GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

EXPERIMENTAL & THEORETICAL STUDY OF VIBRATION RESPONSE ANALYSIS FOR LOWER CONTROL ARM OF SUSPENSION SYSTEM UNDER STATIC AND DYNAMIC LOADING

Miss. P. B. Patil*1 & Mr. M. V. Kharade[2]
*1Department of Mechanical Engineering, Dr. J. J. Magdum College of engineering, Jaysingpur (India)
[2]Department of Mechanical Engineering, Dr. J. J. Magdum College of engineering, jaysingpur (India)

ABSTRACT
All machines, vehicles and buildings are subjected to dynamic forces that cause vibration. Most practical noise and vibration problems are related to resonance phenomena where the operational forces excite one or more modes of vibration. Modes of vibration that lie within the frequency range of the operational dynamic forces always represent potential problems. Modal analysis is an efficient tool for describing, understanding, and modelling structural dynamics. The general function of control arms is to keep the wheels of a motor vehicle from uncontrollably swerving when the road conditions are not smooth. In this study Macpherson strut suspension system with Lower control arm is considered. It has an "A" shape on the bottom known as wishbone shape which carries most of the load from the shock received. The lower control arm takes most of the impact that the road has on the wheels of the motor vehicle. During the actual working condition, the maximum load is transferred from suspension system to the lower arm which creates possibility of failure in the arm.

Keywords- *FEA, Lower control arm, Modal analysis*

I. INTRODUCTION
The general function of control arms is to keep the wheels of a motor vehicle from uncontrollably swerving when the road conditions are not smooth. The control arm suspension normally consists of upper and lower arms. The upper and lower control arms have different structures based on the model and purpose of the vehicle. By many accounts, the lower control arm is the better shock absorber than the upper arm because of its position and load bearing capacities. In this study Macpherson strut suspension system with Lower control arm is considered. It has an "A" shape on the bottom known as wishbone shape which carries most of the load from the shock received. The lower control arm takes most of the impact that the road has on the wheels of the motor vehicle. It either stores that impact or sends it to the coils of the suspension depending on its shape. The present study will contribute in this problem by using finite element analysis approach.

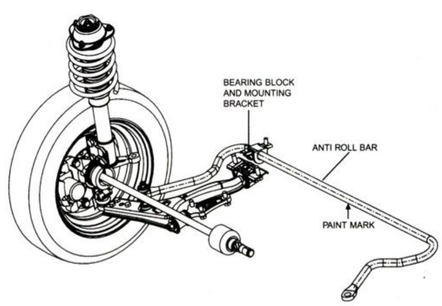


Fig: location of lower control arm

II. RELEVANCE
Independent suspension (i.e. double wishbone, McPherson and multilink) leads to better ride and handling capabilities. It is important to analyze the suspension systems that have been designed to predict the behavior of the system than followed with improvements. The suspension must be properly designed because it is a crucial subsystem in vehicle in order to:

• Carry the weight of vehicle and also its weight (unsprung weight).

• Keep the wheels perpendicular to the road for maximum grip resultant good ride and handling performance.

ISSN 2348 – 8034
Impact Factor- 3.155

• Take the forces for accelerating or braking the vehicle.

• Ensure that steering control is maintained during maneuvering.

• Take the forces involved when cornering the vehicle.

Many loads act on the Lower control arm which can cause its failure.

The following dynamic conditions are considered for the calculations

- Road bump
- High speed cornering
- Sudden braking

Vibration and modal analysis is carried out to find out deformation, von-mises stress plots and natural frequency of the component.

Fig: Lower control arm

III. OBJECTIVE

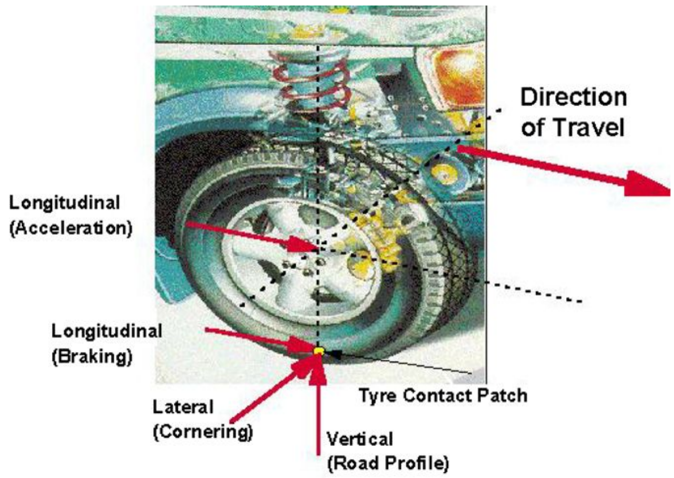
The main objective of the study is to find frequencies at different mode shapes. Care must be taken that these frequency is not close to the surrounding frequency to avoid resonance condition.

To achieve this objective following steps must be taken:

- To study various research papers to know the work done on lower control arm.
- To draw CAD model in CatiaV5
- Study boundary conditions and loadings acting on the lower control arm.
- Carryout analysis.
- Conclusion

IV. PROBLEM STATEMENT

Subjected to combination of forces rolling, pitching, braking, Acceleration, bumps, ditches, Deformation occurrence is observed and sometimes break down. Optimization of the shape considering maximum deformation analysis at different modes and to avoid resonance frequency break to ensure that potentially catastrophic structural natural frequencies or resonance modes are not excited by the frequencies present in the applied load



V. SCOPE

It is proposed to do vibration analysis on control arm, as per the following:

- Experimental Analysis: Testing the control arm under actual conditions and carrying out the calculations.
- Theoretical Analysis: Running the problem in any FEA software and comparing the results with the experimental analysis.

VI. METHODOLOGY

- CAD Model Generation
- Input parameters:- Input parameters will be getting through reverse engineering. Reverse engineering will follow a method of hand calculation using blue light scanning.
- Model creation in CATIA V5 from input parameters.
- Determination of loading for road bump case, when a car is moving.
- FEA analysis of lower control arm discretized model by applying the required boundary conditions and for the various loadings and carrying out modal and vibration analysis.
- Testing will be carried to validate analysis results.
- Validation

VII. LITERATURE REVIEW

The general function of control arms is to keep the wheels of a motor vehicle from uncontrollably swerving when the road conditions are not smooth.A complete FEM analysis of a 3-D solid parametric model of a suspension link for bending vibrations, pitching, bouncing and combined mode dynamic analysis for deformation and stresses is done[1], An experimental device have been developed to study fatigue phenomena for nodular cast iron automotive suspension arms. On the base of a detailed fracture analysis, it is shown that the major parameter influencing fatigue failure of casting components are casting defects: the High Cycle Fatigue behavior is controlled mainly by surface defects such as dross defects and oxides while the Low Cycle Fatigue is governed by multiple cracks initiated independently from casting defects[2,4]

Improve dynamic characteristics of a front lower suspension arm and aerodynamic effects of a hand-made hybrid vehicle designed[3], To obtain the material monotonic properties, tensile test has been carried out and to specify the material mechanical properties of the used material, a fatigue test under constant amplitude loading has been carried out using the ASTM standard specimens. Then, the results used in the finite element software to predict fatigue life has been evaluated later to show the accuracy and efficiency of the numerical models which they are appreciated, The prediction of fatigue failure from notches and other stress concentrator's is complicated by factors relating to the local notch geometry and stress field [5,6] MBD Analysis was carried out using MSC ADAMS. A double wishbone independent suspension has been designed for the front axle and has been successfully integrated with the vehicle[7], the kriging interpolation method is adopted to obtain the minimum weight satisfying the static strength constraint. the real experiments on 1/4 car is conducted to validate the FEM analysis. At last, the correlation of each case about durability life is obtained[8].

VIII. CONCLUSION

By using above case studies, we can determine the working and design (always very tricky) of lower control arm. The modal parameters that describe each mode are: natural frequency or resonance frequency, (modal) damping, and mode shape. The modal parameters of all the modes, within the frequency range of interest, represent a complete dynamic description of the structure. By using the modal parameters for the component, the model can subsequently be used to come up with possible solutions to individual problems.

REFERENCES

[1] *Pratik S. Awati, Prof. L.M.Judulkar, "Modal and Stress Analysis of Lower Wishbone Arm Along With Topology", International Journal of Application or Innovation in Engineering & Management (IJAIEM) Volume 3, Issue 5, May 2014 ISSN 2319 - 4847*

[2] *Y. Nadota, V. Denierb,1, "Fatigue failure of suspension arm: experimental analysis and multiaxial criterion", Elsevier, Engineering Failure Analysis 11 (2004) 485–499*

[3] *Guebum Han1,2, Kang-Min Lee1,2, and Seong Keol Kim, "A Study on Improving Dynamic Characteristics of a Front Lower Suspension Arm and Aerodynamic Effects of a Hand-Made Hybrid Vehicle", international journal of precision engineering and manufacturing vol. 15, no. 9, pp. 1897-1908*

[4] *M. M. Rahman1, M. M. Noor1, K. Kadirgama1, Rosli A. Bakar1, M.R.M. Rejab, "finite element modeling, analysis and fatigue life prediction of lower suspension arm, Malaysian Technical Universities Conference on Engineering and Technology June 20-22, 2009*

[5] *N.A. Kadhim1, S. Abdullah2, A.K. Ariffin and S.M. Beden, "Fatigue Failure Behaviour Study of Automotive Lower Suspension Arm", Key Engineering Materials Vols. 462-463 (2011) pp 796-800*

[6] *D. Taylor a,*, P. Bologna b, K. Bel Knani b, "Prediction of fatigue failure location on a component using a critical distance method", Elsevier, International Journal of Fatigue 22 (2000) 735–742*

[7] *G. Fourlaris a,*, R. Ellwood a, T.B. Jones b, "The reliability of test results from simple test samples in predicting the fatigue performance of automotive components", science direct, Materials and Design 28 (2007) 1198–1210*

[8] *V.V. Jagirdar*, M.S. Dadar, and V.P. Sulakhe, "Wishbone Structure for Front Independent Suspension of a Military Truck", Defence Science Journal, Vol. 60, No. 2, March 2010, pp. 178-183.*