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OPTIMIZATION & ANANLYSIS OF A HEAVY VEHICAL CHASSIS USING COMPOSITE MATERIALS

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Abstract: *The chassis forms the main structure of the modern automobile. A large number of designs in pressed-steel frame form a skeleton on which the engine, wheels, axle assemblies, transmission, steering mechanism, brakes, and suspension members are mounted. During the manufacturing process the body is flexibly bolted to the chassis.*

structural and fatigue analysis was conducted to find stress locations, factor of safety and fatigue levels (Alternating stress) using mild steel, FRP & CRPF along with honey comb structure.

The module does not emphasize all pro engineer commands but instead make use relevant capability that the software has to create a design concept pro engineer is a tool in this model any relevant features that the software has and can be utilize during the design concepts will be dealt in the text.

Key Words: Chassis, FRP & CRPF, Mild steel

1. INTRODUCTION

The chassis forms the main structure of the modern automobile. A large number of designs in pressed-steel frame form a skeleton on which the engine, wheels, axle assemblies, transmission, steering mechanism, brakes, and suspension members are mounted. During the manufacturing process the body is flexibly bolted to the chassis.

This combination of the body and frame performs a variety of functions. It absorbs the reactions from the movements of the engine and axle, receives the reaction forces of the wheels in acceleration and braking, absorbs aerodynamic wind forces and road shocks through the Suspension, and absorbs the major energy of impact in the event of an accident.

1.1 INTRODUCTION OF CHASSIS FRAME:

Chassis is a French term and was initially used to denote the frame parts or Basic Structure of the vehicle. It is the back bone of the vehicle. A vehicle without body is called Chassis. The components of the vehicle like Power plant, Transmission System, Axles, Wheels and tier, Suspension, Controlling Systems like Braking, Steering etc., and also electrical system parts are mounted on the Chassis frame. It is the main mounting for all the components including the body. So it is also called as Carrying Unit.

1.2 LAYOUT OF CHASSIS AND ITS MAIN COMPONENTS:

The figure 1 show main components of the Chassis are

1. Frame: it is made up of long two members called side members riveted together with the help of number of cross members.

2. Engine or Power plant: It provides the source of power

3. Clutch: It connects and disconnects the power from the engine flywheel to the transmission system.

4. Gear Box: A gearbox is a mechanical method of transferring energy from one device to another and is used to increase torque while reducing speed. Torque is the power generated through the bending or twisting of a solid material. This term is often used interchangeably with transmission.

5. U Joint: A u-joint is a universal joint that allows the driveshaft to continue applying torque to the rear axle as the truck goes down the road and pivots to allow for the up and down and rotational motion of the axle as you go through dips and up driveways and such at an angle.

6. Propeller Shaft: The shaft that transmits power from the gearbox to the differential gear in a motor vehicle.

7. Differential: When a car turns a corner, one wheel is on the "inside" of a turning arc, and the other wheel is on the "outside." Consequently, the outside wheel has to turn faster than the inside one in order to cover the greater distance in the same amount of time. Thus, because the two wheels are not driven with the same speed, a differential is necessary.

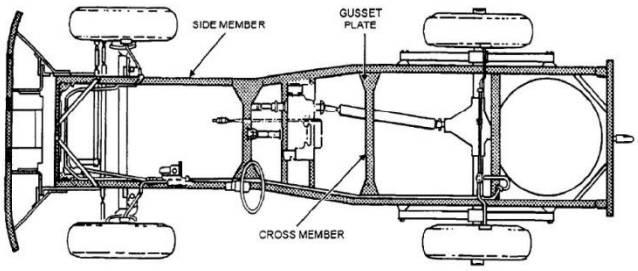


Figure 1

1.3 FUNCTIONS OF THE CHASSIS FRAME:

1. To carry load of the passengers or goods carried in the body.
2. To support the load of the body, engine, gear box etc...
3. To withstand the forces caused due to the sudden braking or acceleration
4. To withstand the stresses caused due to the bad road condition.
5. To withstand centrifugal force while cornering.

2.1 TYPES OF CHASSIS:

1. Motorcycle Chassis:

An important type of automotive chassis, motorcycle chassis comprise of different auto parts and components like auto frame, wheels, two wheeler brakes and suspension. It is basically the frame for motorbikes that holds these components together. A motorbike chassis can be manufactured from different materials. But the commonly used materials are steel, aluminum, and magnesium.

2. Car Chassis:

The main structure of a car is known as chassis. Car chassis functions as a support for the different car parts. Automotive parts like engine, suspension & steering mechanism, braking system, auto wheels, axle assemblies and transmission are mounted on the car chassis.

3. Bus Chassis:

Bus chassis is the design and quality of bus chassis depends on the capacity of bus. It can be made according to the needs and can be availed with features like transverse mounted engine, air suspension as well as anti-roll bars. A well manufactured bus chassis offers various benefits like high torque from low revs, superior brake performance and more. Bus chassis designed for urban routes differs from the one manufactured for suburban routes.

4. Truck Chassis:

Truck chassis, the backbone of any truck is designed to provide a comfortable and dependable ride. New invention in automotive sector has influenced the automobile chassis manufacturers to adopt latest trends and come up with new designs. In the present world, a truck chassis comes with enhanced geometry, power steering, disc brakes and other truck parts.

3. CHASSIS MATERIALS

Traditionally, the most common material for manufacturing vehicle chassis has been steel, in various forms. Over time, other materials have come into use, the majority of which have been covered here.

1. STEEL

The main aim with a chassis is to build a stiff structure to ensure other components can work as they're designed to, and steel really scores in this respect, as it is a pretty stiff material. In addition, steel rates well in terms of both yield strength (how likely it is to bend permanently under load) and ultimate strength, particularly if it is carefully alloyed and processed. Steel also resists fatigue failure well (fatigue failure is where a material fails due to repeated loading and unloading, even though the loads involved may be far below the ultimate strength of the material). This last fact is extremely useful - even if the chassis flexes under load, such flexing need not lead to a critical failure.

2. ALUMINIUM

Aluminum is probably the material that springs to mind when you think about lighter alternatives to steel, and with

good reason - the density of aluminum is in the region of 35% of that of steel. However, the first thing we should cover is the fact that when we talk about aluminum as a structural material, we are almost always talking about an alloy of aluminum - with an addition of magnesium, zinc etc depending upon the intended end use of the metal. The reason for this is that raw aluminum has too low a yield strength for structural use in a vehicle chassis.

3. TITANIUM

Titanium has an association with space tech, and is regarded by many people as an "ultimate" material. It has a density roughly half that of steel, and also a little over half the stiffness value. It's a similar situation with regards to ultimate and yield strengths. A major advantage of titanium is it's resistance to corrosion, and also to fatigue failure. It costs, though: Titanium is not a cheap material by any stretch of the imagination, and is impractical to use for any normal road vehicle.

4. MAGNESIUM

Magnesium is the lightest metal that's likely to be used in a vehicle chassis, with a density about quarter that of steel. This weight advantage helps to compensate for the fact that its strength and rigidity is below even aluminum, and with careful design can be used to build a light, stiff structure. Magnesium can react quite easily, and will ignite under extreme circumstances. Although in most cases the sections of material used in vehicles are too thick to be at risk from this, it does mean that special care needs to be taken during manufacture - particularly with filings from machining operations etc.

5. FIBREGLASS

Raw plastics do not have anywhere near enough stiffness to be used for structural components in cars. If strands of glass are added to the mixture, though, their properties improve remarkably. This gives you a Glass Fiber Reinforced Plastic (GFRP or GRP), most commonly referred to as fiber-glass.

6. CARBON FIBRE

Carbon fiber is very similar to fiberglass, only with carbon strands rather than glass strands as the reinforcing medium - it's correct description would be Carbon Fiber Reinforced Plastic (CFRP/CRP), though almost everyone refers to it as simply "carbon fiber".

Table 1.Properties of S- glass:

Physical properties	metric
Density	2.48-2.49kg/m^3
Mechanical properties	metric
Tensile strength	521MPa
Ultimate strength	2145MPa At temperature 540°c
Elongation at break	5.40%
Modulus of elasticity	85.5-86.9GPa
Poisson's ratio	88.9GPa
Shear modulus	35.0GPa

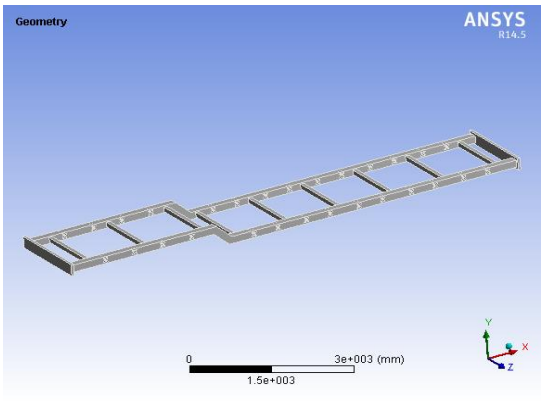
Table 2.Properties of E- glass:

Physical properties	**metric**
Density	2.54-2.60kg/m^3
Mechanical properties	metric
Tensile strength	4585MPa
Ultimate strength	2145MPa At temperature 540°c
Elongation at break	4.80%
Modulus of elasticity	72.3GPa
Poisson's ratio	0.200
Shear modulus	30.0GPa

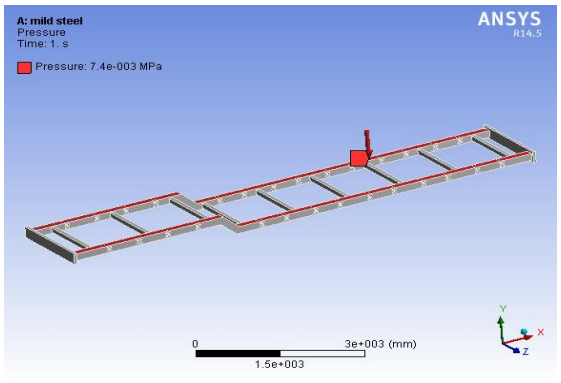
Table 3.Properties of Mild steel:

Physical properties	**metric**
Density	7.872 kg/m^3
Mechanical properties	**metric**
Elongation at break	5.40%
Modulus of elasticity	200 GPa
Poisson's ratio	0.29
Shear modulus	80 GPa
Bulk modulus	140 GPa

4. IMPORTED MODEL OF CHASSIS

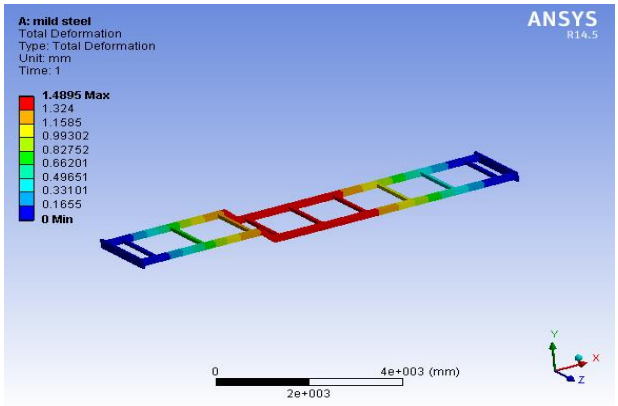


4.1 LOAD APPLIED ON THE CHASSIS

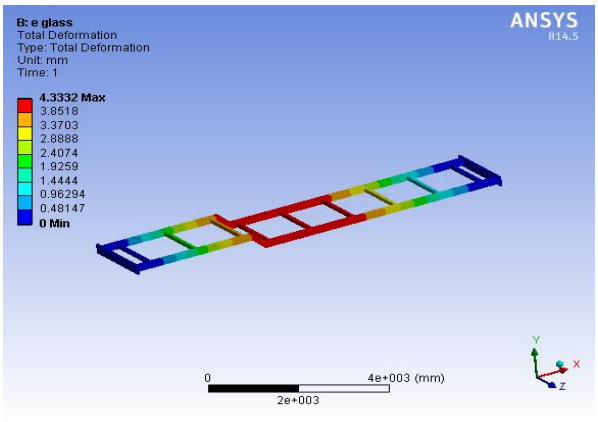


5. STRUCTURAL ANALYSIS ON EXISTING DESIGN OF CHASSIS

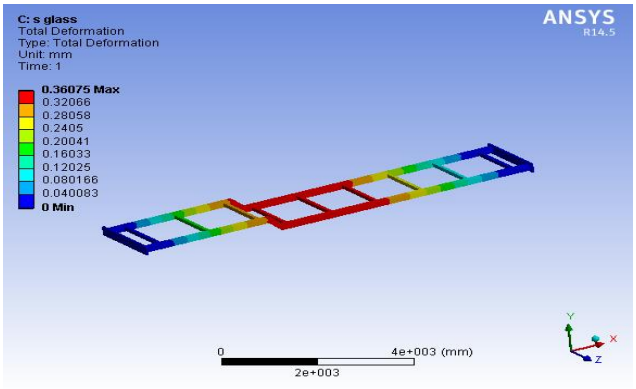
5.1 Mild steel:



5.2 E-glass:

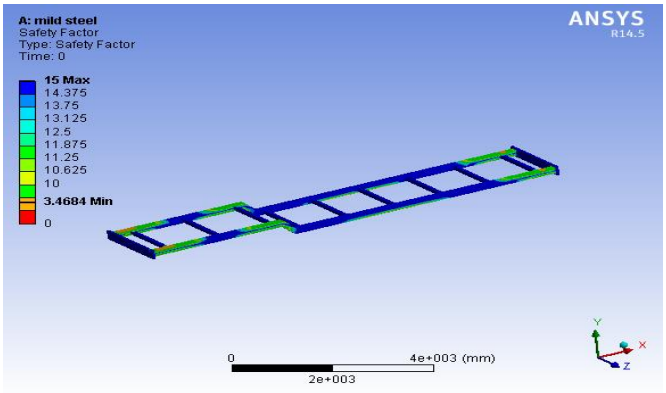


5.3 S-glass:

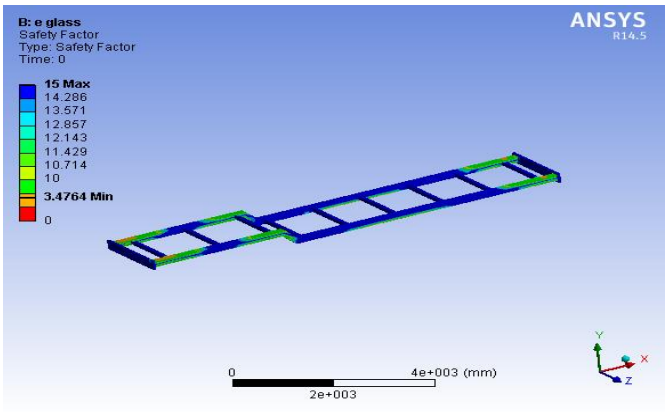


6. FATIGUE ANALYSIS ON EXISTING DESIGN OF CHASSIS

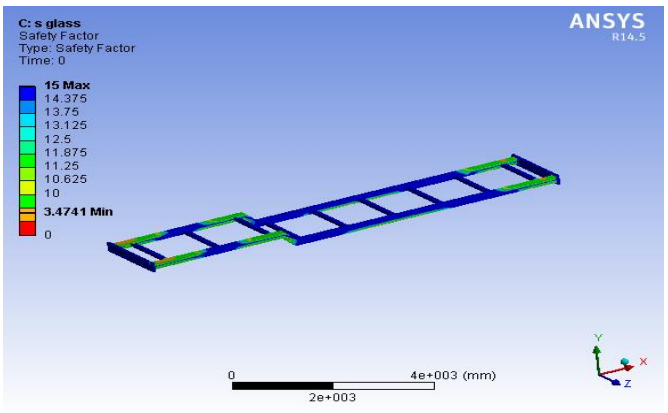
6.1 Mild steel:



6.2 E-glass:



6.3 S-glass:



7.1 IMPACT ANALYSIS OF EXISTING CHASSISS

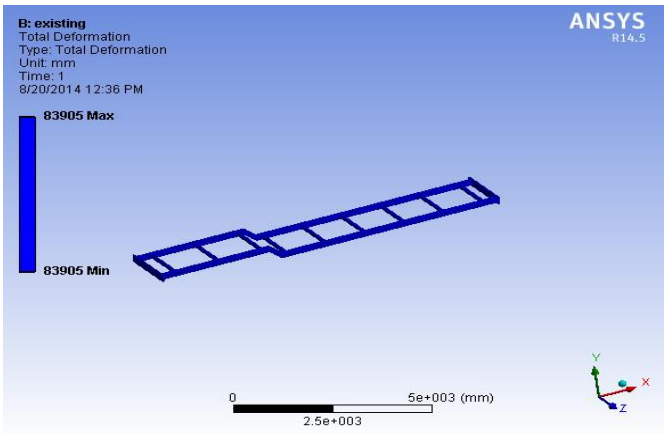


Figure: displacement

The above image shows displacement value 1.3107e5 mm

7.2 IMPACT ANALASIS OF HONEY COMB CHASSIS

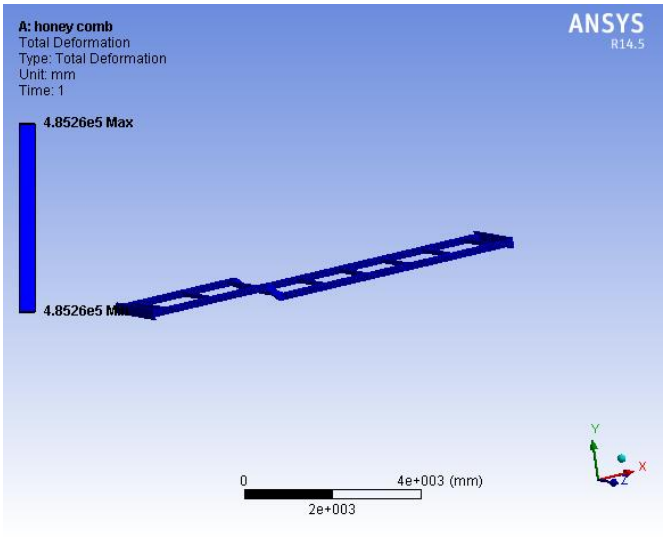


Figure: displacement

The above image shows displacement value 4.8526e5 mm

8. Results

Table 4: Existing values

EXISTING			
	Mild Steel	E-Glass	S-Glass
Displacement	1.489	4.333	0.360
Stress	12.426	12.398	12.406
Strain	5.928e^{-5}	0.0001715	1.4305 e^{-5}
SafetyFactor = yelidstrenght/stress	44.262	40.329	369.57
Biaxiality indication	0.914	0.913	0.9242
Alternative Stress	24.853	24.795	24.812

MODIFIED			
	Mild Steel	E-Glass	S-Glass
Displacement	1.640	4.7729	0.39734
Stress	12.509	12.644	12.531
Strain	6.377 e^{-5}	0.000190	1.5744 e^{-5}
SafetyFactor = yelidstrenght/stress	43.968	39.544	365.89
Biaxiality indication	0.99532	0.992	0.9961
Alternative Stress	25.017	25.289	25.2062

Table 5: Modified values

HONEY COMB			
	Mild Steel	E-Glass	S-Glass
Displacement	3.4035	9.9334	0.8634
Stress	39.594	40.381	40.154
Strain	0.000194	0.00057333	4.7511 e^{-5}
SafetyFactor = yelidstrenght/stress	13.890	12.382	114.18
Biaxiality indication	0.9966	0.99516	0.9969
Alternative Stress	79.188	80.763	80.309

Table 6: Honey comb chassis

8.1 IMPACT ANAYLSIS

Material: s-glass

Material	existing	modified	Honey comb
Displacement	0.83905	1.3107e5	4.8526e5
Stress	16.869	16.917	47.382
Strain	0.000021605	0.000021617	0.000054645

9. CONCLUSION

In this work heavy vehicle chassis is design by using PRO-E and Structural and fatigue analysis are done on the chassis using ANSYS 14.5. The analysis is done using three materials MILD steel, S-GLASS and E-GLASS.

On three models existing, modified, honey comb. Present used material for chassis is mild steel. Structural and fatigue analysis was conducted to find stress locations, factor of safety and fatigue level's (Alternating stress) using mild steel, FRP and CRPF along with honey comb structure.

By using composites instead of mild steel, S-Glass along with honey comb structure weight is reduced up to 75% and quality is improved by 87% than by using steel because density of steel is more than the composites. So better to use above suggested model and material. So it is better to take S-Glass chassis manufacturing is very easy while compared with Mild steel.

I. REFERENCES

[1] JOSEPH SHIGLY, CHARLES MISCHIKE., MECHANICAL ENGINEERING DESIGN, TMH, 2003.

[2] V.B. BHANDARI., DESIGN OF MACHINE ELEMENTS.

[3] R.S. KHURMI MACHINE DESIGN.

[4] A CRITICAL REVIEW OF THE CRITERIA FOR NOTCH-SENSITIVITY IN FATIGUE OF METALS BY C. S. YEN, T. J. DOLA

[5] H.F. HARDRATH, L. OHMAN, "A STUDY OF ELASTIC AND PLASTIC STRESS CONCENTRATION FACTORS DUE TO NOTCHES AND FILLETS IN FLAT PLATES". NISHIDA K. STRESS CONCENTRATION.