

ANALYSIS OF TORSION BAR OF LIGHT MOTOR VEHICLE CAR FOR ITS NONLINEAR BEHAVIOR WITH HELP OF CAE

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Abstract: Now a day's suspension system is more important for automobile industry because of customer needs comfort, handling and safety. In many automobile industry lot of research going on improvement of suspension system as per as customer requirement. The purpose of suspension system is used as accomplished by influencing the motions affected on the uneven road surface to the wheels and axles and it's minimizing their effect on the vehicle body and frame. Torsion bar is used in ground vehicle and purpose is to reduce body roll by resisting any uneven vertical motion between the pair of wheels suffer from fatigue failure. In this study, analysis of torsion bar of light motor vehicle or passenger car were carried out by means of determine stress distributions and torsional stiffness by Finite element (FE) technique. The results of FE analysis indicate that, there is variation in linear and nonlinear analysis for shear stress and torsional stiffness of torsion bar.

Keywords: Torsion bar, Finite Element Analysis, Torsional Stiffness, Stress Analysis.

INTRODUCTION

Torsion bar is a suspension component that is used to keep the vehicle from excessively rolling during sharp turns. They can be mounted across the car or along the car and the springing motion is provided by the metal bar's resistance to twisting. Torsion bar operates like a torsion spring during a cornering manoeuvre in which the vehicle weight transfer from one side to another side of the vehicle. The torsion bar is resistant torque and it 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 it is resisted by the bar's torsion resistance. It is needed improvement in the ride and handling while during the vehicle roll but it will provide comfort and stability. Torsion bar in a suspension system is supported with chassis by a frame structure. In this paper, torsion bar is subjected to shear, bending and torsion loads together.

LINEAR FINITE ELEMENT ANALYSIS

Now a day's most of the company referring ANSYS which is used for analysis purpose. In ANSYS analysis, there is three steps such as 1) Build the model, 2) Apply the loads and obtains the solution and 3) Review the results. In CAE analysis, there are two ways exists such as 1) Creation of the model in ANSYS Design Modular and 2) Importing the model from an IGES file (Initial Graphics Exchange Specification). Before first steps CAE analysis is CAD modeling of torsion bar. Any Torsion bar of geometry that is even shapes, irregular shapes or even with irregular shapes will be created in CATIA V5R20. Torsion Bar will be manufactured by steel (SAE9262) and it is suitable for highly stressed springs. SAE9262 materials of mechanical properties are as following as

Standard	Steel (SAE9262)
Young's modulus of elasticity (E) [GPa]	200
Yield strength (S _y) [MPa]	800
Ultimate strength (S _{ut}) [MPa]	100
Poisson's Ratio (μ)	0.3

Table No. 1:- Mechanical Property of SAE 9262

After build model, material property of data is put in ANSYS. Now second step in the analysis is generating a nodes and element on model geometry. In torsion bar, as this is simple geometry triangle mesh pattern is used to mesh the geometry, which uses fines mesh on surface. For linear deformation, behavior of the material was assumed as linear isotropic.

For linear static analysis of torsion bar clamp is not considered only simple bar is considered which is fixed at one end. There is no requirement contact for linear analysis. For displacement constraints exit at two locations that is at the end of bar. For spherical joints, the UX, UY degrees of freedom are constrained at the end of bar. If pin joints are used then ROTY and ROTZ degree of freedom are constrained. For linear analysis, fix it all degree of freedom. For loading the first load step is a known force F for determination of shear stress, applied to the bar ends in -Z at free end.

NON-LINEAR FINITE ELEMENT ANALYSIS

In ANSYS analysis, finite element model of torsion bar is similar but its addition of clamp in the torsion bar. In CAD model, torsion bar assembly is created CATIA V5R20. After assembly model that will be converted into IGES file which is helpful for ANSYS workbench 14. In ANSYS workbench, the CAD model is imported into ANSYS workbench, after that geometry model is bring up into which CAD geometry is generated and reviewed for any variance. For the deformation of the clamp, behavior of the material was assumed as nonlinear.

Standard	Steel (SAE 9262)	Polyurethine
Young;s modulus of elasticity (E) [GPa]	200	50
Yield strength (S_y) [MPa]	800	5
Ultimate strength (S_{ut}) [MPa]	100	15
Poisson's Ratio (μ)	0.3	0.45

Table No.2: Mechanical Properties of Torsion Bar

After creating model, the bar will be meshed. As this is simple geometry triangle fine mesh pattern is used to mesh the geometry. In nonlinear analysis, geometry and contact nonlinearities are considered. In nonlinear analysis, clamp which is made by polyurethane material which is highly nonlinear which is considered in nonlinear analysis. Clamps are considered keep in place hence bonded contact is used to simulate the behavior. In nonlinear analysis, clamps are fixed in all direction and load is applied at another end of the torsion bar. For loading the first load step is a known force F for determination of shear stress, applied to the bar ends in -Z at free end.

RESULTS AND DISCUSSION

The analysis results exhibits that shear stress seem to be same and occurred at the fixed location region. Fig.1 showing that linear analysis results of shear stress distribution in torsion bar.

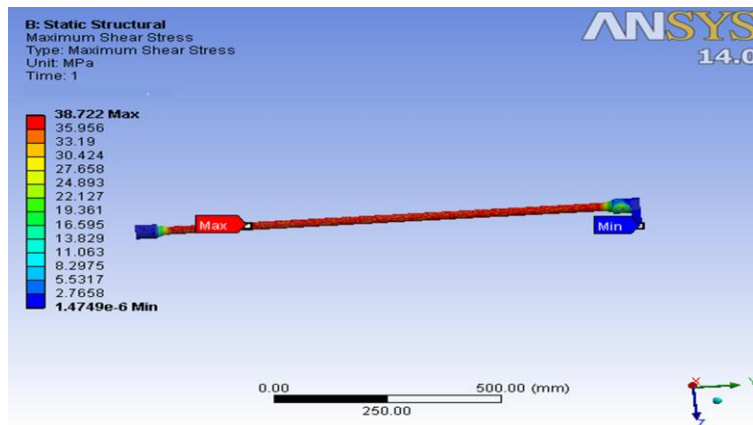


Figure No. 1:- Shear Stress Distribution Of Linear Analysis of Torsion Bar

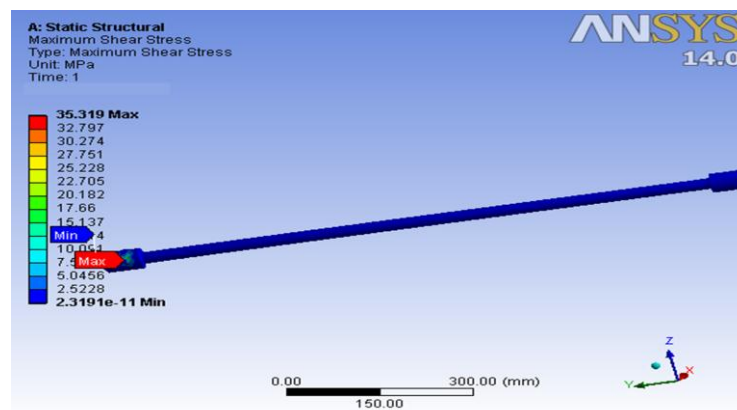


Figure No.2:- Shear Stress Distribution of Nonlinear Analysis of Torsion Bar

Various tests reading taken in ANSYS analysis for both linear and nonlinear analysis. Figure No.3 indicates that shear stress calculating the angle of twist of torsion bar for respective stress. Fig. shows that slop of results shows torsional stiffness from linear analysis.

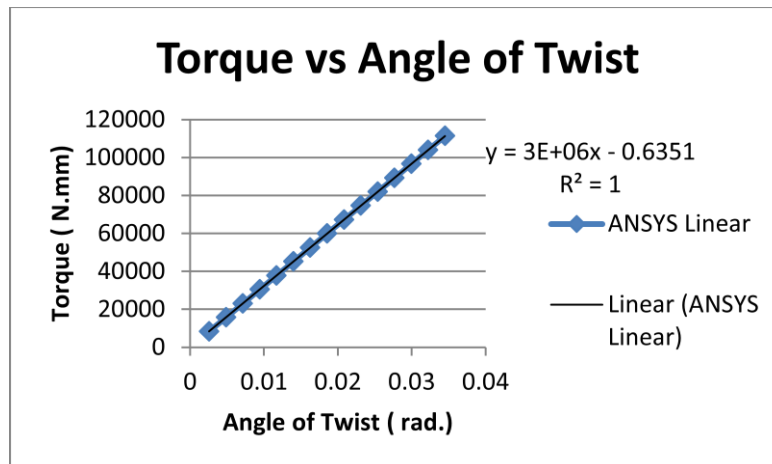


Figure No.3:- Results of Linear Analysis of Torsion bar

Figure No.4 shows that nonlinear analysis of torsion bar. Fig. shows that we are calculating of torsional stiffness of torsion bar for nonlinear analysis by slop.

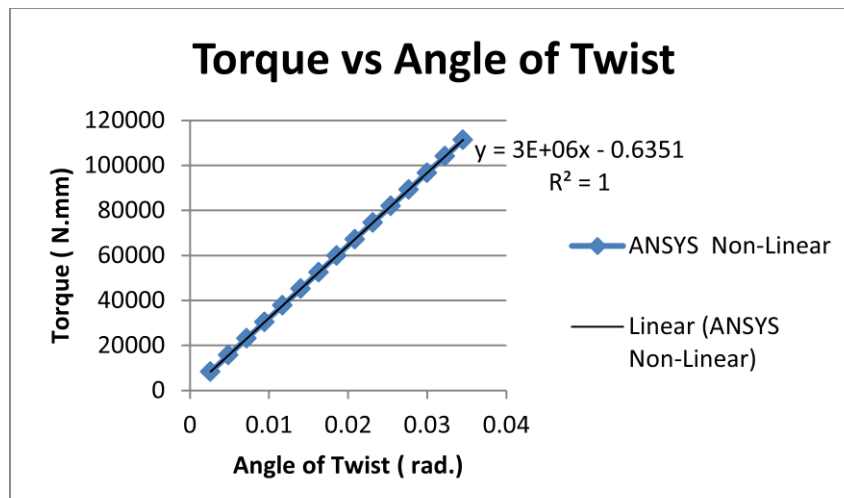


Figure No.4:- Results of Non-linear Analysis of Torsion bar

CONCLUSION

Stress distribution of a torsion bar has been investigated by using FE method for various loads. Linear and Nonlinear results indicated that the shear stress took place at the clamping location. It was concluded that the reduction of shear stress in torsion bar could be realized by the clamp provided. There is also increase in torsional stiffness approximately 40%. This nonlinear analysis show real-life situation of torsion bar, so use nonlinear analysis for analyzing torsion bar in CAE software to better results.

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