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# DESIGN AND ANALYSIS OF WHEEL HUB

Sachin S. Natu
BE Department of mechanical Engineering
Dr. D.Y. Patil COE & Innovation, Varale, Pune, India

Deepak P. Mali
BE Department of mechanical Engineering
Dr. D.Y. Patil COE & Innovation, Varale, Pune, India

Gopal D. Mali
BE Department of mechanical Engineering
Dr. D.Y. Patil COE & Innovation, Varale, Pune, India

Nikhil V. Marathe
BE Department of mechanical Engineering
Dr. D.Y. Patil COE & Innovation, Varale, Pune, India

**ABSTRACT: Wheel hub assembly uses various methodologies for analysis of Mahindra TUV wheel hub and upright assembly. Our primary aim is to carry out analysis and optimization of the forces applied on the vehicle assembly structure. This review will help researchers working in the field of development of the structural design, analysis and mass reduction of vehicle through optimization methods conducted by FEA software and Catia V5 and Ansys (Workbench 16). Stationary load and fatigue load simulation by Ansys software and analysis is done by using this method in FEA Software.**

**Keywords**: **Wheel hub and upright, WHA, FEA**

## I. INTRODUCTION

Wheel and upright assembly or the knuckle assembly is the important part of vehicle suspension system. Hub and upright assembly are support to vertical weight of the vehicle and transfer the motion vehicle into wheel. The design of wheel hub is important thing in reduction of weight of vehicle. The improvement in technology causes weight or mass reduction for this technology used are material selection, design analysis and optimization method. The whole mass or weight of vehicle is transfer to wheel by hub. Hub is attached to motor shaft which transfer the motion into wheel. The vehicle which required large speed such as sport car, it is require that their mass or weight should be minimum. It is mandatory for a Designer to have knowledge of the product design and analysis, versatile optimization techniques, physical material selection.

## II. EASE OF USE

The main purpose of wheel hub is to support the vertical weight or mass of vehicle. The conventional wheel hub is mostly made up of material Cast Iron (Mahindra TUV). In our case the material used are Carbon fiber and Kevlar, Magnesium alloy, Aluminum alloy, Stainless steel 304, which have more stress capacity and also more strength.

## III. LITERATURE REVIEW

In this paper the study was done for the optimization of vehicle, for this various techniques are used. This research is done for the structural development of design and reeducation of mass. For this process FEA software is used such that Catia V5 R20 and Ansys. Due to adding of composite material it increases stress capacity of wheel hub. [1]

In this paper using the concept of product design and development in order to design, analyze, manufacture and test of wheel hub for an All-Terrain Vehicle. For reduction of cost for material and manufacturing, we compared the result of various materials and various deign and selected the optimum combination of material and design for manufacturing. This results in quality product with competitive costs. [2]

In this paper it is assumed that the driving torque and break torque are not vary, as they are transient in nature the actual stress are more. Even then the maximum stress will be very less than the endurance limit of carbon steel, mild steel and cast iron. [3]

In this paper describe process of design and optimization of wheel assembly of a formula student car. In automobile system wheel hub and steering knuckle attached wheel to motor shaft (axle). [4]

In this paper studied on "simulation and optimization of wheel hub and upright of vehicle" there are various types of technique adopted for upright assembly and wheel hub. This paper discusses on analysis and shape optimization of vehicle. The review will assist shape development, static load and fatigue load analysis using FEA software. [5]

## IV. PROBLEM STATEMENT

The Automotive suspension a steering upright is the part which contain wheel hub component, variously is called as steering knuckle, spindle or hub. The wheel is attached to hub with fasteners. The present TUV hub is made from cast iron which has more the weight affecting the efficiency.

## V. PREVIOUS RESEARCHES

The wheel hub analysis and design are carried out by using the composite material [Carbon fiber (2%) +Kevlar (0.8)] in stainless steel material and make hub model. This paper concludes that adding the composite material on the stainless steel, result is increasing the stress capacity of wheel model.

## VI. EXPERIMENTAL WORK

In this experiment adding material namely Aluminum alloys, Magnesium alloy, Carbon fiber and Kevlar and Stainless steel 304. By analyzing this material and compare with present wheel hub after comparing all this material the best results out of them take into account for further process.

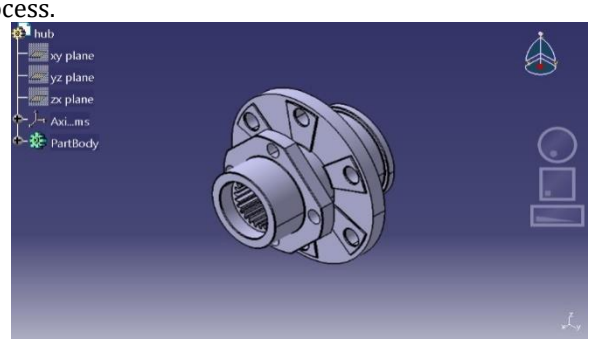


**Fig. 1: Catia model of TUV wheel hub**

- CALCULATIONS

Brake pedal force:

1. The Brake applied on the pedal is assumed to be 300N (30.6 kgf)

Pedal ratio of every 4-wheeler is 6:1

$f_{max}$ = force × pedal ratio

= 294.3 ×6

= 1800N.

Where,

$f_{max}$ = force applied onto the master cylinder)

Hence, $P = \frac{fmax}{(\frac{\pi}{4})\times d2}$

(P =hydrostatic pressure, d = diameter of master cylinder's piston)

$F_{max} = P \times \frac{\pi}{4} \times D^2$ [by Pascal's Law]

($F_{max}$ = force acting on each Cylinder, D = diameter of the piston Cylinder in the caliper) By Solving,

$F_{max} = f_{max} \times (\frac{D}{d})^2 = (1800) \times (0.03 / .019)^2 =$ 4487.53 N

Torque acting on the disc:

$T = F_{max} \times \mu \times Re \times$ number of pistons per caliper = 4487.5346 ×0.3 × 0.097 ×3= 391.76N-m

μ = Coefficient of friction between brake pad and disc (0.3), Re = Radius of the disc.

Max velocity of Vehicle =156 kmph. Mass of the vehicle=2225kg

From Newton's second law of motion:

F = m × a

= 2225 × 9.81= 21827.25 (N)

F= 21827.25 N

Force Applied on each Wheel

=F/4

= 21827.5/4

F = 5456.8125 N.

## VII. ADVANTAGES

1. This Wheel hub is less in weight (Al Mg alloy, Carbon fiber and Kevlar) as compare to conventional CI wheel hub.
2. It has High torque transmitting capacity. Due to less weight increase efficiency and speed.
3. It has high corrosion resistance.
4. High strength to weight ratio.
5. Low Thermal Expansion.

## VIII. ACKNOWLEDGEMENT

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