'DESIGN AND ANALYSIS OF ATV WHEEL ASSEMBLY'

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ABSTRACT: In automobile industry it is essential to produce the light weight assembly in order to increase the vehicle performance. Also, lots of forces during braking, acceleration and bump conditions are also applied directly during dynamic condition. So, the project is concerned with design, analysis and manufacturing of knuckle and hub. The objective of this paper is to reduce weight and performance of vehicle. This paper deals with calculation of various loads and their simulation. We also have used the lotus to find the hard point of the knuckle to improve the steering geometry as well as the suspension geometry of vehicle. The FEA result indicates that the upright assembly is able to perform safely in real track condition as per performance requirement.

It must also be noted that the components must be designed in such a way that they have a minimum weight at the same time care must be taken that they do not cross a certain limit of stress value. In this Project, the Complete Design Procedure of the Wheel Assembly for AT-111 Rims with Tires (23*7*10) has been presented along with the optimization of the same components. The weight of the vehicle is considered to be 300 kg along with the driver. The project illustrates the forces acting on the components, the failure criteria, and the optimization of the components. The project deals with finding out the dimensions of the individual components and also detecting the probable regions of stress concentration. The design procedure follows all the rules laid down by FMAE Rule Book for Quad bike design challenge.

Keywords ATV, design, wheel assembly, optimization, analysis, knuckle, hub.

INTRODUCTION

There are always two types of masses in an automobile – sprung and unsprung mass. All the mass of the vehicle that is damped by the spring is called the sprung mass. As the Wheel Assembly mass is not damped by the spring, it comes into the unsprung mass category. We know that the unsprung mass must be lower than the sprung mass and also should be as least as possible to provide proper drive stability and load balancing of the vehicle. Thus, it becomes important to reduce the mass of the wheel assembly and the rims and tires. But while doing this care must be taken that the mass of the wheels, tires, and the wheel assembly must be enough to prevent the lateral toppling of the vehicle at the time of cornering or impact.

There are a lot of forces acting on the wheels in the static and especially in the dynamic condition. As the Wheel assembly is directly connected to the wheels, all these forces also have an impact on the designing of the Wheel Assembly. A lot of forces act on the wheel assembly during accelerating, braking, cornering, and tilting.

A good Wheel Assembly is one that can sustain such forces over a longer period. Thus, it is required to design the wheel assembly considering all these factors. A failure of any component of the Wheel Assembly means a breakdown of the automobile and in some cases might also be hazardous for the driver. Thus, utmost care must be taken while designing the Wheel Assembly. The objective of Optimization is always to find the best possible and suitable dimension. This is because optimization does not always mean reducing dimensions it also means finding out the dimensions which will be just enough to sustain the force.

AIMS AND OBJECTIVES

The aim of this project is to optimize the performance of automobiles by reducing the weight and removing stress acting on it by designing and analysis. According to the calculation using the right material to reduce size and weight.

LITERATURE REVIEW

[1] Designing and Optimization of Wheel Assembly of a Formula Student Car Joijode Vrushabh Umesh†* and Yadav Abhishek† †Mechanical Engineering Department,

Vishwakarma Institute of Technology, 666, Upper Indira Nagar, Pune-37, India Accepted 02 March 2016, Available online 15 March 2016, Special Issue-4 (March 2016)

Upright is a part of the wheel assembly which holds the hub and allows rotation of the wheel. The forces from the tire contact patch are transmitted by the upright to the suspension links. The suspension geometry of a standard FSAE race car has been used for the calculation of the forces. The target values for concerning and braking have been set according to the tracks present in the FSAE International events. Tire data has been used to find out the friction coefficient at the contact patch which varies to the normal load on it.

[2] Design and ANSYS analysis of Components of Wheel Assembly of SAE Car Sameer Santosh Mahadik†* †Mechanical Engineering Department, G.V. Acharya Institute of Engineering and Technology, Shelu Road, Shelu, Maharashtra – 410101, India. Received 18 Feb 2018, Accepted 20 April 2018, Available online 26 April 2018, Vol.8, No.2 (March/April 2018)

While designing and developing any automobile the designing of the wheel assembly is critical. It is due to the reason that a lot of forces are acting on the wheel assembly during accelerating, braking, cornering and tilting. Furthermore, the Wheel Assembly is an important part of an automobile and its failure is hazardous endangering human life. Therefore, is required to design the Wheel Assembly and its components considering all the factors leading to the failure by developing a safe Design. It must also be noted that, the components must be designed in such a way that they have a minimum weight at the same time care must be taken that they do not cross a certain limit of stress value Optimization has been carried out by doing analysis of the components in Hyper works.

[3] 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. Javir 1,2,3,4Department of Mechanical Engineering 1,2,3,4Rajendra Mane College of Engineering and Technology, Ambav, Mumbai University

The goal is to produce a lighter and performance-oriented design of upright assembly in comparison with previous car and thereby contributing in making of car of next season better than its predecessor. Use of conventional upright assembly will increase the overall weight of race car. For FSAE car, weight criteria are a main factor in making of race car and as well as competition point of view. The goal of lighter weight upright assembly can be achieved by less complex design and proper material selection. Also, the proper stiffness and reliability can be achieved by analysis of design of upright assembly.

[4] Design and Analysis of Suspension and Steering system along with the Wheel Assembly of a BAJA ATV Shripad Mane Research Scholar, Sinhgad Academy of Engineering, Pune, India Vol. 7, Issue 8, August 2018

The steering rack and pinion assembly should be mounted to the frame first before any other modifications to the steering column are made. The required alignment of the steering rack is 94 mm backward of the wheel location to allow of necessary alignment with the tie rod arm points of rotation on the knuckle. Once this is accomplished the steering column and steering wheel may be aligned to allow for the best movement of the U-joint that transfers the rotation from one axis to another. The mount for the steering column should then be welded firmly in place at the correct angle and should allow a stress free and no bending situation for the steering wheel.

[5] Design and analysis of suspension system, brakes and wheelassembly for an all-terrain vehicle – a design report Naved Khan, Dithindas Devadasan 2, Sayali Jangam3, Siddhesh Darole, Preet Shetye5, Vinayak Patil61,2,3,4, 5, E. Student, Department of Mechanical Engineering, Bharati Vidyapeeth College of Engineering, Kharghar,Navi Mumbai, India

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An ATV is supposed to have the best of the suspension systems than the other categories of vehicles. The unpredictable nature of off-road racing creates the need for a reliable and efficient suspension system. Selection of suspensions was based on the criteria of their degree of freedom, roll-center adjustability, ease in wheel alignment parameters etc.

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DESIGN OF COMPONENT

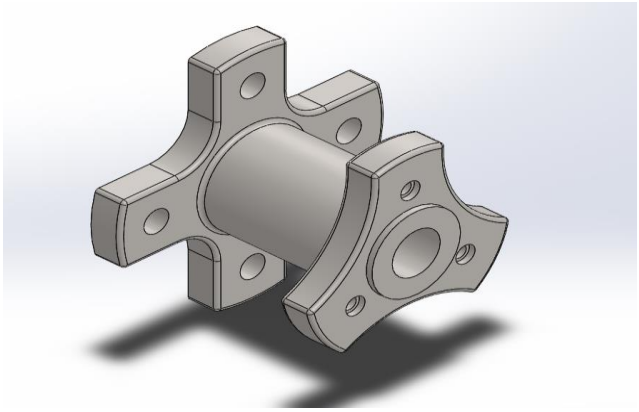

Fig. 1 Hub CAD Model

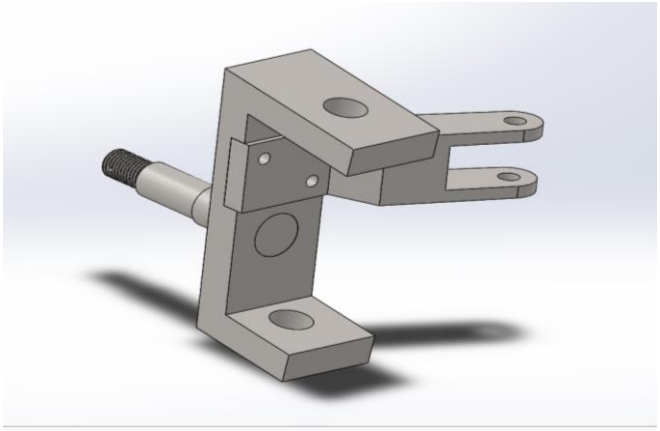

Fig 2 Knuckle CAD Model

ANALYSIS

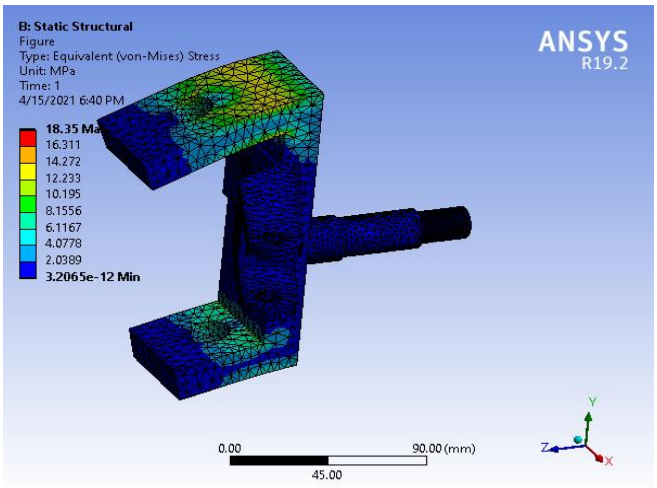

FIGURE 3
Model (B4) > Static Structural (B5) > Solution (B6) > Strain Energy

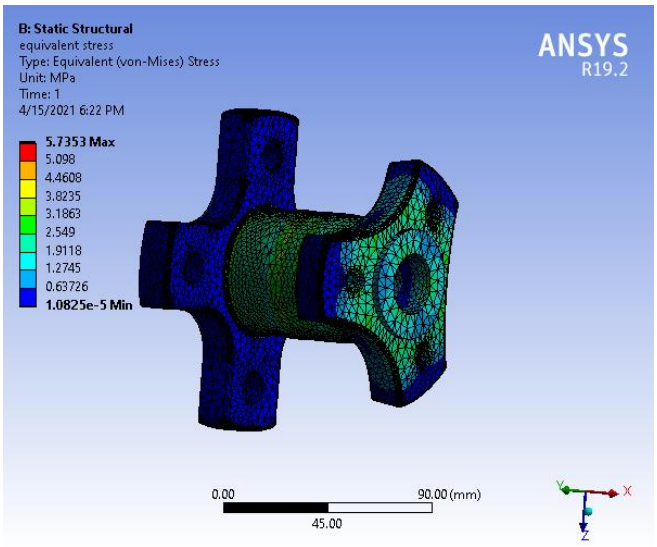

FIGURE 4
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress > equivalent stress

LOTUS RESULT

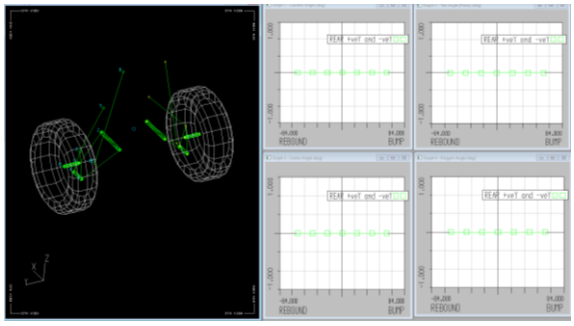

Figure 5

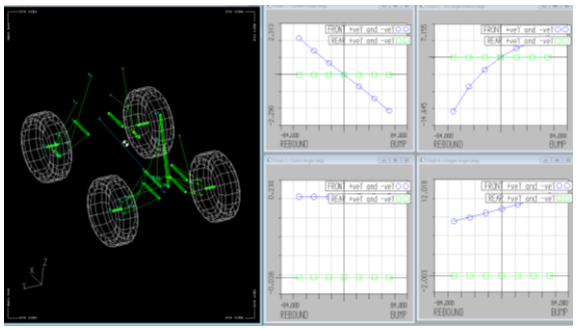

Figure 6

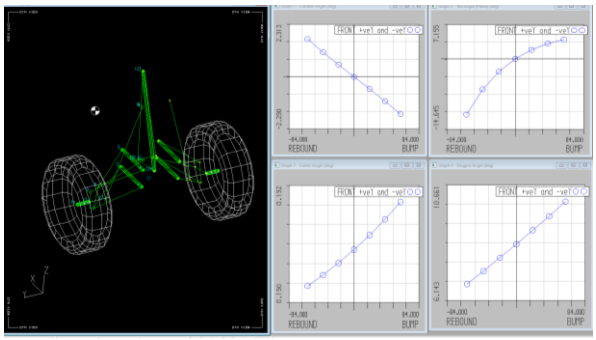

Figure 7

CONCLUSION

Following conclusions can be drawn from the paper, for a component undergoing fatigue loading, the design criteria must always be Fatigue or Endurance Strength. For carrying out optimization, material should be removed from the low stress concentration areas. In order to minimize stress concentration areas, sharp corners and edges should be avoided. If the component is subjected to fatigue failure like knuckle, then analysis of the components must be carried out in order to obtain actual stresses induced in the component. For accurate results of analysis, mesh quality must be high and failing elements must be less than 3%. As spindle serves as a component on which the assembly is press fitted, its factor of safety is taken high.

REFERENCES

[1]Designing and Optimization of Wheel Assembly of a Formula Student Car by JoijodeVrushabhUmesh and Yadav Abhishek †Mechanical Engineering Department, Vishwakarma Institute of Technology, 666, Upper Indira Nagar, Pune-37, India.Accepted 02 March 2016, Available online 15 March 2016, Special Issue-4 (March 2016)

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[3] Force Calculation in Upright of aFsae Race Car AnshulDhakar and RishavRanjan Department of Mechanical Engineering, RV College of Engineering, Bangalore, India

[4] Design and ANSYS analysis of Components of Wheel Assembly of SAE Car Sameer Santosh Mahadik†* †Mechanical Engineering Department, G.V. Acharya Institute of Engineering and Technology, Shelu Road, Shelu, Maharashtra – 410101, India. Received 18 Feb 2018, Accepted 20 April 2018, Available online 26 April 2018, Vol.8, No.2 (March/April 2018)

[5] Design and Analysis of Suspension and Steering system along with the Wheel Assembly of a BAJA ATV Shripad Mane Research Scholar, Sinhgad Academy of Engineering, Pune, India Vol. 7, Issue 8, August 2018