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Design of All-Terrain Vehicle

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Abstract: This study aimed to deal with designing and analysis of an ATV (All-Terrain Vehicle) Frame. An ATV is designed in order to run on various terrains such as soil, gravel, pebbles, etc. so due to difficult terrain our main focus was on driver safety and better ergonomics at the same time. As the load acting on the frame is directly proportional to the weight of the frame we also considered the factor of weight depletion as a key area of focus. In order to achieve proper parameters, and satisfy driver safety and reduce weight correct alternative of material was required to be concluded.

I. INTRODUCTION

ATV, an All-terrain vehicle is a vehicle designed to handle a wide variety of terrain than most other vehicles. The main objective of our project is to design and analyze an ATV and view its versatility, safety, durability, and high performance like an off-road vehicle. The design of this ATV is based on the principles of engineering science to express their knowledge in the automotive. We will design an all-terrain vehicle that meets international standards and is also cost-effective and try to optimize every parameter considering its effects on the performance of another component of the vehicle. Our project is confined only to the design & analysis of chassis (Roll cage), Braking, Steering & Suspension systems of the vehicle. Transmission & Fabrication methods are not incorporated here.

II. MATERIAL USED

The material used in the designing and developing this project is AISI 4130. This steel provides the necessary strength. This metal is merged with both iron and carbon elements along with manganese, sulphur chromium, and silicon. Due to its versatile properties.
It is dominating in the current market. It is so useful that the American iron & steel industry and Society of Automotive Engineers (SAE) outlined numerous grades of steel that are made for specific purposes and denoted by 3 to 5-digit identifiers. 4130 is commonly used alloy steel.

A. Physical Properties of AISI 4130

4130 steel gets its name from specific rules outlined by SAE & AISI. The first digit i.e. 4 of 4130 alloys indicates the class of steel. The second digit i.e. 1 represents the relative percentage of this alloying element and other important secondary elements present in the material and the remaining last two digits which is 30 represent the carbon concentration. By knowing these rules of 4130 steel, 4XXX & 41XX series (chromium-molybdenum steels)with around 1% molybdenum/chromium by mass with an included 0.30% carbon.
The chemical breakdown for AISI 4130 normalized steel at 870^0c is given below:

1) 0.28 - 0.33% Carbon
2) 0.7 - 0.9% Manganese
3) 0.8 - 1.1% Chromium
4) 0.15 - 0.25% Molybdenum
5) ≤ 0.04% Sulphur
6) 0.15 - 0.35% Silicon
7) ≤ 0.035% Phosphorus

B. Mechanical Properties OF 4130 Steel Normalized AT 870^0c

Mechanical properties	Metric
Modulus of Elasticity	220 MPa
Ultimate tensile strength	731 MPa
Tensile yield strength	460 MPa
Rockwell B Hardness	92
Elongation of Break	25.5%

The elastic modulus is a measure of a material's elasticity, it is a common mechanical property which is used to show material stiffness.

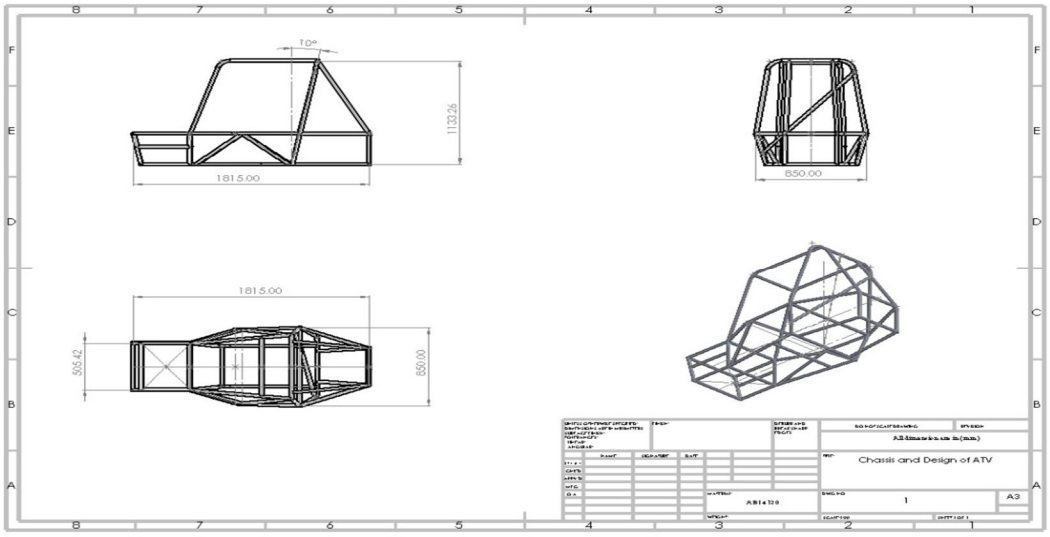
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C. Application of 4130 Steel

4130 alloy steel is an exceptionally tough material vital to welding, manufacturing, cutting, grinding, and other high-stress applications in industry. 4130 steel's great heat treatment characteristics impart a high toughness and, combined with its great machinability, workability and thus the reason why this steel is widely useful.

III. CHASSIS AND DESIGN

The material used to make the chassis is AISI 4130 steel. Which has good weld-ability, ductility, and hardness. While making this chassis we used arc welding and MIG welding. Chassis is the main component in ATV which bears all the weight and provides suspension, so it should have good hardness and should not be compromised with flexibility. The design of the chassis is done by Solid-works software as shown in fig. The weight of the chassis is 100kg.



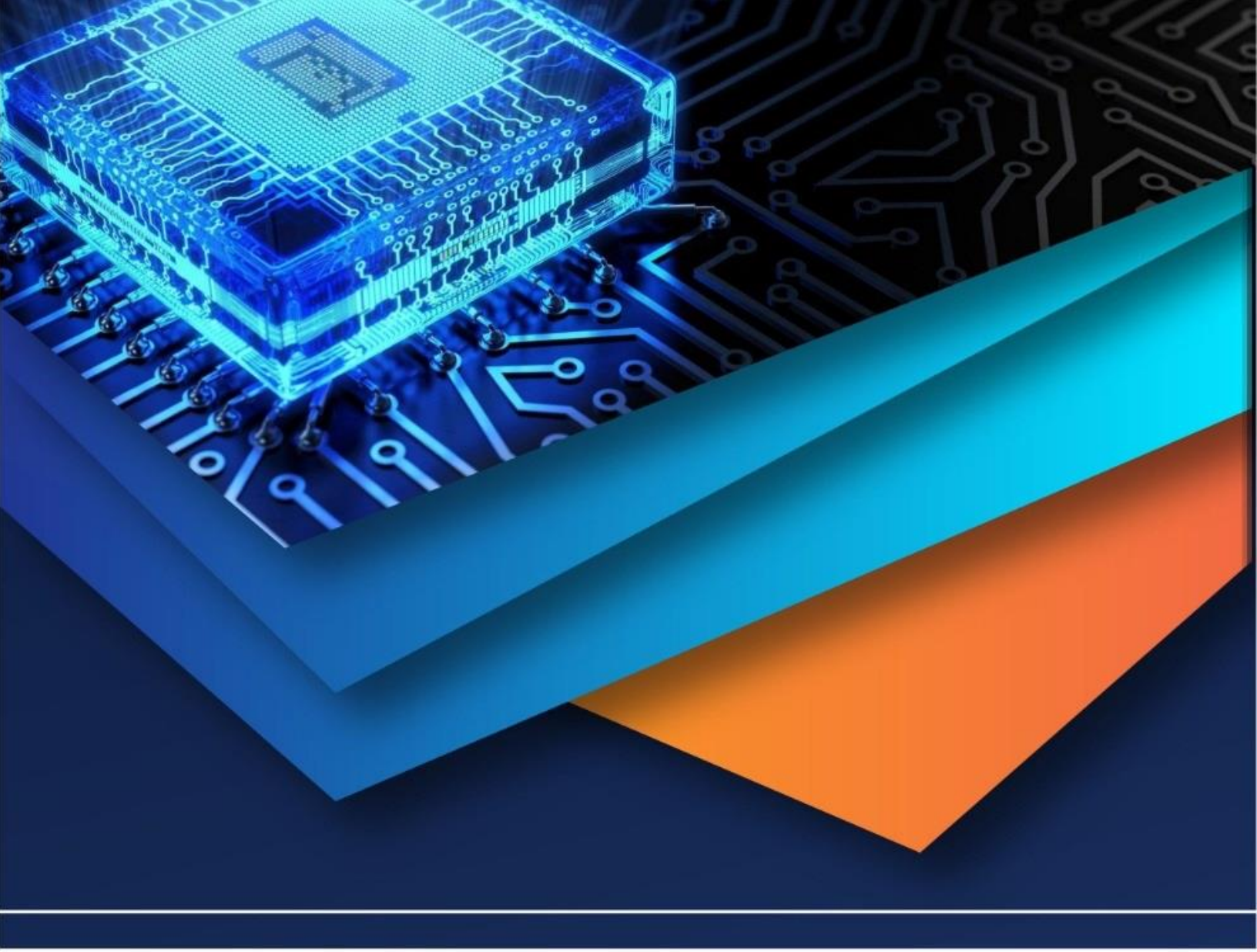
IV. SOLID-WORKS FUNDAMENTALS

The Solid-Works application is mechanical design automation software that grasp's upper hand of the familiar Microsoft Windows graphical user interface. This easy-to-learn tool implement the possibility for mechanical designers to quickly sketch ideas, experiment accompanied by features and dimensions, and produce models and detailed drawings.

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