REDESIGN OF TRUCK CAB SUSPENSION FOR IMPROVED RIDE COMFORT

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**Keywords**

Ride Comfort; Quarter Truck Suspension Model; Cabin Accelerations; Design of Experiments

**Objective**

Ride is the study of a vehicle’s vibration response to the road excitation. Evaluation of ride characteristics in a truck is very important as the drivers are exposed to vibrations all day long which lead to driver fatigue, damage to their trucks and the environment. In a truck primary suspension takes care of handling and load carrying while secondary suspension takes care of ride i.e. achieving comfort. The objective of this study was to redesign a truck’s cabin suspension for achieving improved ride comfort.

**Methodology**

A 25 ton tipper is selected as the benchmark vehicle. A quarter vehicle suspension model of the truck representing primary and secondary suspension is considered to arrive at equations of motion. Using equations of motions mathematical model is built in MATLAB-Simulink and the accelerations at the cabin, chassis and axle are found. Vibration testing on the benchmark vehicle is carried out by using data acquisition and mounting accelerometers at appropriate locations. The results from vibration testing are validated with results from MATLAB-Simulink. The quarter truck suspension model is also built using ADAMS-View software and the results are validated with Simulink results. After validation, Design of Experiments (DOE) is carried out using ADAMS-Insight to arrive at combination of spring stiffness and damper coefficient values that result in cabin accelerations and displacement values lower than the existing values.

**Results**

Simulations are carried out in Simulink and ADAMS-View for laden and unladen conditions at vehicle velocities varying from 10 to 100 km/h, assuming road to have a sinusoidal profile with one half amplitude of 1 cm for regular road and 10 cm for bump condition. Displacement and acceleration at the cabin is analyzed at all velocities. DOE is performed to reduce cabin acceleration and displacements, while keeping the suspension working space same. A spring of stiffness 15000 N/m and damper having coefficient of damping equal to 1400 Ns/m is selected from DOE study. With this combination, there is a 35-38% reduction in vertical accelerations at the cabin and the natural frequency of the system is within the acceptable limits.

**Limitations of this study**

An important limitation of this study is that it considers only 1D vertical dynamics and not combined bounce and pitch dynamics. Objective ride evaluation methods have not been used to study vibrations induced in the truck cabin.

What does the paper offer that is new in the field including comparison to other work by the authors?

A design of experiment (DOE) methodology using ADAMS Insight is performed for selecting a combination of suspension spring stiffness and damping co-efficient during initial phase of cabin suspension design. This approach helps in systematic way of selecting cabin suspension design parameters for achieving better ride.

**Conclusions**

The quarter truck model built in Simulink has been validated in ADAMS-View and also by conducting physical test on a truck. A design of experiment (DOE) methodology using ADAMS Insight is performed and the new combination of spring and damper with stiffness and damping coefficient of 15000 N/m and 1400 Ns/m respectively was selected which resulted in reduced cabin vertical acceleration by 35-38%, displacement by 25-40% and natural frequency of vibration is within the desired range of 1-1.5 Hz.