© 2015 IJSRSET | Volume 1 | Issue 6 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

An Overview of Disarray in Finite Element Analysis of Composite Torsion Bar

Kumbar R. B [*1], Dr. Sonawane C. R [2], Pranav N. Abhyankar[3]

[1*]Design Dept. of Mechanical, SavitribaiPhule Pune University, Pune, India
HOD, Dept of Mechanical, Sanjay Ghodawat Polytechnic, Atigre, Kolhapur
[2]Dept. of Mechanical, Zeal Education Society's, Dnyanganga College of Engineering and Research, Narhe Pune, India
SavitribaiPhule Pune University, Pune, India
[3]Director, Abhynkar Consultancies, Pune, India

ABSTRACT

Torsion bar suspension is commonly used on tracked vehicles, although there are some wheel driven vehicles using this type of suspension. The suspension works by having one end of the bar fixed in position on the vehicle chassis to prevent rotation, whilst the other end is connected to a control arm and wheel hub. The control arm is fixed to the chassis using rubber bushings which allow only vertical movement about the mounting points. The torsion bar is connected to the control arm through a number of splines which translate the vertical movement of the control arm into a rotational or torsional force. This paper tries to give an idea about the previous researches & their finding about study of Torsion Bar, Static analysis (FEA) of torsion bar and study related applications of composite materials.

Keywords: Torsion Bar, Control Arm, Composite Material FEA, Rubber Bushings, Spline

I. INTRODUCTION

The most common place to find a torsion bar is in the suspension of a car or truck, in machines used for production or in other precision devices. The flexibility of the spring is the main reason that a torsion bar is used. If a more rigid structure were used such as a steel rod were used too much load bearing pressure would be placed on the both the wheels and the under body of the vehicle. A torsion bar works by resisting the torque on it. When one end of the torsion bar is affixed to an object that cannot be moved, the other end of the bar is twisted, thus causing torque to build up. When this happens, the torsion bar is resistant to the torque and will quickly back to its position once the torque is removed. Vertical motion of the wheel causes the bar to twist around its axis and is resisted by the bar's torsion resistance. The effective spring rate of the bar is determined by its length, cross section, and shape, material and manufacturing process. Torsion bars are used as automobile suspension. They offer easy adjustment on ride height depending on the weight of the car. Torsion bars are essentially metal bars that function as a spring. At one end, the torsion bar is fixed firmly in place to the chassis or frame of the vehicle. The other end of the bar may be attached to the axle suspension, or a spindle, depending on the specification of the vehicle. As the vehicle moves along the road. The forces generated by the motion of the vehicle create torque on the bar, which twists it along its axis. Counteracting the torque is the fact that the torsion bar naturally wants to resist the twisting effect and return to its normal state. In doing so, the suspension provides a level of resistance to the forces generated by the movement of the vehicle. This resistance is the key principal behind a torsion bar suspension system. The torsion bars do not offer what is known as progressive spring rate [1]. In this dissertation a torsion bar will be considered under analysis. Factors affecting the failure of torsion bar will be studied. A finite element method approach will be considered for modelling the problem. Different load conditions will be simulated using commercial FEA software. The results obtained from the FEA simulation will be validated by experimental results. An appropriate experimental method will be selected and results will be calculated. If the results are validated then different shapes and boundary conditions will be simulated using the FEA software.

By considering all above facts, this paper tries to cover literature which deals with study and Finite Element Analysis of Composite Torsion Bar.

II. LITERATURE REVIEW

Many of researchers have contributed in development of Torsion Bar

Feasibility of Hallow Stability Bar

Prof. Laxminarayan Sidram Kanna et al. published paper on Feasibility of hallow stability bar. In this paper they considered Chromium-molybdenum material for stability bar and 30 mm diameter. Stability bar also referred to as Anti-rolls bar or sway bar. The bar's torsional stiffness (resistance to twist) determines its ability to reduce body roll, and is named as "Roll Stiffness". A stability bar improves the handling of a vehicle by increasing stability during cornering or evasive manoeuvres. Most vehicles have front anti-roll bar stability bar. Stability bar bars at both the front and the rear wheels can reduce roll further. Properly chosen (and installed), stability bar will reduce body roll, which in turns leads to better handling and increased driver confidence. Stability bar analyses in the past were performed using analytical methods, which required a number of assumptions and simplifications. In general, stability bar analyses are multidisciplinary, including calculations related to the stresses and to tribological failures such as like wear or shear, scoring. In this trying to design stability bar to resist bending, shear failure. As computers have become more and more powerful, people have tended to use numerical approaches to develop theoretical models to predict the effect of whatever is studied. This has improved stability bar analyses and computer simulations. Numerical methods can potentially provide more accurate solutions since they normally require much less restrictive assumptions. The model and the solution methods, however, must be chosen carefully to ensure that the results are accurate and that the computational time is reasonable [1].

Vehicle Anti-Roll Bar Analysed using FEA Tool ANSYS

P. M. Bora and Dr. P. K. Sharma analysed Vehicle Anti-Roll using FEA tool ANSYS.

The aim of this paper is to report the analysis of Vehicle anti-roll bars (stabilizer bars)used for suspension components limiting body roll angle using the finite element analysis tool ANSYS. Vehicle anti-roll bars have a direct effect on the handling characteristics of the vehicle. Ride comfort, handling and road holding are the three aspects that a vehicle suspension system has to provide compromise solutions. Ride comfort requires insulating the vehicle and its occupants from vibrations and shocks caused by the road surface. In this study, the effects of anti-roll bar design parameters such as diameter of anti-roll bar, type of bushing, bushing location, type of end connection final anti-roll bar properties are estimated at varying load.

Experimental and Finite Element Investigation of Annealing on the Torsional Aspects of Carbon Steel St35

Hani Aziz Ameen et al. investigated effect of Annealing on the Torsional Aspects of Carbon Steel St35. This paper provides experimental procedure to carry out torsion test of torsion bar. These investigations explain the effects of annealing on the torsion aspects of carbon steel St.35. ANSYS 12 software was used in investigation. Test specimens were prepared according to ASTM and heated with different temperature namely 850, 650, 450 and 150 °C for one hour and followed by cooling process via furnace. Microstructure and torsion test after heating were examined. It was found that increasing annealing temperature, the hardness decreased and torsion properties and consequently increasing the plastic depth and the optimum heat treatment conditions is annealing at 450°C which produce angle twist 680°Ccompared with metal as received [3].

CFRP Torsion Bar: Load Introduction Problem

Gerald R. Kress et al introduces use of CFRP composite material for torsion bar. Torsion bars made from carbon fiber reinforced plastics (CFRP) can be shown, by simplified preliminary stress analysis, to outperform those made from steel. A remaining problem is to introduce the torsion moment into the fiber-wound bar. This work investigates the load introduction problem connected with, and to be solved by, a proposed design and manufacturing principle [4].

Analysis of Torsion Bar by the Finite Element Technique

Yogesh Sharma analyses torsion bar by the finite element technique. For this study, full vehicle simulations were done in ANSYS to predict the response of the proposed solutions. A Maruti Alto 800 was used as the test vehicle to verify the results of the simulations. In this paper he analyses, liner analysis of antiroll bar is carried out. A stress analysis is also carried out by the finite element technique for the determination of highly stressed regions on the bar. Result obtained based on FEM analysis by ANSYS 14 software is compared with some well-known damage theories. The maximum value of stress calculated is within yield strength of the material. And therefore, the factor of safety of theoretical calculations is more than two; whereas for the FE simulations the stress developed are within yield strength of the material, so again the factor of safety in this case is more than two. Considerable factor of safety (FOS) or design factors is applied to the anti-roll bar design to minimize the risk of failure & possible resulting injury [5].

Application of Finite Element Method in the Study of Variables that Influence the Stiffness of the Anti-Roll Bar and the Body Roll.

Ribeiro, S. and Silveira, M published paper in SAE Technical Paper 2013. The objective of this work is to analyse the main geometric variables that alter the stiffness of the anti-roll bar, which consequently influence the charge transfer between the wheels of the axle, while in a curve, and the body roll. To calculate stiffness FEM software was use. Unit force was applied at the ends of the anti-roll bar in the numerical model and was observed the response of the system in terms of deformation. It was verified the change in stiffness caused by varying the position of the bushings that are used to hold the bar, profile cross-section. The ratio between stiffness and weight served as a comparison for the bars, and revealed for what configuration studied was achieved the best effect in reducing rollover and with minor addition of weight to the vehicle.

Stress concentration at corner bends of anti-roll bar of front axle suspension system for parametric optimization.

Preetam Shinde and M. M. Patnaik studied stress concentration at corner bends of anti-roll bar of front axle suspension system for parametric optimization. They use solid and hollow anti-roll bar for this study. This project looks into the performance of stabilizer bar with respect to their stress variations at corner bends and weight optimization. In order to do this, parameters which constitute the geometry of the stress concentrated regions are determined. Design of Experiments (DOE) approach and parametric correlations are used for evaluating effect of these parameters on stress concentration. For the limited deformation of the bushings, behaviour of the material was assumed as linear isotropic. The maximum equivalent stress is determined at the bending section is80 % of the yielding strength of material for solid bar and 90% for hollow bar. Therefore, application of the Parametric Optimization Process to minimize the stress concentration at these regions of the anti-roll bar that is subjected to dynamic loading during the service life of the vehicle is very much essential. To minimize the stress concentration at the corner bends the transition length and the transition radius that constitute the geometry of the critical regions are studied for solid as well as hollow stabilizer bar. FE analyses showed that it is possible to decrease the maximum equivalent stress at the critical regions for solid and hollow stabilizer bar to 11% and 12% with a mass increase of 3.75% and 3.45% respectively. An increase of the transition length decreases the equivalent Von misses stress at the corner bends, however raises the anti-roll bar mass. Also the effect of increasing the transition radius raises the equivalent stress and also the notch effect at the critical regions over an optimum transition radius value. Increasing the transition radius also decreases the anti-roll bar mass [7].

Design and Optimization of Passenger Car Torsion Bar

Rajashekhar Sardagi and Dr. Kallurkar Shrikant Panditrao are designed torsion bar for passenger car. Torsion bar is generally made of mild steel but they use Nylon is alternative material for torsion bar. Test could conduct on nylon material. It is also compared with mild steel properties. The modelling and failure analysis is done using CATIA and ANSYS. In this work they conduct torsion test on mild steel specimen and nylon specimen. For comparing testing data they use ANSYS software for analysis. The ANSYS result of the torsion bar shows favourable results to select Nylon as alternative material for torsion bar. For comparing the nylon and mild steel the specimen is subjected for torsion test. The mild steel specimen diameter is 16 mm. The torque of 50,000 N/mm is applied; it took 17,500 degree, which is 5 revolutions to break. The torsion rigidity is 102 N/mm2 and maximum shear stress of 1.01 N/mm2.it took around 5 revolutions to break. However in practice the torsion bar will not be rotated so many rotations. The MS is used due to cost and easy machinability. The results show the nylon can be one of the alternative materials for torsion bar [8].

Design and Software Base Modelling of Anti-Roll System

Durali, M. and Kassaiezadeh are published paper in SAE Technical Paper 2002.This paper focuses on design and modelling of anti-roll system for a subcompact passenger car. In this paper two software are linked and a complete model is made for study and controller design. ADAMS software is use model of the car basic dynamics and bond graph model of the hydraulic anti roll system is contracted and its state equations are entered into MATLAB/Simulink. The system consists of hydraulic assisted torsion bars on car suspensions, a hydraulic power unit, and controls. This paper introduces the method as a useful tool for vehicle dynamics studies and discusses the problems and advantages of the method. [9]

III. CONCLUSION

By the literature review various methods to carryout experimental and finite element analysis of composite torsion bar are studied. In earlier researches steel material torsion bars were considered as new material are developed it necessary develop new applications of composite material. So it is important to consider the Composite material in designing the torsion bar.

IV. REFERENCES

[1]. Prof. Laxminarayan Sidram Kanna, Prof. S. V. Tare, Prof. A. M. Kalje, "Feasibility of hallow stability bar" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), e-ISSN: 2278-1684, p-ISSN: 2320-334X, PP 76-80, 2014.

[2]. P. M. Bora and Dr. P. K. Sharma, "Vehicle Anti-Roll Bar Analyzed using Fea Tool Ansys", International Journal of Advanced Technology in Engineering and Science, Volume No.02, Issue No. 07, PP 130-136,July 2014.

[3]. Hani Aziz Ameen, Khairia Salman Hassan, Muwafaq Mahdi Salah, "Experimental and Finite Element Investigation of Annealing on the Torsional Aspects of Carbon Steel St35", Journal of Mechanical Engineering and Automation, .jmea.20120206.03, PP 135-139, 2012.

[4]. Gerald R. Kress, Paolo A. Ermanni, "CFRP Torsion Bar: Load Introduction Problem", International Conference on Composite Materials, PP 1-7, 2007.

[5]. Yogesh Sharma "Analysis of torsion bar by the finite element technique" IJRIME Vol. 3, Issue 6 ISSN: 2249-1619.

[6]. Ribeiro, S. and Silveira, M "Application of finite element method in the study of variables that influence the stiffness of the anti-roll bar and the body roll" SAE Technical Paper 2013-36-0643, 2013.

[7]. Preetam Shinde, M.M.M. Patnaik "Parametric optimization to reduce stress concentration at corner bends of solid and hollow stabilizer bar" IJRAME Vol. 1 Issue 4 August 2014

[8]. Rajashekhar Sardagi, Dr. Kallurkar Shrikant Panditrao "Design and optimization of passenger car torsion bar" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 15-18, 2014.

[9]. Durali, M. and Kassaiezadeh "Design and software base modeling of anti-roll system" SAE Technical Paper 2002-01 -2217, 2002.