

Analysis and Fabrication of Auxetic Structure Rigid Chassis

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Abstract— The chassis of a car is a crucial part of the vehicle. The chassis serves as a framework for the body and other components of the vehicle. To handle shock, twist, vibration, and pressures, it should also be stiff and unyielding. Along with strength, bending stiffness is a significant component in chassis design for improved handling qualities. So, for the design of the Chassis, maximum equivalent stress, equivalent strain, deformation, safety factor, and so on are significant factors. In the automobile industry, weight loss is a major issue. Steel and aluminium are commonly used for chassis. Because of the higher density, these chassis variants are rigid and hefty, resulting in lower mileage and increased mechanical losses.

The goal of this research is to minimise chassis weight by substituting inflexible solid chassis with I-section beehive chassis, as well as compare composite materials such as Kevlar, Aluminum Alloy. Because the densities of the materials are lower than those of conventional materials, the chassis weight is reduced, resulting in increased load bearing capacity, reduced fuel consumption, and improved overall vehicle performance. The original chassis and the beehive structure are modelled and compared. The best material suited among three materials is studied using static structural analysis to determine which type of chassis weighs the least. SOLIDWORKS is used to model the chassis, and ANSYS is used to do the analysis.

I. INTRODUCTION

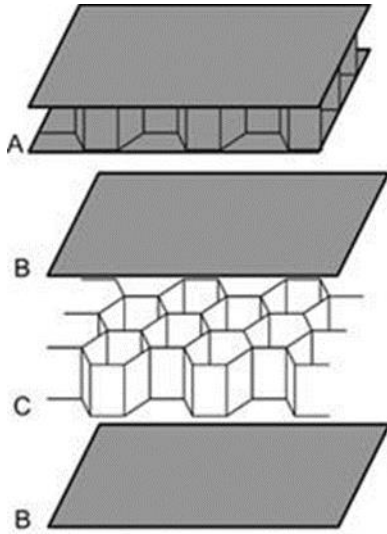
The vehicle chassis is a skeletal frame in which various mechanical parts such as engines, tires, axle assemblies, brakes, and steering are bolted together.

The chassis is considered the most important component of the car. This is the most important factor in providing strength and stability to the vehicle in a variety of conditions. The car frame adds strength and flexibility to the car. The backbone of a car is a structural frame to which the body of the engine and the axle assembly are mounted. The chassis of a vehicle is considered one of the key structures of an automobile. It usually consists of a steel frame that holds the body and engine of the car. More specifically, an automobile chassis or chassis is a skeletal frame in which various mechanical parts such as engines, tires, axle assemblies, brakes, and steering are bolted together. At the time of manufacture, the car body is flexibly molded according to the structure of the car body. Car chassis are usually made of lightweight sheet metal or composite



plastic. It provides the strength needed to support vehicle components and the payloads placed on them. The chassis or chassis of a car helps maintain the stiffness, stiffness, and stiffness of the car. The car chassis guarantees low levels of noise, vibration, and harshness throughout the vehicle.

- BEEHIVE STRUCTURE INTRODUCTION:



Beehive structures are natural or man-made structures with the geometry of a beehive to allow for the reduction of the quantity of material utilised in order to achieve minimal weight and material cost. beehive structures come in a variety of shapes and sizes, but they all have an array of hollow cells produced between thin vertical walls in common. Columnar and hexagonal cells are commonly found. A beehive-shaped structure gives a material low density and high out-of-plane compression and shear capabilities.

INTRODUCTION OF FRAME

The frame is the main structure of the chassis of an automobile. All other components are connected to it. One term for this is design, body-on-frame structure. In 1920, every car had a frame except some motorcycle-based cars. Since then, almost all cars have moved to body structures, but almost all trucks and buses still use frames.



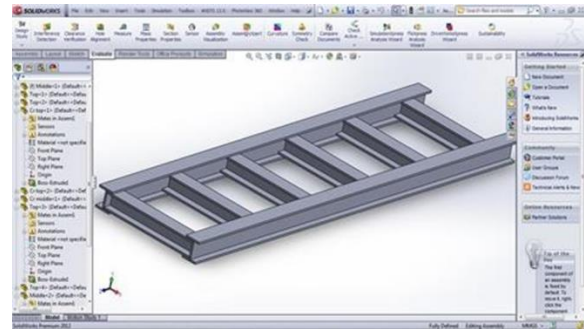
Property

Combined with the two skins applied to the beehive, the construction provides a sandwich panel with excellent rigidity and minimal weight. The operation of the beehive structure is orthogonal anisotropy. This means that the panel reacts differently depending on the orientation of the structure. Therefore, it is necessary to distinguish the symmetric direction of, the so-called L direction and W direction. The L direction is the strongest and hardest direction in. The weakest direction is 60° from the L direction (in the case of a regular hexagon), and the most adaptable direction is the W direction. Another important property of the honeycomb sandwich core is Compressive strength. Due to the efficient hexagonal construction in which the walls support each other, the compressive strength of the honeycomb core is usually higher (for the same weight) compared to, for example, other sandwich core structures. B. Core made of foam or corrugated core.

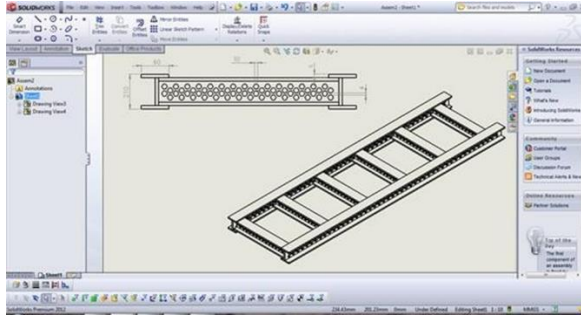
Chassis Modeling

Chassis modeling is done using Solidworks software. This is 3D parametric modeling software widely used in the design of the automotive sector.

Modeling of rigid solid chassis:



Detailing of BEEHIVE chassis



Chassis Analysis

ANSYS is a general purpose finite element analysis (FEA) software package. Finite element analysis is a numerical method that breaks down a complex system into very small pieces (of user-defined size) called elements. The software implements equations that control the behavior of these elements and solves them all. Create a comprehensive description of how the entire system works. These results can be displayed in tabular or graph format. This type of analysis is typically used to design and optimize systems that are

too complex to analyze manually. Systems that can fall into this category are very complex due to their shape, scale, or governing equation. ANSYS is a standard FEA educational tool found in the mechanical engineering departments of many universities. ANSYS is also used in the divisions of Civil Engineering, Electrical Engineering, and Physics and Chemistry. ANSYS provides a cost-effective way to study the performance of a product or process in a virtual environment. This type of product development is called virtual prototyping. Virtual prototyping technology allows users to perform different scenarios and optimize their products long before production begins. This reduces the risk and cost levels of ineffective designs. The multifaceted nature of the ANSYS also provides a means for users to see the impact of the design on the overall operation of the product, such as electromagnetic, thermal, and mechanical.

Material Properties:

Property	Kevlar	Aluminum Alloy	ASM A710 steel
Young's Modulus (GPa)	72.5	70	83
Poisson ratio 1/m	0.35	0.30	0.26
Yield strength (MPa)	527	225	456
Density (g/cm ³)	14.20	2.5	7.80

COMPARISON OF RESULTS

Models	Materials	Total Deformation in mm	Von stress missis i n N/mm ²	Volume in mm ³
Standard rigid chassis	A710 steel	3.14298	150.917	221560.30
	Aluminum Alloy	2.06775	202.66	
	Kevlar	1.6542	237.155	
Bee hive chassis	A710 steel	2.2213	167.359	192920.80
	Aluminum Alloy	1.234	220.209	
	Kevlar	0.9872	264.25	

CONCLUSION

In this project, chassis is modeled with beehive structure and without beehive structure. Cross section of the chassis is I section. It is used with materials like Kevlar Aluminum Alloy, A710 steel. By observing the structural analysis results, the stress and deformation values are slightly less for with beehive structure chassis compared to without beehive structure chassis. Finally, based on results it is concluded that weight reduction is the major consideration of the chassis is reduced nearly to 18% using honey comb structure chassis compared to without beehive chassis. By reducing the weight, the mileage of the vehicle increases. A analysis using a variety of materials finally concluded that Kevlar with a Beehive chassis was the best composite.

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