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OVERVIEW OF LONG-TERM, MULTIPLE PAVEMENT TYPE, TIRE / ROAD NOISE STUDY

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INTRODUCTION

The Volpe Center Acoustics Facility, in support of the California Department of Transportation (Caltrans), has begun a five-year study to assess several types of pavement for the purpose of noise abatement. On Highway 138 in Southern California (a desert area about 20 miles west of Lancaster), a 6.4-kilometer (4-mi) stretch of roadway has been chosen as the site for pavement overlays. A preliminary measurement program determined that the existing pavement on this roadway was highly irregular and in need of repair. As such, this stretch of Highway 138 will first be treated with a leveling course in order to have uniform base pavement, after which 4 or 5 different types of pavement will be overlaid in long sections, the shortest being 0.4 km (0.25 mi). The leveling course will be dense-graded asphalt concrete (DGAC), and the pavement types for the overlays are expected to include open-graded asphalt concrete (OGAC) with varying depths, rubberized asphalt concrete (RAC), and bonded wearing course (BWC). The overlay sections are referred to as the test sections. Two sections of the uniform base will remain untouched without any overlays; these sections are referred to as the reference sections.

Two times a year for 5 years, data will be collected in all test sections and the reference sections simultaneously. A base or reference set of measurements will be performed after the leveling course; all subsequent measurements will be performed after the overlays are in place. Microphones will be deployed in multiple configurations, the set-up dependent on the section. One position common to all sections is 15.2 m (50 ft) from the center of the near travel lane with the microphone at a height of 1.5 m (5 ft). In addition to acoustical data collection, meteorological data, traffic composition and speed data, and ground impedance data will also be acquired. All data will be analyzed, including comparisons between the test sections and reference sections and possible degradation of individual sections over time. If a particular pavement performs well in terms of both noise and safety, it may be selected for use throughout California as a noise abatement tool.

MEASUREMENT SITE

The 6.4-kilometer (4-mi) stretch of Highway 138 used for this study is adjacent to Neenach, CA, in a relatively flat desert area. The terrain consists of medium-packed dirt, desert grass and brush, and an occasional Joshua tree. Figure 1 shows a portion of the area where the measurements are being performed (picture taken during preliminary measurements). The monthly average high temperatures in this area range from about 14° C (57° F) to about 36° C (97° F).

Figure 1 – Portion of measurement area for Caltrans pavement study.

INSTRUMENTATION AND DATA COLLECTION

The primary instrumentation deployed at each site includes Bruel & Kjaer microphone systems, Larson Davis Laboratory spectrum analyzers and sound level meters, Sony DAT recorders, Qualimetrics meteorological systems, and Sony camcorders. All data are collected and analyzed in general conformance with ANSI standards [1 and 2] and FHWA's procedures [3].

For all measurement sections, microphones will be deployed at a distance of 15.2 m (50 ft) from the center of the near travel lane at a height of 1.5 m (5 ft). (Please refer to Figure 2 – picture taken during preliminary measurements.) In addition, in one reference section and the adjacent test section, microphones will also be deployed at distances of 7.6 m (25 ft) and 61 m (200 ft), again at a height of 1.5 m (5 ft). There is the possibility of adding a 4.6 m (15 ft) microphone to the 15.2 m (50 ft) position.

Acoustical data will be measured on-site using either a spectrum analyzer or a sound level meter and will also be captured using a DAT recorder. Third-octave band A-weighted L_{eq}s will be available for analysis either by accessing the spectrum analyzer data from the field or by processing the DAT recordings in a laboratory environment.

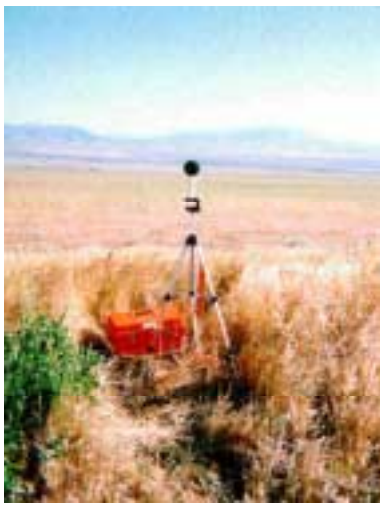

Figure 2 – Typical microphone set-up for acoustical measurements next to highway.

Figure 3 – Typical set-up for measuring ground impedance.

Meteorological systems will be deployed at a distance of 30.5 m (100 ft) at a height of 1.5 m (5 ft). The data captured will include temperature, relative humidity, wind speed, and wind direction.

Video cameras will be deployed to record traffic information. Vehicle identification and speeds will be extracted in a laboratory environment. Supplemental speeds may be captured during field measurements using a radar gun.

Ground impedance measurements will also be performed as part of this study. Applying the methodology described in the ANSI S1.18-1999 standard [4], a point source / two-microphone configuration is deployed over the ground surface of interest, and data is captured for multiple frequencies. (Please refer to Figure 3 – picture taken during preliminary measurements.) This system is currently being tested for practical use in determining the effective flow resistivity for different types of pavement.

PRELIMINARY MEASUREMENTS

In May 2001, preliminary measurements were performed for the Caltrans pavement study. This set of measurements provided vital information for the feasibility, instrumentation set-up, and data processing for all subsequent measurements.

The old DGAC pavement in the stretch of roadway to be used in this study was determined to be inconsistent. So as not to cause any bias in the sound levels in the different test sections, the pavement will be treated with a leveling course prior to paving the overlays.

The traffic was found to be quite sparse, hindering comparable time block averages, but favoring multiple single vehicle pass-bys. Traffic data analysis shows that it is possible to capture ten or more clean vehicle pass-by events per hour. In processing the data in terms of pass-by events, all data captured for this study can form a preliminary set of emission levels for a California vehicle emission levels database in addition to providing answers concerning noise abatement.

The background sound level was found to be quite low, in general about 40 dB(A). This requires a broad dynamic range during the measurements considering the pass-bys can reach 80+ dB(A).

Wind speeds can become very high at times, especially in the afternoons, adversely affecting the acoustical measurements. In planning future measurement trips, the wind conditions will be considered when choosing the time of year and the hours during the day that will best provide for the collection of uncontaminated acoustical data. Although intense heat, up to 38° C (100° F), and blowing dirt were encountered, they did not cause any instrumentation malfunction. The instrumentation systems were housed in plastic toolboxes which satisfied the requirements for functionality and protection.

SUMMARY

The Volpe Center in support of Caltrans is conducting a five-year study to determine the acoustical characteristics of tire/pavement noise for multiple types of pavement. The study is designed to provide information on the usefulness of a particular type of pavement as a noise abatement tool and also accommodates acquiring a preliminary set of vehicle emission levels specific to California. Preliminary measurements have provided valuable data in helping with the planning of future measurement trips. The baseline measurements for the study are expected to occur Fall 2001, with the first set of the overlay measurements to follow.

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