OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF ENVIRONMENTAL SERVICES
RESEARCH IMPLEMENTATION PLAN

Title: Parallel Barrier Effect for Distant Receivers

State Job Number: 14687
PID Number:
Research Agency: Ohio University
Researcher(s): Lloyd Herman
Technical Liaison(s): Elvin Pinckney
Research Manager: Monique Evans
Sponsor(s): Howard Wood, Tim Hill
Study Start Date: 12/1/1997
Study Completion Date: 9/1/2002
Study Duration: 57 Months
Study Cost: $274,096.00
Study Funding Type: 80 Federal / 20 State form ODOT SPR (2)

STATEMENT OF NEED:

This research project was needed to scientifically quantify and qualify the perception of residents a distance from the project area, that traffic noise was worst in certain areas than before the traffic noise barriers were installed. To determine the nature and extent of any problems with the noise barrier construction, a preliminary assessment project was initiated. The assessment indicated that the perception of increased traffic noise levels due to noise barrier construction was the most pervasive complaint and was sited most often by residents living between 600 feet and 1800 feet from the roadway. Additionally, residents protected by parallel barrier configurations were more likely to perceive increased levels than those protected by single barriers.

RESEARCH OBJECTIVES:

- Verifying both the existence and significance of multiple reflections for parallel barrier configurations through field measurements.
- Ascertaining the range in ground attenuation forfeited by noise barrier construction by applying the noise propagation theory and computer modeling to representative sites.
- Performing computer modeling to determine both the potential for noise level increases from multiple reflections between parallel barriers, and the potential for noise level reduction by using sound absorptive barriers.
- Identifying modeling procedures to be used on future projects that can avoid existing problems and indicate when absorption materials should be employed.
- Developing a field measurement database to evaluate future modifications to existing noise barriers and correct problems in the project area.

RESEARCH TASKS:

- Since a method to both detect the location and measure the relative intensity of any reflections was needed. A major part of the project involved the conception and development of a test system that incorporates a signal processing component.

- Field measurements at both locations outlined in the research project. In Hamilton County along I-71, north of Cincinnati, and in Summit County along S.R. 8 in the communities of Cuyahoga Falls and Silver Lake.

- The noise barrier system along S.R. 8 in Cuyahoga Falls has been retrofitted with sound absorptive material with positive acoustic results.

- Data reduction from field measurements including acoustical and meteorological data.

- Computer modeling and analysis using TNM (Transportation Noise Model) Version 1.0 to assess ground attenuation.

- Data analysis and tabulation and discussion of results.

RESEARCH DELIVERABLES:

A final report outlining research methods, data collected findings, conclusions, and recommendations.

RESEARCH RECOMMENDATIONS:

1. The parallel noise barriers constructed on this project had width-to-height ratios in the less than 10:1, and the 10:1 to 20:1 ranges. Therefore, the use of sound absorbing walls is specifically recommended for parallel barrier configurations with these ratios.

2. The primary goal in abatement design is to provide acceptable noise levels for residents close to the highway. Strategies that both meet this goal and address the loss of ground attenuation for distant receivers should be considered. Using TNM (Transportation Noise Model) for noise barrier design results in lower noise barrier heights compared to designs based on STAMINA 2.0 noise level predictions. The FHWA mandated use of TNM will therefore result in lower noise path heights as a result of lower barrier heights.

3. When space within the right-of-way is not an issue, earth berms should be considered. Earth berms will provide more ground attenuation than noise walls of the same height. Where the right-of-way may be restricted, an earth berm and wall combination might be utilized.

4. Controlling traffic noise at its source is a comprehensive strategy. Lower traffic noise source levels will result in fewer and shorter noise barriers. Lower noise barriers will result not only in more ground attenuation but also in less surface area for reflections between noise barriers. While Transportation agencies cannot control the vehicle component of traffic noise, they can control the pavement component. Pavement types resulting in lower levels of tire/toad noise should be considered.

5. The extreme reflection problem for residents in the test section D should be addressed. Alternative design strategies, such as installing sound absorbing materials to reduce the intensity of reflections or increasing the height of the barrier closest to the affected residents to provide shielding from reflections, should be implemented.

PROJECT PANEL COMMENTS:

No review panel associated with project. The results of the report were given to management and the Environmental section of District 8 at ODOT.

IMPLEMENTATION STEPS & TIME FRAME:

Of the recommended strategies listed in the final report, ODOT has implemented the following:

1. Overlap Gaps in the noise barrier system on the HAM-71-11.44 project have been closed, having positive acoustic results.

2. A requirement to have sound absorptive material included on specific projects based on project conditions have been included in the ODOT noise policy.

3. The use of the TNM noise analysis model has been implemented and will be used for all ODOT noise analyses and abatement design. The average height of barriers designed by this model are generally shorter with less surface area compared with those designed by the previous STAMINA 2.0 model, complementing one of the recommendations listed in the report.

EXPECTED BENEFITS:

The benefits of the above implementation are:
- Reduced noise reflections between parallel barriers.
- Less negative public comment in reference to increased noise after barrier construction.

EXPECTED RISKS, OBSTACLES, & STRATEGIES TO OVERCOME THEM:

There are no risks, and obstacles have been overcome. Additional cost of sound absorptive material has been found to be affordable and is included in the overall budget for barriers

OTHER ODOT OFFICES AFFECTED BY THE CHANGE:

The Office of Structural Engineering has been involved in the approval process for sound absorptive material.

PROGRESS REPORTING & TIME FRAME:

N/A

TECHNOLOGY TRANSFER METHODS TO BE USED:

- The Transportation Noise Model (TNM) has been implemented for use on all ODOT projects warranting noise analyses and abatement design. The use of this model is now mandated by the FHWA for all State DOTs.

- The final report of this research will be available online at the ODOT website.

- The Final Report was also distributed to all other state departments of transportation in addition to national libraries and repositories.

IMPLEMENTATION COST & SOURCE OF FUNDING:

Funding source is project funding for Type I noise barriers. Funding source is the Retrofit Noise Wall (NWR) program for Type II noise barriers.

Approved By: (attached additional sheets if necessary)

Office Administrator(s):

Signature: Tim Hill Office: OES Date: 12/13/2005

Division Deputy Director(s):

Signature: Howard Wood Division: Planning Date: 12/15/2005