Design & Analysis of Solar Operated Vehicle Chassis

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Abstract- *In Today's Modern world Where Transportation is Need of Human Being like its Need of Food, Clothing, & Shelter, To Travel From One Place to Another For Past Century Human Being is Using Different Vehicles Which Requires Fuels Like Petrol, Diesel etc For its Working, Since This Need of Transportation will never end but This Fossil Fuels Will, A Alternate Solution for This Crises Has Been Sorted Out By Using Non-Conventional Source of Energy of Sun Also Know As Solar Energy To Propel The Vehicle. Hence, This Research Work Focus on the Design and Analysis of Solar operated Vehicle.*

Keywords- Roll cage, Solidworks2013, Load, Analysis, Impact, and Factor of Safety.

I. INTRODUCTION

Chassis is the Structural Backbone of any vehicle. The Main function of the chassis is to carry the loads placed upon it. The Chassis has to bear the stress developed and the deformation occurs in it and that should be in the limit. The 3D model of the chassis has been developed in Solid works 2013 and The Stress analysis has been done in the Ansys 14.5 Workbench. . [1]

II. TECHNICAL CONTENT

2.1 Design Considerations for the Roll Cage:

1. The Roll Cage Material is Isotropic.
2. All the Roll Cage Members have Uniform Cross-Section.
3. We Are Using AISI 1018 Low Carbon Steel because it has Good Weld ability, Having Carbon Percentage Between 0.14% to 0.20%.
4. Welding Process to be used is Metal Inert Gas Welding (MIG Welding).
5. The Weight of the Chassis is 47kg.

2.1.1 Chassis Modeling:

- With The advent of powerful computers and robust software, computational modeling has emerged as very informative and cost effective tool for material design and analysis.
- Modeling often eliminates. Costly experiments and provide more information than that can be obtained experimentally.[3]
- In this research SOLIDWORKS2013 is used for modeling and Ansys 14.5 is used for analysis

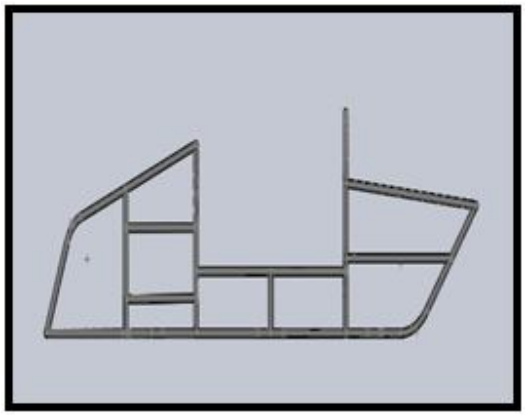

Fig 2.1: Side View of the Chassis

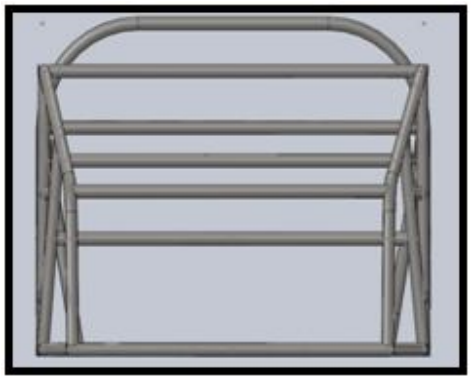

Fig 2.2: Front View of the Chassis

2.2 Material Properties:

Material selection is one of the key factors in designing the frame of the Solar Car as it is the measure of safety, reliability, performance and strength of the roll cage. We conducted a thorough research on the tube materials and compared them in multiple categories

Material	AISI 1018	AISI 4130	AISI 1020	DUPLEX 2205 STEEL
Outside Diameter	2.540 Cm	2.540 Cm	2.540cm	2.540cm
Wall Thickness	0.2 cm	0.2 Cm	0.2cm	0.1cm
Bending Stiffness	2971 Nm^2	2971 Nm^2	2171 Nm^2	
Bending Strength	390 Nm	371Nm	385Nm	260.4Nm
Carbon %	0.18	0.20	0.19	0.

As AISI 1018 Had Good Strength Also Cheaper Compared To Other Steel. Hence, We Have Opted For AISI 1018.

2.1.2 Welding of AISI 1018:

- AISI 1018 mild/low carbon steel can be instantly welded by all the conventional welding processes.
- Welding is not recommended for AISI 1018 mild/low carbon steel when it is carbon nitrided and carburized
- Low carbon welding electrodes are to be used in the welding procedure, and post-heating and pre-heating are not necessary.
- Pre-heating can be performed for sections over 50 mm. Post-weld stress relieving also has its own beneficial aspects like the pre-heating process

2.1.3 Finite Element Analysis (FEA):

- The finite element method (FEM) is a numerical method for solving problems of engineering and mathematical physics.
- It is also referred to as finite element analysis (FEA). Typical problem areas of interest include structural analysis, heat transfer, fluid flow, mass transport, and electromagnetic potential.
- The analytical solution of these problems generally require the solution to boundary value problems for partial differential equations.
- The simple equations that model these finite elements are then assembled into a larger system of equations that models the entire problem.
- FEM then uses variation methods from the calculus of variations to approximate a solution by minimizing an associated error function.[4]

Three Impacts were done to Analyze the Roll Cage:

1. Front Impact.
2. Rear Impact.
3. Side Impact.

Force Calculation: Using 4G Condition Force was calculated as follows,

Weight of the Vehicle including Driver: 300 kg,
Therefore, 300x4=1200N.

Since, Force = Mass x Acceleration.
F = 1200 x 10 = 12000N.

Material Specification of AISI 1018:

1. Young's Modulus = 205000 Mpa.
2. Density = 7473 Kg/m3
3. Tensile Yield Strength = 370 Mpa
4. Ultimate Tensile Strength = 460 Mpa

Ansys 14.5 Software Was Used For the Analysis of Chassis
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1. Front Impact:

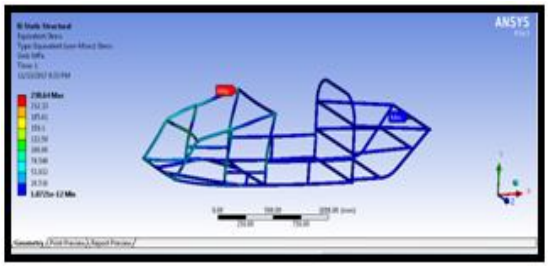

Fig 2.3: Front Impact

- Load Applied: 12000 N.
- Max. Stress: 238.64 Mpa.
- Max. Deformation: 3.165 MM.
- Factor of Safety: 1.75

2. Rear Impact:

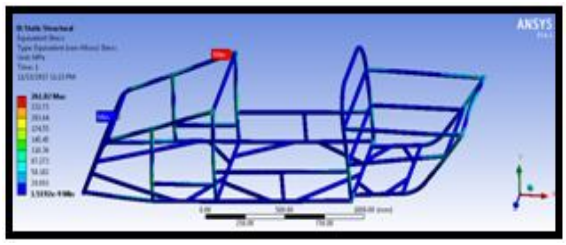

Fig 2.4: Rear Impact

- Load Applied: 12000 N.
- Max. Stress: 261.82 Mpa.
- Max. Deformation: 16.73 MM.

- Factor of Safety: 1.51

3. Side Impact:

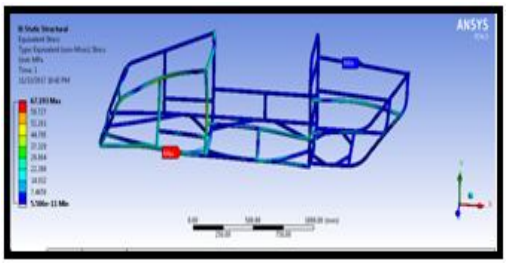

Fig 2.5: Side Impact

- Load Applied: 12000 N.
- Max. Stress: 67.293 Mpa.
- Max. Deformation: 0.7925 MM.
- Factor of Safety: 5.51.

IV. CONCLUSION

The team gained knowledge in the field of designing through the virtual design and analysis with optimum usage. The team's goal was to produce a design that met or exceeded the Solar Chassis criteria for safety, durability and maintainability as well as provide features that would have mass market appeal to the general off-road enthusiast such as performance, comfort and aesthetics. Design decisions were made with each of these parameters in mind.

Computational design and analysis software solid works, Hypermesh and ANSYS were used to verify whether each part of the design met or exceeded its stated objective. Use of these design tools also allowed the team to address and rectify conflicts between any interfacing before fabrication, saving both time and cost. Design goals were met, resulting in a final product that will withstand the rigors of off-road travel while providing the driver with the necessary comforts. The vehicle is appealing to the customer in design, driver comfort and safety, and maintainability. The vehicle is appealing to the producer in manufacturability and reliability.

V. ACKNOWLEDGMENT

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REFERENCES

[1] Stanakova and Jovan vu. (2010) 'Impact of anthropometric measurements on Ergonomic driver posture and safety', periodicumbiologorum Vol. 112, no 1, 51-54.

[2] Darliana Mohamad, Baba MdDeros, Dzuraidah Abdul Wahab. (2010) 'Integration of Comfort into a Driver's Car Seat Design Using Image Analysis', American Journal of Applied Sciences 7 (7): 937-942, 2010.

[3] Keith J. Wakeham, Introduction To Chassis Design, January 2, 2009

[4] Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering",Pearson Education 2002, 3rd Edition.