

Design and Development of Steering Knuckle with Spindle and its Optimization- A Review

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Abstract:-Steering Knuckle plays major role in many direction control of the vehicle it is also linked with other linkages and supports the vertical weight of the car. Therefore, it requires high precision, quality, and durability. The main objective of this work is to explore performance of the steering knuckle. This can be achieved by performing a detailed load analysis. Therefore, this study has been deal with two steps. First part of the study involves the determination of loads acting on the steering knuckle through hand calculations. Then the stress analysis will be performed using analysis software ANSYS and based on it optimization of steering knuckle will be suggested. This may also improve the depth knowledge of its function and performance in terms of durability and quality.

Keywords: Spindle, Optimization, Stress Analysis, EN8, Redesign Knuckle.

1. INTRODUCTION

Steering knuckle is main part in any vehicle because it requires lots of attention in selection because replacement has to be done if it damaged. Steering knuckle is a prominent component in car which takes the loads from the wheels and transfers these forces to the suspension system. Structural Components such as a steering knuckle is generally strong component which is capable to withstand if load is but it can fail under fatigue and dynamic load. Depending on the vehicle and suspension design, the steering hub or spindle will also vary slightly. In the design variables of vehicles like all wheel drive and front wheel drive; knuckle joint will be point at which steering is connected.

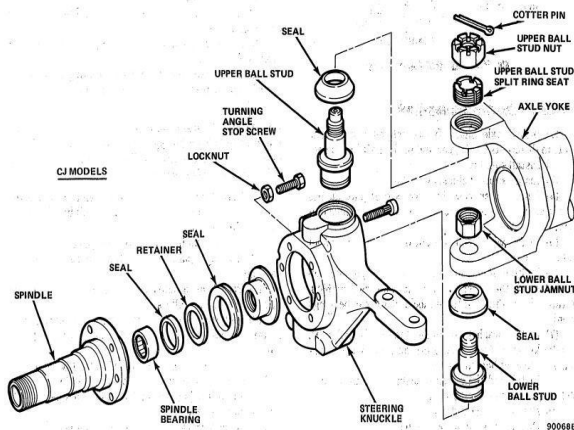


Fig No1.1 Exploded view of Knuckle joint with spindle

The vehicle wheel will attached to the exterior part nearest steering knuckle with the help of spindle or hub (as shown in Fig1.1) The suspension inboard connection and the tie rod will be connected with each other by special mounts which allows pivot movement to the knuckle to the turning motion of steering wheel. The steering knuckles keep the wheels at point on the vehicle and allow you to select the direction according to your will. It shows that knuckle joint plays an important role in automobile steering system.

2. LITERATURE REVIEW

Mehrdad Zoroufi and Ali Fatemi:- studied steering knuckle which undergoes different time-varying loads during its working life. As it under goes Fatigue stress, the behaviour of fatigue stress will have major impact on the characteristics of knuckle joint hence it should given prime importance while designing knuckle joint. This research paper aim assess fatigue life and compare fatigue performance of steering knuckles made from three different materials using different manufacturing techniques.

Chang Yong Songa, JongsooLee:-This paper discusses reliability-based design optimization (RBDO) of knuckle joint install in an automobile and its behaviour under bump and brake loading conditions. The probabilistic design problem is to reduce the weight of a knuckle component undergoing stresses, deformations, and frequency constraints in order to meet the given target reliability.

Wan Mansor Wan Muhamad:-The static analysis of steering knuckle is done by applying dynamic loading conditions and carried out using Hyper mesh. Optimization of the same is performed using shape optimization method. The main objective was mass reduction and finally the result is 8.4% reduction in mass of steering knuckle. It has also been observed that the maximum stress has not changed significantly.

Viraj Rajendra Kulkarni:-This paper focuses on optimization of steering knuckle targeting reducing weight as objective function, while not compromising with required strength, frequency and stiffness. Taking into consideration static and dynamic load conditions, structural analysis and modal analysis were performed.

4.5 Result Validation and Discussion

This work gives a experimental, analytical and theoretical study of stress analysis on different parts of steering knuckle.

The results obtained should be validated using above manual calculations and FEA report. The results of old and new design is compared and validated.

Redesigned steering knuckle is expected to perform better and it also leads to reduction in weight. The weight reduction will hence lead to better fuel efficiency

IV. CONCLUDING REMARK

By using above case studies, we can determine the working and design (always very tricky) front suspension system which also takes care of steering system attached to the same front wheel. The vehicle suspension system is responsible for the vehicle control, driving comfort and safety as the suspension carries the vehicle body and transmits all the forces between the road and the body.

Based upon studies, we can apply boundary conditions to the model and carry out analysis.

Analysis can be done on FEA software to determine the nature of failure caused due to stresses developed.

Based on analysis optimization of steering knuckle be stated.

5. CONCLUSION

From the review of the Research papers it is concluded that in most of the cases steering knuckle faces a problem that once it is damaged it has to be replaced by other. So, here is a scope for us to improve. We can make a spindle that is integrated with steering knuckle and check for its improved performance.

Acknowledgement

This project work is supported by Associate Professor S.S.Patil and Asst. Professor Mr M.L.Harugade

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