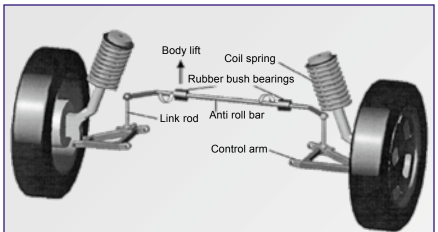
Abaqus FEA and fe-safe™ Used for Automobile Stabilizer Bar Analysis

Safe Technology, Ltd. reseller ProSIM R&D Private Limited of Bangalore, India used Abaqus and fe-safe for design verification and optimization of an automobile stabilizer bar. The study, which also involved automotive OEM Mahindra and Mahindra and tier-1 vendor Tube Products of India, analyzed the effects of bending, shot peening, and induced residual stress.

A stabilizer bar is part of an automobile suspension system. This U-shaped metal bar connects opposite wheels together through short lever arms and is clamped to the vehicle chassis with rubber bushes. Its function is to reduce body roll while cornering, which enhances safety and comfort during driving.

The study first subjected tubular stabilizer bars with varying levels of shot peening-induced residual stress to maximum load during accelerated fatigue testing. Fatigue test life, without considering shot peening effects, was found to be 11,000-20,000 cycles; life with shot peening was 60,000-78,000 cycles. Failure locations were detected in the vicinity of one of the rubber bushes.



Stabilizer bar in the assembly of suspension system.

Configuration of a typical stabilizer bar with rubber bush.

A virtual bench test using Abaqus and fe-safe was then created to analyze the bending process to estimate bending strain and its effect on life. The stress analysis found the effect of rubber bushes (modeled as hyperelastic material) to be critical. An elastic-plastic analysis was also carried out for durability assessment.

For fatigue life assessment, stress and strain history was taken from the FE analysis to fe-safe. Different simulation scenarios were considered for the durability assessment, including the effects of surface roughness and residual and mean stress.

After the fatigue analysis, crack initiation was observed near the rubber bush in the simulation. The number of cycles for crack initiation was noted to be 17,540 without shot peening, and 67,712 with shot peening residual stress. Simulation results matched well to the experimental observations, and based on this work, a design and development protocol was created for the design, analysis, and optimization of stabilizer bars—reducing time for further development activities by over 50 percent and testing effort by over 70 percent.

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