

# Fatigue Analysis of Front Wheel Hub for FSAE Vehicle

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**Abstract** – This paper represent design and analysis of front wheel hub for FSAE vehicle. Wheel hub continuously undergo cyclic load, so there may be chances of induce fatigue, this lead to failure of material. Fatigue is basically initiation and propagation of cracks in material due to cyclic loading. So we need to analyze model so it should not brake in between the race. By selecting proper material we can reduce fatigue. By studying properties of various material we selected Al 7178 alloy for wheel hub. By designing CAD model and analyze using ANSYS software we can predict fatigue life of wheel hub.

**Key Words:** Wheel hub, Fatigue Analysis, ANSYS, SOLID WORKS, Optimisation.

## 1.INTRODUCTION

Formula SAE (Society of Automotive Engineers) is international competitions in which teams of students compete to design and manufacture the best performing racecars. The Formula SAE competition series tests the ability of students to design, manufacture and tune an open wheel racecar under a strict set of rules.

In this project we will design a hub of front wheel assembly. Hub is a part of wheel assembly of a car. Hub is rotating part of assembly where disk is mounted on one side and wheel is mounted on other side. Hence it is important to design this part by considering various safety considerations. Proper material selection is to be taken in consideration as well as cost is also important. Design is to be done by keeping in mind the safety of the part and manufacturing point of view.

Hub is subjected to time varying load during service life leading to induced fatigue. Hub should bear number of cycles and should not brake at the middle of race. So by doing fatigue analysis we can predict up to what condition it can sustain.

## Literature review

There are so many researchers who did study on stress-strain fatigue characteristics of wheel hub using FEA.

Design and optimization of wheel hub for formula ATA race car by Abhishek Dabb<sup>1</sup>, Aditya Mukati<sup>2</sup>, Yuvraj singh Rathod<sup>3</sup>, Anujith Nair<sup>4</sup> Adil Radhanpura<sup>5</sup>, Shantanu Gadekar<sup>6</sup>. In these paper, it redesigned the wheel hub and reduce the unprung mass on wheel hub for better performance and to improve traction between tire and road.

Design and Analysis of Hub and Knuckle of FSAE Race Car by Mr.Sangram K. Pisat<sup>1</sup> Mr.Aditya S. Phule<sup>2</sup> Mr.Rohan R. Shinde<sup>3</sup> Prof. Arun V. Javir<sup>4</sup> In this paper the proper selection of material by comparing various metals and focus on reducing weight.

Fatigue based design and analysis of wheel hub for student formula car by simulation approach.

V Gowtham, A S Ranganathan, S Satish, S John Alexis, S Siva kumar In this paper, for reduce the weight of wheel hub a new model of wheel hub is designed for SF cars. The design was done based on requirements, load acting on wheel hub. The weight of wheel hub reduced considerably when compared to OEM hub.

Design Analysis & Optimization of Hub Used in FSAE Car Pruthviraj Vitthal Wable, Sahil Sanjog Shah.

In this the implement shape optimization for weight reduction by comparing material and shape optimization techniques they can reduce up to 40%of weight.

Material Optimization of Wheel Hub using Finite Element Analysis Sangram B. Kokate, Gururaj R. Kulkarni .In this paper, the comparison of various metals is shown. By considering metal they select metal which have high strength and low density materials. They also consider the cost of metal.

## Problem definition

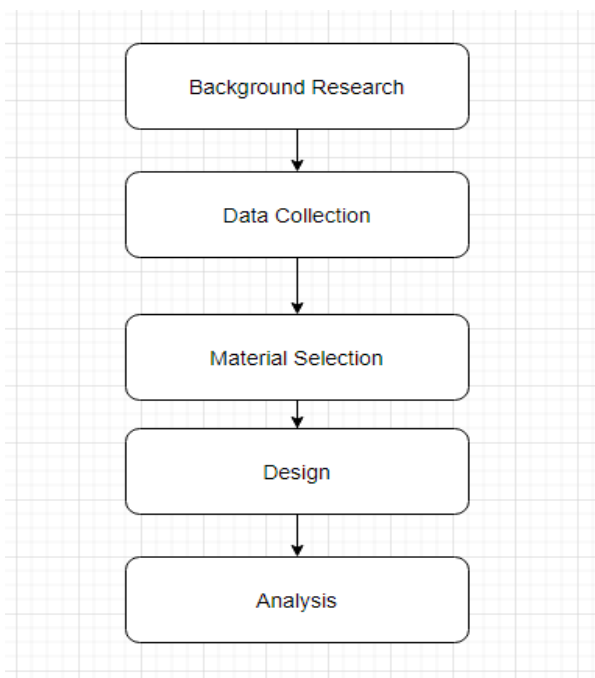
- Hub should not brake in between the race for that we need to analyze it.
- By analysis we can predict its fatigue life up to how much load it can sustain.
- Current material of wheel hub has more weight.
- Wheel hub can bend or break during cornering and bumping and sudden braking.
- Cost of manufacturing is more.

## Objective

- To find simple and optimum design for wheel hub.
- To predict fatigue life of wheel hub.

- To increase lifespan of hub by selecting best material.
- Production process should be easier and affordable.
- Overall weight of the hub should be kept minimum as possible.

### Propose system



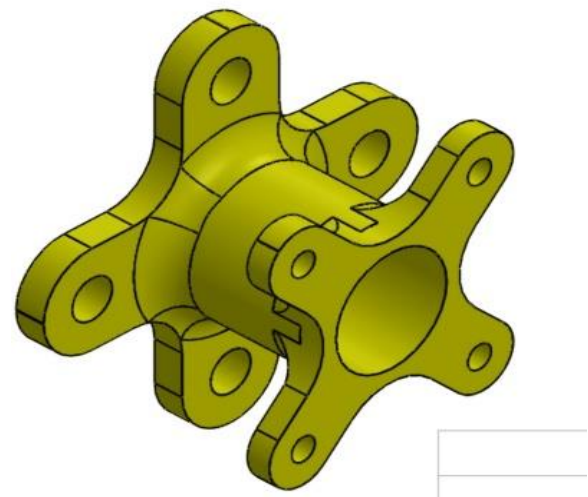
**BACKGROUND RESEARCH:** by referring various papers done on wheel hub we understand key area of research done so far.

**DATA COLLECTION:** after background research we will collect useful data require for project.

**MATERIAL SELECTION:** After finding out factor affecting on fatigue life of wheel hub, according to load applied, stress induced and considering weight we have selected best material for wheel hub.

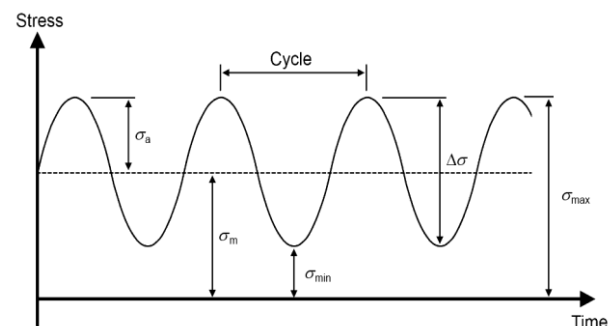
**DESIGN:** Using SOLID WORKS software we made CAD model of wheel hub.

**ANALYSIS OF HUB ON ANSYS SOFTWARE:** after finding load and other required parameter we will do analysis to find out fatigue life of wheel hub using ANSYS software.



### Fatigue Analysis:

In fatigue life analysis it is important to distinguish stress amplitude, maximum stress and stress range. stress range drive fatigue damage than the maximum stress. Going hand in hand stress amplitude  $\sigma_a$  and mean stress  $\sigma_m$  are important parameters in fatigue life analysis.



After fatigue analysis of wheel hub we can predict

Fatigue life of wheel hub.

Fatigue damage at a specified design life of wheel hub.

Fatigue factor of safety.

### Conclusions

- Design of wheel hub was made using suitable parameters on SOLIDWORKS software.
- The proper designed assembly can gives the stability during the rotation of wheel.
- Based on fatigue analysis we can predict fatigue life of wheel hub.
- We can design wheel hub with good factor of safety.
- We can reduce the cost of wheel hub which is cheaper than OEM.

**References**

1. Design and optimization of wheel hub for formula ATA race car by Abhishek Dabb1, Aditya Mukati2, Yuvrajsingh Rathod3, Anujith Nair4 Adil Radhanpura5, Shantanu Gadekar6.
2. Design and Analysis of Hub and Knuckle of FSAE Race Car by Mr.Sangram K. Pisat1 Mr.Aditya S. Phule2 Mr.Rohan R. Shinde3 Prof. Arun V.
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