

Vibration Modeling and Experimental Analysis of a Locomotive Cab

by

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This study evaluates noise and vibrations in a heavy freight locomotive cab, and provides several measures for providing more comfort to the crew. A full-scale production cab and sill structure is used to provide the results. The cab is setup in a controlled laboratory environment in a manner similar to the installation on a locomotive. Field measurements are used to emulate actual vibration input to the cab structure. A 16-channel data acquisition system is used to collect both noise and vibration data on various parts of the cab structure and inside the cab.

Upon establishing the baseline for laboratory vibration measurements and correlating them with field data, a design of experiment was conducted to evaluate the vibration contribution of various parts of the cab. This showed that the cab floor and cab roof had the largest vibrations. A series of solutions including stiffening the cab floor and damping the cab roof were investigated. The results showed that although such solutions reduce localized vibrations, the overall effect on reducing cab interior noise is minimal.

As a more global solution, the cab was isolated from the sill structure through six elastomeric elements mounted at the base of the cab and at the crash post. The mounts at the base were selected such that they support the static weight of the cab, provide a resonance frequency that is below the excitation range, and offer good lateral and longitudinal stability. Two tube-form elastomeric mounts were placed between the cab structure and the crash posts which attach to the front of the sill structure.

The test results showed that the soft-mounted cab had significantly lower noise and vibration than the original cab. The vibration levels were reduced 10 to 100 times at certain locations and frequency ranges. The overall noise level was reduced by approximately 6 dBA. In an attempt to provide an estimate of effectiveness of the mounts with different stiffness values, a simulation model was prepared in Matlab. Although the model did not yield accurate results, it resulted in several recommendations for future research work.

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