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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Contents

1 Background 1

1.1 Introduction ................................................................................................................................ 1

1.2 Literature Review .......................................................................................................................... 2

1.2.1 Vehicle Vibration Isolation ........................................................................................................ 3

1.2.2 Cab Vibration ............................................................................................................................... 4

1.2.3 Noise, Vibration, and Harshness ............................................................................................... 5

1.2.4 Locomotive Cab .......................................................................................................................... 5

1.2.5 Locomotive Noise and Vibration ............................................................................................... 5

1.2.6 Cab Isolation ............................................................................................................................... 6

1.3 Research Objective ....................................................................................................................... 6

1.4 Outline .......................................................................................................................................... 7

2 Vibration Test Setup 8

2.1 Cab Configuration ......................................................................................................................... 8

2.2 Cab Installation .............................................................................................................................. 10

2.3 Actuation System .......................................................................................................................... 11

2.4 Actuator Setup ............................................................................................................................. 13

2.5 Excitation Input ............................................................................................................................. 15

2.6 Data Acquisition System ............................................................................................................. 16

2.7 Data Analysis ................................................................................................................................ 18

3 Hard-Mounted Locomotive Cab 24

3.1 Hard-Mounted Configuration ....................................................................................................... 24

3.2 Test Arrangements ......................................................................................................................... 24

3.3 Baseline Tests ................................................................................................................................ 27

3.3.1 Floor Measurements .................................................................................................................. 27

3.3.2 Cab Roof Measurements .......................................................................................................... 30

3.3.3 Nose Cab Floor .......................................................................................................................... 33

3.3.4 CA1 Cabinet, Consoles, and LSI Cabinet Measurements ...................................................... 35

3.3.5 Sill Measurements .................................................................................................................... 41

3.3.6 Nose Cab Measurements ........................................................................................................... 44
List of Figures

1.1 Literature Search Flow Chart According to Keywords and Number of “Hits”… 3
2.1 Plan View of Locomotive Cab…………………………………………………………….. 8
2.2 Side View of Locomotive Cab…………………………………………………………….. 9
2.3 Goodyear Airbag Installation…………………………………………………………….. 11
2.4 MTS 506 Series Hydraulic Power Supply………………………………………………… 12
2.5 MTS 263 Hydraulic Service Manifold…………………………………………………… 13
2.6 MTS 249 Actuator with Swivel Ends……………………………………………………… 14
2.7 MTS Model 407 Servo Hydraulic Controller…………………………………………….. 14
2.8 Actuator Installation on the Locomotive Cab…………………………………………….. 15
2.9 PCB Accelerometers Used for Vibration Measurements…………………………………… 16
2.10 (a) HP Workstation and (b) Zonic 7000 Data Acquisition………………………………… 17
2.11 Coherence Plot Center Lower Floor………………………………………………………… 20
2.12 Force Plot from the Actuator………………………………………………………………. 21
2.13 Displacement Plot from the Actuator……………………………………………………… 21
2.14 Noise Level Baseline Compared to Maximum System Dynamics in g’s………………… 22
2.15 Noise Level Baseline Compared to Maximum System Dynamics in mV’s……………… 23
3.1 Hard-Mounted Locomotive Cab Configuration (a) Front (b) Needle Beams……… 22
3.2 Floor Accelerometer Locations…………………………………………………………….. 24
3.3 Accelerometer Floor Location 1…………………………………………………………….. 26
3.4 Accelerometer Floor Location 4…………………………………………………………….. 26
3.5 Accelerometer Floor Location 11…………………………………………………………… 27
3.6 Cab Roof Measurement Locations………………………………………………………… 28
3.7 Accelerometer Cab Roof Location 1………………………………………………………… 29
3.8 Accelerometer Cab Roof Location 8………………………………………………………… 30
3.9 Nose Cab Floor Accelerometer Locations………………………………………………… 30
3.10 Accelerometer Nose Cab Floor Location 1………………………………………………… 31
3.11 Accelerometer Nose Cab Floor Location 2………………………………………………… 32
3.12 CA1 Cabinet Measurement Location……………………………………………………… 33
4.5 Schematic Comparison Between Fluid Mounts and Elastomeric Mounts........ 64
4.6 Isolation Advantage for Fluid Mounts.................................................. 64
4.7 Dynamic Stiffness Comparison Between Active and Passive Mounts.......... 66
4.8 Mount Configuration (a) Plan View (b) Front View............................... 68
4.9 Base Mounts, Lord P/N CB-2205-3.......................................................... 68
4.10 Crash-Post Mounts, Lord P/N J-14056-4.............................................. 69
4.11 Welded Joints Eliminated for Soft-Mounting the Cab............................ 70
4.12 Front-Mounting Bracket Installation.................................................... 71
4.13 Modifications to the Cab for Installing Aft Base Mounts......................... 71
4.14 Crash Post Mount Brackets................................................................. 72
4.15 Stands for Supporting the Cab During the Installation of the Base Mounts.... 73
4.16 Accelerometer Cab Floor Location 1...................................................... 75
4.17 Accelerometer Cab Floor Location 4...................................................... 75
4.18 Accelerometer Cab Floor Location 11...................................................... 76
4.19 Accelerometer Cab Floor Location 1...................................................... 77
4.20 Accelerometer Cab Roof Location 8....................................................... 77
4.21 Accelerometer Nose Cab Floor Location 1............................................... 78
4.22 Accelerometer Nose Cab Floor Location 2............................................... 79
4.23 Accelerometer CA1 Cabinet Location 1.................................................. 80
4.24 Accelerometer CA1 Cabinet Floor Location 4......................................... 80
4.25 Accelerometer Engineer’s Console Location 10...................................... 81
4.26 Accelerometer Conductor’s Console Location 6...................................... 82
4.27 Accelerometer CA1 Cabinet Location 4.................................................. 82
4.28 Accelerometer LSI Cabinet Outside....................................................... 83
4.29 Accelerometer B-Side Mount............................................................... 84
5.1 Single Degree-of-Freedom System......................................................... 87
5.2 Transmissibility for Various Damping Ratios.......................................... 88
5.3 Simplified Base-Mounted Model............................................................ 88
5.4 Comparison Between Test and Simulation Results for $\zeta = 0.05$............ 90
5.5 Comparison Between Test and Simulation Results for $\zeta = 0.90$............. 90
5.6 Mount Transmissibility Included in Simulation....................................... 91
5.7 Mount Phase Angle Included in Simulation ................................................. 91
5.8 Measured Mount Transmissibility............................................................. 92
5.9 Measured Mount Phase Angle................................................................. 93
List of Tables

3.1 Different Cab Arrangements ................................................................. 23
3.2 Coordinates of Floor Measurements .................................................. 28
3.3 Coordinates of Cab Roof Accelerometers .......................................... 31
3.4 Coordinates of Nose Cab Floor Accelerometers .................................. 34
3.5 Coordinates of Cab roof Accelerometers ........................................... 36
3.6 Coordinates of Sill Accelerometers ..................................................... 42
3.7 Coordinates of Nose Cab Accelerometers ........................................... 45
3.8 Coordinates of B-Side Accelerometers ............................................... 48
4.1 Requirements for Soft Mounts From Lord Corporation ....................... 67
4.2 Mount Part Numbers and Locations ................................................... 68
4.3 Soft-Mounted Cab Tests ................................................................. 74