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Literature review on kinematic and dynamic analysis of McPherson Suspension

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Abstract: *McPherson suspension system is generally used as the front wheel suspension system in mostof the commercial vehicles and cars as it occupies less space and provides enough area for engine and other mechanical components. The poor design in the suspension system causes excessive vibrations and may difficult for handling. As this suspension system is widely used there are many areas yet to be covered. This paper gives the complete review of the studies carried on the Mcpherson suspension system and also suggestive design changes for the futureresearch.*

Keywords: Kinematic, dynamic analysis, McPherson strut, Suspension systems.

1. INTRODUCTION

Suspension system plays a major role in the comfort and handling of an automobile. Suspensionsystems allow dual purpose contributing to the vehicle's road holding/handling and braking for good active safety and driving pleasure, and keeping passengers comfortable and reasonably well isolated from road noise, bumps, and vibrations, etc.

The McPherson strut is very widely used as front suspension of small and mid-size cars. Fig. 1 shows a McPherson strut suspension. The McPherson strut also called as the Chapman strut,was discovered by Earl McPherson in the year 1940.

Fig. 1. McPherson strut

Lower control arm is associated with the chassis frame with the assistance of rotating joint. The strut and the chassis are placed in the middle of the spring and damper along the cylinderto retain shock and vibration which is brought by street knocks. The tie rod is additionally connected to the strut of McPherson suspension system with the assistance of round joint. Chiefly McPherson suspension system is use to help the heaviness of the vehicle which gives successful confinement for the chassis from excitations because of uneven roads, to keep up better stringing control of the wheel camber angle is kept up inside the range so tire of the vehicle stays in contact with the road surface. Suspension system for the wheel plays a significance job for holding the tires to the roads, better riding quality and limiting the transientpower to the automobile body.

This paper is the review on recent researches done by the simulation of different components interlinked to the McPherson strut suspension system by developing the CAD methodology. The highest probability of the damage occurs in the strut mount in the suspension system as it is affected by the heavy stresses caused by the road shocks. In this writing some simulation methodology which are recently utilized are reviewed depending on static and dynamic analysis like multi body simulation, FEA with the assistance of different tools. In the recent studies it is seen that the done work currently followed a methodology like

dynamic, kinematicetc., independently for various parts of McPherson suspension for example, McPherson strut, lower arm, upper and lower damper, coil spring and hub.

2. NEED OF ANALYSIS

McPherson suspension system is a significant component of vehicle which can withstand the weight of the vehicle, absorbing shocks for the road and will give comfort while riding. Road shocks gets transmitted to the wheel of an automobile and there will be a chance of opposite, parallel and extreme wheel travel because of which extreme forces occurred at several points of associated components which may tends to fail of several suspension components in dynamic condition, for example, lower arm, coil spring, strut mount, strut, axle and tie bar. So,the forces should be minimum for the effectiveness of suspension. Proper material should be chosen to maximize the strength of the suspension. To satisfy these prerequisites analysis of these parts should be carried out.

3. LITERATURE REVIEW ON THE BASIS OF TYPE OF ANALYSIS

3.1 Kinematic analysis

Kinematic investigation is utilized to characterize movement, which is the way of estimating the kinematic capacity. Kinematic analysis in a component is utilized for measuring acceleration, speed and link's position. Such sort of analysis is done to know measurements oflinkages and also acceleration, speed increase and position of its links according to the DOF the linkages have. The two distinct techniques are bringing up in a component to figure out thevelocity of a link ty the instant center of rotation method and relative velocity method

Naser Sina [2015], explored the Kinematics of McPherson strut suspension system has to upgraded in order to accomplish the ideal behavior of kinematics and to maximize dependability of the vehicle. For kinematic analysis Working Model 3D software is developedand ADAMS for the validation of procedure optimization. It wraps that the performance improvement was observed after optimization of toe angle and camber angle which is not carried out by the previous researchers.

Jorge Luiz Erthal [2007], introduced the kinematic analysis of a car suspension system which is numerically modeled adopting Davies's methodology for the thought of two types of kinematic equations that is by Kirchhoff's Circuit law and Assur virtual chains. Results appeared form the computed data of relative movement and displacement between any pairs ofbodies of the kinematic analysis and kinematic chain is a powerful tool to automatize.

3.2 Dynamic analysis

Mr. Dilip Kotiya [2015], has designed and done analysis of MacPherson strut suspension system by contrasting with double wishbone suspension system equipped to high velocity F1 cars. This suspension system is developed in CATIA V5, analysis using ANSYS software andby using Lotus Shark a suspension analysis software results are validated. In this paper the twosuspensions are compared for different conditions and summarizes that the double wishbone suspension has better results under dynamic loading when compared to the McPhersonsuspension.

Chetan S. jadhav [2014], has observed analysis of brake pull analysis and baseline parallel wheel travel of McPherson suspension and Double wishbone suspension system modeling andanalysis are carried out, the results are plotted on the graphs and the modifications depend on the joint's position. By using ADAMS software, the analysis of the two motion of the wheel I.e., brake pull and parallel wheel travel was performed. This investigation is accomplished forbetter handling and comfortable ride of the vehicle, while in past paper just numericaldemonstrating of McPherson suspension was done.

A. Purushotham [2013], improved a numerical model of the McPherson strut suspension by considering the vertical movement of the chassis as well as translation and rotation of wheel assembly, which incorporates wheel mass and its moment of inertia along the longitudinal axis.MATLAB Simulink is utilized to execute the model, whose dynamics was approved against a sensible two-dimensional model created with the help of ANSYS software. The outcomes gotfrom ANSYS model and Simulink numerical model are corelated, which shows the acceleration and displacement of the chassis of a car which gives good comfort to traveler.

Darshan Vijay [2012], done sensitivity analysis of hard point of Macpherson strut and twist beam to evaluate handling and comfort riding of an automobile. ADAMS programming, Computational Methods and Classical methods are utilized to do the sensitivity analysis. SPMM got almost equal results as ADAMS/CAR results. Consequently, the standard correlation achieved is 75% hence it gives better handling and comfortable ride for anautomobile.

Xiaobin Ning [2011], has develop an ADAMS parametric model having Knowledge Based Engineering application that points the designer to rapidly perform designing iterations by minimizing the time required for development. This module is used to analyze the dynamic and kinematic analysis of front and back suspension of a vehicle and the result shows that by the use of this module testing the suspension has offset frequency and plus excitation which reflects that the chassis meet the ride comfort.

4. Conclusion

MacPherson strut suspension system was widely used in the small and midsized cars. From this literature review it is clear that the kinematic and dynamic analysis of the suspension is done by modification of the design leads to the modified suspension system which can absorb road shocks and gives better handling and riding comfort. Also due to the maximum induced forces and wheel displacement the strut may lead to failure so, modified design in strut will reduce the failure of the suspension, which can be done in future research.

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