DESIGN AND ANALYSIS OF TRUCK CHASSIS

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Abstract— **Automotive chassis is an important part of an automobile. The chassis serves as a frame work for supporting the body and different parts of the automobile. Also, it should be rigid enough to withstand the shock, twist, vibration and other stresses. Along with strength, an important consideration in chassis design is to have adequate bending stiffness for better handling characteristics. So, maximum stress, maximum equilateral stress and deflection are important criteria for the design of the chassis. This report is the work performed towards the optimization of the automotive chassis with constraints of maximum shear stress, equivalent stress and deflection of chassis. Structural systems like the chassis can be easily analyzed using the finite element techniques.**

A sensitivity analysis is carried out for weight reduction. So a proper finite element model of the chassis is to be developed. The chassis is modeled in SOLIDWORKS. FEA is done on the modeled chassis using the ANSYS Workbench R14.5.

Keywords—Chassis, Strength, Strain, Stress, Deformation

I. INTRODUCTION

Many types of pollution such as water pollution, noise pollution, thermal pollution and air pollution. Air pollution can be considered as one of the main hazard to the health of human being. The air pollution is due to the increasing number of vehicle use by human. When the number of vehicle increase, the usage of the petrol increase respectively.

The lack of the source of the petrol makes the price increase by time to time. The emission from the vehicle makes the environment faces the air pollution that in critical level. Many steps need to reduce the number of the vehicle in other side to reduce the price of the petrol. Besides that also use to reduce the air pollution. The big number of vehicles in each country makes the prevention to reduce the number of vehicle difficult. So, the other prevention is increase the efficiency of the vehicle's engine.

When the engine at the efficient level, the emission is at the low level and the most important is the usage of petrol is low. The prevention is reducing the weight of the body and chassis of each vehicle.

This project focused to reduce the usage of petrol by design and analysis the chassis to reduce the weight of the chassis of vehicle. At the same time, the global usage of the petrol also reduced.

II. PROBLEM STATEMENT

Nowadays, the usage of transport increasing day to day on the road. The number increase due to those people that usually choose to use own vehicle than public transport. When the vehicle number increase, the price of petrol (fuel) also increase. At the same time, the emissions from the vehicles increase the air pollution. The prevention steps need to reduce the number of car and price of petrol. Cars emitted high emission and use high amount of petrol when the cars have bigger weight. Preventive step by reducing the weight of the body and chassis can reduce the usage of petrol.

There is growing demand for transportation of non-standard loads, i.e. ones that do not meet the standard legal requirements determined by traffic regulations on external vehicle dimensions, gross vehicle weight or load per axle. Heavy and oversize loads are transported by specially designed trailers.

These trailers differ from one another both in allowable load limits and the degree of specialization – adjustment to the transportation of particular loads. High specialization G. Koszaáka, H.DĆbski, M. Dziurka, and M.Kaczoron the one hand facilitates transportation of specific loads but on the other hand limits the range of a trailer's applications. In Poland, there is large demand for vehicles of high versatility which enable transportation of various oversize loads.

Moreover, numerous companies, especially smaller ones in sectors such as transport or construction, which do not specialize in the transportation of non-standard loads, want to have vehicles that would allow them to transport large machinery and other oversize loads and that could simultaneously be used for the rest of the time to transport standard loads. For a trailer to satisfy the expectations of such users, it should meet the requirements for standard vehicles when it is used to transport standard loads.

This allows a user to avoid additional administrative procedures and costs. The Wielton Company in cooperation with the Lublin University of Technology has developed a universal semitrailer, which makes it possible to transport heavier-than-standard loads, among others, owing to the use of a larger number of axle lines, and oversize loads thanks to the possibility of extending the length and width of the load deck.

At the same time, in its "unexpended" state, the semitrailer meets the requirements for standard vehicles, which allows it to move on road and to transport standard loads without special permits and extra fees.

This article presents the course of research and development work on designing the supporting frame of the semitrailer, in particular the application of FEM calculations in the design process.

III.   DESIGN CALCULATIONS

A. DESIGN AND ANALYSIS OF FRAME OF TATA 216TC

Automobile chassis usually refers to the lower body of the vehicle including the tires, engine, frame, driveline and suspension. Out of these, the frame provides necessary Ansys Geometry Model Of Chassis support to the vehicle components placed on it. Also the frame should be strong enough to withstand shock, twist, vibrations and other stresses. The chassis frame consists of side members attached with a series of cross members.

Along with the strength an important consideration in the chassis design is to increase the stiffness (bending and torsion) characteristics. Adequate torsional stiffness is required to have good handling characteristics. Normally the chassis are designed on the basis of strength and stiffness. In the conventional design procedure the design is based on the strength and emphasis is then given to increase the stiffness of the chassis.

Structural systems like the chassis can be easily analyzed for the stress, and stiffness, etc. using finite element techniques. The chassis is modeled in PRO-E. FEA is done on the modeled chassis using the Pro-Mechanica.[1]

Table 3.1 RESULT FOR STAINLESS STEEL

Stress	901.47Mpa (Min)	2.2644e8Mpa (Max)
Strain	1.1652e-8Mpa(Min)	0.0011334Mpa (Max)
Deformation	0.00032499Mpa (Min)	0.017934Mpa (Max)

Table 3.2 RESULT FOR ALUMINUM

Stress	923.79Mpa(Min)	2.2671e8Mpa (Max)
Strain	3.5266e-8Mpa(Min)	0.0031965Mpa(Max)
Deformation	0.00090464Mpa(Min)	0.050484Mpa (Max)

Table 3.3 RESULT FOR EPOXY

Stress	901.51Mpa(Min)	2.2644e8Mpa(Max)
Strain	7.7684e-9Mpa(Min)	0.00075562Mpa(Max)
Deformation	0.00021666Mpa(Min)	0.011956Mpa(Max)

IV. ANALYSIS OF TRUCK CHASIS

The ANSYS Workbench platform is the framework upon which the industry's broadest and deepest suite of advanced engineering simulation technology is built. An innovative project schematic view ties together the entire simulation process, guiding the user through even complex multiphysics analyses with drag-and-drop simplicity. With bidirectional CAD connectivity, powerful highly-automated meshing, a project-level update mechanism, pervasive parameter management and integrated optimization tools, the ANSYS Workbench platform delivers unprecedented productivity, enabling Simulation- Driven Product Development.

Fig. 4.1. Ansys Geometry Model of Chassis

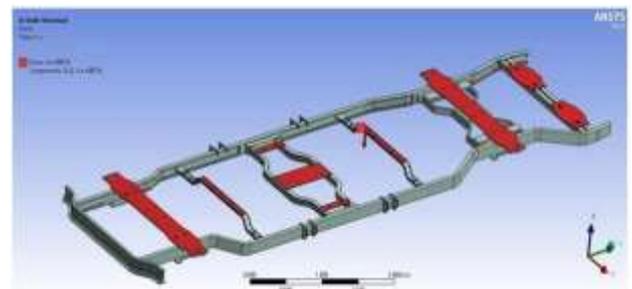Fig. 4.2. Meshing of Truck Chassis
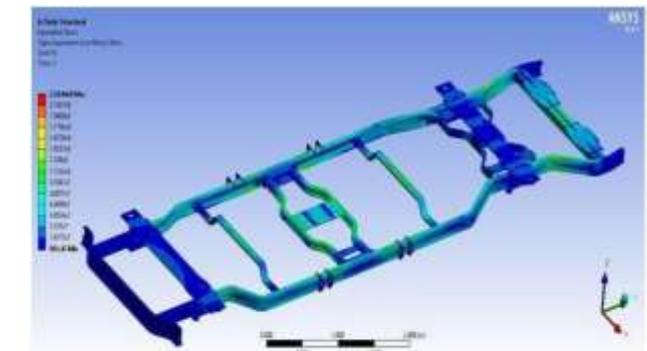

Fig. 4.3. Load applying on Top of Chassis
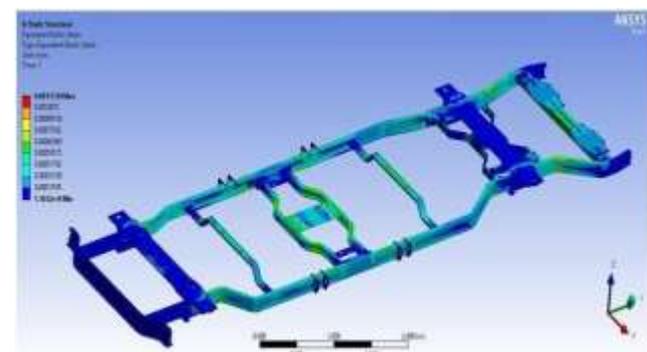

Fig 4..4. Stress Analysis for Steel

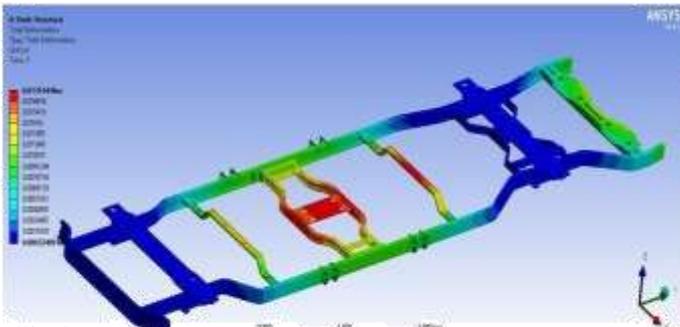
Fig .4.5. Strain analysis for Steel

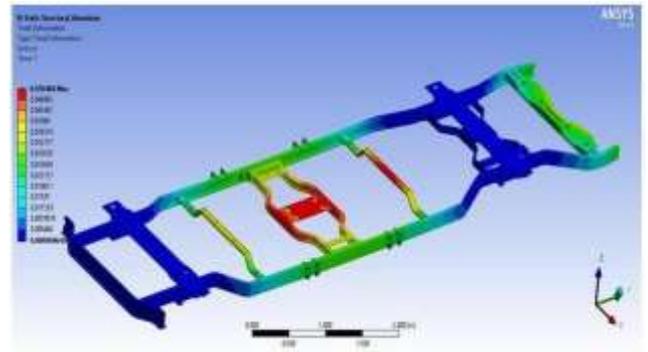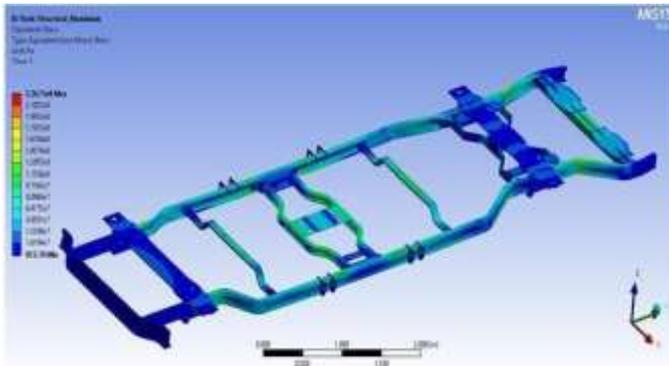Fig .4.6.   Deformation Analysis for Steel

Fig. 4.7.   Stress Analysis for Aluminum

Fig. 4.8.   Strain Analysis for Aluminum

Fig.4. 9.   Deformation Analysis for Aluminum

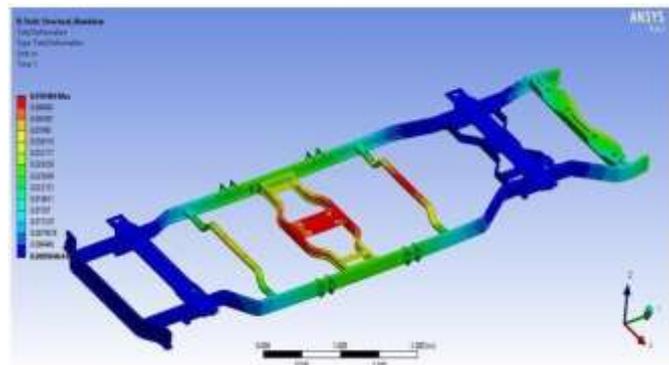Fig .4.10.   Stress Analysis for Epoxy

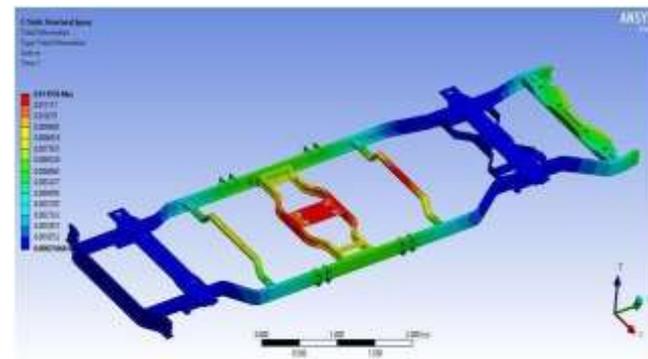Fig .4.11.   Deformation Analysis for Aluminum

Fig . 4.12.   Deformation Analysis for Epoxy

V. MATERIAL SELECTION

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

STAINLESS STEEL

Stainless steel is selected as engineering material mainly because of their excellent corrosion resistance in many environments.
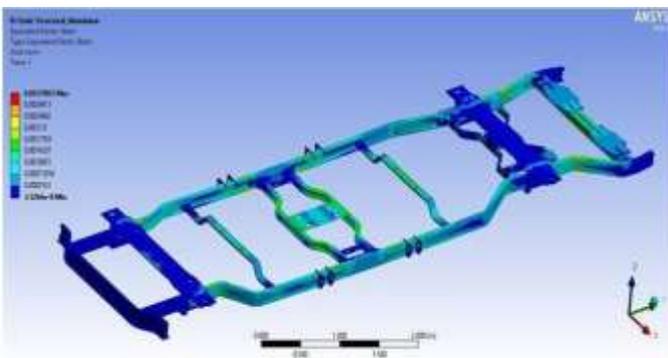
Table 5.1 MECHANICAL PROPERTIES OF STAINLESS STEEL (AISI 317)

PROPERTIES	VALUES
Ultimate tensile strength	505 MPa
Density	8.0 g/cm3
Modulus of elasticity	200 GPa
Shear strength	152 MPa
Yield strength (0.2% offset)	215 MPa
Melting point	1454 °C
Elongation	35%

ALUMINIUM

Aluminum is a nonferrous material with very high corrosion resistance and very light material compared to steels.

Table 5.2 MECHANICAL PROPERTIES OF ALUMINUM ALLOY 6063-T6

PROPERTIES	VALUES
Ultimate tensile strength	195 MPa
Density	2.7 g/cm3
Modulus of elasticity	69.5GPa
Shear strength	150 MPa
Yield strength (0.2% offset)	160 MPa
Melting point	600 °C
Elongation	14%

EPOXY

Epoxy is the cured end product of epoxy resins, as well as a colloquial name for the epoxide functional group.

Table 5.3 MECHANICAL PROPERTIES OF EPOXY

PROPERTIES	VALUES
Ultimate tensile strength	530 MPa
Density	7.3 g/cm3
Modulus of elasticity	275GPa
Shear strength	202 MPa
Yield strength (0.2% offset)	300 MPa
Melting point	1600 °C

VI. DESIGN TOOL (SOLIDWORKS)

Solid Works is a 3D mechanical CAD (computer-aided design) program that runs on Microsoft Windows and is being developed by DassaultSystèmes Solid Works Corp., a subsidiary of DassaultSystèmes,

S. A. (Vélizy, France). SolidWorks is currently used by over 2 million engineers and designers at more than 165,000 companies worldwide. FY2011 revenue for SolidWorks was 483 million dollars.

MODELING METHODOLOGY

SolidWorks is a Parasolid-based solid modeler, and utilizes a parametric feature-based approach to create models and assemblies. Parameters refer to constraints whose values determine the shape or geometry of the model or assembly. Parameters can be either numeric parameters, such as line lengths or circle diameters, or geometric parameters, such as tangent, parallel, concentric, horizontal or vertical, etc. Numeric parameters can be associated with each other through the use of relations, which allows them to capture design intent.
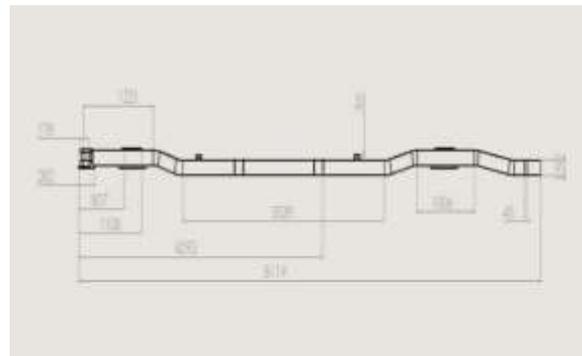
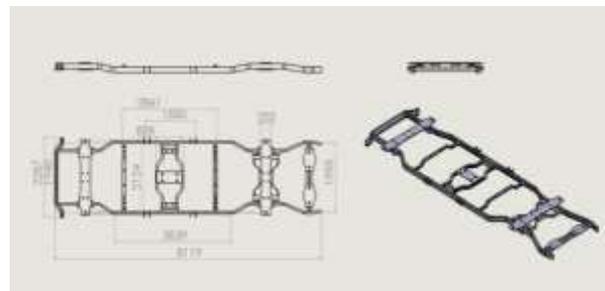*DESIGN OF CHASSIS*

Fig .6.1 Cad Modelling Diagram (Side View)
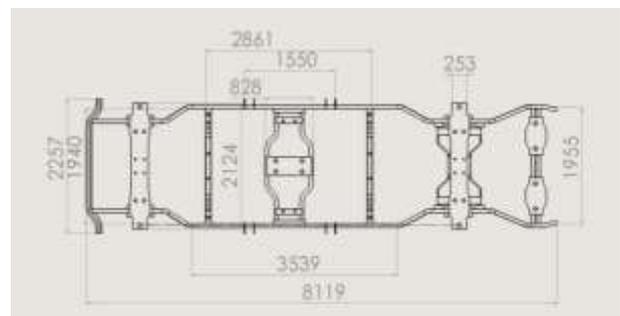

Fig.6.2 Cad Modelling Diagram (Top View)

Fig.6.3   Cad Modelling Diagram (Overall View)

CONCLUSION

To observe the all results and to compare the heavy vehicle chassis for Steel, Aluminum, and Epoxy material the heavy vehicle chassis with respect to weight, stiffness and strength. By employing a Steel heavy vehicle chassis for the same load carrying capacity, there is a reduction in weight. Load should be applied at 15tons loading condition.

Present used material for chassis is steel. I have considered Stainless Steel, Aluminum alloy, and Epoxy for chassis material. Based on the results, Stress for three materials are constant and the strain values is varied according to the material properties. strength and stiffness and lesser in weight compared to steel and other materials.

From the results, it is observed that the Stainless Steel heavy vehicle chassis is high strength and more economical than the conventional materials chassis with similar design specifications.

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