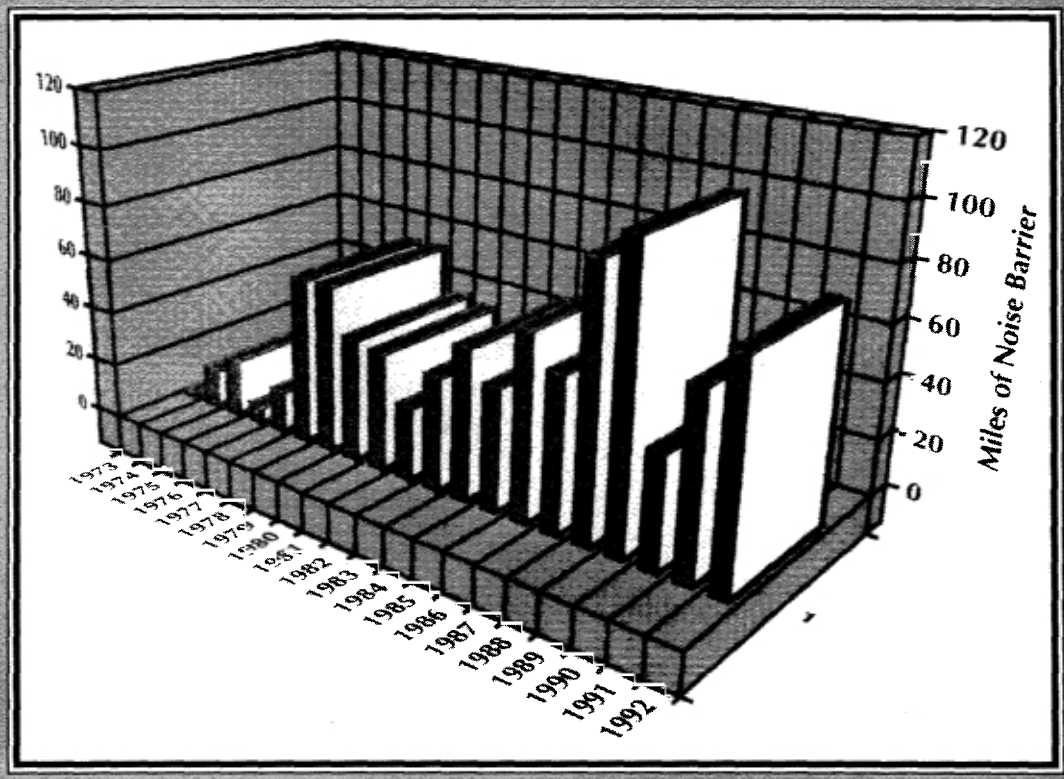
The Wall Journal™ 15

Issue No.

The International Journal of Transportation–Related Environmental Issues



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Highway Traffic Noise Barrier Construction Trends

A Further Sorting of the Data from the FHWA Report on Noise Barrier Construction in the United States from 1972 to 1992 — A Useful Tool for the Barrier Marketeer

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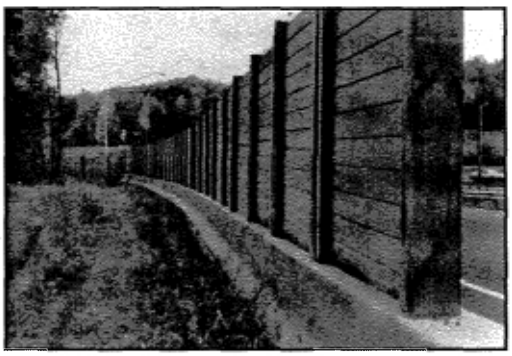
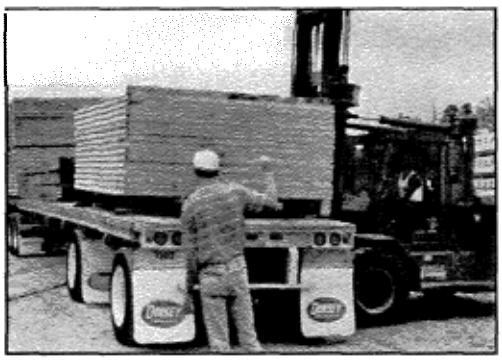
THE SOUND SOLUTION

PLYWALL Post and Panel
Permanent Engineered Wood Barrier Systems



PLYWALL can be mounted on traffic barriers and bridges. These 4"x10" posts were inserted into cast-in-place sockets which extended down into the footing of this traffic barrier.



Thousands of square feet of ready-to-install panels can be shipped economically by truck anywhere in the U.S. Panels are loaded with a large forklift equipped with 8-foot long forks. All posts, panels, cants, spikes and freight charges are included in the selling price.

This bottling plant had received noise complaints from nearby homes. The complaints stopped after installation of this 15-foot high PLYWALL barrier.

- *Prefabricated*
- *Easy to Install*
- *5.5 PSF / STC - 38*
- *Attractive and Maintenance Free*
- *Leakproof*
- *Shipped Nationwide*
- *Relocatable*

NEW! *Now Using Parallam® PSL Engineered Wood Posts For Heights to 25 Feet*

PLYWALL'S installation creates very little site disturbance, This barrier was installed a few months earlier with no damage to the trees or overhanging limbs. Sloping ground is easily accommodated.

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The Wall Journal

The International Journal of Transportation-Related Environmental Issues

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Editor
El Angove

Director of Publications
John G. Piper

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Subscription and advertising information are shown on page 24 and the back cover page.

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Editor's Corner

by El Angove

I've had a very bad time with making resolutions and promises, and I have promised myself not to do that anymore. It seems like every resolution I made this past year has ended in disaster.

The year started off badly with a triple by-pass and proceeded to get worse. The move to Florida was good for my health, but it raised the devil with moving my publishing operation and getting it up and going with all new business contacts such as printers, imagesetters and suppliers.

Hopefully that's all behind me, but that's not a promise. I have given up on giving dates to the issues, relying instead on simply numbering them. That way, no one can blame me for missing a deadline or schedule.

However, I recognize the need for publishing on a more or less regular schedule now and wll endeavor to make that happen. It mostly depends upon timely submission of articles and reports, and you are going to have to be of more help to me. Otherwise, I will be forced to turn to pure fiction, and I shudder to think what can happen; I've had a motley existence. If you'd like to see what I really want to be doing, take a look at page 16.

Of course, that's only a dream, but it will give you some idea of the sacrifices that I am making in order to turn out this publication. I hope that you will show some pity. I sure need it.

Have a nice life.

From All the Staff of The Wall Journal

to All of Our Faithful Readers

We Hope You Had a Very Merry Christmas

and We Wish You a

Very Happy New Year

In Coming Issues:

The Fundamentals of Sound — Part IV: The Receiver

Noise Barrier Construction Forecast Update

More Professional Articles and Reports

And More...

HITEC Opens Its Doors to Innovative Highway Products

By Peter Kissinger, Director, HITEC

Got a new product you would like to market to the highway industry? Want to streamline the process by having your product evaluated by an independent testing and evaluation center?

Then get in touch with HITEC — the Highway Innovative Technology Evaluation Center, which has just opened its doors for business.

HITEC provides a much needed service. It provides the product developers of innovative highway products for which there are no specifications or standards, the opportunity to have an impartial panel evaluate the new product or technology. The panel, which will be comprised of representatives of the public sector, the private sector, and academe who are technically knowledgeable about the product and its use, who will develop an evaluation plan and, once the testing has been completed, will prepare and distribute a final report. Testing is expected to be conducted at existing facilities throughout the United States through a HITEC contract process.

HITEC is administered by the Civil Engineering Research Foundation, the research affiliate for the American Society of Civil Engineers, with start-up funding being provided by the Federal Highway Administration. Ultimately, HITEC will be self-funded through the fees it is collecting from developers whose products are accepted for evaluation.

HITEC is designed to break down some of the barriers to innovation and new product introduction. Currently, a new product must be tested and marketed in multiple locations or by an agency which conducts its own testing and evaluation program for the product. HITEC is designed to make that process more efficient, through consensus-oriented, collaborative testing and evaluation. It is hoped that the evaluation will reduce the need for specific agency testing.

Products must meet three criteria before they are accepted for evaluation by HITEC:

- *Market Ready: The product must be beyond the conceptual stage. It should be generally ready for use by the highway industry.*
- *Ownership: The applicant must be able to demonstrate ownership or legal rights to the product.*
- *Innovative: The product must be one whose functional performance cannot be easily evaluated against an existing standard of specification (defined as a standard of specification with national recognition or wide acceptance within the highway community).*

If products are not market ready or if there are existing standards for which the product can be evaluated against them, the developer will be referred to other specific programs for assistance.

AASHTO strongly supports the formation of HITEC. As noted by Francis Francois, Executive Director of AASHTO, "We recognize the need for a mechanism that will enable industry to have its products and processes formally evaluated, to indicate to the States the value of new ideas."

By providing independent, impartial evaluations of technologies for which no industry standards exist, HITEC aims to encourage private industry to invest in highway-oriented research and development, as well as to make it easier for State and local governments to put innovative highway products to use.

"HITEC should encourage innovation by making it easier for entrepreneurs to have their products evaluated and then marketed to the States," says Francois. "It can be a win-win situation, with the States getting independent evaluations they can rely on, and with manufacturers no longer having to visit each State to market their product."

HITEC is currently organizing a Technical Evaluation Panel for ann innovative highway traffic noise barrier. The panel will be comprised of individuals with expertise in all aspects of the performance of noise barriers, including acoustics, structural behavior, materials, and aesthetics. Individuals interested in volunteering should contact HITEC immediately.

HITEC is headed by J. Peter Kissinger, formerly with the National Transportation Safety Board. For more information, contact HITEC, 1015 15th Street NW, Suite 600, Washington, DC 20005 (telephone 202 842-0555).

LETTERS TO THE EDITOR

Dear Mr. Angove:

I have recently started to receive The Wall Journal and I enjoy it very much. It is a very focused journal that talks about many things that I work with on a regular basis. I am a professor in mechanical engineering doing research into wave-based analysis of road noise barriers. I have some quite interesting results comparing ray-based versus wave-based analysis of barriers and berms. I am wondering if an article of this type would be of interest to The Wall Journal. If so, please let me know the format and length that you would desire of an article for submission.

I am also interested to get in touch with a couple of your regular contributors to The Journal, namely Domenick Billera and Bob Armstrong, as I think they might also be interested in this work. I am particularly interested in finding how I might be able to attend a TRB A1F04 committee meeting as well.

Keep up the great work.

Ken Fyfe, Associate Professor
University of Alberta
Mechanical Engineering
Edmonton, Alberta, T6G 2G8
Canada
Tel 403 492-7021, fax 403 492-2200

Dear Sir:

Recently I received information that you publish a professional journal which is devoted primarily to highway noise barriers, and it is free of charge to university members. If it is possible, I would like a subscription.

I am on the staff of the university "Kyushu Institute of Design" aand so far I have studied noise barriers for more than 20 years. My main theme is to develop a new barrier system which is more effective than conventional noise barriers in keeping the barrier height constant.

Professor Dr. Kyoji FUJIWARA
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Kyushu Institute of Design
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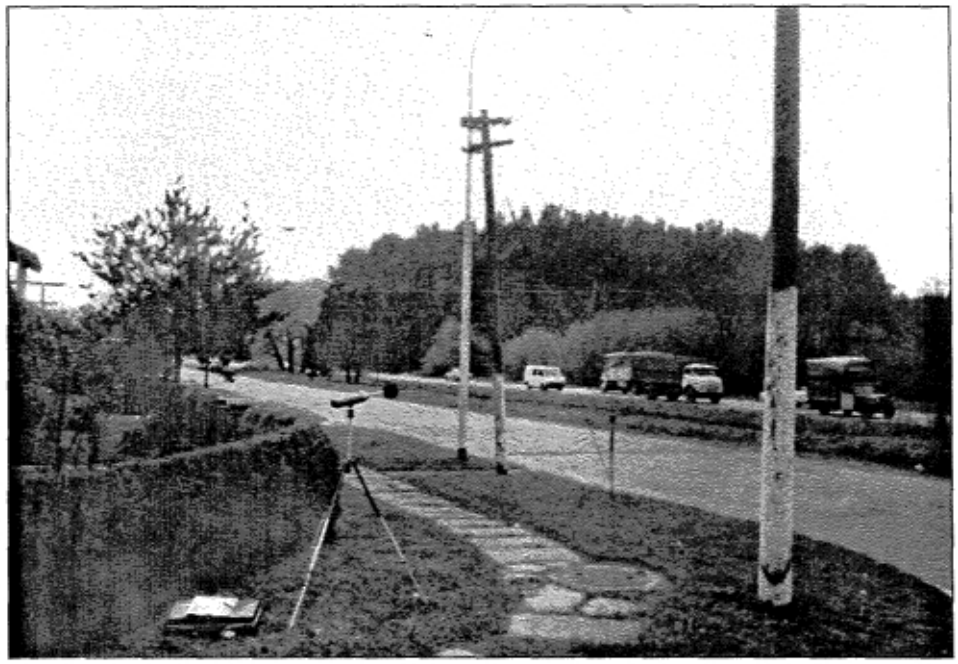
Noise Study for "Down Under"

By Bela Schmidt



View showing data collection at a residential property line near the airport.

No, we don't mean Australia this time but rather the fast developing, vast country of Argentina where progress calls for more transportation routes and vehicles to keep pace with life's demands. To connect the capital city of Buenos Aires with neighboring provinces, four modern highways are currently in various phases of planning and construction.

These highways begin near the city limits and proceed radially outward. The Ricchieri Tollway is one of the more important of these highways because it is the major artery leading to the city's international airport located near the town of Ezeiza, outside the city limits. Plans in the first phase call for widening this roadway and installing a barrier type toll plaza near its northern end.

The revenues generated will be used later to extend the Tollway beyond the airport to aid in the development of areas south of the capital. Like so many plans for developing much needed infrastructure, this one too needs substantial financing to get it underway.

International sources for lending headed by the International Finance Corporation (IFC), an agency of the World Bank, were prepared to help but with conditions attached. One of the conditions was that an Environmental Assessment (EA) detailing existing conditions and future impacts be compiled according to the requirements of the World Bank.

In view of the Bank, this requirement is in a line with a worldwide concern about environmental degradation and the threat that this degradation poses to human well being and economic development. In response to this concern, many industrial and developing nations as well as donor agencies have already incorporated EA procedures into their decision making.

Environmental Assessments identify environmental issues early in a project cycle, enable the design of environmental safeguards and may avoid the need for costly after-the-fact compensating measures to counter adverse impacts discovered later. World Bank procedures require that an EA or other analyses be the responsibility of the borrower. The Bank's staff is available to assist the borrower whenever requested, especially in determining the scope of work and developing terms of reference.

On this project, the environmental report to be prepared included air and noise sections and required a field trip at short notice by two specialists from Louis Berger International, Inc. of East Orange, New Jersey. This account chronicles only the task of generating the noise study section of the EA for the project area. The first finding impacting our work was the lack of guidelines for receiver noise levels along highways, like our FHWA 7.7.3 for example. A discussion was held at the government's Research Center for Acoustics to learn about relevant legislation or precedents for highway transportation noise levels but none was available. There was an interest in the methodology and guidelines employed on US based noise studies but no decisions to use any of these were made during our stay.

Another finding was more subjective and related to noise levels of highway vehicles. A number of vehicles had defective mufflers and were generally in need of maintenance. The condition of some secondary roads forced vehicles to slow down, followed by acceleration at full throttle, thus adding peaks to the ambient noise levels. The seemingly higher operating noise levels raised the thought that STAMINA could be more accurate in predicting traffic noise levels in Argentina than in the USA.

After a review of engineering designs, maps, traffic data and results of site visits, noise level measurements were conducted at representative locations using a B&K Type 2231 precision grade Sound Level Meter programmed with BZ 7101 module. Noise levels at each of four sensitive locations were measured 3 times, including once during the night.

The measured noise levels were averaged over 1 hour or 1/2 hour and ranged from 44 dBA to 71 dBA depend-

ing on location and time of day. The above photograph is typical in showing data collection at a residential property line near the airport. In addition to the residential property lines, the playground and classroom interior of a kindergarten next to a busy section of the existing highway was also measured with the permission of officials. Traffic was generally the heaviest on the northern part of the existing Tollway where conditions approximating LOS C to D were often seen.

Results of traffic counts were in the order of three and a half to four thousand vehicles on a 3 lane highway including typically 12 percent trucks and 2 percent motorcycles. The greatest project generated impact was foreseen to happen outside the airport area where a local road will be replaced with a new 4 lane highway and toll plaza. The adjacent low cost housing area has low ambient noise levels generated mainly by an abundance of stray (but friendly) dogs, children playing the national pastime (soccer) on empty lots, birds and occasional airplanes from the international airport.

Other notable impressions we gathered were the friendliness of people we met and the curiosity filled faces of children wanting to know what we were up to. Language was not a problem.Generally, there was a lot of interest in our methods, the results we obtained and the instrument we used. It was recognized during one official meeting that more transportation oriented noise surveys should be done in Argentina to find out what some typical noise levels are and more specifically, that noise impact studies should be done for upcoming projects without being requested to do so by outside organizations.

The noise study was successfully completed on schedule and is currently being reviewed by the IFC. With this one requirement complied with, the time will hopefully arrive when construction could begin on this important roadway. In closing the author wishers to thank the people of the local consortium responsible for this project for their hospitality and support in carrying out the field work and showing some of the highlights of their vibrant capital city. The helpful comments received from our staff are also acknowledged with thanks. ■

Contributed by
Bela Schmidt
Louis Berger International Inc.
East Orange, New Jersey 07019
telephone (201) 678-1960, ext. 471.

Highway Traffic Noise Barrier Construction Trends

A Further Sorting of Data as Published in Issue No. 14

Ed. Note: Following the response we received from our readers after Issue No. 14 was published, I asked our good friend Bob Armstrong of FHWA if he would exercise his database to provide us with a sorting of barriers types by State, which he was kind enough to do.

Personally, being a former marketer, I found the data illuminating and I trust those of you among our readers who are also noise barrier marketers will find this information useful).

INDEX TO THE TABLES

Concrete Noise Barriers Constructed

	1970 -1982		1983 - 1987		1988 - 1992	
STATE	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**
Arizona			291,000	$10.00	45,000	$14.00
California	539,000	$14.00	268,000	$11.00	29,000	$22.00
Colorado			7,000		99,000	$14.00
Connecticut	150,000	$6.00				
Florida	66,000	$16.00	11,000	$20.00	1,894,000	$15.00
Georgia	114,000	$12.00				
Illinois	224,000	$14.00				
Iowa	22,000	$19.00			22,000	$15.00
Kentucky					213,000	$11.00
Louisiana					16,000	$7.00
Maryland	57,000	$31.00	672,000	$27.00	1,477,000	$22.00
Massachusetts	59,000	$11.00	13,000	$22.00		
Michigan	358,000	$13.00	57,000	$12.00	223,000	$18.00
Minnesota	365,000	$12.00	131,000		17,000	$13.00
Missouri	15,000	$21.00			13,000	$13.00
Nebraska					7,000	$15.00
Nevada	111,000	$10.00				
New Jersey	167,000	$11.00	980,000	$21.00	2,976,000	$21.00
New Mexico					77,000	$12.00
New York	80,000	$12.00	506,000	$14.00	843,000	$22.00
North Carolina	60,000	$5.00	46,000	$12.00	433,000	$10.00
Ohio	61,000	$8.00	81,000	$8.00	16,000	$12.00
Oklahoma					132,000	$16.00
Oregon	139,000	$7.00	31,000	$9.00	541,000	$11.00
Pennsylvania	35,000	$19.00	172,000	$21.00	2,198,000	$21.00
Puerto Rico			10,000	$8.00	35,000	$22.00
Tennessee	10,000	$20.00	383,000	$15.00	261,000	$8.00
Texas	29,000	$16.00	75,000	$22.00	1,169,000	$13.00
Utah	39,000	$7.00	9,000	$6.00	530,000	$9.00
Virginia	98,000	$7.00	303,000	$24.00	1,702,000	$15.00
Washington	173,000	$10.00	103,000	$14.00	209,000	$8.00
Wisconsin	14,000	$11.00	83,000	$23.00	474,000	$18.00
TOTAL	**2,986,000**	**$12.00**	**4,231,000**	**$18.00**	**15,651,000**	**$17.00**

A Report: "Performance Evaluation of Experimental Highway Noise Barriers."
Authors: Gregg G. Fleming and Edward J. Rickley, USDOT VNTSC. FHWA-RD-94-093, 140 pp.

During the period from October, 1986 through April, 1994, USDOT's Volpe National Transportation Center conducted a research project entitled "Evaluation of Experimental Highway Noise Barriers." This report is the third and final publication resulting from this research project and presents the results of additional analyses of previously collected data and summarizes the findings of the multi-year study.

One of the key recommendations coming from this study is a criteria for categorizing parallel barrier sites. A table provides a guideline for identifying parallel barrier sites that may potentially be subject to significant degradations in barrier performance. This table displays three ranges of width to height ratios and corresponding maximum insertion loss degradation that can be expected based on experience acquired during the performance of the research project. This information will be extremely useful to all noise specialists who have to address parallel barrier degradation issues. ■

(For further information on the availability of this report, contact Gregg Fleming at 617 494-2372).

Combinations of Noise Barriers Constructed

	1970 - 1992		1983 - 1987		1988 - 1992	
STATE	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**
Alaska	75,000					
Arizona	214,000	$8.00				
Arkansas	33,000	$10.00				
California	137,000	$17.00	300,000	$12.00	207,000	$15.00
Colorado	513,000	$6.00	121,000	$8.00	572,000	$7.00
Connecticut	285,000	$8.00	34,000	$6.00	265,000	$13.00
Georgia					499,000	$6.00
Illinois	21,000	$24.00	306,000	$11.00	49,000	$7.00
Iowa	16,000	$11.00			5,000	$12.00
Louisiana	82,000	$7.00				
Maryland	110,000	$15.00	41,000	$27.00	68,000	$31.00
Massachusetts	93,000	$8.00	13,000	$13.00		
Michigan	23,000	$16.00	406,000	$22.00	549,000	$21.00
Minnesota	1,762,000	$8.00	108,000	$13.00		
Nebraska					16,000	$8.00
Nevada	94,000		176,000	$14.00	40,000	$12.00
New Jersey			88,000	$14.00	61,000	$18.00
New York			252,000	$19.00	516,000	$11.00
N Carolina	25,000	$10.00	38,000	$5.00		
Ohio	23,000	$11.00	154,000	$8.00	37,000	$13.00
Oklahoma			66,000			
Oregon	350,000	$7.00	23,000	$12.00	47,000	$13.00
Pennsylvania	15,000		24,000		125,000	$23.00
Puerto Rico			21,000	$9.00	39,000	$22.00
S Carolina					163,000	$8.00
Tennessee			225,000	$15.00		
Vermont			6,000	$6.00		
Virginia	734,000	$17.00	185,000	$20.00	6,000	$17.00
Washington	10,000	$8.00			154,000	$7.00
Wisconsin					127,000	$10.00
TOTAL	**4,615,000**	**$10.00**	**2,587,000**	**$15.00**	**3,545,000**	**$12.00**

Noise Wall Construction Continues in Florida

From Win Lindeman, Florida DOT

Another series of five noise walls have been let for construction along I-95 in Palm Beach County. Murphy Construction Company of West Palm Beach will construct the walls along a stretch of I-95 between Lincoln Boulevard and Woolbright Road. The $3.4 million job will bring the total cost of noise barrier wall projects along I-95 in Palm Beach and Broward County to over $22 million.

According to FDOT bid tabulations, 258,758 square feet of wall is involved in this project, with a cost of $13.19 per square foot. The walls will feature a fractured fin finish on the highway side in a sandalwood color and a broom finish on the residential side. Graphics will include Laughing Gulls, Brown Pelicans, Snowy Egrets, Sailing Boats, Flamingos and White Ibis.

Meanwhile, Overstreet Paving Company of Largo is constructing a 1,250-foot long noise wall along a portion of State Road 580 from Landmark Drive to Allen Avenue in the Clearwater area. The cast-in-place concrete wall will be eight feet high and feature a fractured fin finish on both sides of the wall along with a cap and pilaster appearance. Detailed cost figures are not available at this time since the wall was bid as a major roadway project. An estimate of the cost will be made and included in the Noise Barrier Status Report update in the future. Further details on the status of these and other noise walls elsewhere in Florida will be reported as they become available. ■

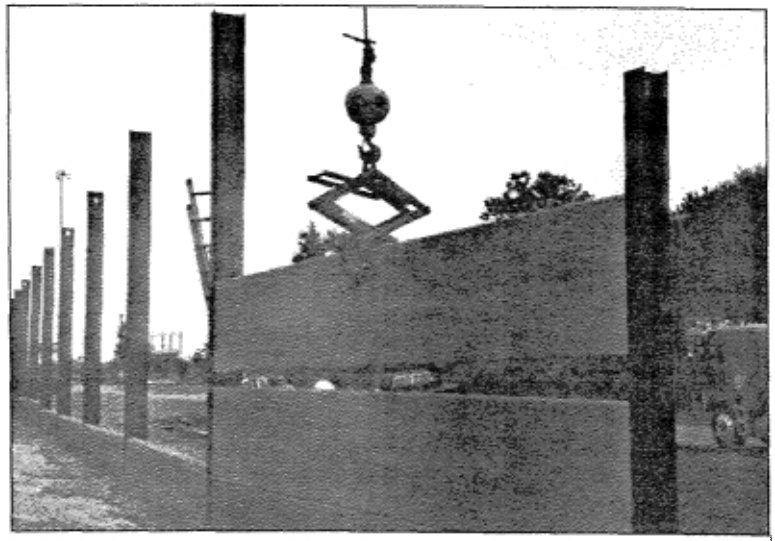
Wood Noise Barriers Constructed

	1970 - 1982		1983 - 1987		1988 - 1992	
STATE	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**
Alaska	29,000		54,000	$15.00	125,000	$9.00
California	25,000	$9.00	19,000	$14.00		
Colorado	686,000	$6.00	297,000	$7.00	132,000	$5.00
Connecticut	203,000	$9.00	268,000	$7.00	1,067	$11.00
Eastern Fed			106,000	$14.00		
Georgia			18,000	$20.00		
Illinois	19,000	$17.00	84,000		372,000	$13.00
Iowa	13,000	$16.00				
Louisiana			50,000	$5.00		
Maryland			176,000	$29.00		
Massachusetts	71,000	$6.00				
Michigan	35,000	$10.00	16,000	$14.00	5,000	$18.00
Minnesota	1,697,000	$11.00	117,000	$8.00	337,000	$10.00
Missouri	6,000	$4.00	3,000	$14.00	9,000	$17.00
New Jersey			295,000	$13.00	835,000	$17.00
New Mexico						
New York	26,000	$10.00	183,000	$20.00	696,000	$16.00
N Carolina	109,000	$11.00			25,000	$8.00
Ohio			104,000	$11.00		
Oregon	3,000				12,000	$9.00
Pennsylvania	13,000	$19.00			30,000	$26.00
Texas	161,000	$7.00			10,000	
Vermont					14,000	$19.00
Virginia	96,000	$6.00	106,000	$9.00		
Washington	10,000	$9.00	102,000	$9.00		
WestVirginia					8,000	$17.00
Wisconsin	12,000	$9.00	49,000	$20.00	220,000	$18.00
TOTAL	**3,214,000**	**$9.00**	**2,047,000**	**$13.00**	**3,897,000**	**$14.00**

Press Release

KENCO INCORPORATED, December 15, 1194

Kenco has developed another innovative product for use in the highway construction industry. It is the Kenco Sound Wall Lifter. Instead of having to cast lifting eyes in the panel or wrap it in chains, the Contractor only needs to set the Sound Wall Lifter on the panel and lift; the weight of the panels causes a gripping action of 3:1. The Lifter uses urethane pads to grip the panel without scratching or marring the surface, and it can be used on panels constructed of concrete, wood, fiberglass and metals. Lifters are available to lift panels from one to five tons, and custom Lifters are also available. For more information, write Bill Douglas, Sales Manager, Kenco Incorporated, P.O. Box 6069, Pittsburgh, PA 15211, or phone 412 431-2666 or fax412 431-8225



Berm Noise Barriers Constructed

	1970 - 1982		1983 - 1987		1988 - 1992	
STATE	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**
Alaska	5,000		2,000	$9.00		
Arizona	272,000	$6.00	194,000			
Arkansas	34,000					
California	76,000	$5.00				
Colorado	16,000	$4.00				
Connecticut	106,000	$6.00	4,000	$5.00		
Eastern Fed			44,000	$6.00		
Florida			11,000	$6.00		
Illinois	100,000	$7.00	43,000	$13.00	14,000	$4.00
Iowa	38,000		45,000	$4.00		
Maine	7,000	$3.00				
Maryland	8,000		41,000			
Massachusetts	9,000					
Michigan	54,000	$5.00	47,000	$4.00	12,000	$2.00
Minnesota	14,000					
Nebraska	27,000					
Nevada			7,000	$2.00		
New Hampshire	16,000	$5.00	10,000	$2.00		
New Jersey					21,000	$12.00
New York	279,000	$3.00	4,000			
N Carolina	248,000					
Oklahoma			20,000			
Oregon	358,000				137,000	$3.00
Pennsylvania	5,000		89,000		10,000	$12.00
Texas					8,000	
Utah			1,000			
Washington	436,000	$3.00	28,000		48,000	$1.00
West Virginia	6,000					
TOTAL	**2,114,000**	**$4.00**	**590,000**	**$3.00**	**250,000**	**$3.00**

Barriers on Bridges — A Case History

By Jim Amundsen, P.E.

"What do we do about putting noise barriers on the various bridges we have on this project?"... A question all too often asked by many Departments of Transportation. Michigan DOT was one of those asking that very question during the recent construction conference on a noise barrier project along I-91 in Taylor, Michigan.

Initial plans considered the use of a decorative block noise wall on either side of the bridge. This type of wall was popular with area residents but it presented a problem...it was too heavy for use on the bridge.

Solution... Sound Off ™... a new noise wall system, that COR TEC had recently introduced to the market, resolving a like problem in Columbus Ohio. The Ohio project included Sound Off panels being installed over two bridges and on a retaining wall.

Sound Off panels were selected by ODOT for the Columbus project because of its tough, durable construction, its graffiti resistant surface, and its light weight... Just right for use on bridges.

Sound Off panels are constructed of a tough fiberglass reinforced composite skin with a resilient polyester gel coat surface laminated to a plywood core. The technology utilized in the manufacture of Sound Off is the same used in making fiber reinforced panels for the truck and trailer industry for the past 15+ years, with excellent performance.

Sound Off panels are not only durable, graffiti resistant and easy to install, they are available in colors to compliment the surrounding community or environment. They also weigh less than 5 pounds per square foot, making it one of the lightest barrier materials on the market today... and just right for the bridge in Taylor Michigan.

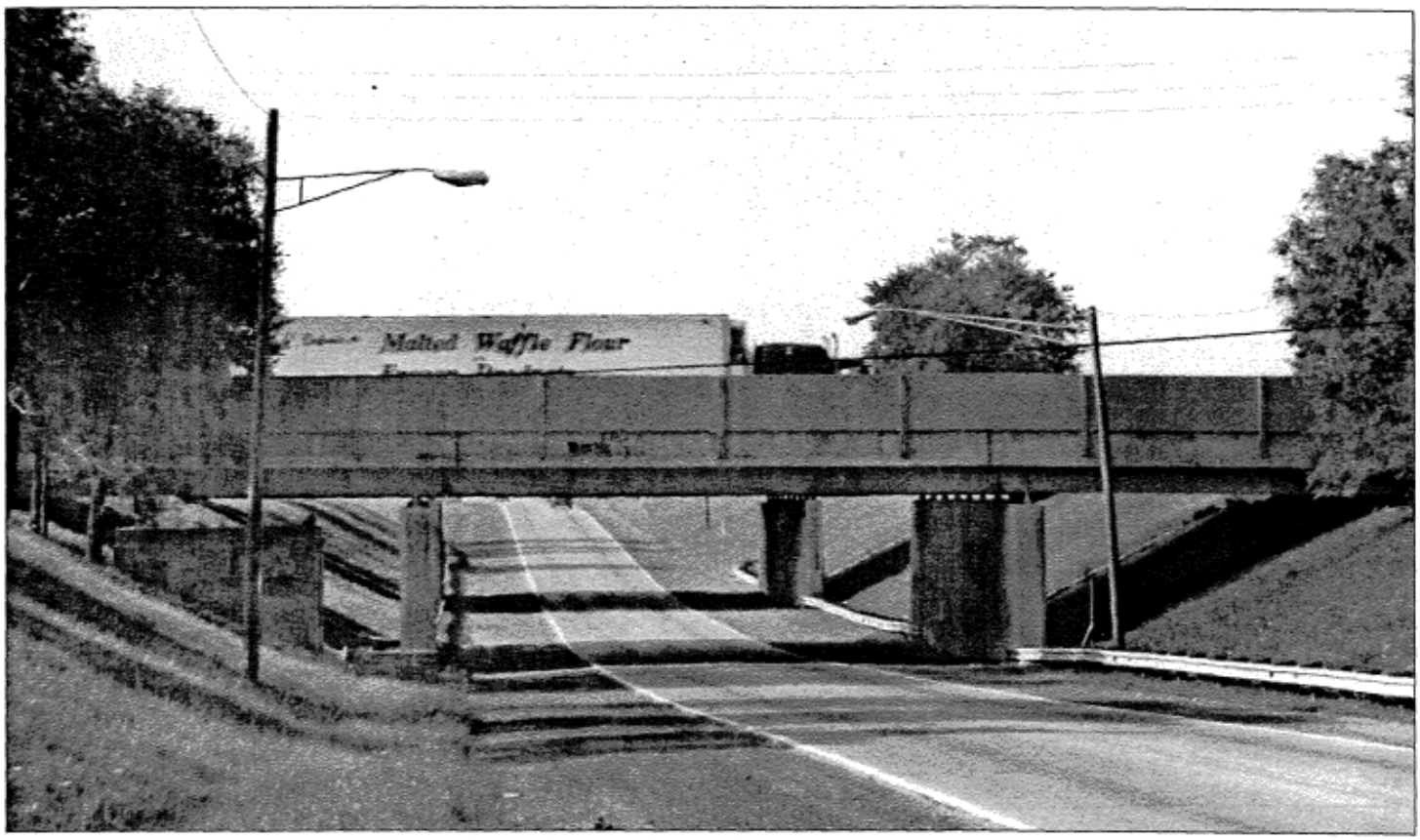
It was this weight advantage that attracted Michigan DOT to try the Sound off system. Walter Toebe Construction Company of Wixom, Michigan was the contractor awarded the I-94 barrier project. Construction went smoothly until a local business organization decided to change their mind on the wall's color scheme. They preferred gray rather than the previously selected brown... and they convinced Michigan DOT to make the change.

This color change created a major problem for the block manufacturer, delaying their work by about 2 months. The color change for the Sound Off portion created no such problem, with the panels delivered to the site and installed 3 weeks after the color change was approved.

The Walter Toebe Company also found Sound off to be easy to install. The anchors and eleven posts for the approximately 150 lf of wall were installed easily within a single day. Installation of the 700+ sf of panel went even quicker. As the project foreman put it, "We started to lift the first panel off the truck at about 9 am and we were done and ready to leave before noon."

Sound Offî also proved easy to connect to the adjoining block wall by using a couple of pieces of angle steel and anchors set into the face of the block. The walls were then connected by a short span of Sound Off panel that provided closure and a neat ìfinishing touch.

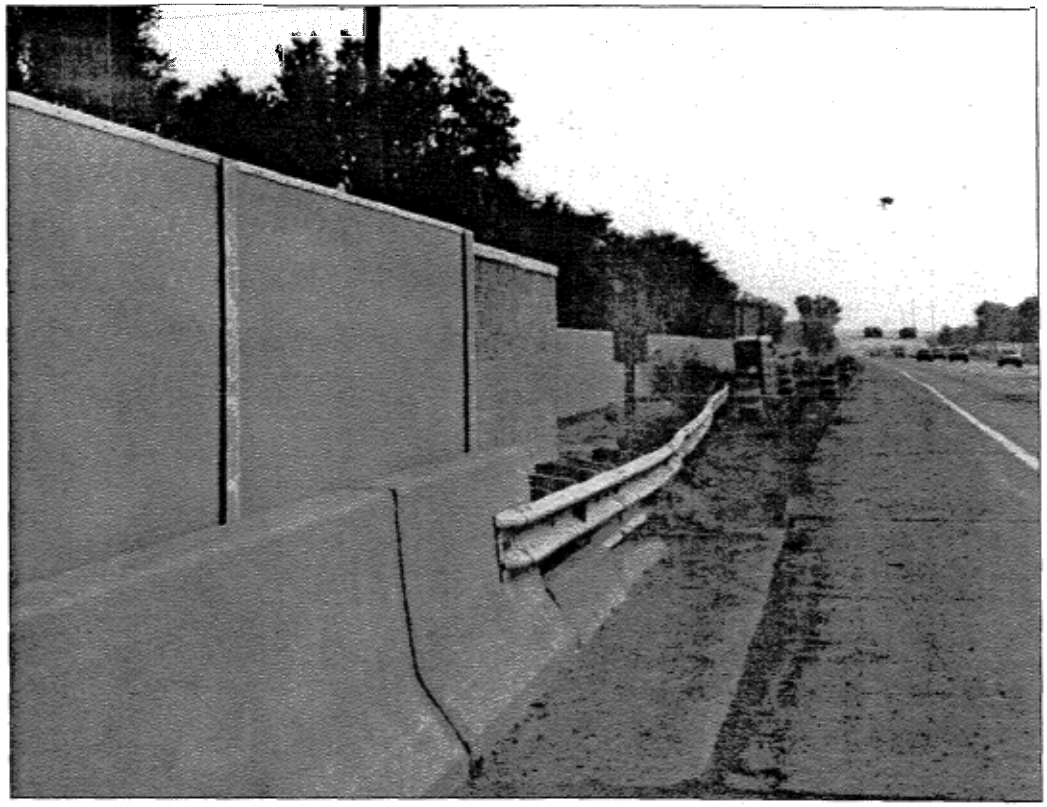
Michigan DOT inspectors were pleased with the appearance of the



new barrier. Its color and texture blended well with the two sections of block wall it connected. They are also confident of the durability of the tough FRP panels that have already proven capable of taking years of exposure to road salt and rough weather on truck and trailer bodies across the country.

Sound Off's toughness, weatherability, graffiti resistance, ease of installation and light weight make it the right choice for not only bridges but for entire noise abatement projects.

For more information about Sound Off, call COR TEC at 1-800-879-4377 and ask that information be sent to you. Or write to: Sound Off, COR TEC Company, 2351 Kenskill Ave., Washington Court House, OH 43160. For more information about the MiDOT and ODOT projects, contact Jim Amundsen, P.E., COR TEC Design Engineer, at 614-335-7273.■



Nonlinear Feedback in the Conversion of Sound ...

A Continuation of the Articles on Parametric Amplification

By Frank Hodgson

This article complements and extends the presentations made in previous articles in The Wall Journal (Issues 11 and 13) on the Mayan wall phenomena. The temple wall located in the Yucatan Peninsula of Mexico at Chichén Itzá appears to convert sound frequencies upward.

The escalating frequency response noted at the Mayan wall is now believed by the author to arise from a form of nonlinear feedback. It is still probably proper to call it a form of parametric amplification. The process seems to only generate odd harmonics rather than to eliminate even harmonics as had been previously thought.

The process seems to be relatively independent of the angle of incidence of the incoming sound waves and the escalating frequency noted seems to be consistent with this type of transformation. The frequency profile of the echo should be virtually independent of the character of the incoming signal for a given wall configuration.

The key factor is the creation of a resonant frequency in the long shallow gaps which are cut into the stone face of the stairway of the main temple (see photo of temple in Issues No. 13), and which surround each square-faced block. Assuming that resonance across the gap is a half wave length and that the speed of sound is 600 mph, a 1/8" gap width would resonate at 42.24 kHz [(880 x 12/2)/(1/8)]. A 3/16" gap would resonate at 28.16 kHz. The second key factor is the rectilinearity of the structure of the surface. This not only gives rise to a strong local resonant signal in the gaps, but forms the basis for the propagation and creation of the higher harmonics.

This process would explain why the echo is so uniform and so independent of the type of input. The orientation of the gap with regard to the corner should not be critical (Fig. 1). To understand the effect, it may help to examine the boundary condition created between the resonant frequency and an average incoming wave when the 3rd harmonic is first beginning to be created (Fig. 2).

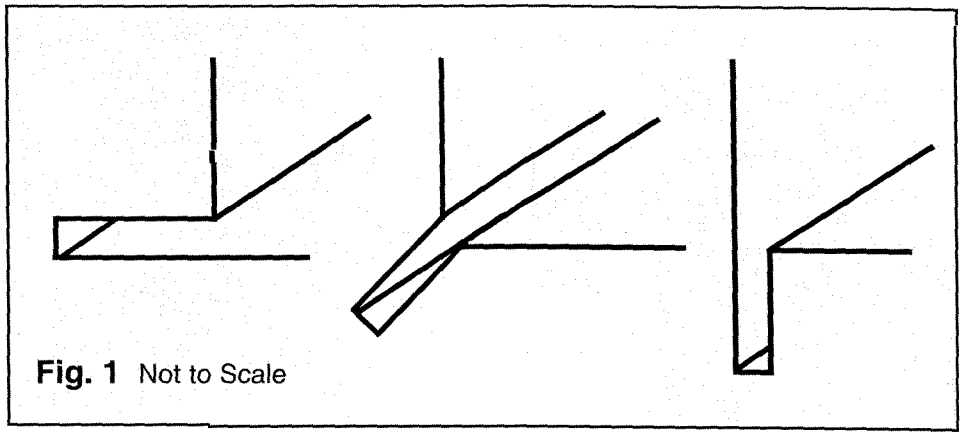


Fig. 1 Not to Scale

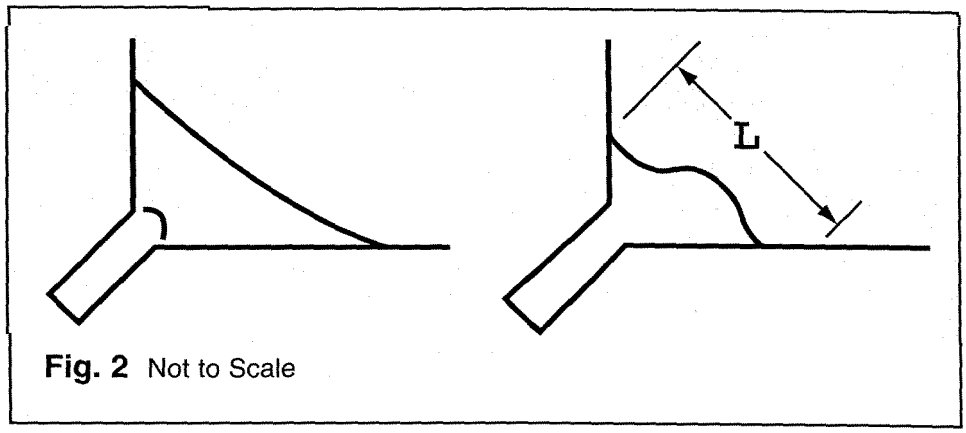


Fig. 2 Not to Scale

At some distance "L" from the corner, the impinging wave and the resonant wave propagated by the gap combine to give structure to the 3rd harmonic. It seems to bend the middle of the incoming wave back away from the corner. This is a rather simplified explanation of the process which is a kind of a progressive propagation of the interference through the incoming wave form(s).

For surfaces which utilize liquids rather than gases, the higher propagation speeds of sound in liquids would seem to require smaller structures and smaller gaps to obtain comparable results. If such surfaces contain square-bottomed gaps, the reults in converting frequencies upward to reduce ground-propagated sound and vibration should be reasonable. Restated, the generation of odd harmonics in ground walls which are liquid filled and which have these special surfaces on the interior should function well, and the problem of the harshness of these harmonics when propagated in air do not arise. Such ground walls should be very effective in dampening ground-propagated sound.

Consideration is now given to the problem of creating a surface which will produce a sound acceptable to the public. The best prospect for generating a reasonabe sound would seem to be to utilize cylindrically-bottomed gaps. The diameter of the cylinders should be a full wave length (that is, twice the width of the gap). It is not clear what the depth of the gap should be, but a full wave seems like a good starting point. The use of half a wave length greater or less in the gap depth may make a noticeable difference.

The general structure of the surface should contain a lot of rectilinearity, and thus a wide variety of surfaces should function very well. Any stepped rectilinear pattern should serve well.

This would include checkerboard patterns and ribbed or parallel arrays of blocks.

Upon reflection, a specific pattern is suggested. It is a simple stepped pattern (Fig. 3) with the cylindrical gaps interconnected to form an internal grid. The pattern is then formed into panels with the grid orientation at 45 degrees. A block size of 8" square with a 6" inset should be fine. Taking a block-center-to-block-center array of six blocks gives a square panel some 2.828 feet on a side. This approach permits the easy cleaning of the structure as the cylinders could be flushed with water and would drain well. This approach has the advantage of offering a way to clean out insects and other debris which might otherwise fill up the structure. Using 3/16" gaps and 3/8" diameter cylinders, the cleaning process would require some care. Drainage from the bottom and ends of the wall is thus required.

It appears that these panels could be fabricated from fiberglass and reinforced with a polyurethane foam. The high portions and the inset portions could be produced separately in long sections and then joined together. They would then be cut into the 45-degree angled panels. With proper registration of the panels, they could be aligned accurately and attached to existing walls.

The Kilo Foundation hereby places the designs described herein in the public domain and they may be used freely by anyone. Those parties interested in being involved in the evaluation and/or fabrication of these panels are invited to contact Frank Hodgson at the Kilo Foundation at 708 Matadero Avenue., Palo Alto, CA 94306; phone 415 493-5511). ■

Ed. Note: While I personally do not comprehend much of what Mr. Hodgson writes, his concept has captured my imagination. In addition to responses our readers may make to Mr. Hodgson, I would like your comments and professional opinions on the publishing of this experimental material.

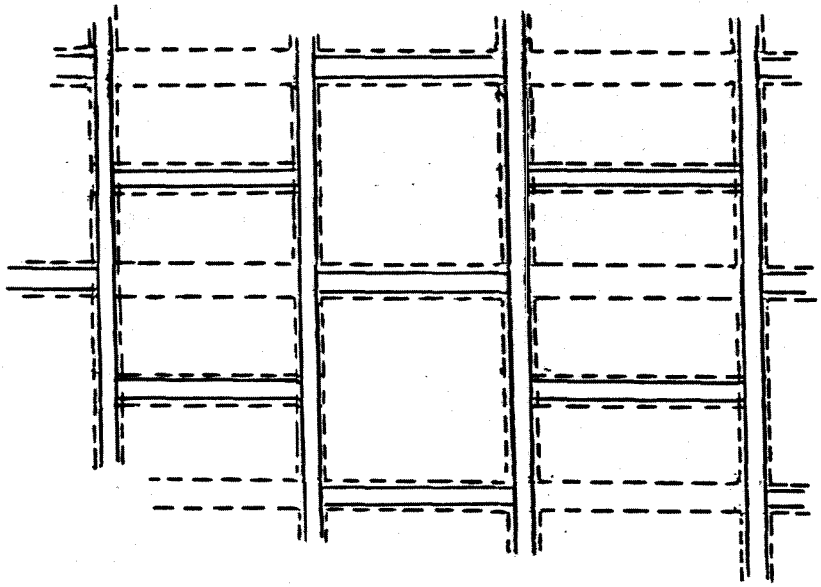


Fig. 3 - Top View

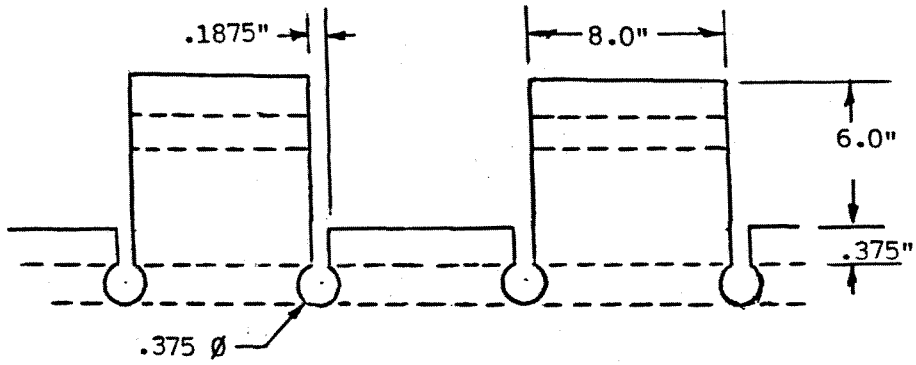


Fig 3.

Fig. 3 - Side View

Editor's Page — My Life and Hard Times

When I retired, I expected to do a lot of traveling to foreign countries...

... and spend some time in the world's great hotels and casinos...

...and shoot some great rounds of golf on the finest courses and chat with dignitaries at the 19th hole...

...and shoot a great game of pool with the world's hustlers...

...and sample vintage wines in dim cafes with lovely ladies...

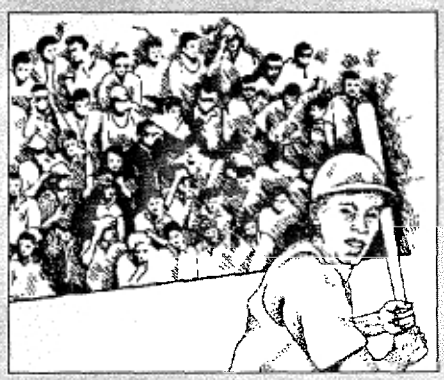
...and meet a few gorgeous traveling companions...

...maybe a baroness, or a duchess, or a princess, or even a queen...

...and dance the nights away with merry female amorists, splendidly gowned and coiffed, with not a care in the world...

...or I might even find a rich widow who permits my wildest extravagances...

...I may even take up exercise to keep my body in trim for the sport



...then too, I could watch the Red Sox and Twins in spring practice right here in Fort Myers...

...and why not dabble in politics; maybe even run for Congress, or Governor of Florida, or President of the U.S.

But no, I can't do any of those things. I am chained to my computer, slaving to get The Wall Journal out on time. It ain't fair. I deserve more. Bah. Humbug.

Letter to the Editor

Dear Mr. Angove:

We enjoy reading The Wall Journal, and appreciate your work in bringing it together. My reason for writing is to tell you this, and to ask you add to your mailing list the name Theron J. Roschen, P.E., of the Transportation Division of the County of Sacramento.

I am working with Theron in a study of the benefits of Rubberized Asphalt in reducing traffic noise. The ongoing study is evaluating the changes in traffic noise levels associated with conventional as well as rubberized asphalt overlays over time. If you are interested in including the results of this study in a future issue of the Journal, please let me know and I will gladly forward the reports to you.

Thank you, and we at Brown-Buntin Associates look forward to many more interesting issues of The Wall Journal.

Paul Bollard
Senior Consultant
Brown-Buntin Associates, Inc.
5150 Sunrise Blvd., Suite D-3
Fair Oaks, CA 95628
Tel 916 961-5822, fax 916 961-6418

TRB Committee A1F04

By Domenick Billera, Chairman

Seasons Greetings! Another TRB Annual Meeting (the 74th) is rapidly approaching with some major changes for this year. Because the Hilton is unavailable for conference/meeting rooms, TRB has shifted to later in the month and our committee's activities take place on Thursday, January 26th through Saturday morning, January 28th at the Sheraton Washington. As always, we have a full schedule of subcommittee and full committee meetings as well as a conference session on the New Generation of Transportation Noise Models and a paper session on Air, Rail and Vehicle Speed Noise Issues. Our Committee Awards dinner is scheduled for Friday evening, January 27th.

A new avenue of programming research needs is now available to us. AASHTO's Research Advisory Committee will accept from each Group 1 TRB section (A1F00) one research need per year for funding consideration. I must select which of our recently prioritized needs is presented as A1F04's candidate for the A1F00 submission to AASHTO. Comments anyone?

Information on the sessions and meetings is listed at the right. For those of you who would like to participate in the activities of A1F04, and who may wish to attend the Summer Meeting in Boston, please write or telephone:

Domenick Billera
New Jersey Dept. of Transportation
1035 Parkway Avenue, CN 600
Trenton, NJ 08625-0600
Tel. 609 530-2384

A1F04 Transportation Related Noise and Vibration Committee

Schedule of Meetings and Sessions

Conference Session: 170 - New Generation of Transportation Noise Models
Thursday, January 26th, 8:30 am, Maryland A & B

Paper Session: 252 - Air, Rail and Vehicle Speed Noise Issues
Saturday, January 28th, 8:30 am, South Cotillion

Committee Meeting: Friday, January 27th, 2:00 pm, Nathan Hale

Subcommittee Meetings:
- Aircraft Noise: Thursday, January 26th, 2:00 pm, Nathan Hale
- Rail Noise: Thursday, January 26th, 7:30 pm, Nathan Hale
- Highway Noise: Friday, January 27th, 9:00 am, Nathan Hale

Agenda

- Call to Order
- Welcome and Introduction of Members and Guests
- Statements by Ken Cook, TRB Staff Liaison
  Wayne Kober, Section Chairman
- Review of Minutes of January 12, 1994 Meeting
  Win Lindeman, Secretary
- TRB Membership — Domenick Billera
- Reports:
  - Summer 1994 Meeting — Jim Byers
  - 1995 Activities & Sessions — Domenick Billera
  - New FHWA Noise Prediction Software Development — Bob Armstrong, Gregg Fleming, Grant Anderson
  - Aviation Noise Update — Eric Stusnick
  - Highway Noise Update — Ken Polcak
  - Rail/Mass Transit Update — Jim Nelson
- Presentation — Curt Westergaard
  Computer Generated Visualizations of Noise Barriers
- Committee Awards — Roger Wayson
- Discussions:
  - A1F04 Summer Meeting in Boston (1995) — Gregg Fleming
  - Newsletter — Domenick Billera
  - Others
- Announcements:
  - A1F04 Awards Dinner — Gary Figallo
  - Others

☆ ☆ ☆

Continuation of Breakdown of Types of Noise Barriers Constructed from 1970 - 1992

Series of Tables begins on page 8 with Index of all Tables

Block Noise Barriers Constructed

	1970 - 1982		1983 - 1987		1988 - 1992	
STATE	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**
Arizona	2,000		23,000	$9.00	33,000	$10.00
California	3,825,000	$13.00	5,797,000	$16.00	3,303,000	$12.00
Colorado					24,000	$10.00
Connecticut					3,000	
Florida	26,000	$13.00			11,000	$12.00
Michigan			96,000	$21.00	25,000	$23.00
Minnesota	137,000	$22.00				
New Mexico	7,000	$19.00				
Oregon	179,000	$21.00	27,000	$18.00	150,000	$13.00
Pennsylvania	26,000	$34.00				
Puerto Rico	9,000	$8.00				
Utah			227,000			
TOTAL	**4,211,000**	**$13.00**	**6,170,000**	**$15.00**	**3,549,000**	**$12.00**

Metal Noise Barriers Constructed

	1970 - 1982		1983 - 1987		1988 - 1992	
STATE	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**
Arkansas	17,000	$11.00				
California	31,000	$12.00				
Colorado	17,000	$7.00				
Delaware	5,000					
Florida			3,000	$17.00		
Georgia	105,000	$11.00	227,000	$9.00	488,000	$10.00
Illinois			47,000	$23.00		
Indiana					42,000	$9.00
Iowa	125,000	$9.00				
Kentucky	41,000	$10.00			24,000	$21.00
Massachusetts	13,000	$8.00				
New Jersey			4,000	$12.00		
Ohio	115,000	$16.00	95,000	$12.00	143,000	$13.00
Oregon	20,000					
Pennsylvania	5,000					
Tennessee	333,000	$13.00	4,000	$32.00	12,000	
W Virginia	219,000	$9.00			68,000	$15.00
Wisconsin			44,000	$16.00	52000	$12.00
TOTAL	**1,046,000**	**$12.00**	**424,000**	**$12.00**	**829,000**	**$12.00**

Continuation of Breakdown of Types of Noise Barriers Constructed from 1970 - 1992

Series of Tables begins on page 8 with Index of all Tables

Continuation of Breakdown of Types of Noise Barriers Constructed from 1970 - 1992

Series of Tables begins on page 8 with Index of all Tables

Brick Noise Barriers Constructed

	1970 - 1982		1983 - 1987		1988 - 1992	
STATE	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**	**SQ FT**	**$/SQ FT**
Kentucky					82,000	$12.00
Michigan	95,000	$13.00	37,000	$23.00	107,000	$20.00
North Carolina					216,000	$15.00
Ohio			67,000	$17.00		
Oklahoma			10,000	$19.00		
Pennsylvania			18,000	$30.00	10,000	$22.00
Utah			9,000	$15.00		
TOTAL	**95,000**	**$13.00**	**141,000**	**$20.00**	**415,000**	**$16.00**

PRESS RELEASE

FOR IMMEDIATE RELEASE
December 15, 1994
Hamilton, Ontario, Canada
Reston, Virginia, USA

DURISOL AND THE REINFORCED EARTH COMPANY ANNOUNCE NEW PARTNERSHIP FOR THE UNITED STATES

Durisol Materials Limited of Canada and The Reinforced Earth Company of the United States have announced that effective immediately they have agreed to establish a new commercial alliance wherein Durisol Materials Limited, acting through its newly formed U.S. subsidiary, Durisol Materials Incorporated, will be responsible for the manufacture of all Durisol products sold in the United States and The Reinforced Earth Company will become the exclusive distributor for highway and other transportation noise barriers in the United States.

Hans J. Rerup, President of Durisol Materials Limited, said "We are very enthusiastic about this new relationship which allows The Reinforced Earth Company to capitalize on its proven ability to establish Durisol™ as the sound-absorptive noise barrier of choice for highway and transportation noise abatement, and allows Durisol Materials to insure that competitively priced, quality products reach our customers. Further, it allows Durisol to introduce a wider range of products to the residential, commercial and industrial building industries."

Durisol Materials Incorporated intends to sublicense manufacturers for Durisol products throughout the United States, and to establish its own production facilities in certain key demographic areas. Interested parties are requested to contact Durisol Materials Incorporated directly. David P. McKittrick, former President and CEO of The Reinforced Earth Company, has agreed to become Durisol's Managing Director for the United States.

Durisol sound-absorptive noise barriers were first introduced in the United States by The Reinforced Earth Company in 1988. Since that time, Durisol projects comprising well over five million square feet of wall surface have been installed in 15 states and the Commonwealth of Puerto Rico.

For further information, contact: David P. McKittrick, telephone 703 742-0999 or by fax at 703 318-9632.

PRESS RELEASE

SCANTEK, INC. ANNOUNCES NEW PRECISION OUTDOOR MICROPHONE UNIT

FOR IMMEDIATE RELEASE

Silver Spring, Maryland — Scantek, Inc. announces the release of a new environmental microphone system, the Type 41AL, manufactured by G.R.A.S. Sound and Vibration. The Type 41AL complies with ANSI and IEC Type 1 measurement requirements. It comes specifically designed for community noise monitoring, with 90 degree incidence for a reference.

The unit has a unique Phantom Calibration© system which allows precise calibration at multi frequencies in-situ. Included is a windscreen with anti-bird spikes, and an integral rain cap. The noise floor is below 20 dBA.

The unit can be calibrated with a precision calibrator such as the Norsonic 1251, or a pistonphone. A tripod mount on the bottom is standard, as is the availability of interchangeable cables to allow connection to most standard sound level analyzer/meter microphone inputs with 200V polarizing voltage. A dessicator tube is available to attach into bottom of the unit. A Pole Adaptor is available for the dessicator.■

For further information, contact:
Richard J. Peppin, P.E., President, Scantek, Inc., 916 Gist Avenue, Silver Spring, MD 20910. Telephone 301 495-7738 or fax 301 495-7739.

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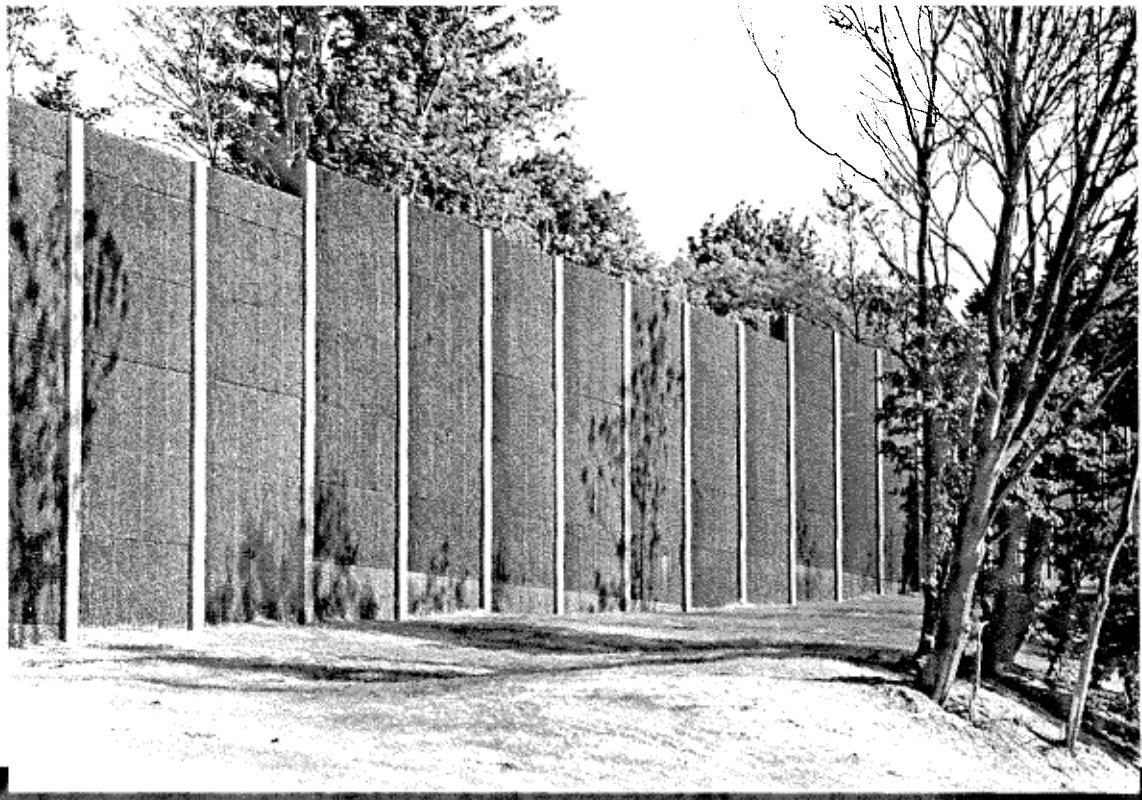
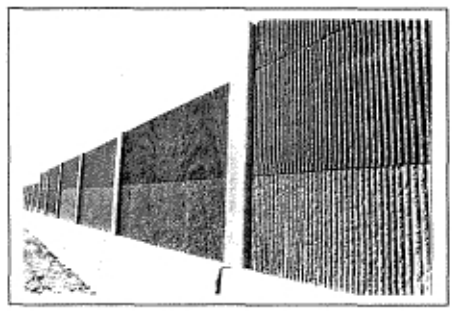


Specify Fosroc.

Sound absorptive highway noise barriers are becoming specified more and more. To significantly improve the appearance and durability of these structures, more specifiers are relying on **Fosroc** *for:*



- **Pigmented, VOC compliant acrylic stains** to provide an attractive, uniform color and water repellent protection. Aesthetically pleasing - anti graffiti properties.
  Specify Cementrate or Cementrate WB.
- Graffiti resistant, pigmented coatings protect soundwalls from vandalism.
  Specify Graffitiguard 2.

Also a wide range of sealers/coatings available:

- **EA-Sealer** high solids, non-yellowing "wet look" acrylic sealer. Solvent and VOC compliant. Also available in "low lustre" finish.
- **Exposed aggregate retarders** create uniform etch reveals on soundwall. **Preco** retarders are more economical, cleaner and less complicated than acid etching or sandblasting.

The ***Preco*** *Precast Division offers enhanced technical support to all of our customers. Free on-site seminars are also available on concrete coating technology. Call or write today for more information on how we can help you on your next soundwall project.*

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