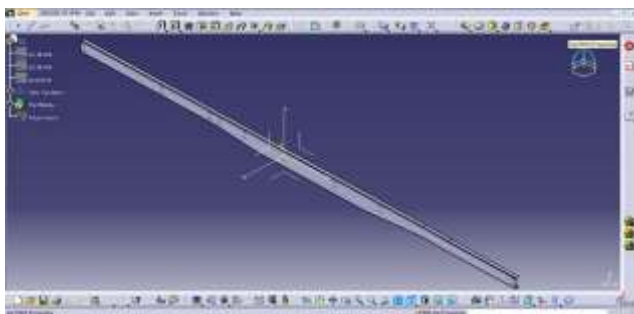


Figure: - long member in part design

4. ASSEMBLY OF THE TRUCK CHASSIS

Process

Add a part into an assembly one by one for making the chassis assembly in this assembly first we add the long member for assembly Click on the "Product1" name in the specification tree opening an existing component in product structure tool after taking product select all product and make it fix by using fix component in constraints feature now you are in the right workbench, you can insert the other part which you want click on product at the top of the tree or the Existing Component icon

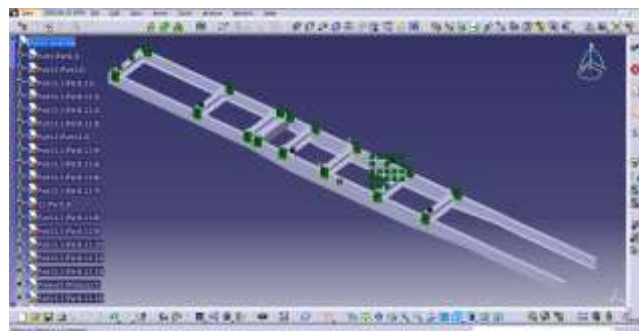
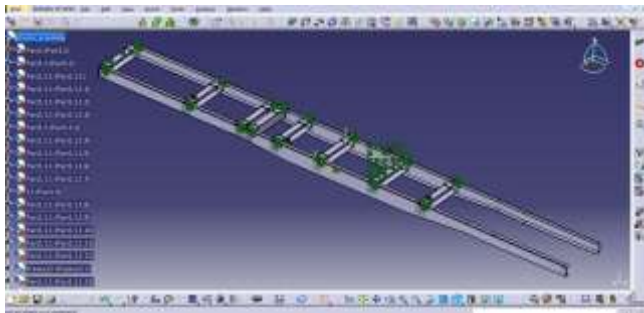
In the contextual menu choose Components + Existing Component you can rotate and move the part by using manipulation tool in move feature. After adjusting both parts now Creating Coincidence Constraints you'll now fix some assembly constraints Select Coincidence e Constraint icon select the center of both parts and make it constraints after that creating Contact Constraints Now you have created some coincidence constraints, you will create a contact constraint to finish mounting the both parts Click on the Contact Constraint Icon Select the faces of both parts and



Figure: - cross member in sketcher

After that exit workbench and go to in the part design and make this sketch pad by using PAD feature in part design give pad length and make it pad.

then adjust it and click update after updating both parts are assemble.



fig;Truck chassis assembly in catia

5. FINITE ELEMENT ANALYSIS OF TRUCK CHASSIS

In this analysis describes design and analysis of automobile chassis. Model of chassis is done in AUTOCAD & CATIA V5 software's and is imported to ANSYS. The model is meshed. The material properties are defined in pre-processing. Initially static analysis has done on the chassis using different materials, and then the modal analysis was done to obtain the mode shapes of the chassis. Its principle function is to undamaged carry the maximum load for all designed operating conditions. An automobile chassis consists of a framework which supports a man-made object. It is same as an animal's skeleton. The chassis is a skeletal frame in which various automobile parts like engine, axle, tires, assemblies, steering, brakes etc. are affixed. Chassis is considered as a most important component of an automobile. It is the most vital element that provides strength and stability to the vehicle under different situation. It is provide strength and flex ability to it.

5.1 MESHING OF CHASSIS FRAME.

Loading condition

40 Tonne (392266 N) of load has been applied on chassis.

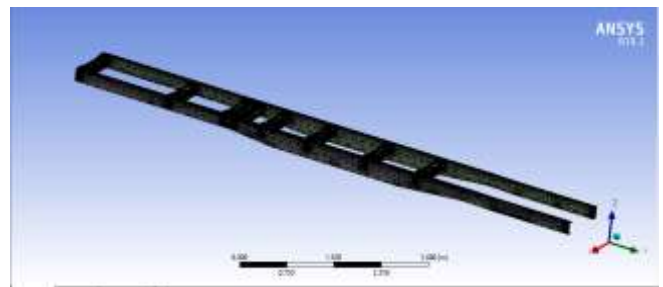


Figure: Mesh details

Fig shows the mesh details of the chassis. 251804 nodes and 120455 elements are used.

5.2 BOUNDARY CONDITION 1.

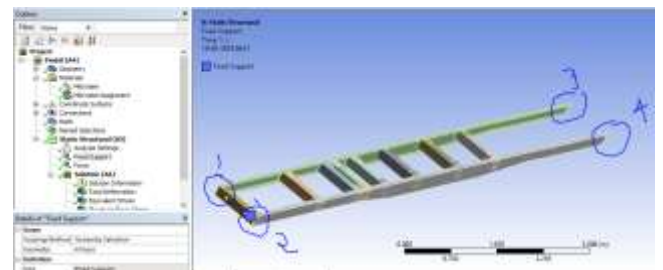


Figure: fixed support on all four ends

As show in figure all four ends of chassis are applied with fixed support as a boundary condition

5.3 BOUNDARY CONDITION 2.

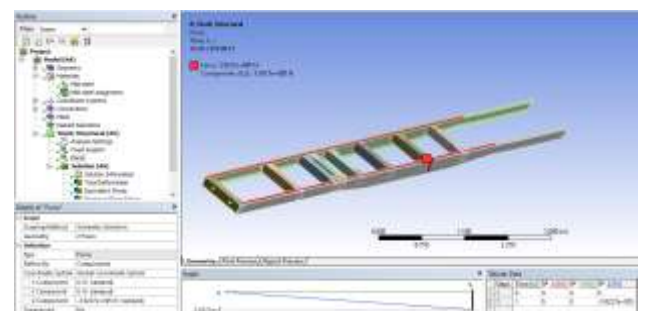


Figure: 40 tonne force on upper side of two faces

As shown in figure force has been applied to the upper two faces of the chassis member by face selection method.

6 .MECHANICAL PROPERTIES

6.1MILD STEEL

- Density= 7.87 g/cc
- Poisson's Ratio = 0.290
- Modulus of Elasticity = 205 GPa
- Bulk Modulus = 140 GPa
- Tensile Strength, Ultimate = 440 MPa

- Tensile Strength, Yield = 370 MPa

Results of mild steel Analysis

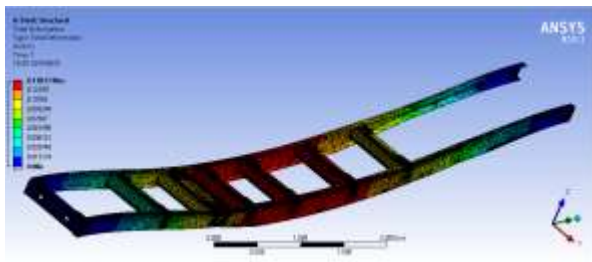


Figure: Total Deformation

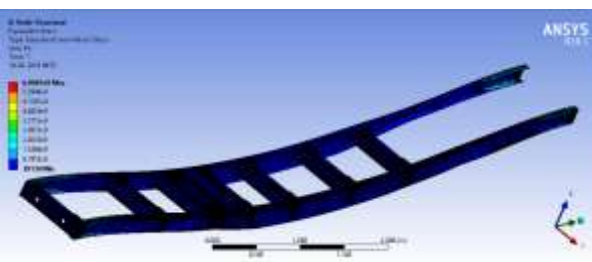


Figure: Equivalent Stress (Von mises)

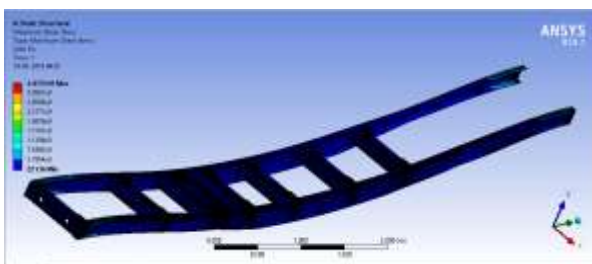


Figure: Maximum Shear Stress

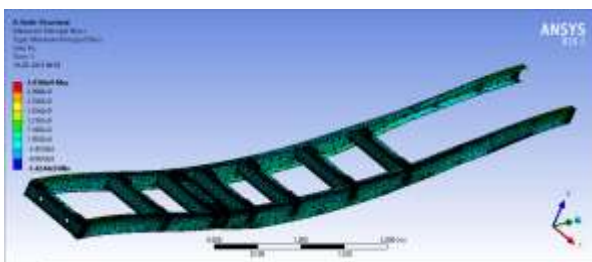


Figure 1: Maximum Principal Stress

6.2 ALLOY STEEL

- Density= 7.85 g/cc
- Poisson’s Ratio = 0.27
- Modulus of Elasticity = 190GPa
- Bulk Modulus = 140 GPa
- Tensile Strength, Ultimate = 655 MPa
- Tensile Strength, Yield = 415 MPa

Results of Alloy steel Analysis

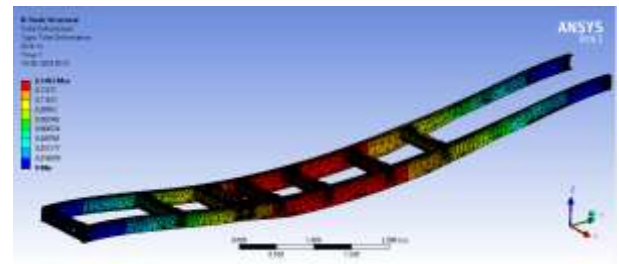


Figure: Total Deformation

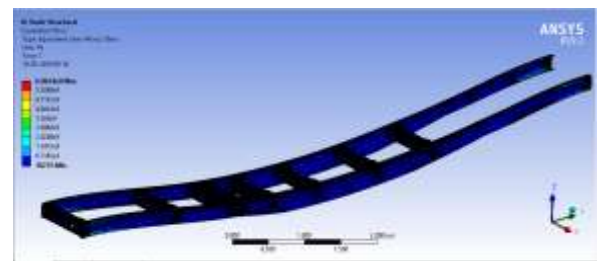


Figure: Equivalent Stress (Von mises)

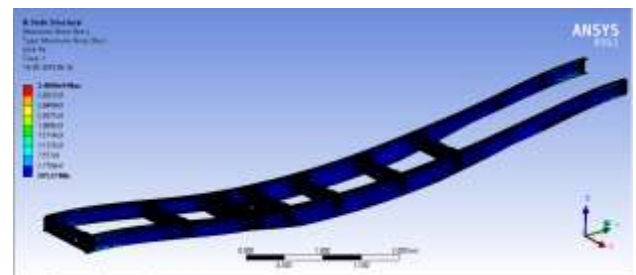


Figure: Maximum Shear Stress

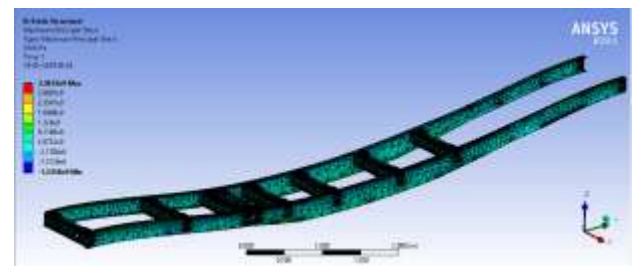


Figure: Maximum Principal Stress

7. RESULTS COMPARISON (MAXIMUM VALUES) OF MILD STEEL & ALLOY STEEL

Properties	Mild Steel	Alloy Steel
Total Deformation	0.13837	0.1493
Equivalent Stress (Von mises)	6068.7 MPa	6062.4 MPa
Maximum Shear Stress	3415.7 MPa	3400.6 MPa
Maximum Principal Stress	3436.6 MPa	3383.5 MPa

DISCUSSION

In this analysis we have studied the MILD STEEL properties are greater than as compare to ALLOY STEEL. For making a chassis of MILD STEEL is a suitable material for carry 40 Tonnes load.

8. CONCLUSIONS

From above Study it is conclude that for chassis mild steel is best material than alloy steel material as per the Ansys result obtained. In order to examine the performance characteristics of the chassis, Structural and thermal analysis were conducted. The following conclusion was obtained.

1. For chassis the maximum shear stress that produce for mild steel material is 34157 Mpa which is greater than the for Alloy steel i.e. 3400.6 Mpa. Also as per the weight and cost comparison the mild steel material is preferred.
2. For chassis the Equivalent and produced is 6068.7 Mpa for mild steel material which is greater than value obtained by using Alloy steel material i.e. 6062.4 Mpa. Also as per weight and cost comparison the Mild steel Material is preferred

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BIOGRAPHIES



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