Optimization & Structural Analysis Review For Anti Roll Bar

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ABSTRACT

Anti-roll bar is the part of an automobile suspension system that connects the left and right wheel members through short lever arms and is clamped to the vehicle chassis with rubber bushes. It forces each side of the vehicle to lower, or rise, to similar heights, to reduce the sideways tilting (roll) of the vehicle on curves, sharp corners, or large bumps. It also resists roll or swaying of the vehicle which occurs during cornering or due to road irregularities. In this study FEA is carried out to perform structural analysis of Anti-roll bar using ANSYS Parametric Design Language (APDL). The proposed work is focus on to prepare the methodology for analysis of the anti-roll bar, the methods of its optimization.

Keywords: Structural analysis, APDL, Optimization

INTRODUCTION

Anti-roll bar is also known as anti-sway bar, sway bar or stabilizer bar. It is the part of much automobile suspension system, which helps to reduce the body roll of a vehicle during fast cornering or over road irregularities. It is a rod or tube which is usually made of steel, that the bar's torsional stiffness (resistance to twist) determines its ability to reduce body roll, and is named as “Roll Stiffness” [1]. Most vehicles have front anti-roll bars. Anti-roll bars at both the front and the rear wheels can reduce roll further. Properly chosen (and installed), anti-roll bars will reduce body roll, which in turns leads to better handling and increased driver confidence. The anti- roll bar, as being a suspension component, is used to improve the vehicle performance [3].

Fig.1. Fitment picture of Anti-roll bar on vehicle [3]

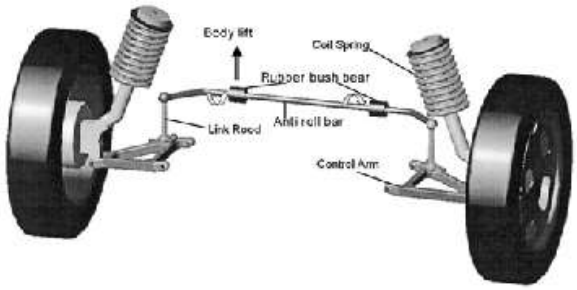

Fig.2.A typical Anti-roll bar

Purpose of anti- roll bar Anti- roll bar being a component of a suspension system is used to improve the performance of vehicle with respect to the three aspects i.e. ride comfort, handling and road holding, The ride comfort requires isolating the vehicle and its occupants from vibrations and shocks caused by the road surface. Handling requires providing safety in maneuver sand in ease in steering. For good road holding the tires must be kept in contact with the road surface to ensure the directional control.

Working Principle

The anti- roll bar is usually a torsion spring that resists body roll motions. It is usually constructed out of a cylindrical steel bar. Formed into a "U" shape that connects to the body at two points and at the left and right side of the suspension. If the left and right wheels move together, the bar rotates about its mounting point but if the wheels move relative to each other, the bar is subjected to torsion and forced to twist [4]. The ends of the bar are connected to an end link through a flexible joint. The anti- roll bar end link connects in turn to a spot near a wheel which transfers forces from a heavily loaded axel to the opposite side. So in anti- roll bar forces are transferred from heavily loaded axle to the connected end link via a bushing, to the anti- roll bar via a flexible joint to the connected end link on the connected end link on the opposite side of the vehicle to the opposite axel.

Connections of Anti-roll bar

Anti-roll bars are connected to the other chassis components via four attachments. Two of these are the rubber bushings through which the anti-roll bar is attached to the main frame. And the other two attachments are the fixtures between the suspension members and the anti-roll bar ends, either through the use of short links or directly [1].

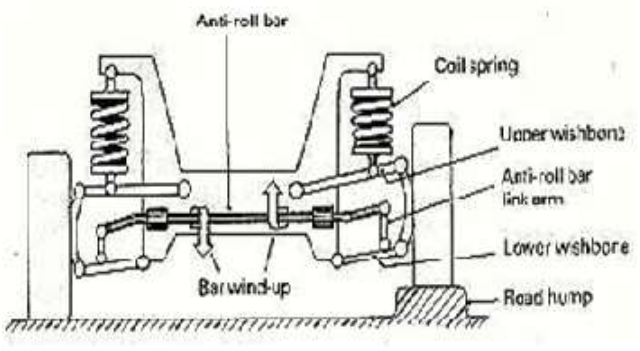

Fig.3. An anti-roll bar attached to double wishbone type suspension.
(The vehicle is crossing over a road bump on one side)[1]

Bushings of Anti-roll bar

According to the axial movement of the Anti-roll bar in the bushing, the bushings are classified into two types. The Anti-roll bar is free to rotate in the bushing in both the types. In the first bushing type, the bar is also free to move along bushing axis while the axial movement is prevented in the second type.

Fig.4. Bushing (rubber bushings and metal mounting blocks)[1]

The bushing material is another important parameter. The materials of bushings are commonly rubber, nylon or polyurethane, but even metal bushings are used in some race cars. As the spring stiffness of bushing material increases the roll stiffness of the bar also increases.

Fig.5.A vehicle experiencing body roll during cornering.

When a vehicle has excessive bodyroll, the majority of its weight is shifted to the outer tires during a turn, causing less weight to sit on the inner tires. Lateral grip is something we don't want to sacrifice on a racetrack. A sway bar's purpose is to keep suspension movements relative throughout turns. This means that when the vehicle makes a right turn, the left side of the vehicle's suspension will compress similarly to the right side, keeping more weight on the inner tires.

OBJECTIVES

An objective of this proposed work is to do the structural analysis of an existing anti-roll bar. Enlist the parameters affecting the performance of anti-roll bar under different dimensions of bar. Evaluate the sensitivity of structure against different input parameters. Create the methodology for the Analysis purpose of anti-roll bar. Enlisting the optimum parameter selection for anti-roll bar.

METHODOLOGY

From the literature review, Anti-roll bar and its design study is carried out. In this study Finite element modelling and analysis of the existing anti-roll bar is performing using the ANSYS software. Initially the parametric model of anti-roll bar is prepared in ANSYS using the ANSYS Parametric Design Language (APDL) and analysis of anti-roll bar is performed. Experimental validation of the analysis will be done using parametric

model. Finally the optimization of the Anti-roll bar is performed using the above validated parametric model. The proposed work is for the overall methodology for the analysis of anti-roll bar and its optimization.

Problem Definition

The geometry of the Anti-roll bar is depends on the design and location of other chassis components. If the design of chassis components is to be changed then the design of Anti-roll bar is changed because it is simple as compared to design other components. But it is to be finalized for best parameters, and hence there is need to work on such parameters those will reduce the weight of the anti-roll bar without failure i.e. stress generated should be within permissible limit.

Parameters for Optimization
1) Outer diameter
2) Cross sectional thickness
3) Corner radius
4) Position of bush from centre

Analysis of existing Anti-roll bar: the structural analysis of the existing anti-roll bar is carried out using the APDL and the results are given below

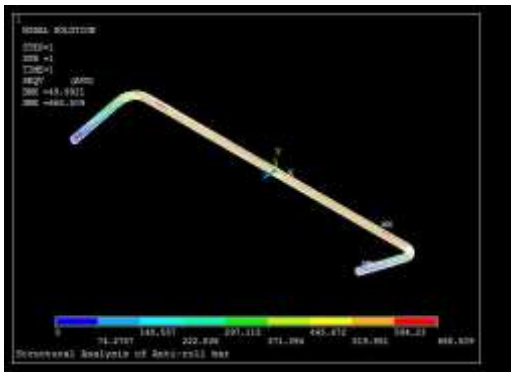

Fig.6. Equivalent Stresses in Anti-roll bar

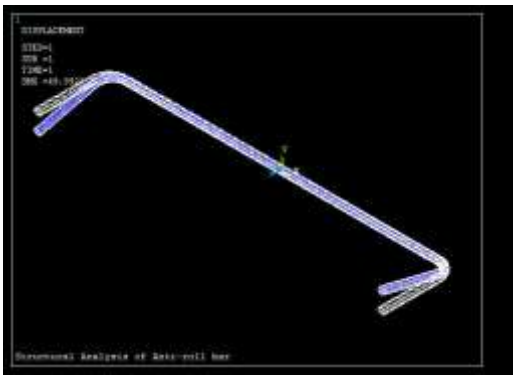

Fig. 7. Displacement of Anti-roll bar

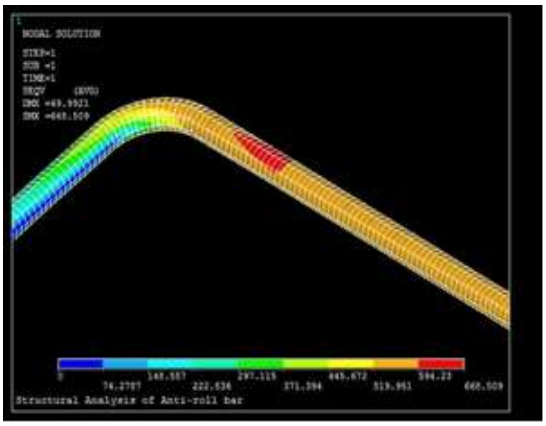

Fig.8. Equivalent Stresses-2 in Anti-roll bar

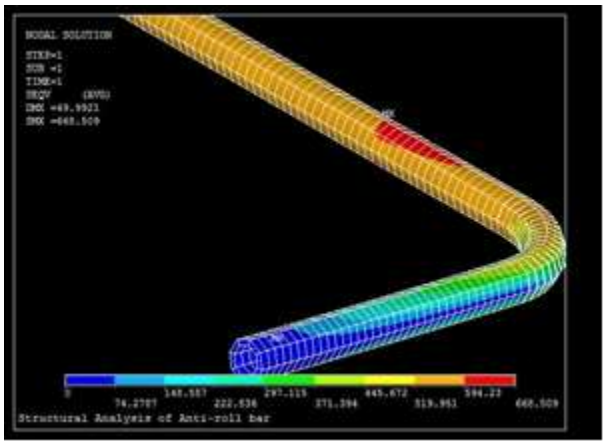

Fig .9. Equivalent Stresses-3 in Anti-roll bar

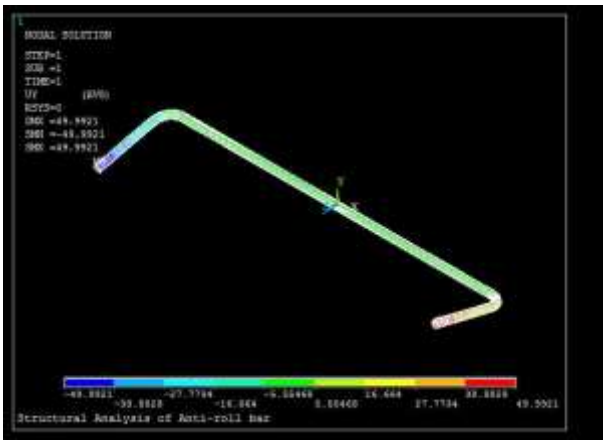

Fig.10. Displacement of Anti-roll bar in Y-direction

Conclusion and Future work

In this way we got the result for structural analysis of Anti-roll bar using the ANSYS Parametric Design Language. We prepare the methodology for the work. After studying the existing Anti-roll bar we decided the optimization parameters. Still we are working over the project for optimization using APDL.

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