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Design and Optimiozation of Front A – Arm Suspension System for Speciqal Purpose Electric Vehicle

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Abstract

An electric vehicle also called as EV is a vehicle that makes use of the electric motors for its operation. It can be operated by a set of electronics system, with power from an external battery source also from the solar panels and sometimes from converting fuel to electricity using fuel cells. This project is mainly focused on the comfort and handling area of the EV's and hence worked more on the suspension system. Suspension system is basically used to gain good road holding while driving, cornering events and sudden braking conditions and also to keep the proper steering geometry while various road conditions. Another important reason for suspension system is to offer comfort to the occupants against road shocks and provide a riding comfort. In this project, we extensively worked on the suspension system types, its design, optimization and manufacturing aspects for the initial prototype. A – Arm suspension system was selected for the study and an initial concept of the suspension system was made using Creo Parametric Software and then the optimization was performed using M.Sc Adams software for better handling behaviour. Manufacturing drawing were also created for initial prototype build.

1.0 Introduction

An electric motor drives an EV, rather than a fuel-burning internal-combustion engine, which produces power and torque. As a result, electric vehicles are a wonderful alternative for internal combustion automobiles in terms of reducing pollution, global warming, and natural resource depletion, among other issues. The notion of electric vehicles has been around for a long time, but it has gotten a lot of attention in the last decade due to an increase in the carbon footprint and other environmental implications of internal combustion vehicles. Electric vehicles (EVs) play a critical role in combating climate change throughout the world by reducing emissions and reducing reliance on fossil fuels. When it comes to handling and comfort, the electric vehicle's suspension and steering systems are quite crucial. Through springs, shock absorbers, and axles, the vehicle's chassis is connected to the front and rear wheels. Suspension system refers to all of these components that work together to safeguard parts from being damaged by shocks. The springs link the vehicle chassis to the axles instead of the axles directly. Its purpose is to protect the vehicle from road shocks so that bounce, pitch, roll, and sway can be reduced. These road shocks make for a bumpy ride and put a strain on the vehicle's construction and body.

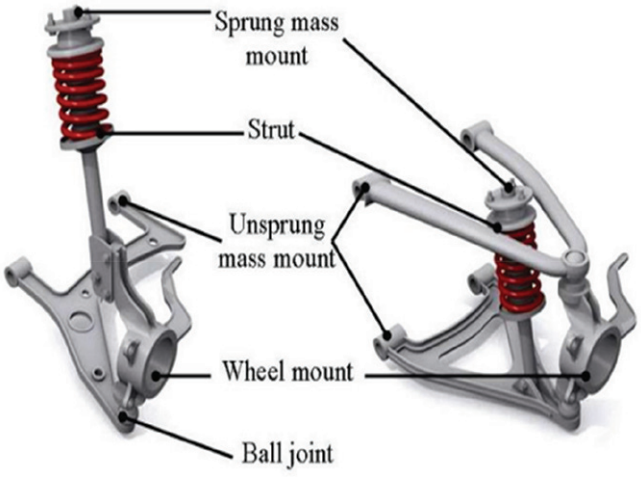
2.0 Types of Vehicle Suspension System

Independent Vehicle Suspension System

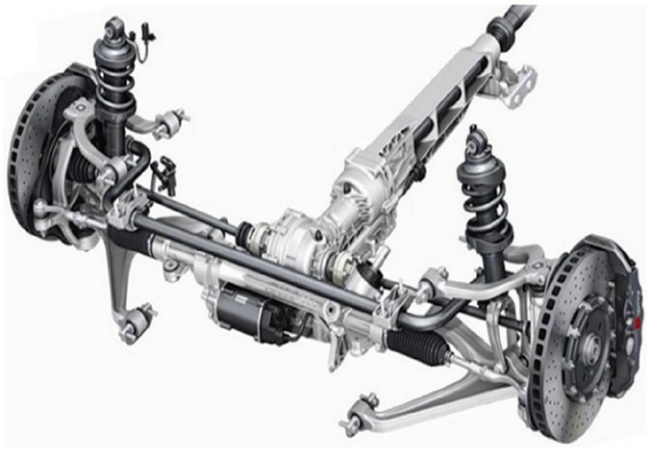
During driving on an uneven road surface, the suspension allows the vehicle's wheels to move up and down vertically independently. Because there is no mechanical relationship between the two hubs of the same vehicle, a force exerted on one wheel has no bearing on the other. It is installed in the front wheels of most vehicles to improve handling.

Dependent Suspension System

Dependent Suspension is a particularly stiff connection that connects the long axle's two wheels. A force applied on one wheel will also impact the vehicle's opposing wheel.



MacPherson Strut Suspension System



Double Wishbone Strut Suspension system

Abnormalities harm the connected wheel for each wheel motion produced by road irregularities.This type of suspension is commonly used in trucks and other large vehicles. It has a higher capability for absorbing road shocks than independent suspension.

3.0 Problem Statement

Aim of the Project

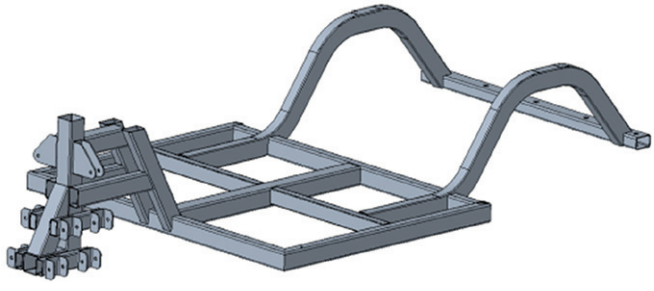
To Design and optimize the prototype model of the double wishbone suspension system for a special purpose electric vehicle.

Project Objectives

- To review the literature on "the scope of electric vehicle market in the world.
- To select the best type of the suspension system for the vehicle based on the handling, comfort and other parameters.
- To design a concept suspension system model in Creo parametric.
- To arrive at the optimized hard points for the suspension system.
- Finding the exact location of the rack and pinion

Methods and Methodology

- Literature review study for the type of suspension system selection is carried out.
- Study of the technical parameters related to suspension system.
- Building the car model using Creo Parametric with approximate hard points.
- Perform Adams analysis on the concept and optimize the hard points.
- Redesign the suspension system based on the optimised hard points.



Vehicle Chassis Structure

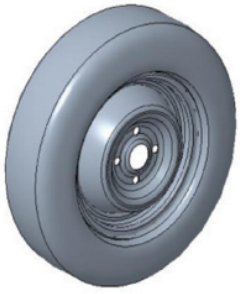
Experimental setup/Mathematical Modelling

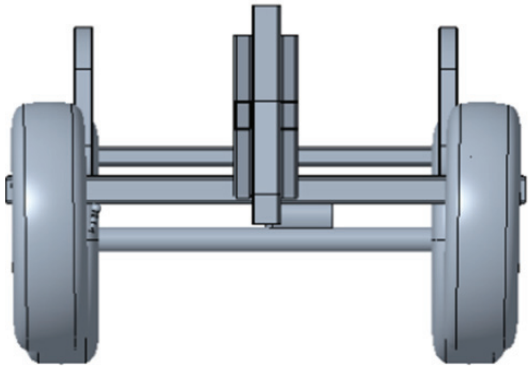
1	DIMENSIONAL FEATURES	Seating Capacity	nos	4 Person
2		Pay Load	Kg(lbs)	320 Kg
3		Wheel Base	mm(inch)	1660/1665
4		Wheel Track- Front	mm(inch)	870/874
5		Wheel Track- Rear	mm(inch)	998
6		Overall Width	mm(inch)	1210
7		Overall Height	mm(inch)	1935
8		Overall Length	mm(inch)	2715
9		Turning Radius	mm(inch)	3315/3350
10		Ground Clearance	mm(inch)	140
11		Steering Wheel Top to Foot Board	mm(inch)	970
12		Steering Wheel Front to Seat Back	mm(inch)	530
13		Weight without Batteries	Kg(lbs)	Not Checked
14		Weight with Batteries	Kg(lbs)	Not Checked

Specitic Dimension Requirements

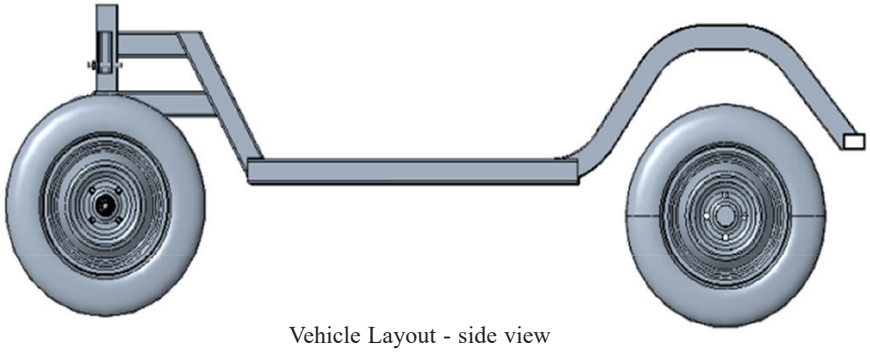
The CAD model of the car chassis structure is made using the concept vehicle technical inputs from the customers.

Wheel design as per standard wheel.

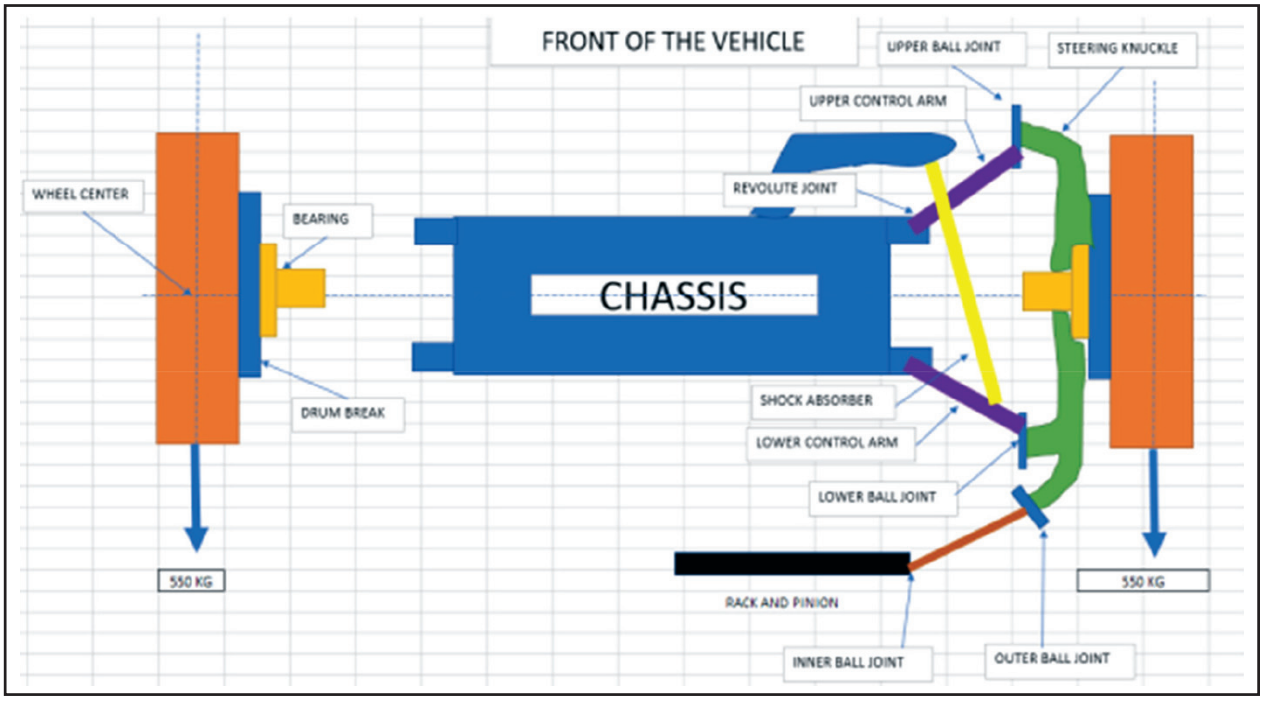




Vehicle Layout - front view

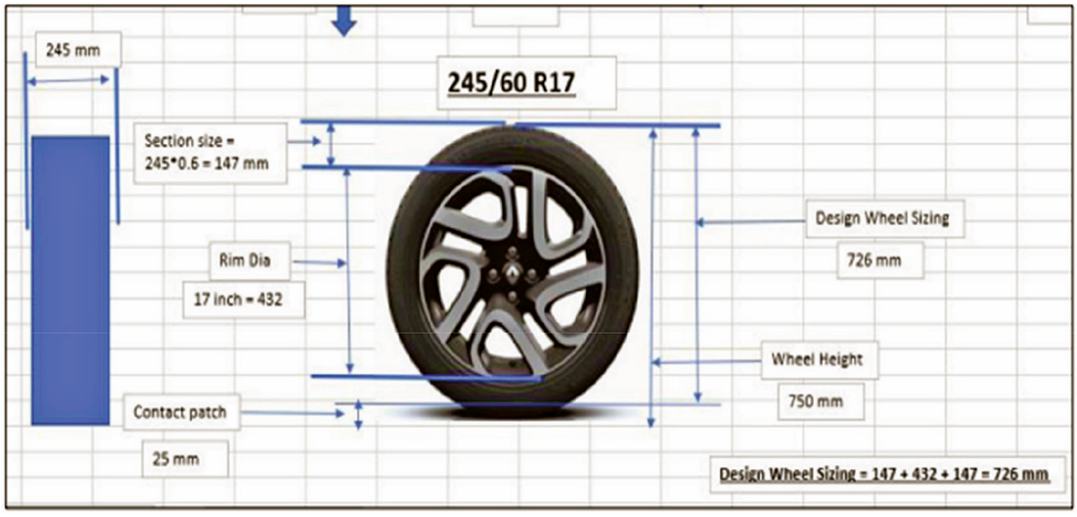


Vehicle Layout - side view



Suspension system concept 2D

Wheel Specification



Suspension Hard Points Table

	Hard Points in suspension	Data Points				Hard Points in suspension	Data Points		
	Point	X	Y	Z		Point	X	Y	Z
1.	Wheel center				6.	Shock Absorber upper joint			
2.	Upper control ARM revolute joint				7.	Shock Absorber lower joint			
3.	Lower control ARM revolute joint				8.	Inter ball joint			
4.	Upper control ARM ball joint				9.	Outer ball joint			
5.	Lower control ARM ball joint								

4.0 Conclusion

It is concluded that, the suspension parameters like camber, caster, toe in/out, steering rack and pinion position and other important points are very much important in fine tuning the suspension system for better handling of the vehicle. Also, it is always preferred to have a understeer effect on all the passenger cars and special purpose vehicles.

5.0 References

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