Chapter 6

Conclusions

This chapter provides a summary of the research presented in the earlier chapters. It further includes a few recommendations for future research related to locomotive cabs.

6.1 Summary

The structural dynamics of a production locomotive cab were studied in a laboratory environment. The cab was set up on four airbags to isolate it from the floor. It was then excited by a 2000-lb hydraulic actuator that closely duplicates the input the cab is subjected to in the field.

A series of tests were conducted to establish the vibration baseline of the cab, and to define how various parts of the cab vibrate. Through these measurements, we identified the cab floor and cab roof to be the main sources of vibration. A series of modifications were made to these areas of the cab to reduce vibration levels. It was shown that stiffening the cab floor can have a major effect on reducing floor vibrations. At some frequencies, the vibrations were reduced by as much as 10 times due to the stiffened floor. The stiffening of the cab, however, did not have a major effect on the interior noise levels; it reduced the overall interior cab noise by only a fraction of 0.5 dBA.

To reduce the roof vibrations, the roof was treated with a commercially available damping material. The results showed that roof vibration can be reduced by a factor of 2-3 times using to the damping material. Similar to the stiffened floor, the damped roof did not greatly affect interior noise.

The cab was modified to allow it to be soft-mounted it on a series of elastomeric mounts. For this purpose, the cab was completely separated from the sill structure that it normally attaches to and was supported on four elastomeric mounts at the base. Two additional mounts were added at the front of the cab in the longitudinal direction between the crash posts and the cab. This increased the longitudinal stiffness needed for locomotive coupling and buff loading. The results for the soft-mounted cab were quite encouraging. Our tests showed that soft-mounting the cab reduced the vibration levels significantly: at certain locations, the vibrations were reduced by as much as two orders of magnitude. The affect on the interior noise was equally significant, unlike other solutions that achieved only a fraction of 1 dBA reduction. Soft-mounting the cab resulted in a 5.7 dBA noise reduction. The noise and vibration levels in the soft-mounted configuration were similar to an office environment.

An attempt was made to simulate the effect of various types of soft-mounts on the cab vibrations. This, however, was unsuccessful.

6.2 Recommendations for Future Research

The tests conducted throughout this research indicated some of the solutions that can be effective in reducing interior locomotive noise and vibrations. Other tests that may prove beneficial are:

1. Testing with different damping material on the cab roof.
2. Removing or modifying the damping materials used on the side walls of the cab.
3. Studying the effect of different mounting arrangements on both reducing noise and vibration and impact loading in the longitudinal direction due to buff loading, as well as coupling and uncoupling.
4. As a part of optimizing the effectiveness of the soft-mounts, one needs to find the modal points of the cab base and attempt to place the mounts near those points. This will further reduce the effect of vibration input to the cab.

These tests may prove to be beneficial once more testing and analysis are completed. A complete analysis on each of these items has not been completed.

In addition to the tests, further progress can be made in completing the dynamic simulation approach that was recommended in Chapter 5. Although an attempt was made to simulate the effect of various types of soft-mounts on the cab, it was unsuccessful. Possible future research in this area include:

1. Validating the new simulation approach that was suggested in Section 5.4.
2. Establishing other methods that can be used to predict the effect of various soft-mounts.