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DESIGN AND ANALYSIS OF FOUR-WHEEL CHASSIS

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Abstract -In this project we are considering some design parameters of various cars that we are using in our daily life so I have considered dimensions of a sedan type of car and I have designed the chassis with the help of solid works software after the completion of design in solid works we are going to check the strength of the chassis in solid works by solidworks simulation in that we are going to perform Static analysis, Bending analysis based on the load cases after repeated analysis process by varying the force, other parameters and by comparing those results we will get maximum stress and maximum load capacity which the chassis can be bear by this process we can design and analysis the chassis.

1.INTRODUCTION

The chassis is an important structure of a car. The frame 3 supports both the automobile body and the power train. Various mechanical components such as the engine and drive train, axle assemblies comprising the wheels, suspension sections, brakes, steering components, and so on are fastened to the chassis. The chassis provides the strength required to sustain the various vehicular components as well as the cargo and aids in keeping the vehicle rigid and stiff. As a result, the chassis is an integral part of the entire safety system. It also assures minimal levels of noise, vibration, and harshness throughout the vehicle.

.2. LITERATURE REVIEW

2.1 C.H. NeerajaA two-wheeler suspension frame is modelled in all instances of "Structural Analysis of The Two-Wheeler Suspension Frame." The models are made with Pro/Engineer. They used four different materials—aluminum, steel, alloy A360, magnesium, and carbon fibre reinforced alloy A360, polymer—to undertake structural and modal evaluations on the suspension frame to validate our design. The results show that the stress levels for all the materials are less than their respective permissible yield stress values. The process's conclusion is that the design was proven to be secure.

2.2 Yaşar Kahraman To optimise the chassis, they all used finite analysis; the main objective was to reduce the chassis' weight; for this, they used three thicknesses: 4, 5, and 6 mm; following the analysis, they came to the conclusion that the 4 mm is superior due to its higher stress and displacement values than the other two thicknesses.

3.FRAME MATERIAL

It is critical to choose the right frame material. Carbon fibre, Titanium grades, AISI 4130, AISI 4140, and AISI 1080 materials were used because they have the best necessary qualities. The material is selected depending on its cost and availability on the market.

Selected Frame Material: American Iron and Steel Institute **(AISI 4130).**

AISI 4130 offers a high level of strength, toughness, and ductility. The density is lower. All traditional processes may be used to weld and manufacture AISI 4130. As a result, this material is appropriate for fabrication processes such as welding, cutting, finishing, grinding, and so on.

4.CHASSIS

Modelling of a chassis can be done through any cad software which has an option to draw 3D models and I have selected solidworks software to design a chassis. In this software first we have selected 3D part drawing option and then started drawing by selecting all the planes.

Procedure Of Modeling:

1. Open solidworks select 3D part modeling.

2. Select planes in this we have to select all the planes such as XY plane YZ plane and ZX plane.

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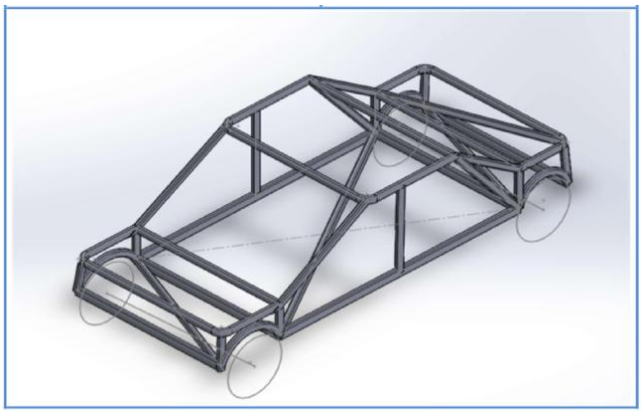
3. Now click on sketching select the plane in which we have to draw.

4. Select the required tools and draw the model of the car with like a line diagram.

5. Now click on structural members select the weldments option and give the structural members to the sketched model.

6. After giving structural members to all the areas of the model.

7. Now the design of chassis is completed



Analysis Procedure:

1. After completion of sketching and surfacing of the designed model we will import that model to simulation.
2. In the simulation we must select type of analysis that we are going to conduct on the beams and members.
3. After selecting the type of analysis we must select the type of material required.
4. After that fixing the joints or vertices by selecting the fixtures
5. Now selecting external loads and giving them by means of force or torque and giving the amount of load.
6. The final step is meshing the designed model and running of the study will gives us the stress and displacement or results of our analysis.
7. I have performed force analysis with respect to bending and torsion cases.
8. In the first force analysis I have done by fixing the boot and giving load at the front of 10000 N of force and the results are shown at the report.
9. In the second force analysis I have performed analysis on the side members by giving the same load of 10000 N those results are shown on the report.
10. In the third analysis I have performed torsional analysis for the same load and those results are shown in the report.
11. And also have performed the bending of whole chassis with respect to the gravitational force and those 15 results are also shown on the report

Material Properties:

Name	Cast Carbon Steel
Model type	Linear Elastic Isotropic
Default failure criterion	Max von Mises Stress
Yield strength	2.48168e+008 N/m^2
Tensile strength	4.82549e+008 N/m^2
Poisson's ratio	0.32
Mass density	7800 kg/m^3
Elastic modulus	2e+011 N/m^2
Shear modulus	7.6e+010 N/m^2
Thermal expansion coefficient	1.2e-005 /Kelvin

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5. Study Properties

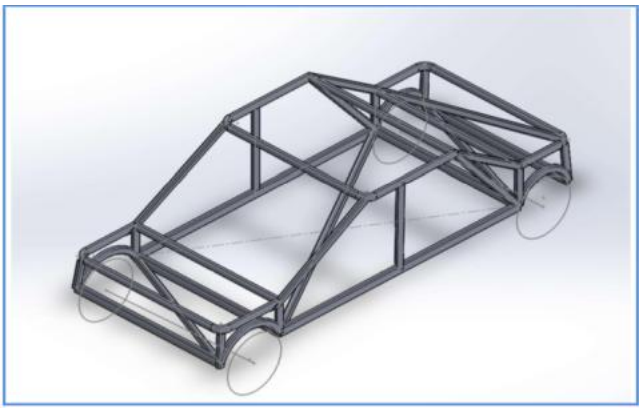
Study Name	Static 1
Analysis type	Static
Mesh type	Beam Mesh
Solver type	Direct sparse solver
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On

Mesh Information:

Mesh Type	Beam Mesh

Mesh Information -details:

Total Nodes	948
Total Elements	868
Time to complete mesh	00:00:06



Resultant forces:

Reaction foces:

Selection Set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0,000770567	-0.000244144141	100000	100000

Rection Momemts:

Selection Set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	4181.32	-2728.77	-1259.35	5149.32

Study Results:

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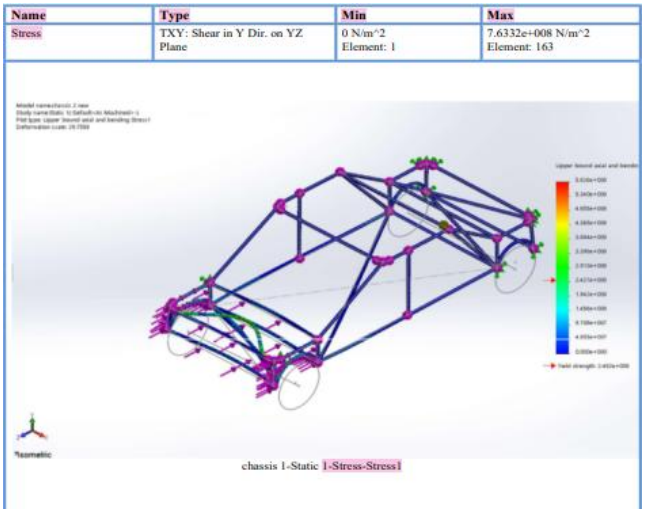
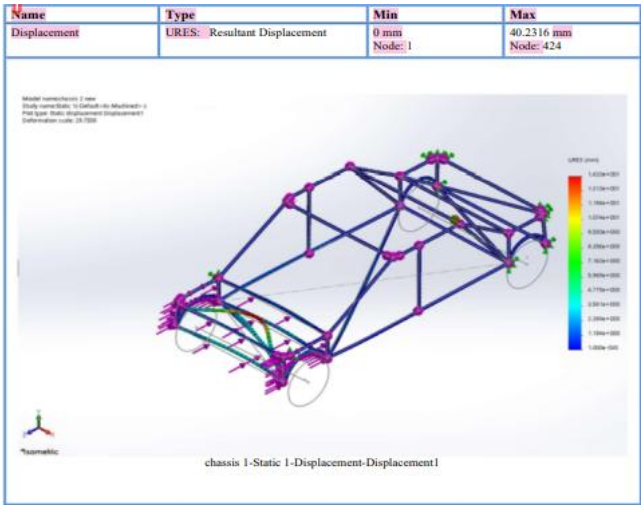


Stress



Displacement

Units:

Unit System:	SI(MKS)
Length/Displacement	Mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/stress	N/m^2

Force Analysis on side members:

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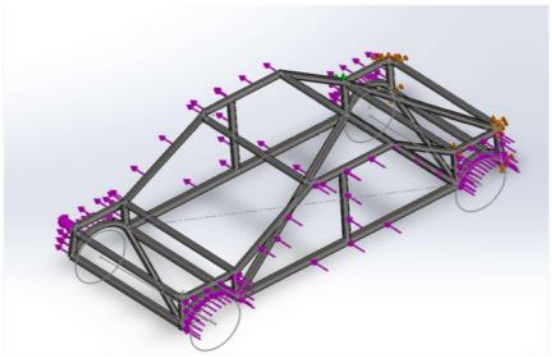
Force Analysis On Side members:

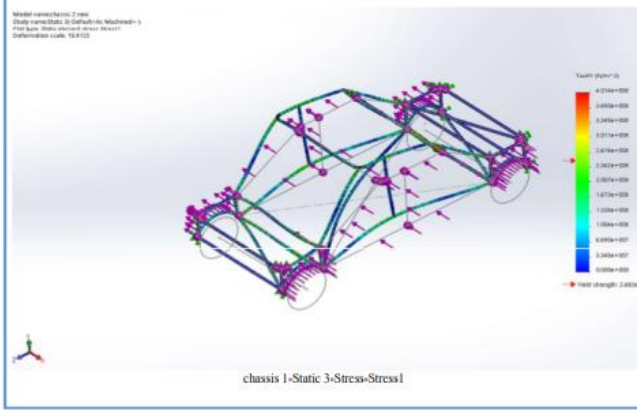


Study Properties:

Study Name	Static 3
Analysis type	Static
Mesh type	Beam Mesh
Solver type	Direct sparse solver
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On

Study Results

Name	Type	Min	Max
Stress1	TXY: Shear in Y Dir. on YZ Plane	406433 N/m^2 Element: 12	3.12434e+008 N/m^2 Element: 535



Stress

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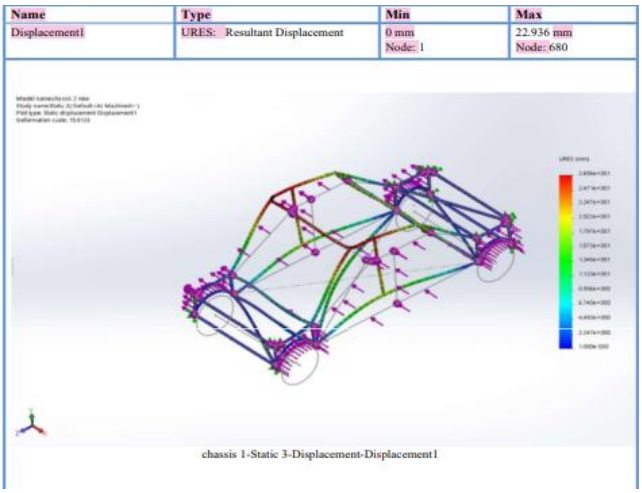
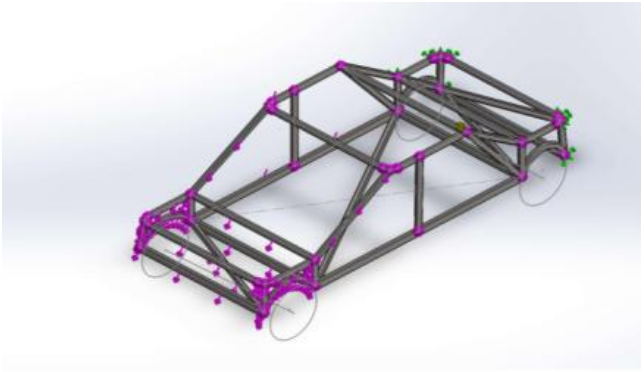


Displacement

Shear Force Analysis:



Study Name	**Dynamic**
Analysis type	Static
Mesh type	Beam Mesh
Solver type	Direct sparse solver
Enplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On

Units:

Unit System:	SI(MKS)
Length/Displacement	Mm
Temperature	Kelvin
Angular velocity	Rad/sec

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6.DESIGN & ANALYSIS

A design tool called Solid Works is used to create models of objects and components by combining classic drawing methods with complex sketching mounts, design modulators, and numerous performance procedures. We used Solid Works 18.0 to construct our frame.

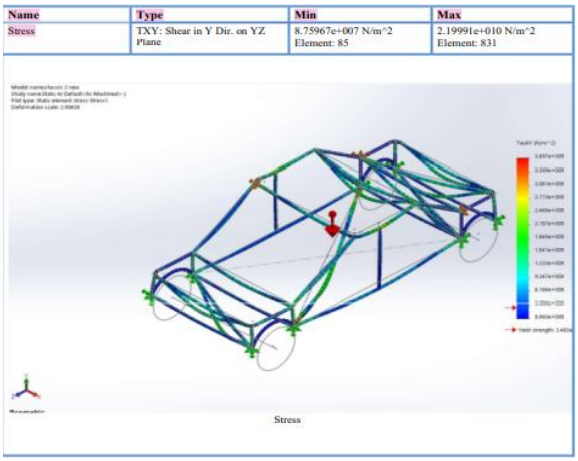
7.FINITE ELEMENT ANALYSIS

To establish the bike's performance in various conditions, the frame was submitted to Finite Element Analysis (FEA). These tests were performed to evaluate the deformation and strength of the bike when it was subjected to various loads throughout the course of itslife. FEA was carried out using the ANSYS 18.1 program version.

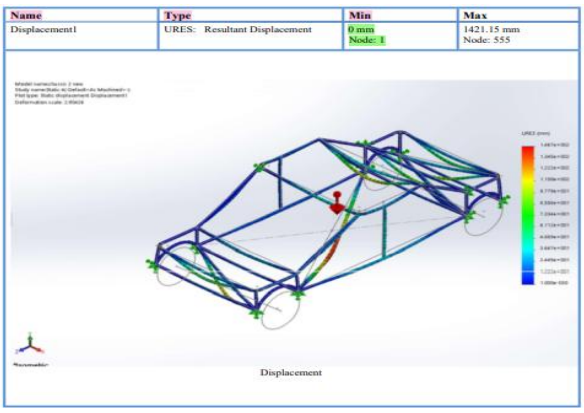
Von-mises was used to test the design to see if it could withstand the necessary load. If the maximum value of the von-mises exceeds the material's strength, the design will fail. As a result, the von-mises stress does not exceed the material's strength.

8.OUTPUT

Stress:



Displacement:



9.CONCLUSION

The main area of focus in recent years has been on the structural design and optimization of chassis. Different literature reviews pertaining to this topic have been examined and suggested in this study. The primary analyses performed on the chassis utilisingSolidworks software are the stress and shear analyses. This is done in particular to identify the weak places and to extend the lifespan and durability of the chassis. For the greater improvement of the chassis structure and design, much more study must be conducted in the near future. The Findings and Discussion Based on the necessary specifications, every part of the design is carefully examined.

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