The Wall Journal™

The International Journal of Transportation–Related Environmental Issues

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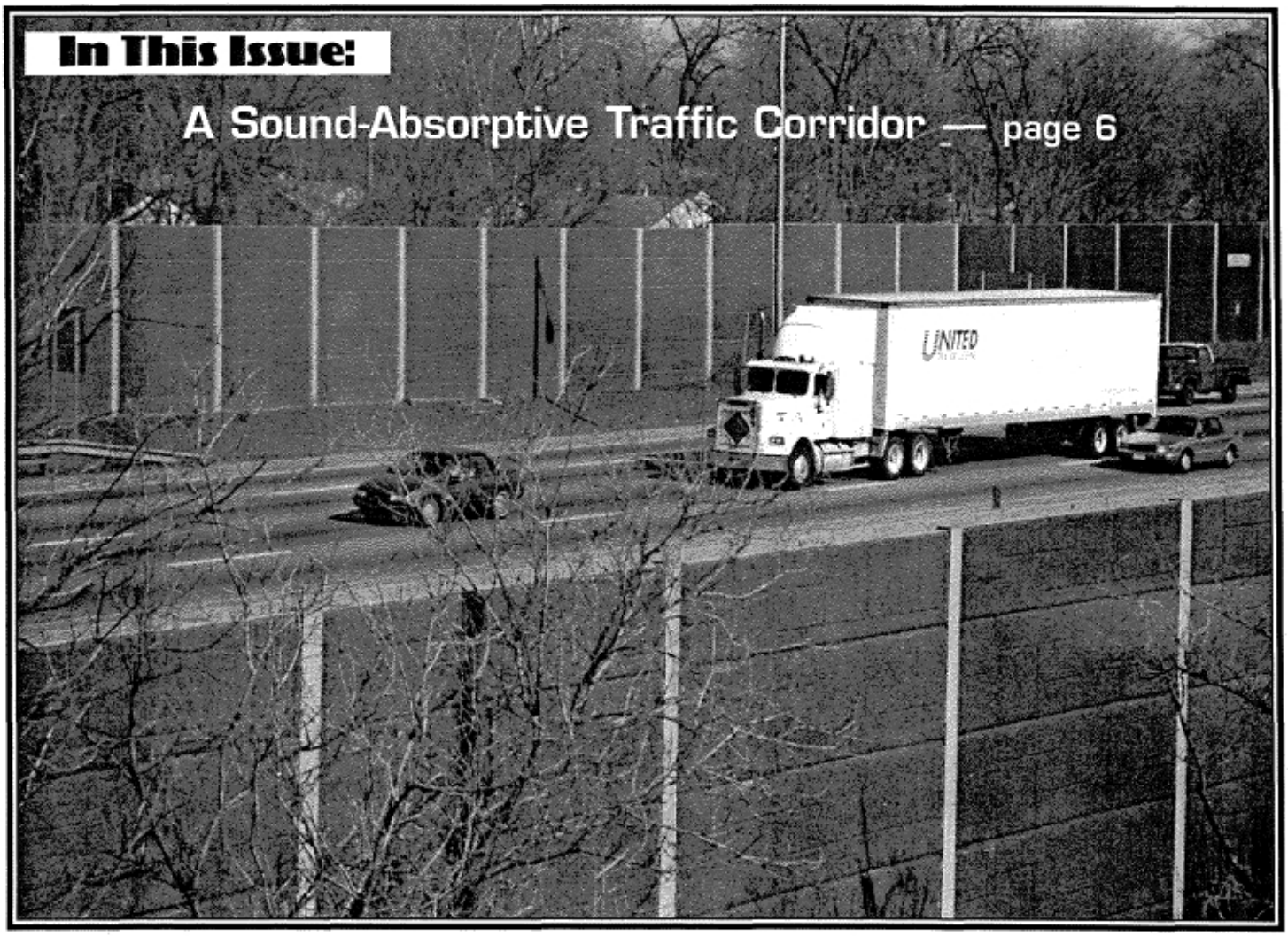

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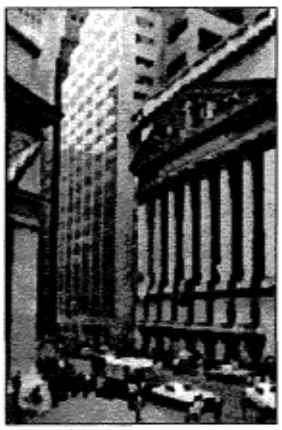

page 12:
Visit our very own
Exhibitors' Hall
for a preview of many of the products, systems and services available in the market for the measurement and abatement of transportation related noise. To borrow a phrase from Ma Bell, "Let your fingers do the walking".

2 Editor's Corner

3 Texas DOT Search for Noise Barrier Solutions

3 Press Release — Industrial Acoustics Company

4 European Standardization for Sound Barriers

10 Insertion Loss Performance of Road Noise Barriers

12 A1F04 Committee Summer Meeting in Boston

24 Reader Registration and Subscriptions

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Editor's Corner

by El Angove

I am not a scientist. I know that, the Good Lord knows that, and I guess just about everybody who knows me knows that one thing I am not, is a scientist. I think I decided not to become a scientist when I was about ten years old. My parents took my brother and I to the Odeon theater in Bonne Terre, Missouri to see the movie "Frankenstein".

When I saw what happened to Dr. Frankenstein (the scientist), I figured that would be a pretty dumb thing to want to be. My younger brother, Don, never even gave it a thought — he sat through the whole movie peeking between his fingers. He turned out to be a baseball pitcher. Figuring out what makes a pitched baseball curve was science enough for him.

Not being a scientist has had its advantages and disadvantages. The advantages are that I didn't get my brain cells cluttered up with all those formulas and equations — I had my whole head clear to think about girls, jazz, fishing, model airplanes, photography and stuff like that. *Real* stuff.

But, lately, not being a scientist has its disadvantages. It seems like I am coming more and more in contact with real live scientists in my endeavors with this magazine. And, some of them are heaping a real load on me. I've gotten to where I know a decibel from a dumbbell, I can write $E = mc^2$ on the blackboard, and I can program my VCR. But, to me, quantum physics means a lot of ExLax.

However, I do have an inquisitive nature, and when some scientist lays a new theory on me, I have *just enough* innate knowledge to grasp the outer edge of what he is talking about. That's my disadvantage — I can't get any further than that.

Take Frank Hodgson, for example. Frank called me some months ago and told me of an experience he had while visiting a Mayan temple in the Yucatan Peninsula. He said that if you stood in front of the temple and shouted at it, the echo came back in a piercing shriek. Frank termed the phenomenon "parametric amplification of sound". I immediately sensed that this might be something of use in the acoustics field, since I had never heard the term used before.

If you have been a regular reader of The Wall Journal, then you know that I have published Frank's articles in Issues 11, 13 and 15, in which he writes at length of his theories on this acoustical phenomenon. He had hoped to find acoustics experts who would work with him to determine if some practical applications could be developed.

Unfortunately, he did not receive much response from the articles. A few people did contact him, but nothing much happened.

By this time, I was even beginning to lose enthusiasm (I have a short attention span). And then, a couple of weeks ago, I had a call from Wayne Van Kirk from Houston. He had read Frank's articles and became very interested since he had a similar experience in the same Mayan ruins. I quote excerpts below from his letter to a friend:

"Last Fall my wife and I went on a vacation to the Yucatan (Mexico) taking in a brief tour to the Mayan ruins at Chichen Itza. The Great Ballcourt (the largest by far of its type) has amazing acoustic properties which you may well be aware of since the phenomena is well known.

I was standing at location C while a couple were having a conversation in a normal speaking voice, one at location A and one at B, 480 feet from one another. The quality of sound at my location C was as if we were in a small well-damped room. Perfectly clear! From what I have read, location C where I was standing was not a chance "sweet spot" but the whole or much of the interior of the Ballcourt has this acoustical quality. This is something that must be experienced to be appreciated.

The Ballcourt acoustics struck me as a paradox in that it seemed too amazing to be accidental but difficult to imagine that the Maya had the engineering capability to create it intentionally. I spoke with an archaeologist who has spent 25 years at this site. She felt that this phenomena had to be an accident as nothing they have unearthed would indicate otherwise.

My search also revealed information regarding unique sound modification properties of the Pyramid of Kukulcan at Chichen Itza, a structure about 200 yards from the Ballcourt. If unwanted noise can be shifted to an inaudible 45 KHz passively with light weight panels, as the information suggests, would this not be revolutionary technology, one that has been lying dormant for 1,000 years"? End of quote.

O.K. I'm not a scientist, but I can sure smell something here. I don't care if aliens from outer space visited Mexico 1,000 years ago and showed them how to build acoustic walls. If there is good science lurking in those ruins, I say we ought to get down there and find out. What do you say, acoustical scientists?

Anyone for Chichen Itza? ■

ANNOUNCEMENT

TEXAS DOT PROJECT 1471 — THE SEARCH FOR EFFECTIVE NOISE BARRIER SOLUTIONS

Principal Researchers:
Professor Richard E. Klingner, University of Texas, Austin, Texas
Dr. Michael T. McNerney, Center for Transportation Research, Austin, Texas
Professor Ilene Busch-Vishniac, University of Texas, Austin, Texas

The need for development and implementation of effective noise barrier technology is recognized not only in Texas, but across the nation. The Texas Department of Transportation (TXDOT) is currently sponsoring research with the goal of developing improved designs for noise barriers which are more effective, economical and aesthetically pleasing. The objectives of this project are to:

- Evaluate existing noise barrier materials and systems in use by TXDOT with regard to their acoustical performance, visual aesthetics, structural requirements, and cost effectiveness.
- Develop performance criteria for different geometric and terrain conditions that permit the quantification of acoustical performance, aesthetics, structural soundness, and life-cycle costs.
- Develop methodology for selecting application specific designs.
- Develop a model for evaluating parallel reflections of noise barriers and make recommendations as to when it should be used for design.
- Develop improved specific noise barrier system designs to include material specifications, acoustic and structural design methodology, and construction details.

The final product will be a complete design guide that provides TXDOT district designers with a set of simple design rules as well as current information on noise wall systems that can be used to design noise walls.

The research team is interested in receiving information from manufacturers, contractors, engineers and state DOT representatives on systems in use or any particular experiences related to the development of a noise wall design guide.

Any manufacturers or interested parties with pertinent information and/or innovative wall systems, should contact, or send literature, to:

Dr. Michael McNerney
Center for Transportation Research
3208 Red River Street, Suite 200
Austin, TX 78705
Fax: (512) 480-0235. ■

PRESS RELEASE

FOR IMMEDIATE RELEASE:

JOHN M HANDLEY OF INDUSTRIAL ACOUSTICS COMPANY APPOINTED SENIOR VICE PRESIDENT, MARKETING & SALES

Bronx, New York. The appointment of John M. Handley as Senior Vice President of Marketing & Sales for Industrial Acoustics Company (IAC), an international noise control engineering and manufacturing company in New York, has been announced by IAC's President, Martin Hirschorn, effective immediately.

Handley, who joined the company in 1961, is well-known throughout the industry for his expertise in meeting the demands in international markets for IAC's noise control products and systems. Now responsible for directing IAC's sales organization domestically and internationally, he will also spearhead long range planning and marketing.

A graduate of Rutgers University, John Handley has traveled throughout the Pacific Rim including Japan, South Korea, Hong Kong, Taiwan, Singapore, Malaysia and Thailand to obtain licensees and sales representation for IAC. He has lectured extensively and published on the subjects of hearing conservation and noise control.

IAC has first class engineering and manufacturing capabilities in the U.S. and Europe serving the architectural, air conditioning (HVAC), industrial, medical/life sciences, power plant and military/commercial aviation markets.

The company's widely used modular economical studios for broadcasting, recording and music practice – with guaranteed sound reductions and controlled environments from live to echo free – are readily installed.

IAC's range of acoustical ceilings is ideal for auditoria, theaters, convention centers, correctional institutions, food and beverage facilities and commercial buildings. IAC's operable walls permit the effective acoustical subdivision of spaces from very large to very small.

Other company products include HVAC, jet engine and gas turbine silencers – medical audiometric testing rooms – military/commercial aircraft "hush-houses" and engine test cells – operable walls – anechoic, reverberant and other test facilities – power plant and shipboard silencers – traffic sound barriers – quiet rooms/enclosures for industry, and detention cells.

IAC's research and development division is internationally recognized for innovative solutions to unusual problems. Quality control in IAC's Aero-Acoustic Laboratory ensures the ongoing accuracy of all ratings. The laboratory develops special purpose silencers, room enclosures and other products, and arranges witnessed performance testing. ■

European Standardization for Sound Barriers

By Bernard DUCONGE, Association Professionnelle des Rêalisateurs d'Ecrans Acoustiques, Neuilly, France

As a contribution to European Unity, a huge work of standardization began more than ten years ago to compare the standards used in these countries, the main ones being England, France and Germany with BS, NF and DIN. They try to decide common rules, even if that leads too often to agree on the lowest ones.

Concerning sound barriers, the European Commission for Standardization (CEN, from the French title Commission Europeenne de Normalisation) settled the 226th Technical Committee for roads equipment, in which the 6th Working Group is in charge of the sound barriers. Therefore, every European Standard concerning sound barriers will have the reference digits: CEN/TC 226-WG6 and the title "Road Traffic Noise Reducing Devices".

In the working groups, not only the twelve countries forming the European Community meet, but also other countries that would or not join the Union, as Austria, Finland, Sweden, Switzerland, etc... to name those who effectively took part in the Working Group meetings.

After three years of meetings, every three months on average, more than half of the job has been achieved, and five standard texts have been written with internal approval. Two years of approval are still necessary, including submission to a wide public inquiry, to reach the final agreement and give these standards the strength of European common law.

These five standards concern:

1- **No. N 91 E:** Non acoustic performance, part 1: mechanical performance and stability requirements.

Five actions are considered:

- wind loading, developed in the normative annex A
- self weight, treated in the normative annex B, including mechanical requirements for structure, fixing devices, etc.
- damage caused by flying stones: a test method is accurately described in the normative annex C
- safety when collision under impact by vehicles is explained in the informative annex D
- dynamic load from snow clearance, depending on plowing speed, is assessed by calculations or load tests; it is detailed in the informative annex E

2- **No. N 92 E:** Non acoustic performance, part2: general safety and environmental considerations

Six elements are studied:

- fire resistance, developed in the normative annex A that separates the materials into four classes:
  1. fire-proof
  2. fire-resistant
  3. flammable
  0. not tested

  and explain a fire test on a standard and dried panel of 2 x 1.5 m
- secondary safety concerning any danger of falling debris; a test is developed in the normative annex B
- environmental protection against any adverse effect of any components, or on the other hand recycling of products, is shortly treated in the normative annex C
- means of escape in emergency are developed in the normative annex D; they include means of access for maintenance
- reflection of light is explained in the informative annex E
- transparency is developed in the informative annex F with mathematic definition and diagrams including the specific aspect of some dynamic transparency for merging traffic

3- **No. N 98 E:** Test method for determining the acoustic performance. Part 1: intrinsic characteristics, sound absorption.

Test arrangement is more developed than described in EN 20354; it is pointed out that all the reflecting parts, and especially posts, have to be included in the specimen tested for which the sample lay on the floor of the testing room. Single number rating of sound absorption DL α is given by the formula:

$$DL\,\alpha = -10 \log \left[1 - \sum_{\iota=1}^{18} \alpha S\iota \times 10 \right]^{*}$$

ιconcerning each one-third octave band. Five categories of absorptive performance are defined in the normative annex A:

A0 = not tested
A1 = DL α < 4
A2 = 4 to 7
A3 = 8 to 11
A4 = DL α > 11

The informative annex B is a guidance note on use of DL α rating, concerning multiple reflections and undergoing diffraction that may alter the original spectrum and emphasize the low frequency components.

4- **No. N 99 E:** Part 2. Intrinsic Characteristics: Airborne Sound Insulation.

For this test, the sample is standing up, sparing the testing room into two separate parts (EN 20-140-3). The single number rating of airborne sound insulation DL is given by the formula:

$$DL = -10 \log \left[\sum_{\iota=1}^{18} 10^{0,1L\iota} \times 10 \right]^{*}$$

Four categories of airborne sound insulation level are defined in the normative annex A:

B0 = not tested
B1 = DL < 15
B2 = 15 to 24
B3 = DL > 24

*$\alpha S\iota$ = Sound absorption coefficient in the ιth one-third octave band
$L\iota$ = Normalized A-weighted sound pressure level (dB) of traffic noise in the ιth one-third octave band
$R\iota$ = Sound reduction index in the ιth one-third octave band

5- **No. N 100 E:** Part 3, Normalized traffic noise spectrum.

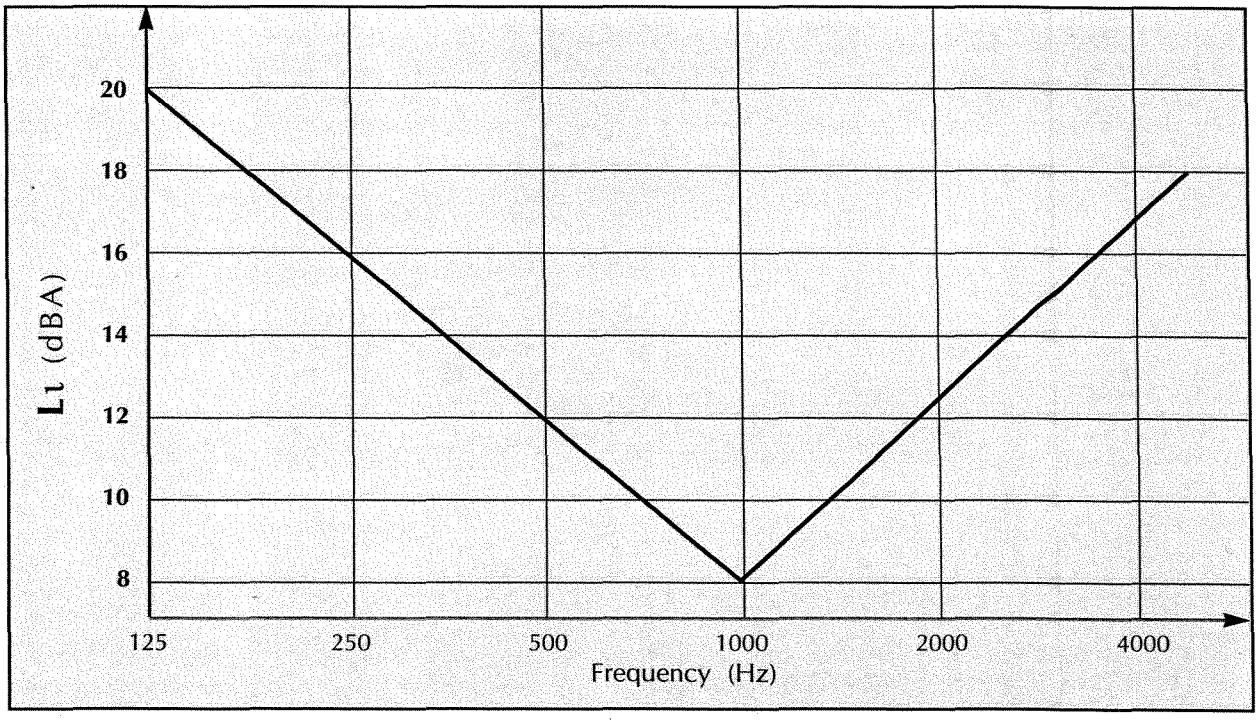
The reference spectrum for assessment of the acoustic performance of traffic noise reducing devices varies roughly as shown on the graphic on the next page. Other points still in study and discussion are:

1. long term durability (part 3 of non acoustic performance).
2. extrinsic performance, i.e., in situ noise decreasing which additionally depends on factors which are not related to the product itself, e.g., the dimensions of the barrier and site factors (site geometry, ground impedance...).

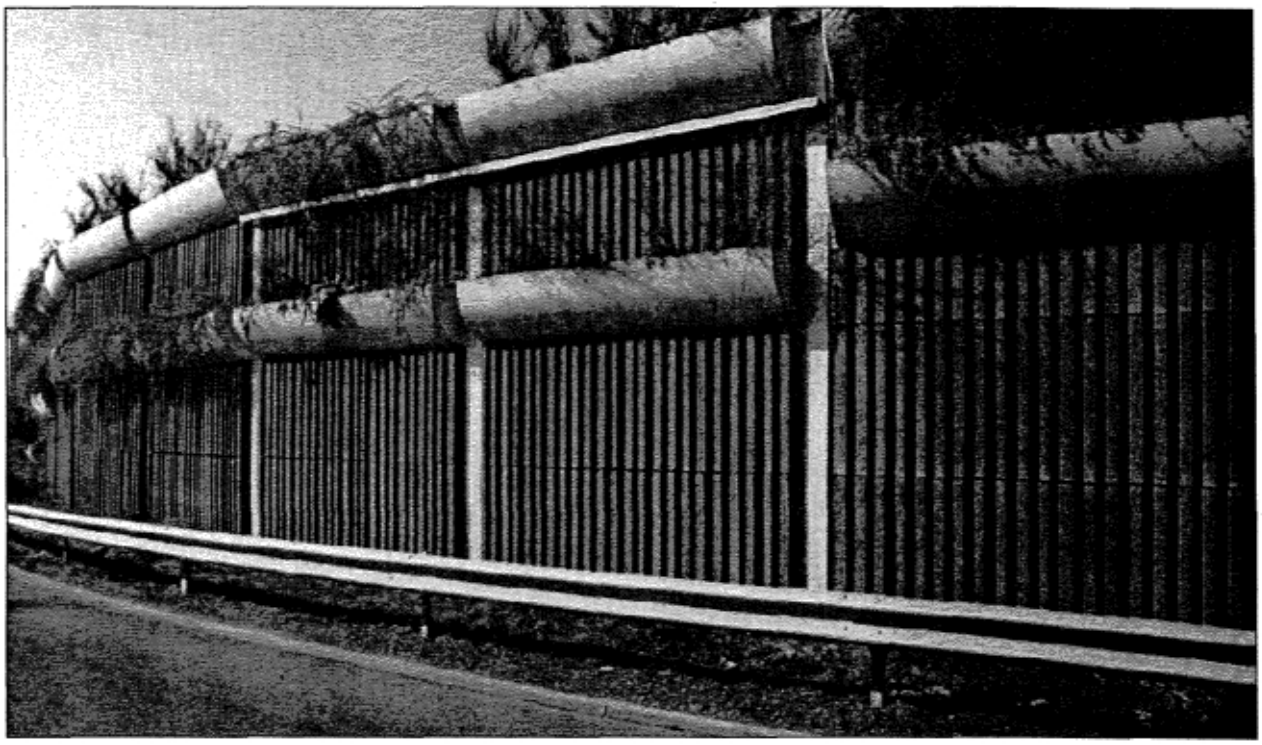
France adopted an in situ test (Standard No. NF 31089) based on a short noise from a revolver shot, the effect of which are registered on computerized microphones at fixed points. But this method did not pass the critiques made by European partners, due to hazardous results in some cases.

3. intrinsic performance for in situ tests. A research survey started, involving a lot of major European laboratories and universities in order to try to clearly define sources, noise treatment and reception, and to study refraction characteristics.

These three subjects have many relations together; therefore, they will be managed by mixing the two initial Task Groups. ■



REFERENCE SPECTRUM FOR ASSESSMENT OF THE ACOUSTIC PERFORMANCE OF TRAFFIC NOISE REDUCING DEVICES



The Beton Bois Systeme Noise Barrier at LYON-ECULLY. This product achieved the first prize in the competition of acoustic screens organized by the Ministry of Civil Engineering and Housing and the State Secretary's Office in Charge of Environment

For further information, please contact:
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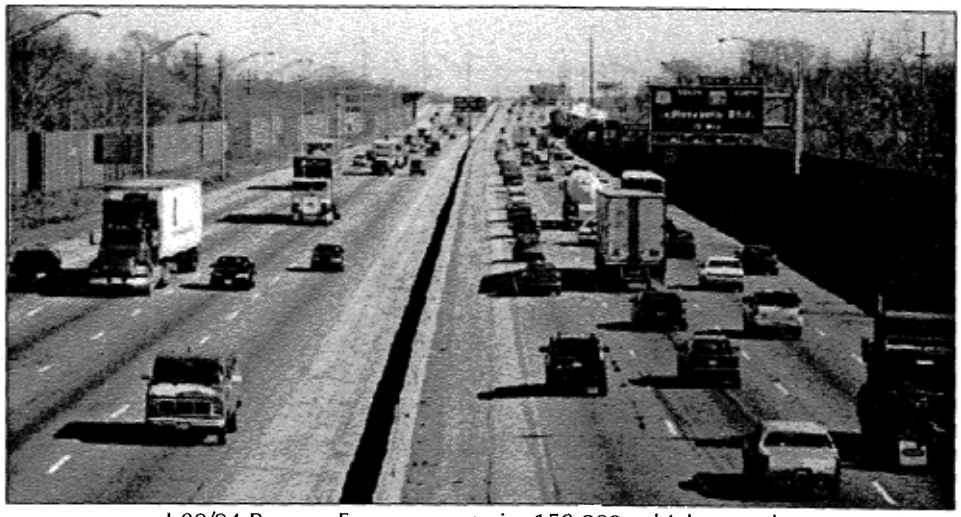
APREA
80, Avenue Charles de Gaulle
92200 Neuilly-sur-Seine
Neuilly, France

A Sound-Absorptive Traffic Corridor

The I-80/94 Borman Expressway in Indiana — A Case Study

By E.A. Lamberson, P.E.



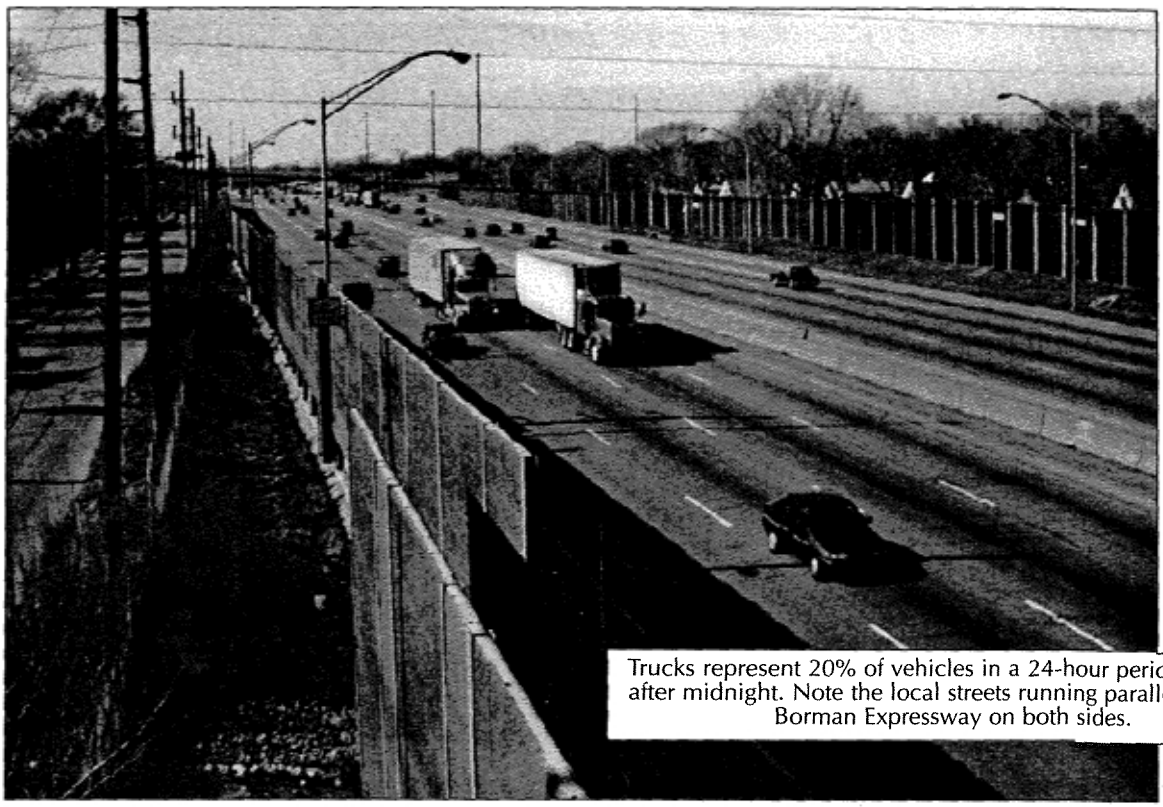
I-80/94 Borman Expressway carries 150,000 vehicles per day.
Sound barrier design was modeled for 192,000 vehicles per day by the year 2016.

The Indiana Department of Transportation (INDOT) has constructed a total of 33,000 lineal feet of parallel sound barriers along a five mile section of I-80/94 Borman Expressway in Hammond, Indiana. The construction was undertaken by the LaPorte District of INDOT under two separate competitively bid design/build contracts.

The Special Provisions for these two projects did not list approved sound barrier manufacturers nor approved systems, but did stipulate minimum performance standards for structural capacity, weathering, durability, appearance and acoustical ratings.

Preliminary engineering layouts for the project specific requirements and sample calculations and details were required to be submitted to the INDOT Project Manager, Mark Zwoyer, and to all prospective contractors after advertisement and before bid. These preliminary submittals were for information and for discussion, but were not formally reviewed and no prebid approval

(Continued next page)



Trucks represent 20% of vehicles in a 24-hour period, or 37% after midnight. Note the local streets running parallel with the Borman Expressway on both sides.

status was granted. Only the post-bid full technical submittal by the successful general contractor using a selected system was reviewed for compliance with the technical requirements of INDOT.

Superior Construction Company of Gary, Indiana was the successful bidder on both contracts. Superior selected the Durisol™ sound-absorptive system to provide the sound barrier requirements for both the post-and-panel ground-mounted and traffic barrier-mounted sound wall requirements.

Due to relative close proximity of the parallel sound barriers and the existence of local streets paralleling the barriers on the residential side, two-sided sound-absorptive barrier specifications were chosen. The barriers were required to have a minimum noise reduction coefficient (NRC) of 0.80 on the highway side and 0.70 on the residential side. A minimum sound transmission loss (STL) of 23 dB was required through product testing.

The INDOT Borman Expressway corridor carries 150,000 vehicles per day.

(Continued on page 8)

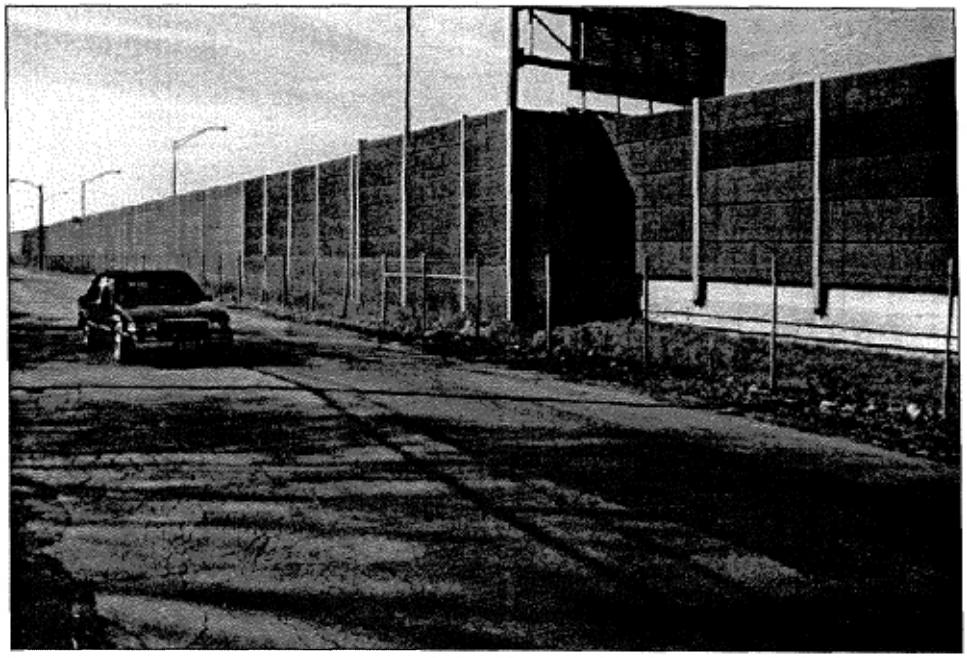
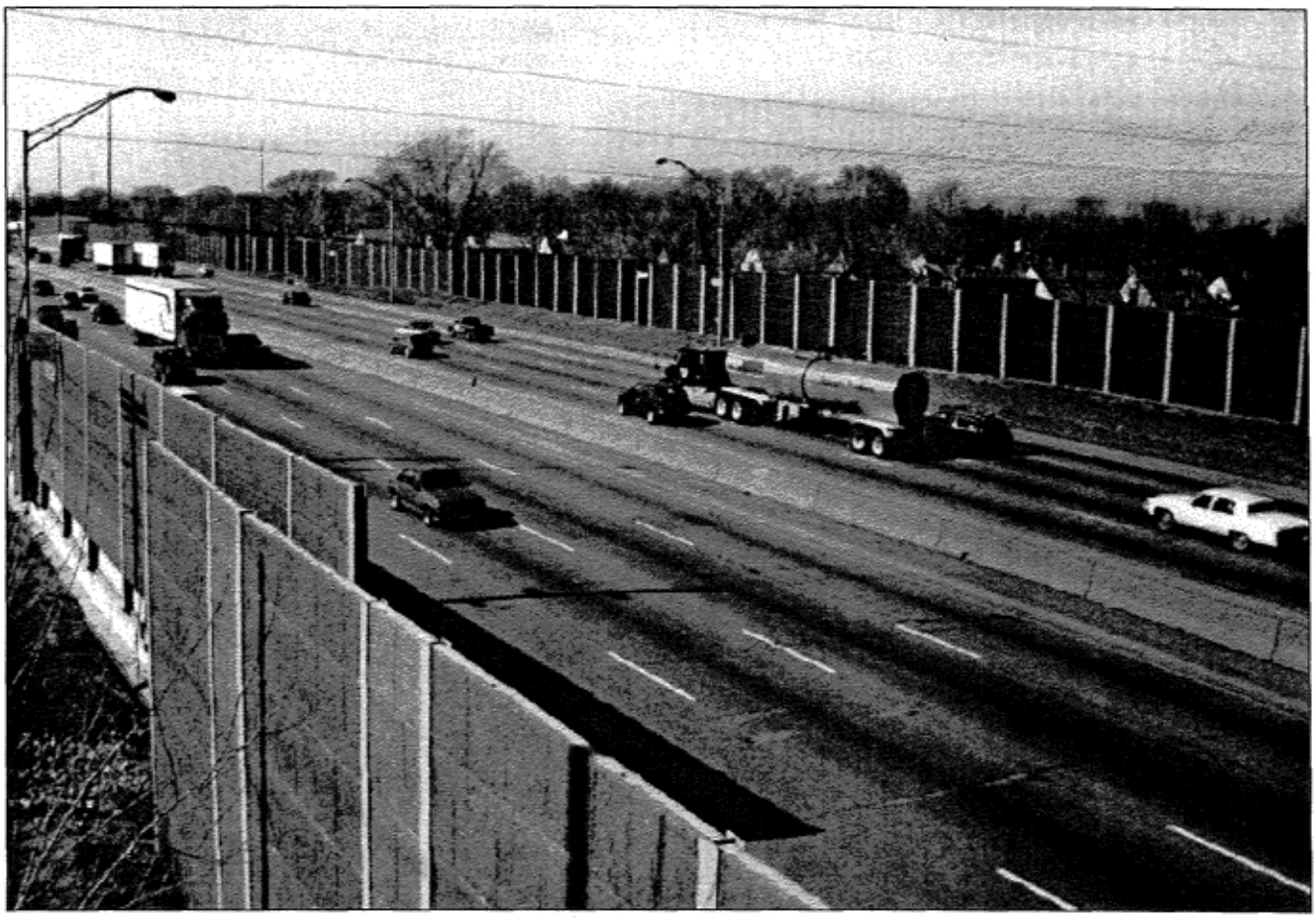


Photo above: A local street on the residential side of the Durisol sound wall, as noted in photo at bottom of previous page. The sound-absorptive surface on both sides of the wall provides noise attenuation for community noise as well as highway noise.

Photo below shows emergency crew access and motorist escape was provided by overlapping sound wall sections. Pressed-in ashlar stone wall texture faces local streets and residences, while vertically fluted texture side faces traffic. 500-foot sections of wall contained full-height sectors of light and dark brown color chosen from the INDOT preselected color alternatives.



(Continued from page 7)

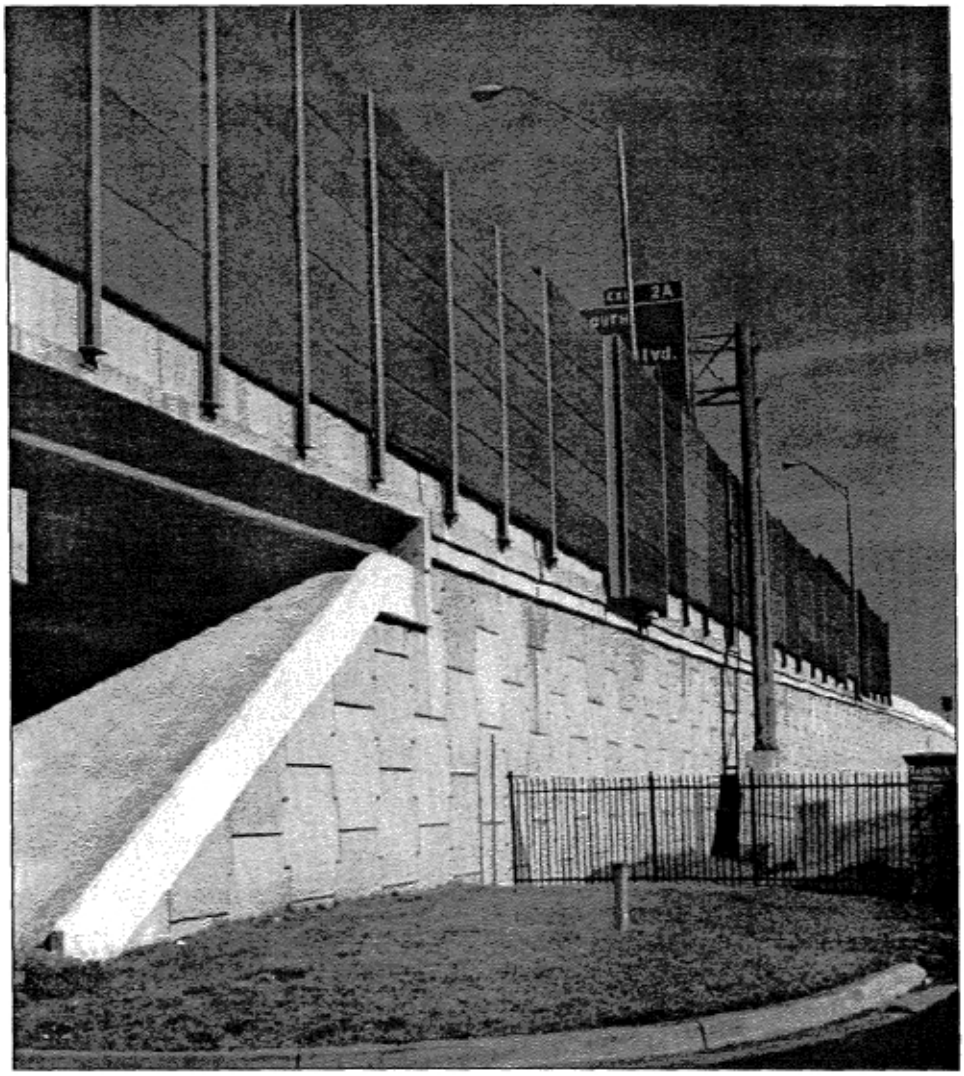
This Michigan/Indiana truck/train corridor is believed to be the busiest in the nation. INDOT Environmental Specialist Robert Buskirk used the Stamina II program to model the project with an expected 192,000 vehicles per day by the year 2016. To reduce the predicted 80-85 dBA sound level to the desired 67 dBA maximum, a sound wall of 26 to 28 feet high would have been required.

As the taller wall was not economically feasible, a 16 foot high wall was selected to provide a 5-7 dBA reduction everywhere and a 13 dBA reduction in some sections. Although the sound model using Stamina II did not include the reverberations of the parallel walls, the decision to use the more efficient sound-absorptive material was made to assure the desired sound attenuation.

The initial acoustical analysis by INDOT and the decision to select the sound-absorptive barriers was supported by a subsequent investigation of one critical section by the acoustical consultants Harris Miller Miller and Hanson.

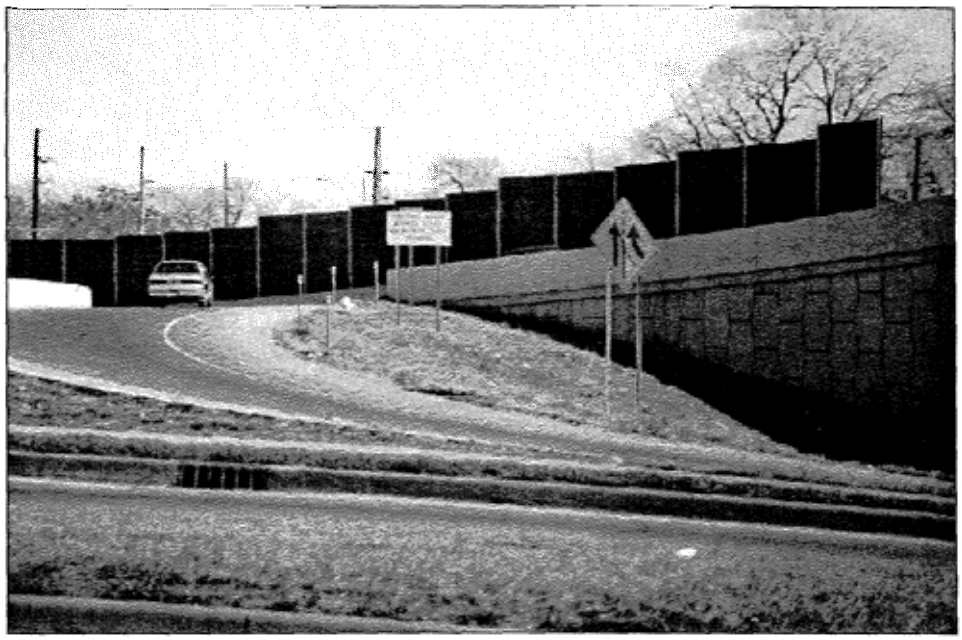
The INDOT Special Provisions required that the soundwall construction use color which was selected from the preselected list of primary and complementary secondary colors chosen by INDOT. Each 500 foot section of the wall used a primary color for 70-80% of the section and a compatible secondary color for the remaining 20-30% of the section. The selected Durisol system used an ashlar stone finish on the residential side and a vertically fluted texture on the traffic side, using a combination of light and dark brown colors from the approved list.

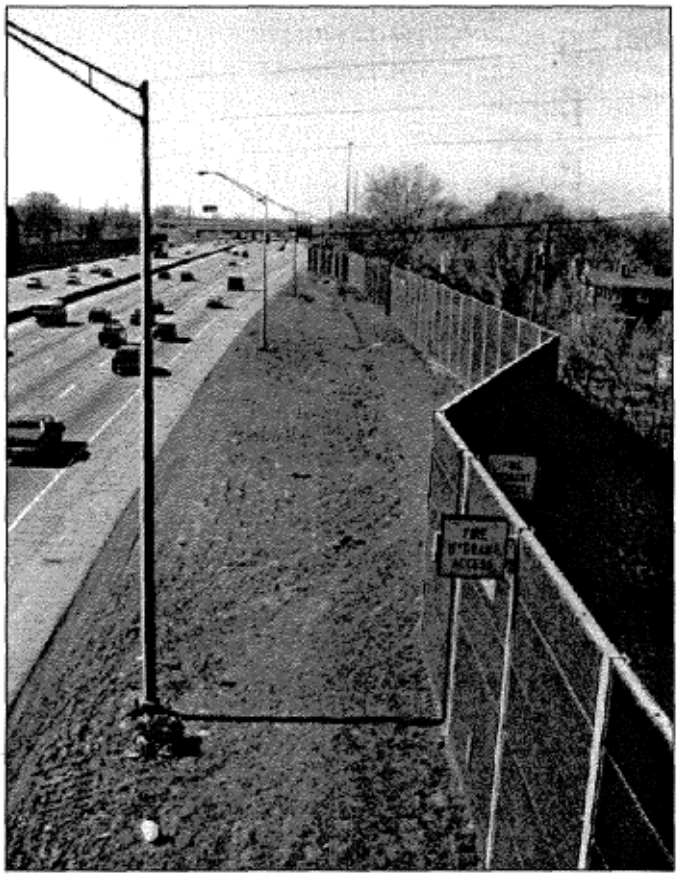
The approved Durisol design solution utilized the maximum allowable post spacing of 15 feet. This post spacing was dictated by the structural capacity of the traffic barrier sleeper slab which was part of a Reinforced Earth© (mechanically stabilized earth) retaining wall system designed by INDOT and constructed under earlier contracts. For the ground-mounted section, anchor bolts were installed in the drilled caissons. Galvanized and painted wide flange steel posts were bolted to the anchor bolts as a second phase of construction.



Sound wall posts are attached to bridge parapet and traffic barriers mounted on Reinforced Earth retaining walls. Box out in barrier accommodates light standard.

15-foot maximum post spacing was controlled by bending capacity of barrier moment slab constructed on top of Reinforced Earth retaining wall constructed under previous contract. Steps in barrier follow sound wall profile.





Undulating, two-sided sound-absorptive sound barrier follows right-of-way line. Fire hydrant access is marked on both sides of the sound barrier.

Traces of salt-laden snow deposited on sound barrier by truck traffic and snow plows are visible 16 feet above pavement on ground-mounted sound barrier 10 feet from the guide rail.

The typical 3'-6" high by 15'-0" nominal horizontal dimension Durisol panels, and other panel heights needed to achieve the project requirements, were stacked one panel at a time between adjacent wide flange posts. The traffic barrier-mounted wide flange units were bolted to the traffic barrier using a special detail which was devised by the contractor to allow attachment to a variable sloping surface but yet obtain the required verticality of the posts. The precise post spacing was not called for in the design/build requirements.

Utilities or other conflicts were identified. The plan submitted for approval was required to locate the posts to avoid these obstructions and obstructions not shown on the plans but detected in the site survey conducted by the contractor after the award. Posts were moved laterally and the wall adjusted perpendicular to the roadway and parallel to the roadway to avoid obstructions. Less than 15 foot post spacings were used where traffic barrier-mounted walls intersected with ground-mounted walls, or where special requirements to fit the utilities were required.

The only registered complaint at INDOT comes from a resident who reported that the sound walls made the area too quiet. Noises were now being heard that could not be heard prior to the construction of the noise barrier along the Borman Expressway. ■

(For additional information concerning this article, contact:

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Insertion Loss Performance of Road Noise Barriers

By K.R. Fyfe and C.C. Harrison, Department of Mechanical Engineering, University of Alberta, Edmonton, Canada

INTRODUCTION

Several parameters influence the effectiveness of roadside noise attenuation barriers. These factors include the source and receiver positions, ground cover properties, barrier insertion loss, and atmospheric-conditions. This paper studies one of these parameters, namely barrier insertion loss.

There have been two principle classes of techniques for predicting the barrier insertion loss. Older methods made use of geometrical considerations that model the problem from an energy point of view and by and large ignore phase. A newer class of methods models the acoustic performance of barriers and berms utilizing wave-based models.

The basic difference between the ray tracing approach and the wave based procedure is in modelling the behavior of sound. Geometrical methods considers sound as a series of rays. Each ray follows a series of straight and diffracted paths from the source until it reaches the receiver. The procedure then utilizes a comparison between direct and diffracted rays in evaluation of the sound field [1]. On the other hand, a wave based method considers sound as a wave. Each direct, reflected and diffracted sound wave has an amplitude and phase, and the sound field is evaluated through interference of these waves.

MODELING

Wave-based acoustic modelling is primarily conducted by means of the finite element or boundary element methods. The former is principally used for interior problems while the boundary element method is ideally suited for exterior radiation and scattering problems. A two-dimensional boundary element model has been used in this work [2,3]. This 2D model assumes that the road and barrier are parallel and infinite and that the traffic can be modeled as a line source. Previous work with this type of a model has shown good agreement with both full and scale size experimental results [2].

The modelling is carried out in two stages. The boundary surface of the barrier or berm is defined utilizing a finite element preprocessor. An input mesh is created by outlining the surface boundary using nodes, discretized at six nodes per wavelength, and connecting adjacent nodes with conventional linear elements. This mesh is then read into the SYSNOISE acoustic analysis software package [3]. Here the source position and frequency, the barrier surface properties as well as the receiver position are defined. SYSNOISE then calculates the field point pressures at desired locations.

The benchmark geometry for the following analyses consists of a source position 15m in front of the center of the barrier, 0.5m above ground with 20 receiver locations spaced every 5m behind the barrier at a height of 1.5m. The standard barrier will be a straight, hard, thin barrier 3m in height. Figure 1 depicts this geometry.

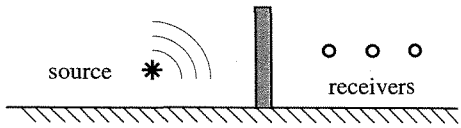

Fig 1: Geometry of a Single Barrier

BARRIER RATING SYSTEM

The barrier performance will be measured in terms of insertion loss (IL). The insertion loss is calculated from the difference of the sound levels with and without the barrier. Figure 2 shows the insertion loss in the shadow region of the standard barrier as a function of both frequency and position behind the barrier. Depending on the chosen frequency and receiver position, any point on the plotted surface could be a measure of the barrier's insertion loss (with a range of about 40 dB).

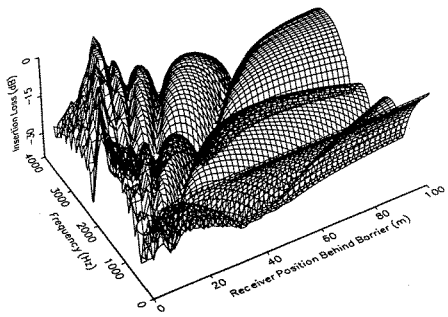

Fig 2: IL vs Distance and Frequency

One way to condense this information is to weight and sum the data according to a traffic noise spectrum. This spectrum will be a function of the type and speed of traffic as well as the road conditions. An example of an averaged traffic spectrum is shown in Figure 3 (ref [4]). It is seen that the majority of the energy is concentrated in the frequency range below 1000 Hz.

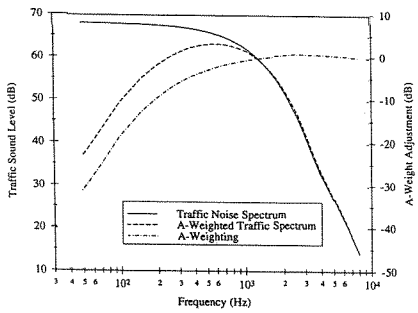

Fig 3: Traffic Spectrum and A-Weighting

Also shown on this curve are the commonly used A-weighting curve and the A-weighted traffic noise spectrum which is used for this work.

In this study, frequency averaged results are obtained by weighting seven octave-band center frequency results between 62.5 and 4000 Hz. As a check, it is found that these results compare almost identically with one-third octave-band center frequency data in the same frequency region. A frequency averaged result is shown in Figure 4 along with representative single frequency curves of 62.5Hz, 500Hz and 2000Hz. A large variation in the response is observed. Using only a single frequency or position would yield results quite different from the spectrally weighted curve. The insertion loss characteristics can be further simplified by considering the mean value over the selected receiver positions. In this case, the frequency weighted and spacially averaged insertion loss would be approximately 11dB.

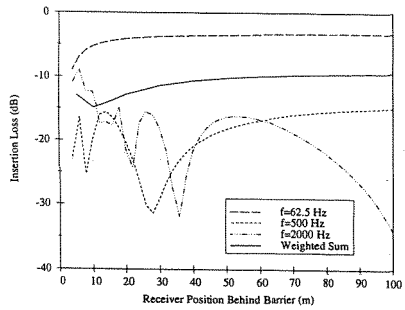

Fig 4: Weighted IL for Standard Geometry

RESULTS

The height of the barrier is the first variation of the standard geometry to be explored. The insertion losses of barrier heights between 2m and 4m tall are shown in Figure 5. A consistent pattern emerges whereby, independent the receiver loca-

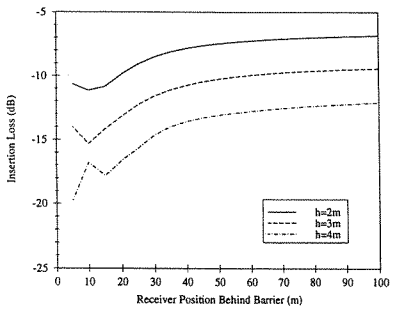

Fig 5: IL of Thin Barriers of Various Height

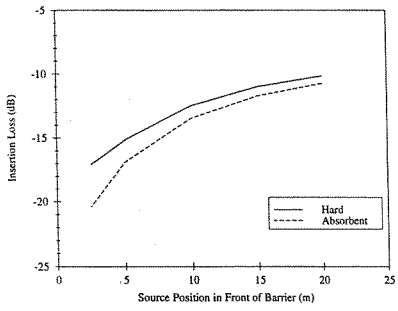

Fig 7: Source Position - Hard vs. Absorbent barrier

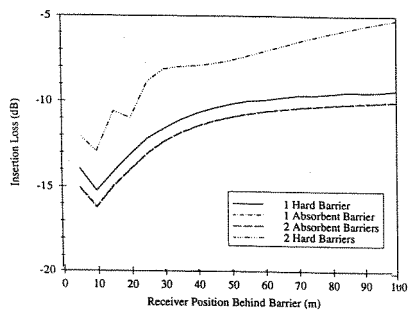

Fig 9: Single/Double Barrier Configurations

tion, for each 1m increase in barrier height, an additional 2.5dB of insertion loss is obtained.

Another important aspect to study is the sensitivity of the source position. Maintaining the source height of 0.5m above the ground, the source is moved between 2.5m and 20m from the barrier. Figure 6 shows the results of this geometrical consideration. The chart shows that the insertion loss increases dramatically as the source is moved closer to the barrier. This phenomena can be explained by the fact that as the source approaches the barrier, a greater percentage of the sound is reflected back towards the source and a lesser percentage diffracts around the top. This percentage can be related to the angle from the source to the top of the barrier. This parameter is one that is widely used in ray-based moels.

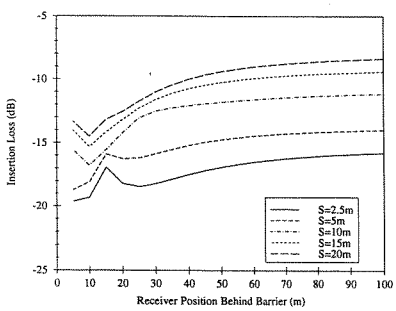

Fig 6: Effect of Source Position

Figure 7 shows the results of the same barrier that has a highly absorptive coating ($\alpha = 1$, over the modelled frequency range). In this figure, the indicated insertion losses have been spacially averaged over the 20 receiver positions in the shadow region. It can be seen that as the source moves closer to the barrier, the effect of the absorption on the insertion loss increases. At a distance of 2.5m from the barrier, the absorptive coating provides an additional 3dB of insertion loss while at a source distance of 20m, the absorption increases the performance above the standard case by only about 0.5 dB. This would suggest that the use of absorptive coatings on a single barrier is most beneficial when the barrier can be located very close to the noise source as is the case with railways.

Introducing some geometrical complexity, the barrier insertion losses are also determined for angular, semi-circular and T-shaped barriers each having a height of 3m. The insertion losses for these geometries are shown in Figure 8. The superior performance of the T-shaped barrier is apparent. It is seen that this barrier has almost 5dB performance advantage over the angular berm of the same height. Similar results have been reported by [2].

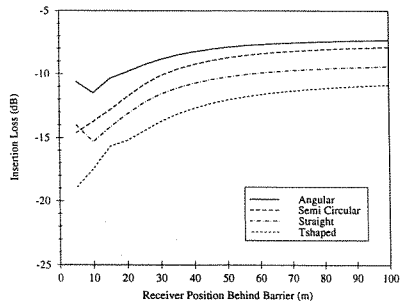

Fig 8: Effect of Barrier Cross-Section

Now consider two 3m high straight barriers 30m apart. The source remains 15m behind the original barrier and 0.5m above the ground. Figure 9 shows the insertion loss against receiver distance curves for several configurations [5]. The most striking result is that the parallel barrier case with no absorption has the lowest performance rating. In this situation, the addition of a second barrier serves as an unwanted noise reflector. To alleviate this situation, both barriers are lined with highly absorbent material. In the same figure, it is seen that this scenario provides the same protection for both shadow regions as does a single perfectly absorbing single barrier to its shadow region. Thus in order to achieve the same performance on both sides of the road as originally intended for just one side with a single barrier, absorbent coatings are critical.

CONCLUSIONS

The boundary element models have revealed several significant relationships between barrier design characteristics and insertion loss. A very important result is the understanding of the frequency dependance of the barrier performance. The source spectrum will thus influence the barrier rating. It has been shown that simple changes in barrier and berm cross-section greatly affect the barrier acoustic performance. When the source is close to the barrier or when double barriers are used, the use of an absorptive lining is highly beneficial.

FUTURE STUDY

Two important simplifications were made in this study: two dimensional modelling and uniform atmospheric conditions. Research is now underway way to study finite length 3D barriers and to model the effects of temperature gradients in the air.

ACKNOWLEDGMENTS

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As previously announced, the Transportation Research Board, National Research Council, Committee A1F04 on Transportation Related Noise and Vibration will hold its annual Summer Meeting at the Omni Parker House in Boston July 16-19, 1995. The meeting will be hosted by Volpe Center Acoustics Facility and by Acentech Incorporated.

The agenda includes 21 professional presentations and four technical tours; after-session activities include a dinner/musical comedy revue on Monday evening and a New England clambake outdoors under tents on Tuesday.

This announcement is intended as general information, and will probably reach you in this publication too late to arrange your attendance if you have not already done so, but you may contact Ms. Brenda Hanley at (617) 499-8010 for further information.

The proceedings of the meeting (and hopefully summaries of the professional papers presented) will be published in the next issue of The Wall Journal. ■

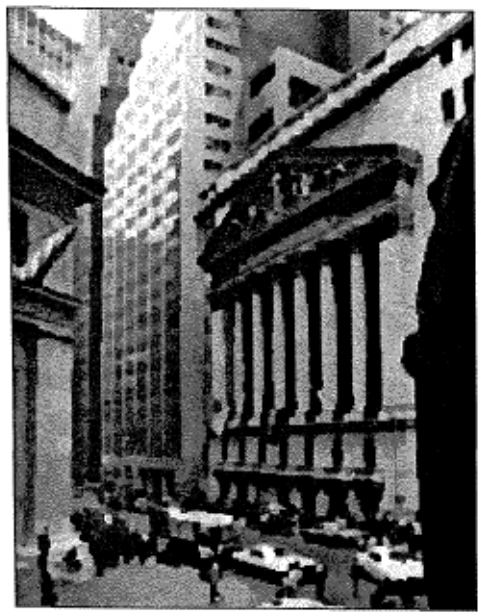
Welcome to The Exhibitors' Hall

For those of you who will not be attending the 1995 Summer Meeting of the TRB A1F04 Committee on Transportation Related Noise and Vibration in Boston, it has become customary for the meeting hosts to provide a room (or 'hall') in which vendors and suppliers to the transportation noise abatement industry may display their wares.

As with most conventions, booth space is allotted for product or service presentations and demonstrations by personnel of the various vendors. Before, after and during breaks in the conference sessions, attendees are invited to visit the 'hall' and meet with the vendor personnel, while refreshments are made available.

This allows all attendees to examine all of the exhibits, side by side, to gather information, ask questions and make comparisons, all in a relaxed and informal manner and in a short period of time.

In our own humble way, The Wall Journal presents herewith our condensed version of an exhibitors' hall, featuring side by side displays of our much-appreciated advertisers and their products and services. ■



This Way to The Exhibits

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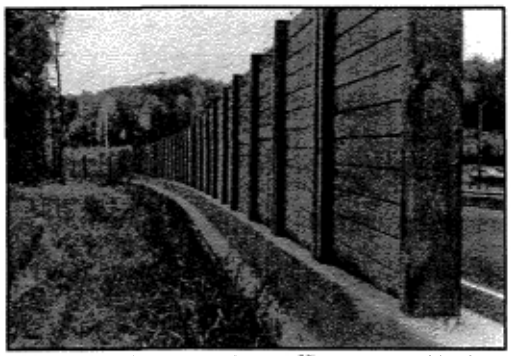

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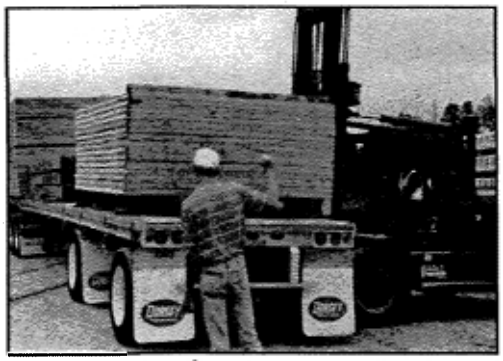

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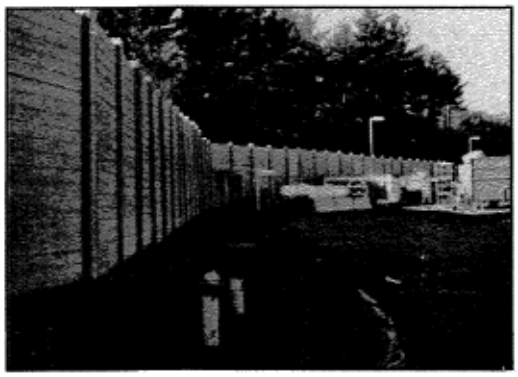

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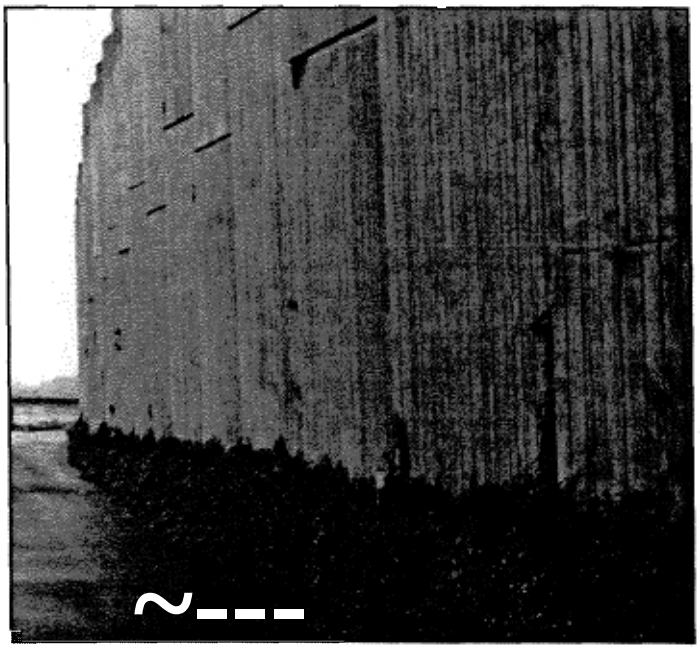

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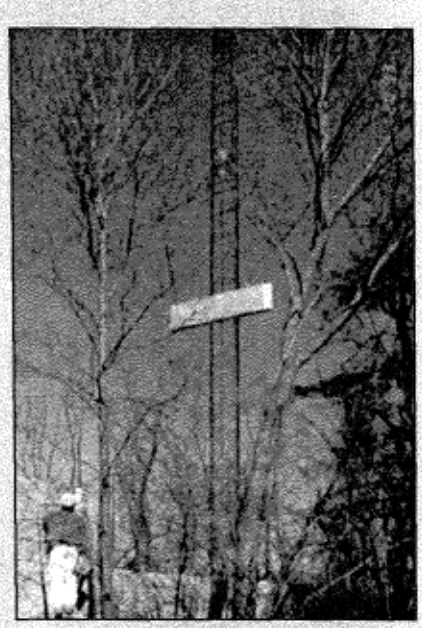

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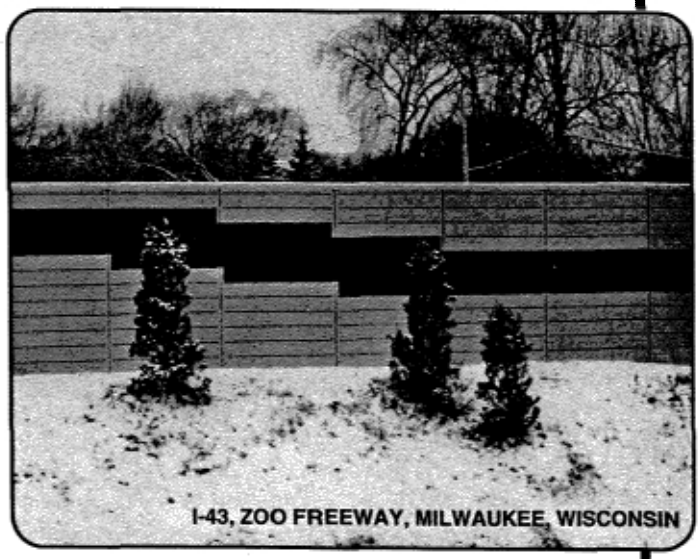
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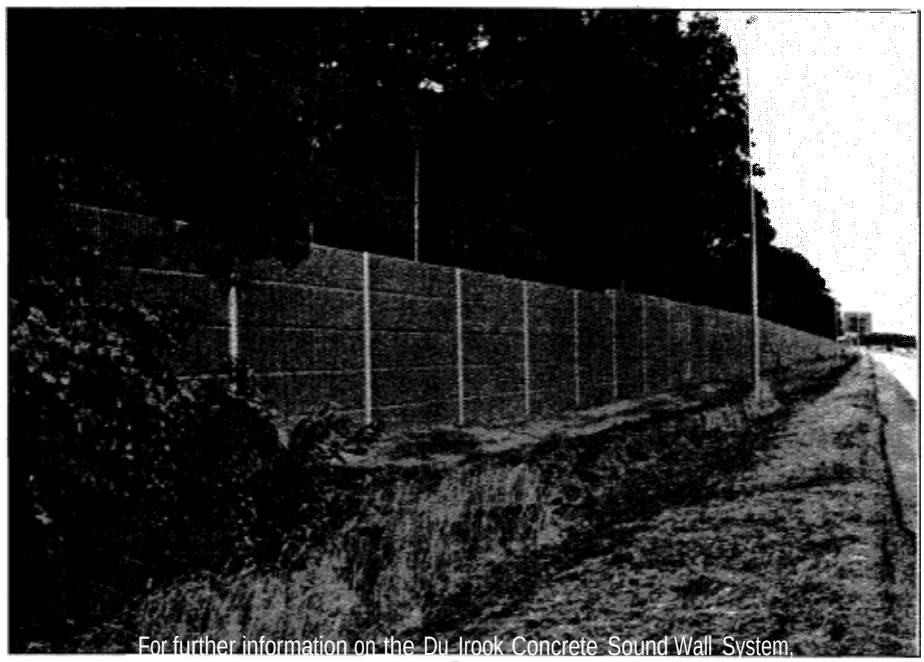
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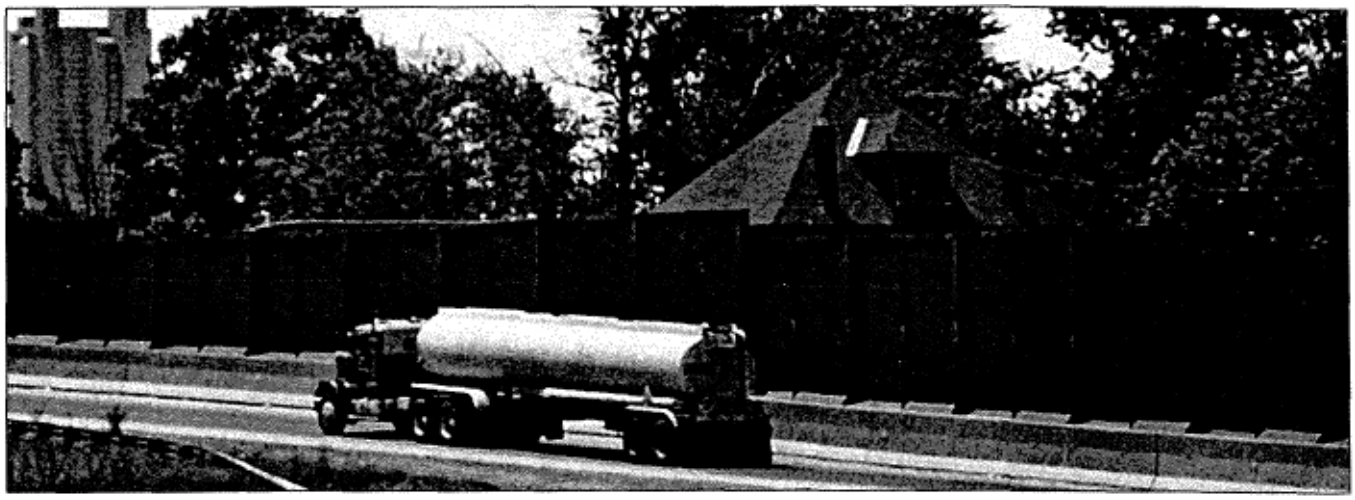

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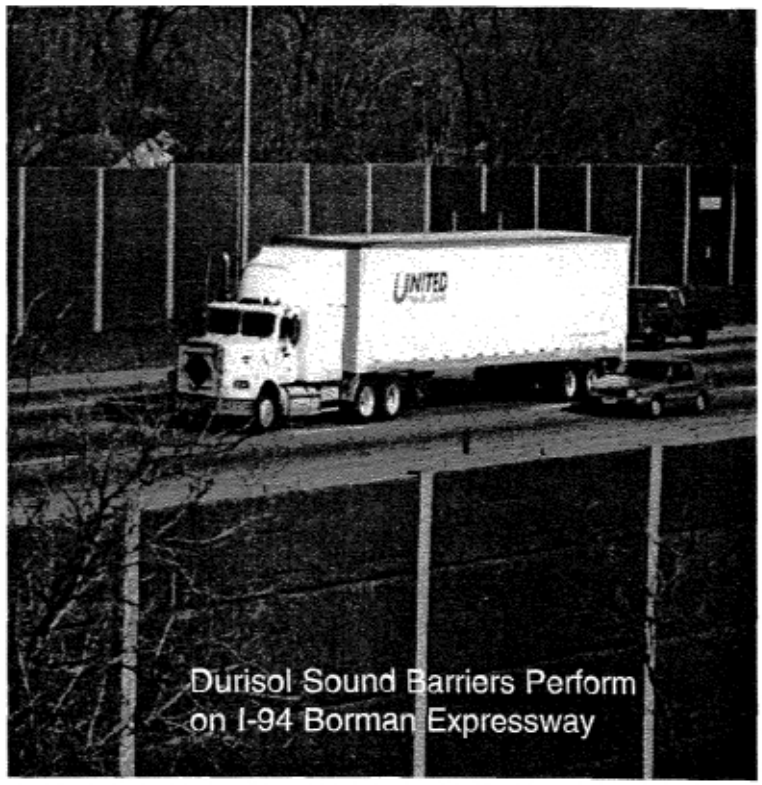

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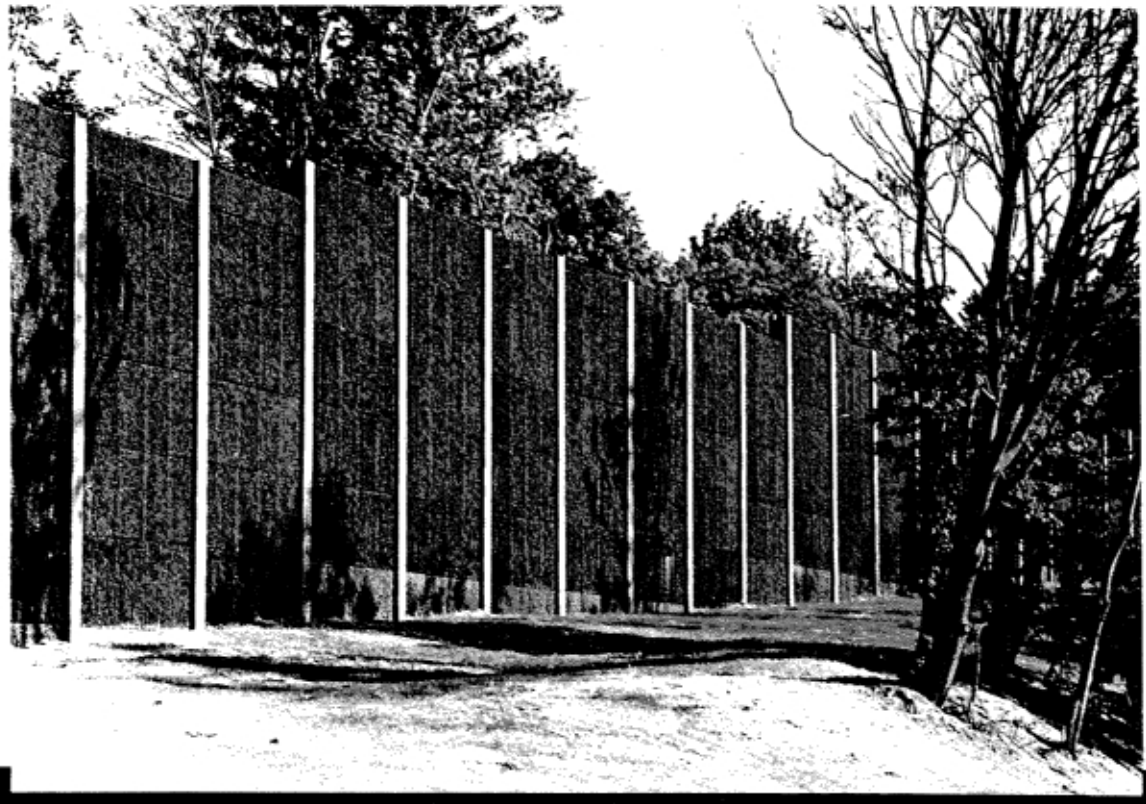

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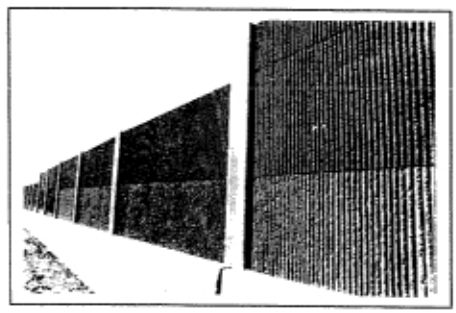

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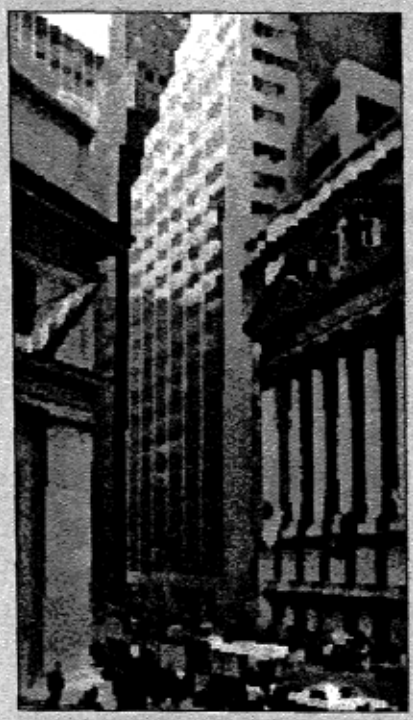

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