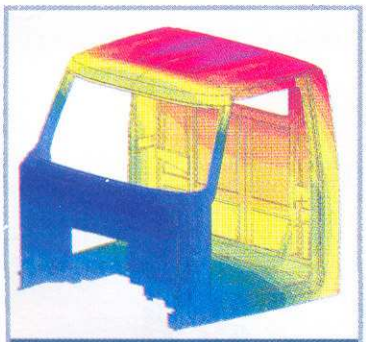
Design Analysis of Heavy - Duty truck cabins result in improved safety

By **Ravi Singh & Raj Dam**

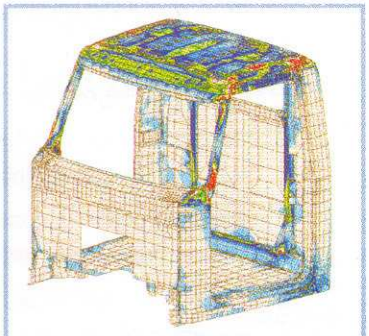
Logging trucks are not everyone's drive. They are as mean as giant machines can get, after all they transit huge piles of logs and sometimes entire trees. An average logging truck can be about 50 feet in length and 15 feet in height and can carry loads above 60 tones. Therefore driving them through hostile terrains of snow, mountains or forests can be quite an excruciating and dangerous task.

A North American Class 8 logging truck manufacturer faced a typical problem – with employee safety as a company ideal as also a key governmental regulation, it had to determine what load the driver cabin can withstand in the event of sudden braking on a fully loaded truck. This was critical as in worst case scenarios if the optimum stress is not defined logs might penetrate the driver's cabin causing exhaustive damage and loss of life.

Class 8 truck cab's are of two forms – conventional and cab-over. In conventional cab design the engine is in the front and cab is between the front, and first set of rear wheels. In the cab over version, the engine is inside and under the cab and the driver sits over the front wheels. A Class 8 Truck cab is manufactured using several stamped steel panels, which are often spot-welded together. The doorframe, windshield frame and rear window frame are constructed to form hollow closed sections to provide adequate stiffness and strength. Floor and rear panels are stiffened using hat or box sections to provide resistance to flutter and localized vibration. All cabs are required to pass through multiple operating load tests as specified by the manufacturer and governmental regulations. Apart from regular and specified tests, the cab is required to withstand localized loads such as roof crush, snow load, and beam penetration due to either falling trees or light/sign poles. One of the most important among these is the beam penetration test. The test condition simulates forward moving logs penetrating the cab from the rear panel if a fully loaded truck were to stop suddenly.



NISA Resultant Displacement Plot – Roof Crush



NISA von Mises Stresses Plot – Roof Crush

The software used is NISA, a popular Engineering Analysis software which uses the Finite Element Technique. A Finite Element Model of the cab is constructed using shell elements. The panels are connected using rigid links for spot-weld simulation, and the frame and suspension are included using beam elements. Finite Element Analysis is then carried out and the resultant displacement and von-Mises stresses are determined. These results give an accurate picture of the loads which the cab can withstand during an eventuality and which components need to be redesigned to maintain the structural integrity of the cabin.

Larry Brinkman is a happy man. As a log truck driver he knows he would never have to be in a cabin that is not designed to proper safety standards. Design Analysis has taken care of that. ■

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