Project 0-2112 Summary Report
Relational Database of Texas Noise Barriers
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PROJECT SUMMARY REPORT

Relational Database of Texas Noise Barriers and Effectiveness of Absorptive Treatments Applied to Noise Barriers: A Summary

What We Did...

The purpose of this project was to develop a relational database and summary document for persons involved in the construction of noise barriers who are looking for design examples and data. The ArcView® database incorporates geographical information system (GIS) technology along with photographs and data that can be analyzed spatially. The summary document (Texas Department of Transportation Noise Barrier Survey) provides a visually appealing and informative display of noise barriers throughout the state of Texas. Each data sheet includes three or four photographs of the sound barrier, two maps locating the barrier, and construction data. The photographs include a distance shot of the noise wall, a photo of a single section of the barrier, and close-up shot(s) showing the surface texture of the wall. An enlarged location map of the area is shown to the left of the data sheet with an inset specifically locating the noise barrier. The inset map is also shown in greater detail on the data sheet. The construction data include the system of construction, materials, surface texture, height, length, approximate cost, and the year construction was completed. The data were then organized by district, so that the user can conveniently acquire design ideas from previously existing walls.

In addition to the construction of a database, research was performed to determine the effectiveness of acoustically absorptive treatments on noise barriers. Four different companies—CPS Systems, TxDOT, Soundsorb, and Durisol—manufactured noise barriers along IH 610 in Houston. All manufacturers but TxDOT developed a barrier which absorbs sound. The TxDOT barrier is a standard reflective barrier. Figure 1 illustrates the location of the different sections of noise barriers on IH 610 and identifies their manufacturers.

Initially, researchers reviewed and organized existing Texas Department of Transportation (TxDOT) and Center for Transportation Research (CTR) data to create a general database of noise barriers constructed by

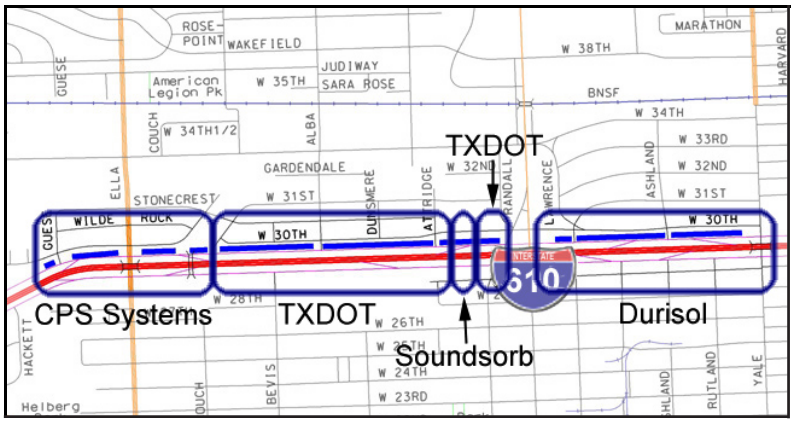

Figure 1: Location of Sound Walls in Experiment

TxDOT. Then, letters were sent to contact personnel in each TxDOT district in which noise barriers had been constructed, requesting corrections to the database, as well as any new or additional data that could be provided. The data that were returned to CTR were used to correct and update the database, which is comprised of records containing various fields related to location, construction, and cost. Then, CTR staff visited each of the noise barriers listed in the database to take photographs and collect additional data. Photographs taken of each noise barrier include views along the barrier showing traffic for scale, an orthogonal view of a typical panel, and close-up views showing surface texture and color detail.

A CAD drawing was made for each barrier showing its layout in plan relative to proximate roadways, and then the drawings were overlain on TxDOT urban county roadway drawings obtained from the Texas Natural Resource Information Service. The composite CAD drawings were used to generate a site map for each noise barrier as well as an area map showing the location of each barrier within its city. Then, a map was made of each TxDOT district in the database, showing the locations of all barriers in the district. Finally, the photographs, maps, and data described above were compiled to create a summary document entitled "Texas Department of Transportation Noise Barrier Survey," included as Chapter 5 in Research Report 2112-1.

Next, the independent CAD drawings of the noise barriers were merged and spatially projected to the Texas Statewide Mapping System to create a GIS layer to be associated with the collected data. This GIS layer was subsequently made into an ArcView® theme, and each set of polylines representing a TxDOT barrier was linked to its associated record in the noise barrier database, as well as to its digital photograph. Other GIS layers that were also converted to the TSMS projection and included in the relational database include: TxDOT districts, Texas counties, Texas legislative districts, U.S. postal codes, and USGS quarter quadrants. The result is a GIS database of Texas Department of Transportation noise barriers that can be queried or spatially analyzed with respect to any of the themes listed above and their associated data, as well as the data collected for the barriers themselves.

Two methods have been applied to determine the effectiveness of noise barriers along IH 610N in Houston. The first is an insertion loss test based on ANSI standard S12.8-1998. A lower bound insertion loss measurement was made because the sound source could not be removed to determine background noise. However, the background noise was considered to be 10 dB lower than the source and was reported as "0 dB assumed." The BEFORE sound pressure level was measured, rather than predicted, and indirect rather than direct. Its position was chosen to be along the same highway where the insertion loss measurements were being conducted. This would minimize any differences in source conditions. The BEFORE and AFTER measurements were all recorded at a consistent distance from the source.

The second method used to evaluate the effectiveness of the noise barriers was to place a microphone within 15 cm of the front of the wall, and normalize it based on a reference microphone located in the same position as the insertion loss tests. The TxDOT noise barrier was taken as the control and difference in sound pressure level (SPL) between it and the other three barriers was considered absorbed as a result of the treatment on the surface of the barrier.

The sound source for the test was the existing traffic flow from the highway. The use of an artificial sound source was ruled out during preliminary tests, and a controlled natural sound source was not feasible because of the heavy traffic along IH 610.

There were some exceptions to the standard in the experimental method. The first exception was that the wind speed and direction were not measured, and the second exception to the standard was that no automobile count was performed. However, these changes are not significant because the BEFORE and AFTER measurements were completed on the same day, and the source and climate conditions were relatively constant.

What We Found...

The research conducted to form the database resulted in a statewide summary of noise

barrier data. The total length of the noise barriers investigated was 210,109 ft (39.8 miles). These barriers had an average height of 12.2 ft, and the average building and construction cost was $16 per sq ft. Therefore, the approximate total cost of these barriers was $41.4 million. This equals $1.04 million per mile of barrier.

Table 2 shows the results of the insertion loss tests. These results seem to support the traditional assumption that absorptive treatments have very little, if any, effect on insertion loss. Although the experiments were conducted using the same source on the same day, the amount of vegetation in the backyards of the residents where the noise was recorded varied. In order to obtain more reliable results, additional tests need to be run at different sites along the same wall, and those results should be averaged.

The results absorption tests are shown in Table 3. The TxDOT barrier represents a typical reflective barrier. Therefore, the difference between any SPL in the "reference - receiver" column and TxDOT's SPL represents absorbed sound. Unlike the insertion loss tests, the terrain between the source and receiver was consistent between sites. These results show that absorptive treatments are effective in reducing sound pressure in front on the noise barrier with up to 4.09 dBA in sound absorption over a standard barrier.

Table 2: Results of Insertion Loss Tests

Section	Manufacturer	Insertion Loss (dBA)	Uncertainty (dBA)
1	CPS Systems	6.67	± .3
2	TxDOT	9.51	± .5
3	Soundsorb	10.78	± .4
4	Durisol	8.69	± .3

Table 3: Results from Absorption Tests

Section	Manufacturer	Reference – Receiver (dBA)	Uncertainty (dBA)
1	CPS Systems	1.51	± .3
2	TxDOT	0.63	± .4
3	Soundsorb	3.92	± .2
4	Durisol	1.92	± .4

The Researchers Recommend...

This project needs additional research and maintenance, which includes updating the database as more noise barriers are constructed. A study of the absorptive performance of the noise barriers tested needs to be conducted over time. It is possible that weather conditions and dirt could degrade the sound absorbing effectiveness of these barriers. Also, the receiver microphone for the sound absorbing tests should be varied in height. This height variance may reduce some of the effects of ground impedance on the sound pressure level in front of the wall. Finally, more insertion loss tests should be conducted to obtain a more accurate insertion loss measurement.

For More Details...

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The research is documented in the following reports:

2112-1 *Relational Database of Texas Noise Barriers and Effectiveness of Absorptive Treatments Applied to Noise Barriers* August 2001

To obtain copies of a report: CTR Library, Center for Transportation Research,
(512) 232-3138, email: ctrlib@uts.cc.utexas.edu

TxDOT Implementation Status February 2002

This research project substantiated existing information regarding the effectiveness of noise barriers, including the application of associated absorptive treatments. The research project also resulted in the development of a comprehensive noise barrier database. The database will be extremely beneficial in the design and construction of future noise barriers in Texas. The database will be provided on compact disc to all TxDOT districts. ENV will be responsible for updating the database as new noise barriers are constructed. For more information, please contact Bill Knowles, P.E., RTI Research Engineer at (512) 465-7648 or email at wknowle@dot.state.tx.us.

Your Involvement Is Welcome!

Disclaimer

This research was performed in cooperation with the Texas Department of Transportation and the U. S. Department of Transportation, Federal Highway Administration. The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement. The engineer in charge was Michael T. McNerney, P.E. (Texas No. 70176).

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