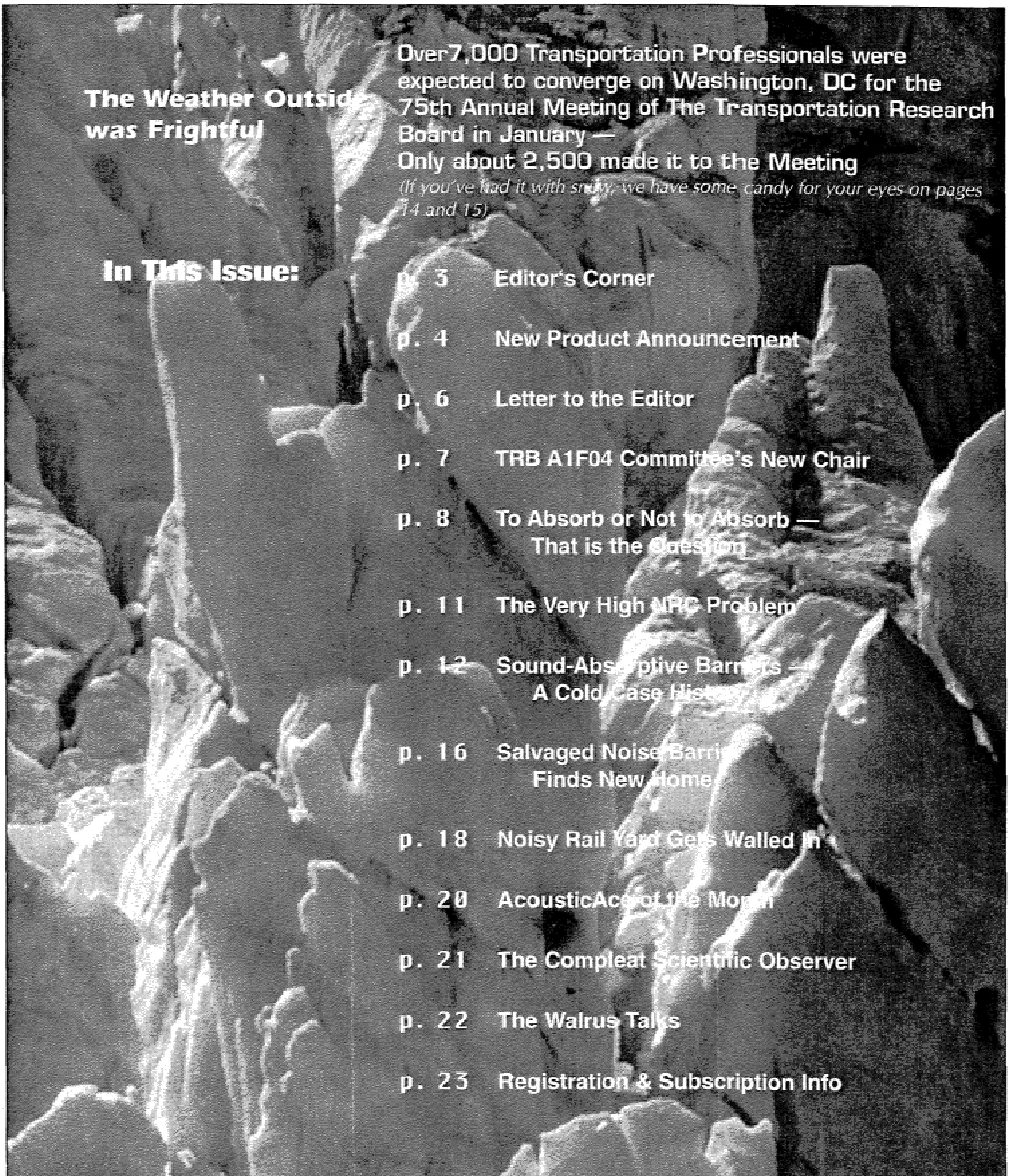
The Wall Journal™

Issue No. 21

THE INTERNATIONAL JOURNAL OF TRANSPORTATION-RELATED ENVIRONMENTAL ISSUES

Jan/Feb 1996

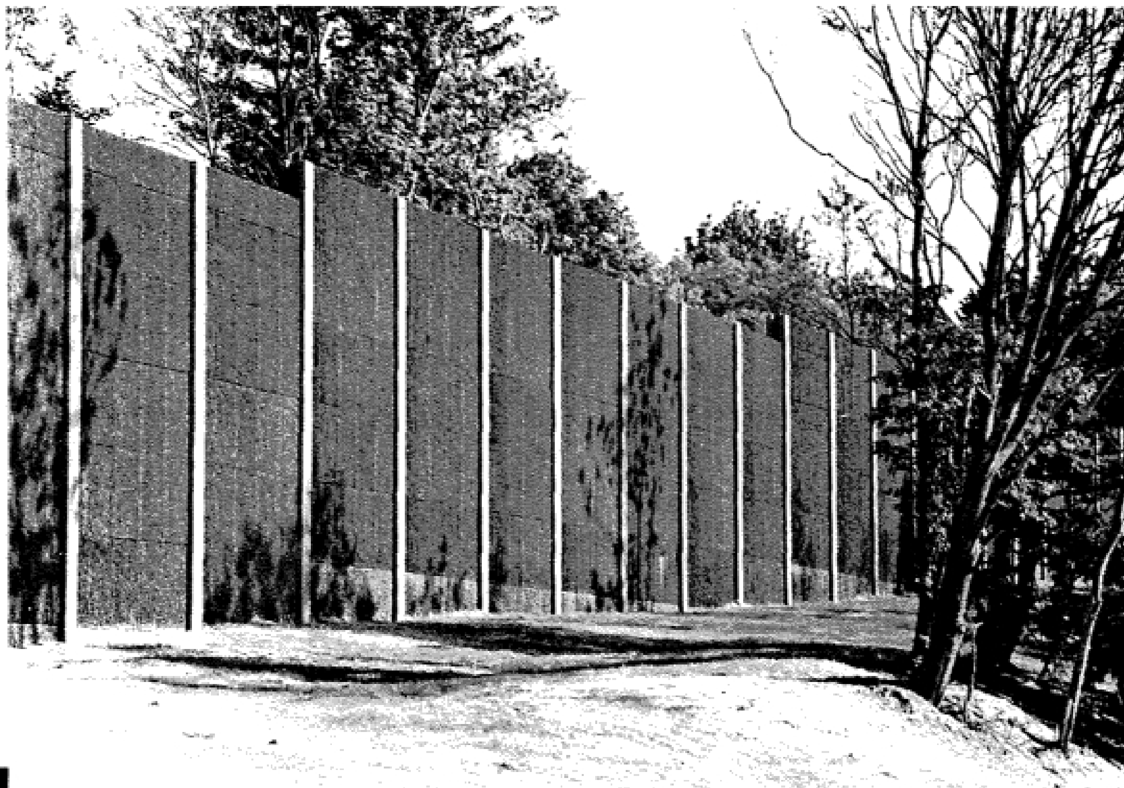


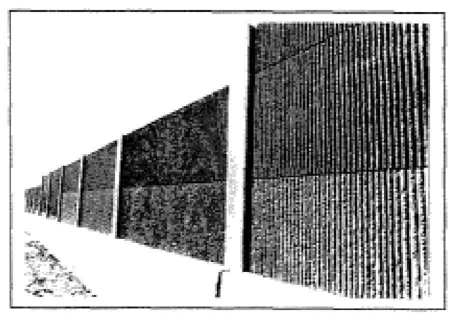
The Weather Outside was Frightful

Over 7,000 Transportation Professionals were expected to converge on Washington, DC for the 75th Annual Meeting of The Transportation Research Board in January —
Only about 2,500 made it to the Meeting

(If you've had it with snow, we have some candy for your eyes on pages 14 and 15)

In This Issue:





The Wall Journal

The International Journal of Transportation-Related Environmental Issues

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El Angove

Director of Publications
John G. Piper

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Subscription and advertising information are shown on pages 23 and 24.

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EDITOR'S CORNER by El Angove

Get Serious, El

All of my education and training has been in architecture, engineering and construction, which was engendered by my father's desire that I become a mining engineer, since I was raised in the lead belt of Missouri. At 17, I was at the University of Missouri at Columbia matriculating in chemical engineering, when I turned 18 and Uncle Sam took possession of my body.

Two and a half years later, I came back from WWII in Germany and went back to Columbia to resume my engineering studies. However, the old zest for the quest for knowledge had given way to some weird, puckish inside persona that wanted fun and games and let the devil take the hindmost.

For the past 50 (believe it) years, I have struggled with this schizophrenia as I have endeavored to sublimate the evil persona and make my mark in the professional world of engineering and construction.

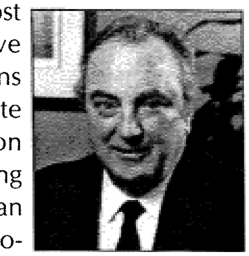
For the most part, I have succeeded. However, like Amadeus Mozart, on occasion I may cast off my sober and professional real-world persona and suddenly burst into giggles or insane comedy. You will have to understand this when I may occasionally write a column of whimsey, nonsense or other pure fabrication. It is my pressure release valve opening.

Now, I am Serious

In Rudy Hendrik's 'opinion' article which begins on page 8 of this issue, he is responding to something I wrote in this column in Issue No. 18, which I reprint:

"What I am missing in this journal are the experts' *opinions*. There are ques tions to be answered. Examples:

1. Is there an implicit advantage for sound-absorptive surfaces on *any* wall?
2. Is there any **real** significance in a very high NRC rating?
3. Should there be an aesthetic height limitation on roadside noise barriers?
4. What is government's position on use of recycled materials in noise barriers?"



What I had most hoped to achieve with these questions was to motivate more interaction between and among readers rather than simply printing project reports and the like. I always felt that you could learn a lot more from debates or exchanges of opinions than from prepared statements.

Rudy has made an absolutely remarkable response to my question No. 1. It is well written, replete with factual data, and thorough in scope. Thanks very much, Rudy (see his reward on page 20).

Now, I personally could take issue with some of his comments, but they are not of an argumentative nature, but more territorial in content. Rudy's knowledge of the subject would seem to be unimpeachable to me. However, I am not allowed to enter this interaction (house rules).

But I am certain some of our readers may wish to join in. And, if so, we all shall have the benefit of expanded knowledge on the subject, as it may apply to the national market for noise barriers.

On Question No. 2, we have on page 11 an opinion on "very high NRC" by a newcomer to The Journal, Edward P. McNair. It will be very interesting to see what responses we get to this.

All responses will be published, provided they fit within our space. You may look at Edward McNair's opinion as a 'short' one and Rudy's as a 'long' one; we can fit these in very nicely. Do not submit books or manuscripts. It is not necessary to send your material on computer disk; a clean laser printout is perfect (we scan them directly into our computer).

Gregg Fleming, the new Chairman of TRB A1F04 Committee, has offered to encourage more of the committee members to submit material to us. We may have to expand the old Wall Journal to a much bigger publication.

I love it. ■

New Product Announcement

Press Release
For Immediate Release
Morristown, New Jersey

New Jersey Inventor Receives Patent for Vertical Barrier With Tilted Faces

On November 28, 1995, Edward P. McNair of Morristown, N.J. was awarded a patent for "Sound Barrier With Oblique Faces". Tilted barrier faces are equally effective as sound absorptive faces in reducing "Barrier Insertion Loss Degradation" from multiple reflections between parallel barriers, according to a 1994 FHA report.

Low Cost

The barriers are comprised of vertical panels that are constructed to be interchangeable with the conventional vertical panels. On the highway side of the new barriers there are tiers of wedges giving the surfaces of the walls the appearance of large clapboards or shingles. "They combine the performance of tilted walls with the cost and ease of assembly of ordinary vertical walls", said McNair.

Easy to Construct

The fabrication and installation of the panels is as easy as for conventional barriers. For example, in concrete, the panels are made with a single pour, either in a horizontal mold with a raked finish on the back, or a vertical mold for a cast finish on the back. They can be designed to fit tongue and groove into vertical H columns.

License for "In House"

The facade can be made of wood, metal, plastic, or any type of concrete. McNair will license the design to qualified contractors that have built conventional barriers of these materials so that they can meet the criteria that many states now have for parallel barriers. The design is currently available as an option with the MONO-WALL™ and TRENWA™ barrier systems.

Acoustical Principle

The 1994 FHA report "Performance Evaluation of Experimental Highway Noise Barriers" states that "Tilting the barriers outward (away from the roadway) was equally effective (when compared with the application of acoustically absorptive treatment) at eliminating the multiple reflections".

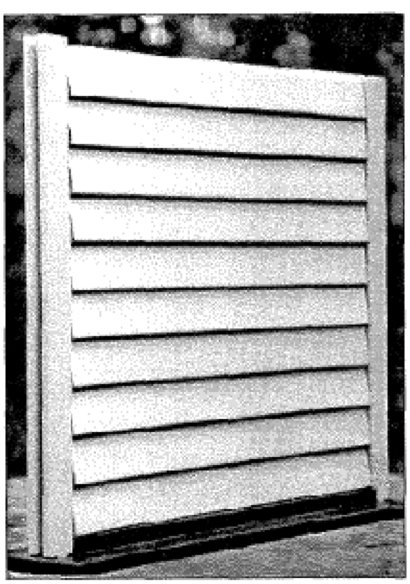
Lord Rayleigh determined that for reflecting any frequency of sound, the effective area of a surface equalled its actual area if the wavelength was no larger than the circumference of the surface. Thus a surface with a height of two feet can aim the reflection of any sound down to 180 Hz and one with a height of three feet can aim frequencies down to 120 Hz.

Typical Dimensions

The surface of each wedge has a height of from two to three feet and has a 6:1 incline, which is a tilt of 9.6 degrees. A two foot wedge would have a base of four inches, a three foot one a base of six inches. Assuming that the back wall was four inches thick, a concrete barrier with the two-foot faces would weigh the same as a vertical faced concrete barrier six inches thick; with three-foot faces it would weigh the same as a seven inch thick barrier.

Pleasing Appearance

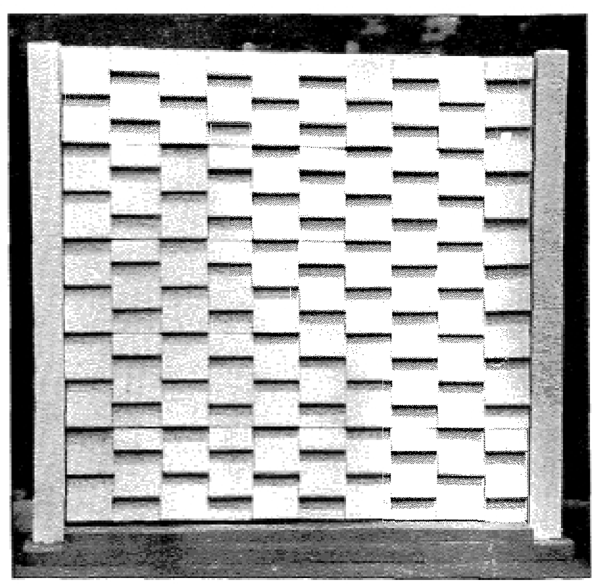
Upon viewing models of the new walls, many people commented that the clapboard and shingles gave less of a "walled in" appearance than straight vertical walls. Their appearance can be further enhanced with textured surfaces.



The scale models shown in the photographs are 1:12 representations of a 'clapboard' texture in the left photo, and a 'shingle' texture in the right photo. At full size as highway noise barriers, these panels would measure 20' x 20', with each 'clapboard' being 24" wide and each 'shingle' being 24" square.

For further information, contact:

Edward P. McNair
59 Chimney Ridge Drive
Morristown, NJ 07960



Your Attention, Please

The U.S. Postal Service has installed all new mail boxes in the Lehigh Acres Office. That's the good news. The bad news is that we now have a new box number — **1389**.

At about the same time, AT&T gave us a brand new area code — **941**.

All of this just after we bought new stationery.

Please make a note:

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Letter to the Editor

January 18, 1996

Mr. El Angove
The Wall Journal
P.O. Box 1389
Lehigh Acres Fl. 33970-1389

Dear El,

The one and only William McColl of New York State DOT, has encouraged me to fire off this note to you. It's to let you know that we in the frozen tundra of upstate New York appreciate the warm efforts of you and your staff, for enhancing our general knowledge of noise related issues.

I received my first issue, #2, while attending Cohn and Harris's Highway Noise Analysis Seminar at the University of Louisville. They suggested that all of the attendees subscribe to the Wall Journal, as this is where the new developments in noise issues would be explored.

The Environmental Unit of this regional transportation office, puts The Wall Journal's articles to good use. The research and related items presented are of high value to us. Articles like "Resurfacing for Noise Reduction" was one that was of great assistance. This type of data would never have crossed our desks without you.

The Wall Journal gives us vital information to inform our design engineers, and the general public. Each have their own concerns which are brought up at various times in the life of a transportation project.

I realize that consumers sometimes look at advertising as a negative issue. Those who advertise with The Wall Journal should be told that without it, their products may never get the recognition that they deserve. It helps units like ours see these products and keep up with changing developments in the field.

In closing, please find the enclosed check to cover the cost of replacing issue number 7, which has disappeared into someone else's office, and for issue number 1, to complete our set.

We here at DOT wish you much continued success in sunny southwest Florida.

Very truly yours,

Christopher Schleede
Environmental Contact
New York State Dept.of Transportation
Region One, Albany, NY

(Ed. Note: Thanks very much for your kind words of praise for our work. I may have to consider making an award for "Best Letter to the Editor"; right now you are in first place Christopher.

For interested readers, the article on "Resurfacing for Noise Reduction" by Bela Schmidt and Robert Fischer appeared in Issue No. 14, July/August 1994).

TRB COMMITTEE A1FO4 ON TRANSPORTATION RELATED NOISE AND VIBRATION

By Gregg G. Fleming, Chairman

I would like to begin my inaugural Chairman's Column for The Wall Journal by thanking Domenick Billera for seven years of meritorious service as Chairman of TRB Committee A1FO4. Throughout his tenure Domenick successfully brought many fresh new ideas to the Committee. Looking at his legacy, some of the things that come to mind include the increased international membership of the Committee, and his emphasis not only on the technical side of issues, but also on the aesthetics — a highway noise barrier won't be perceived to be nearly as effective if it's a public eyesore.

His dedication to the Committee is exemplified by his recent journey to the 1996 TRB Annual Meeting in Washington, D.C. The drive, which would have normally taken approximately 4 hours, took over 7 due to one of the worst snow storms to hit the east coast in recent memory, the so-called "Blizzard of 1996". At the meeting, he chaired the A1FO4 Committee Meeting, the three related Subcommittee meetings, and the A1F100 Committee Meeting. Domenick, I thank you again, and look forward to your continued participation in the Committee as an esteemed Chairman Emeritus.

Unfortunately the weather greatly hampered activities at this year's TRB Annual Meeting in Washington, D.C. In fact, if you didn't get in the Saturday night before the meeting, you did not get in at all, since the three major airports in the D.C. area were closed from Sunday through Tuesday. All of the Committee sessions did, however take place, with limited attendance, and limited presentation material.

During the Monday morning session of the Highway Noise Subcommittee, three presentations related to the Federal Highway Administration's Traffic Noise Model (FHWA TNM®) were originally scheduled, but were unfortunately snowed out. Consequently, a synopsis of each will be presented in upcoming issues of The Wall Journal. Stay tuned.

Also on the TNM front, a BETA version is currently being tested by the FHWA, several state transportation agencies and the Volpe Center. Many of the preliminary comparisons between predictions and measurements have been quite encouraging. The TNM's advanced, Microsoft-Windows-based interface, and its state-of-the-art acoustic algorithms will offer an incremental improvement in accuracy, flexibility, and ease-of-use, as compared with any highway noise prediction program currently available. Based on progress to date, it is anticipated that TNM Version 1.0 will be ready for public release in the Spring 1996 time frame. A full demonstration of the model's capabilities is slated for the 1996 TRB A1FO4 Summer Meeting in Chicago, Illinois in July.

The next version of the Federal Aviation Administration's Integrated Noise Model (INM), Version 5.1, is also slated for a Spring 1996 release. Primary enhancements reflected in Version 5.1 will include the ability to run under Microsoft Windows 95, and the inclusion of the U.S. Air Force's noise data base of military aircraft.

As the newly appointed Chairman of TRB Committee A1FO4, a major focus of mine will be the continued support of El Angove's Wall Journal. I think we all owe El a debt of gratitude for the effort he puts into this valuable bi-monthly publication. I encourage readers to spread the word, and to continue providing El with interesting columns.

If you have any comments or questions, or have any suggestions for Committee A1FO4, please contact:

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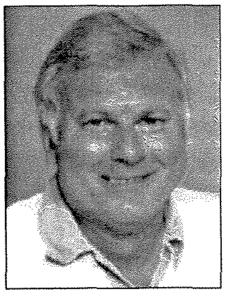
To Absorb or Not To Absorb – *That is the question*

An Opinion by Rudy Hendriks



In The Wall Journal Issue No. 18, Editor's Comer, Editor El Angove posed a challenge to transportation noise experts when he wrote: "What I am missing in this journal are the experts' opinions. There are many questions to be answered.

Example: 1. Is there an implicit advantage for sound-absorptive surfaces on *any* wall?" etc.

Well, El, following is *my opinion.* I am speaking for myself and not necessarily the Department I work for.

The decision to use sound absorptive materials on noise barriers should primarily be based on science, not politics. We should first quantify scientifically what the benefits are of the absorptive surfaces in terms of noise reduction, then decide if the benefits are worth the cost. Unfortunately, in many instances these decisions are pressured by politics, or other non scientific agendas. Since the construction of noise barriers is most often funded by tax payers money, the considerable extra cost of absorptive surfaces is especially important. With shrinking transportation funds we have to make tough decisions on spending priorities.

The purported advantages of using sound absorptive material on noise barrier surfaces are:

1. **Elimination or reduction of noise reflections**. In single noise barrier configurations this means that the unprotected residences (or other locations of interest on the opposite side of the highway) do not experience an increase in noise levels. In situations involving parallel noise barriers (one on each side of the highway) each of the noise barrier's performance is not degraded by the presence of the other.
2. **The performance of a single noise barrier increases**. Receivers behind a noise barrier lined with absorptive material on the highway side or on both sides are benefitted by a further reduction in noise.

The primary disadvantage of absorptive materials is, simply, the price tag. If absorptive noise barriers can be constructed for the same cost (or maybe a "slight" increase), with the same structural integrity, durability, and aesthetic appeal as the "conventional" reflective noise barrier, without requiring more maintenance, I would say: "Go for it!" on every and any noise barrier.

Unfortunately, the increase in cost of noise absorptive material, whether integrated with noise barriers or as a retrofit, is usually at least \$108/m^2 (\$10/ft^2) over the cost of conventional "reflective" noise barriers. For an average noise barrier in California of, say, 4 m (13 ft) high, the extra cost translates into an escalation from about \$0.62 million/km (\$1.0 million/mi) for conventional noise barriers to \$1.06 millon/km (\$ 1. 7 million/mile) for absorptive barriers.

Are these extra costs worth the benefits? Should we forego some of the much needed transportation improvement projects to install sound absorptive material on noise barriers?.

These questions can only be answered by examining how much actual benefit can be expected from absorptive noise barriers. This requires putting potential problems with reflective barriers into proper perspective.

First, let's examine the potential reflection problems from single barriers. Figure 1 illustrates the simplest case. For simplicity, pavement reflections are ignored. The latter would be present both for the direct and reflective noise.

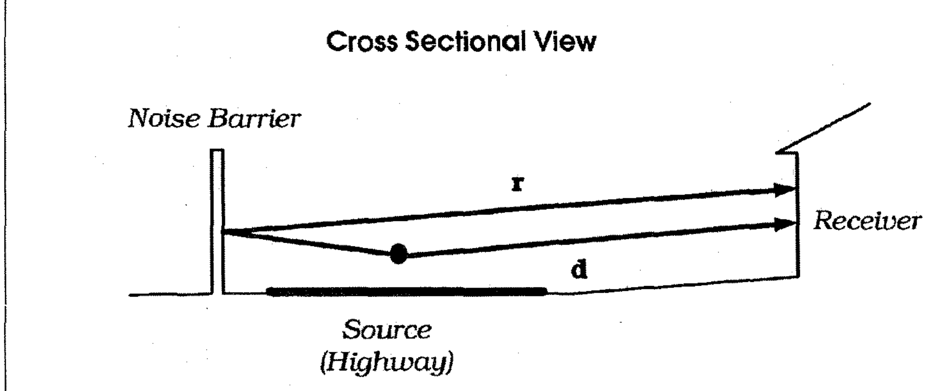
In Figure 1, the reflective noise labeled "r" is almost equal in energy to the direct noise "d", assuming that the noise barrier (wall) is a perfect reflector. The only difference is that the reflective noise path is always longer than the direct noise path. If the receiver is close to the highway (source) the ratio r/d is greater than if the receiver is farther away. As the distance between the source and the receiver increases r/d becomes closer to 1, and for all practical purposes becomes 1.

At that distance, usually about 150 m (500 ft) or greater from a highway, the level of the direct noise approximately equals that of the reflective noise. The total noise level is then 3 decibels (dB) higher than the direct noise by itself. This corresponds with a 100% increase in acoustical energy, which is the maximum increase from the single reflection.

Closer to the highway the reflection does not contribute as much because of the increased r/d ratio. Typically, at the first row of homes next to a freeway, a more realistic increase is about 1 dB. The widely accepted threshold of human perception of change in traffic noise is 3dB. Providing sound absorption for the simplest case depicted in Figure 1 would not yield a noticeable noise reduction and is therefore not worth the extra cost.

Figure 2 depicts a more complicated version of the single barrier reflection.

Figure 1. Single Barrier Reflection



In this case the direct noise path "d" is obstructed, while the reflective noise path "r" is not. A complication arises because of unequal diffraction of the direct and reflective noise. This could be the case in depressed freeways with noise barriers on the opposite side, or at-grade freeways with receivers on a hill-side. For simplicity, Figure 2 shows the source to be in one location only. This case depicts the maximum difference between reflective and direct noise which, due to the differential diffraction, could be well over 5 dB. In reality, however, a six- or eight-lane freeway has the sources (traffic lanes) distributed such that some of the direct noise paths may be diffracted, while others are only partially or not at all diffracted. This situation tends to diminish the differences between the direct noise by itself, and the total noise including direct and reflective noise.

After examining countless possibilities involving four-, six-, and eight-lane freeways using image source modelling techniques, I have come to the conclusion that the total noise (direct and reflective) increases by no more than 5 dB and usually by less than 4 dB. These cases, however, are fairly rare. The site geometry has to be extremely restricted to produce the maximum effect. In such cases, absorptive material may be warranted, but only after careful review and cost/benefit analysis.

Next to consider are parallel barrier configurations and multiple reflections between the barrier surfaces. Some disagreement exists between mathematical modelling, scale modelling and real world before and after in-situ measurements of parallel barrier performance degradations.

In theory, an infinite number of reflections builds up between two hard reflective barrier surfaces from a noise source in between. With each reflection, however the length of the noise path increases dramatically, so that in reality only few reflections are significant (Figure 3, next page).

Although this situation can be mathematically modelled and reproduced in laboratory scale models, such efforts frequently over-predict the negative effects of parallel barriers when compared with controlled before and after field measurements.

Enter public opinion, news media, special interest groups, pseudo-scientists, and politicians (all of which are factors in all noise absorptive issues) and we have the recipe for controversy, and, frequently, misinformation.

Adding to the confusion are the complications caused by long distance noise propagation through the atmosphere. These include the phenomena of refraction due to near-ground wind shear and temperature gradients, and elevated temperature inversions.

Many residents and news media have complained that parallel noise barriers "increase noise levels". If taken literally, the complaints seem to indicate that reflective parallel noise barriers actually increase the noise over that of the no-barrier case. A more appropriate statement would be that parallel noise barrier configurations degrade the performance of each barrier compared to the situation where each barrier existed by itself. For example, if a single noise barrier were to provide a noise reduction (insertion loss) of 10 dB by itself, this reduction could be degraded somewhat, say to 9 or 8 dB. The consequence of this would be that in the presence of another barrier on the opposite side of the highway, a barrier would not be as effective as it could be by itself. It would not mean that the noise levels on either side of the highway would be increased over the "no-barrier" situation.

Independent, controlled field studies by U.S. D.O.T. Volpe National Transportation Systems Center in Cambridge, MA, and Caltrans, Sacramento, CA have recently confirmed that the amount of degradation of reflective noise barriers is linked to the ratio of the separation (width) between the barriers and the average height of the barriers (Figure 4, next page).

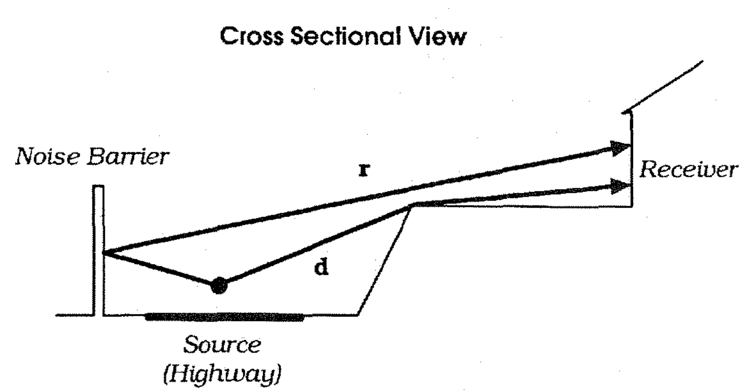
As long as the width-to-height (W/H) ratio equals or exceeds 10:1, it appears that the degradation is limited to a maximum of 2 dB. Below 10:1 degradations may be significantly greater. Virtually all parallel noise barriers in California conform to this criterion. Many sites have W/H ratios of 15:1. I suspect the same is true in other States. In California, the maximum height of noise barriers is limited to 5 m (16 ft). Thus, to maintain a 10:1 W/H, maximum height barriers must be separated 50 m (160 ft).

So, constructing parallel barriers does not automatically justify the additional cost of absorptive materials either.

The final absorptive issue is that of increased performance of a single absorptive barrier over a single reflective barrier for receivers behind the barrier. Studies have shown that this is effective when the barrier is located very close to the source. Low railroad noise barriers constructed to reduce wheel noise are frequently located close to the tracks. Absorptive material

(continued next page)

Figure 2. Direct Noise Shielded, Single Barrier Reflection Unshielded



Absorb *(continued from page 9)*
can be effective for such barriers. For highway noise barriers the improved insertion loss, however, is minimal and certainly does not warrant the additional expense of absorptive materials.

Does this mean that there is no use for sound absorptive surfaces at all? Hardly. But we should only consider using sound absorptive surfaces when it can be shown through accepted modelling techniques, calibrated by reliable noise measurements, that noise reflections are a legitimate problem. Preventing or fixing a problem that does not exist is simply not possible. There has to be a problem before there can be a fix.

Recent concerns of noise barriers increasing noise levels at distances ranging from 0.4 km to 3 km (1/4 to 2 miles) from the highway have also fueled the debates over using absorptive materials. Controlled studies so far have not shown any evidence of noise barriers, single on the receiver side, single on the opposite side, or parallel barriers increasing noise levels at these distances. Meteorology is a major factor in increasing or decreasing noise levels at distant receivers, with or without barriers. Wind speed and direction, vertical temperature gradients, and elevated temperature inversions are the main causes for upward and downward refraction of sound waves and the large freeway noise fluctuations observed at distant receivers.

The best way we can really find out if noise barriers do increase noise levels and, if not, what changes in noise characteristics trigger the complaints, is through fleld studies.

Such field studies are very expensive, because they cover a large area which needs to be instrumented with noise and meteorological monitors. Before and after barrier noise measurements must be carefully matched and compared for the same meteorological and traffic conditions. This increases the amount of measurements to satisfy minimimum sample requirements for each meteorological "bins". The answers, however, may go a long way towards confirming what we think we know, or learning what we don't yet know.

Also, field studies may eventually avoid the indiscriminate use of sound absorptive material on noise barriers. Costly at first, the studies may very well prove to be a wise investment in the long run.

Field studies may also serve to verify and calibrate the new FHWA Traffic Noise Model (TNM), in itself a promising tool for evaluating reflection problems and their possible solutions. Better yet —and here is a challenge for the noise barrier industry to work on: develop sound absorptive noise barriers that are structurally as sound, as durable, as maintenance free, and as aesthetic as their reflective counter parts, with the same (or perhaps slightly increased) cost. Only then can we justify using absorptive barriers all the time.

In the mean time, however, we need to base our decisions on scientiflc evidence, not on political agendas; on objective experimental results, not on subjective opinions and perceptions; and with solid justification for the additional costs if absorptive barriers are warranted. We should always ask the question: "Can this money be better spent on other, more needed transportation improvements?" We owe this to the taxpayers. We owe this to our profession. ■

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(Ed. Note: Rudy Hendriks has started the ball rolling in his usual expert fashion. Other readers are invited to submit for publication their own comments on the subject: this is your Journal — make use of it).

Figure 3. Parallel Barrier Reflections

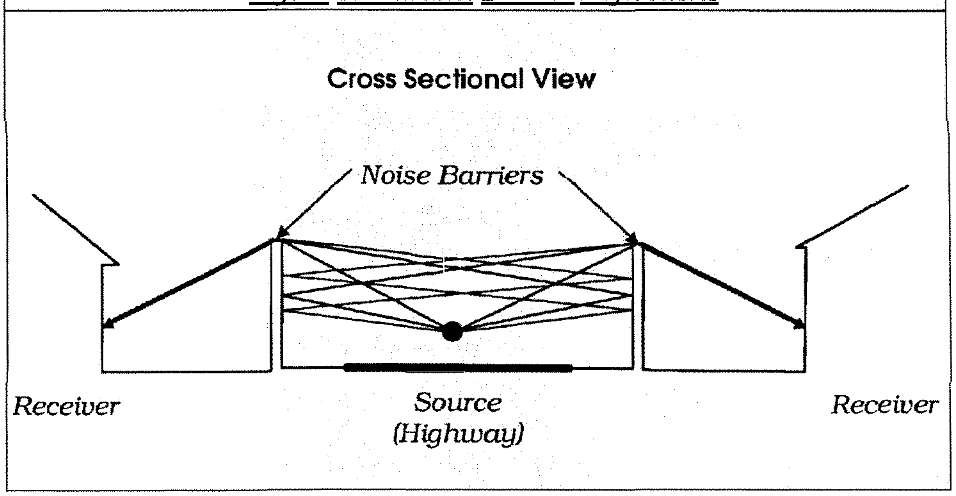
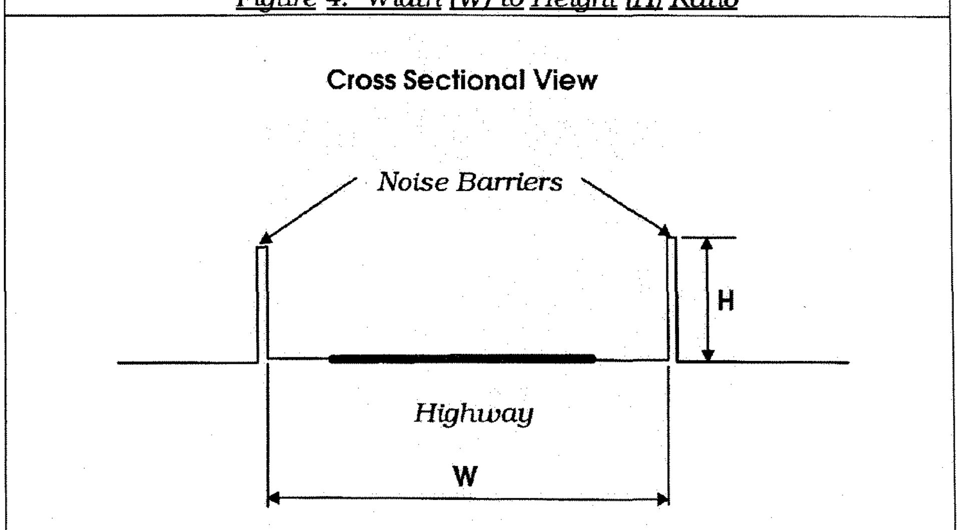


Figure 4. Width (W) to Height (H) Ratio



The Very High NRC Problem

An Opinion by Edward P. McNair

The real significance of a very high NRC is that it raises the questions of credibility and relevance. A sabin is an opening, a "window", with an area of one foot square (or one meter square). How can any sound absorptive material reflect less noise than an open window? It can't, but it can absorb more!

There are two ASTM Standard Test Methods for sound absorption. Currently they are the ASTM Recommended Practice C 384-90a (Impedance Tube Method) and ASTM Recommended Practice C 423-90a (Reverberation Room Method). Both were issued in 1990 and are still current.[1]

In the reverberation room test, randomly diffused noise is intentionally used. We are familiar with the ground wave effect where such natural materials such as grass and snow adsorb large amounts of sound as it travels along the surface. Since sound has no mass, only energy, the ground wave effect can work just as well on a vertical surface as a horizontal surface.

We know that the path of sound energy is affected by refraction, when its speed is changed by wind or temperature gradients. As sound moves along a surface, the barrier layer is slowed by the surface. The effect is just like rowing a boat. If you drag the starboard oar just a little in the water, the whole boat turns to starboard. With an absorptive surface, as some sound is absorbed, more sound turns in toward that surface, much like an ocean wave rolling up on dry sand.

Since the sound in the test is diffuse, only a small amount of the sound is traveling along the surface, yet it is enough to substantially increase the NRC computation, enough, in some cases, to bring it above 1 sabin. The noise that causes Barrier Insertion Loss Degradation, or "BILD" is normal incidence sound and normal incidence sound is also only a small amount of the diffuse sound in the reverberation room. So the test method may be credible, but is it relevant?

BILD as measured in dBA is caused by the sound energy of single and multiple reflections between vertical barriers combining with direct sound energy and passing just over the top edge of one of the barriers so that the combined energy is diffracted toward the ground. In order to do this, the reflected sound energy must strike the vertical surfaces of the barriers at an almost perpendicular, or normal incidence. The objective of adding an absorptive treatment to a pair of barriers is to reduce the BILD.

Under **Scope**, ASTM Recommended Practice C 384-90a states that it is used in the measurement of <u>normal incidence</u> sound absorption coefficients; and, under **Significance and Use**, that normal sound absorption coefficients are more useful than random incidence coefficients.

ASTM Recommended Practice C 423-90a describes ways of measuring the absorption of a room, an office screen, ceiling tile, theater seats and curtains.

Under Significance and Use, Practice C 423-90a states:

4.3 Diffraction effects usually cause the area of a specimen to be effectively greater than its geometric area, thereby increasing the measured coefficient. When the coefficients are large, the measured values may exceed unity....

4.4 A coefficient measured by this test method should be used with caution, for, not only are the areas encountered in practice usually larger than the test specimen, but the sound field is rarely diffuse....

The only official field test that has been done to evaluate BILD amelioration was the 1989 FHWA study at Dulles Airport. The absorptive material that was used for the test was 3" thick fiberglass batts. When tested per the ASTM National Standards Recommended Practice C 384-88 (Standing Wave Tube), it was found to have a Noise Reduction Coefficient (NRC) of .82 with sound absorption coefficients of .53, .90, .91, and .92 at band center frequencies of 250 Hz., 500 Hz., 1 kHz., and 2 kHz., respectively.

The ASTM C 384-90a test is a relatively simple test that should be less expensive to have done than C 423. The only piece of equipment unique to the test is a piece of pipe approximately ten feet long. Although the 384 test is easier to do, the resulting absorption coefficient will come in slightly lower, so in evaluating various walls, it would be unfair to compare the absorption coefficient using the C 384 method to one using the C 423. But it would be reasonable to use the results of Dulles C 384-88 test as a criteria for judging different types of absorptive materials for barriers. It might rearrange the ranking of performance among the various types of absorption materials, and make possible a more accurate evaluation of costs vs. benefits.

The wrong ASTM test is being used. The C 384-90a test does not produce a very high NRC (i.e. above unity). A very high NRC in a C 423-90a test is not important because the 423 test is irrelevant to reducing BILD.

1. American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Tel. 610-832-9500. Note: According to C 423-90, previous methods of testing asymmetric screens in the reverberation room are no longer allowed.

If you wish to correspond with Mr. McNair concerning this article:

Edward P. McNair
59 Chimney Ridge Drive
Morristown, NJ 07960

If you wish to publish a response or other comment on the subject, please send it to:

The Wall Journal
P.O. Box 1389
Lehigh Acres, FL 33970-1389

Sound-Absorptive Barriers —
A Case History of Weatherability on Two Projects

By E. A. Lamberson, P.E.

The trend toward increased use of sound-absorptive barriers in lieu of reflective barriers in the United States continues. The usage is attributed to the absorptive barriers' ability to quiet the residential neighborhoods near traffic corridors more efficiently than reflective barriers while offering a pleasing appearance in a variety of colors and textures in a durable product.

Sound absorptive barriers were first used in North America by the Ontario Ministry of Transportation. The experience and standards of the Ministry are most worthy of study and use. The Ministry first constructed 350 meters of a Durisol single-sided absorptive barrier within four feet of the pavement on Highway 401 near Toronto in 1979.

Eighteen years after the barrier construction, the condition and performance of the various structures on this highway has been evaluated as excellent by the Ministry of Transportation. Subsequent to the initial construction, some 51 kilometers of Durisol two-sided sound absorptive barriers have been constructed throughout the Province of Ontario.

Though all of the Ontario installations are subject to very severe weather, including freeze thaw cycling, salt spray and sand blasting, none of the sound absorptive barriers show disfigurement, concrete core failure or degradation of appearance.

As a matter of standard practice, all Canadian Provinces test absorptive and reflective barriers in accordance with the Canadian national standard for salt scaling durability. This testing is part of product preapproval before use and for periodic evaluation of actual production in progress. Sound barriers are tested in the same fashion as the Ministry has tested concrete traffic barriers and other cementitious composite materials for more than thirty years.

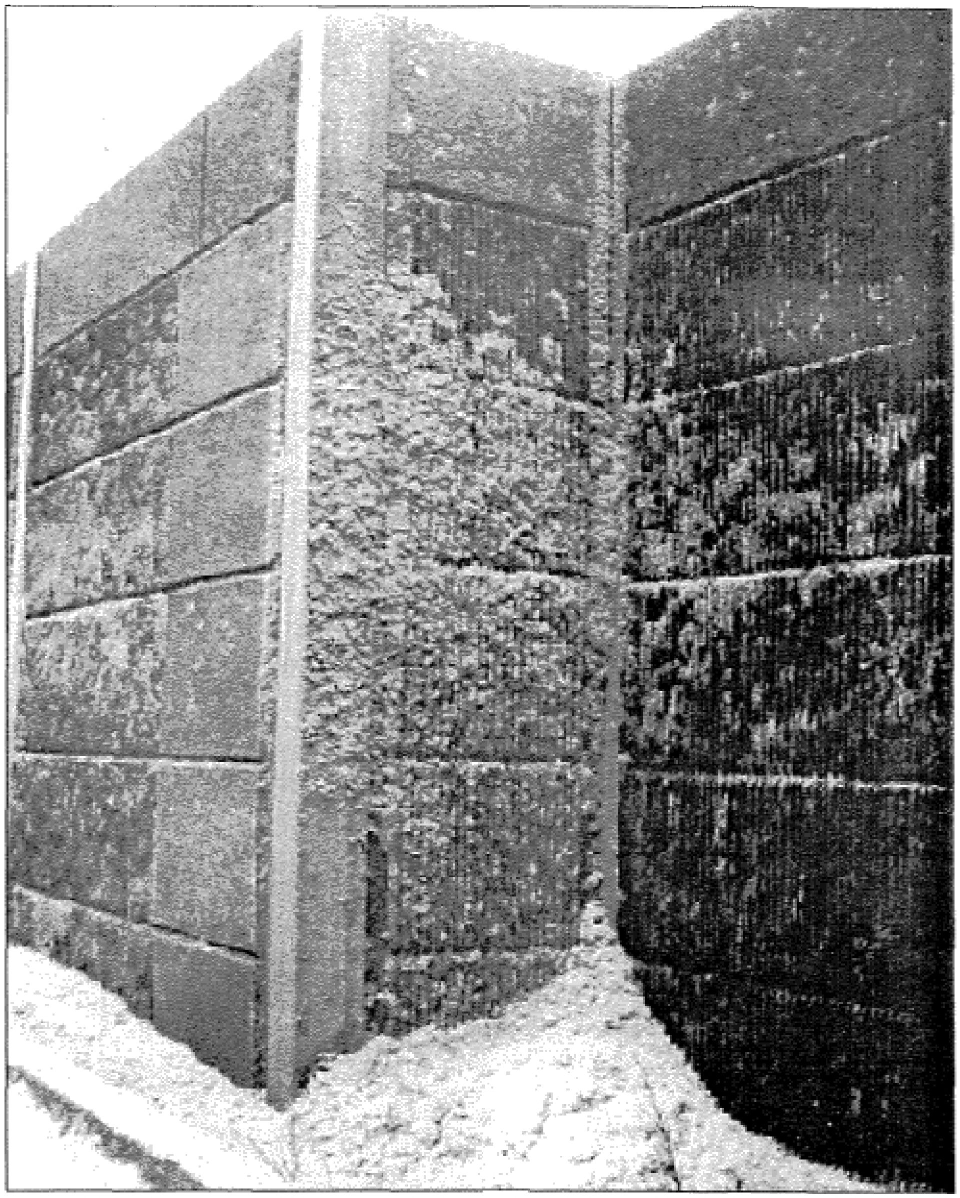
When setting durability standards for product preapprovals for Departments of Transportation, it is obvious that the test methods selected and the tests conducted should model the real conditions where the noise barriers will be performing. Unlike the Canadian provinces, there is no U.S. official standard for durabllity performance. The abusive winter conditions of the northern climate far exceed the abusive natural conditions below the Mason Dixon line.

The article by John Jaeckel of HNTB which appeared in the January/February 1994 issue of The Wall Journal depicted Wisconsin's noise barrier development. Illustrated in the article were the Durisol two-sided noise barriers on I-94 near the General Mitchell International Airport in Milwaukee (photo 1). Durisol absorptive barriers were also constructed by WisDOT on I-43 and I-894, both in the Milwaukee areas and on the Beltline Freeway in Madison.

Photo 1 shows one meter of drifted snow against the 1-94 project near the airport following a winter 1994 heavy snow fall. The piles of plowed and drifted salt laden snow illustrate how salt and water can be trapped in the porous cementitious matrix structure of a free draining cementitious barrier. No damage was present upon inspection in the spring of 1995 after all the snow melted.

The absorptive corridor case study by the author in the May/June, 1995 Wall Journal depicted construction details and the general arrangements of the Durisol two-sided noise barriers constructed on the I-94 Borman Expressway in Hammond, Indiana by the Indiana Department of Transportation as part of a widening project.

The Linden Avenue signs in the adjacent photo (#2) depict the Borman Expressway after blizzard-like conditions nearly shut down the busy freeway in January of 1995. The collection of the material which was impaled into the open celled Durisol matrix consists of earth, salt laden snow, ice and miscellaneous debris. The projectiles have been hurled into the barrier (which is approximately four meters from the pavement) by snowplows, tractor trailers and



1 I-94, Milwaukee, Wisconsin. Drifted and plowed salt-laden snow stands more than one meter above pavement, subjecting absorptive panel surface to standing salt bath which ASTM C-672 (modified) simulates.

other vehicles.

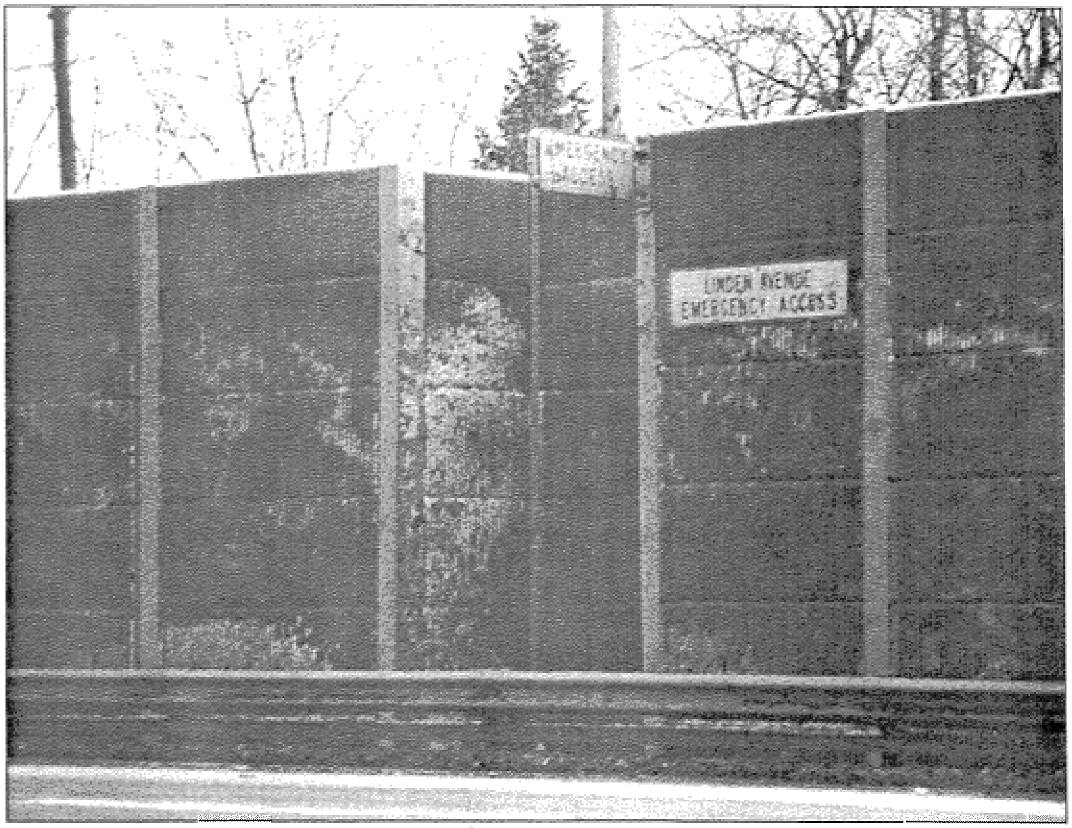
Ice is shown growing from the temporarily trapped water. Surface ice and ice lenses could damage the absorptive materials or delaminate composite materials if the products are not capable of handling the climatic conditions illustrated. In the case of the Borman, no damage was present after a thorough investigation of the site in the spring of 1995.

Salt tracks approximately 100 feet from the Linden Avenue site at Indianapolis Boulevard were washed off naturally by the 1995 Spring rains which eventually unplugged the cores of the free draining Durisol product. Photo 3 illustrates a section on the Borman Expressway one hundred yards away from the Linden sign on the east lanes and shows salt and debris tracks nearly five meters above the pavement after the melting of the plowed and drifted snow. No barrier damage was present.

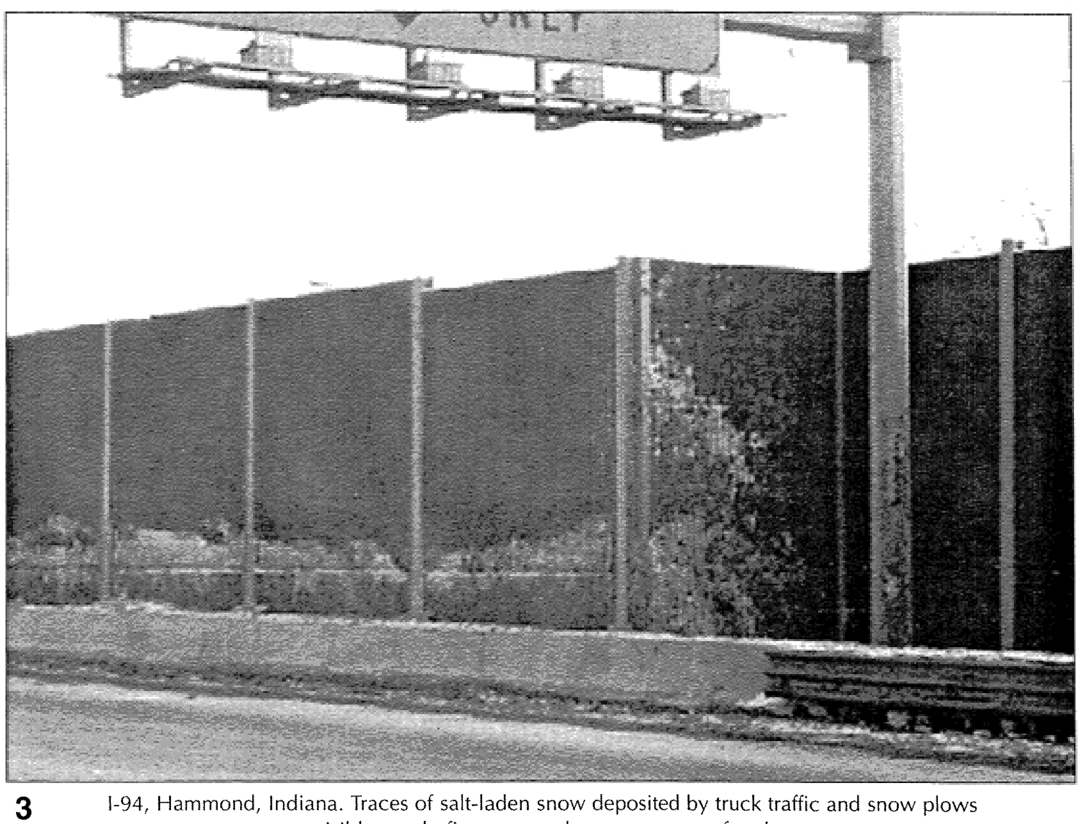
Both the Wisconsin and Indiana Departments of Transportation prequalify sound-absorptive barriers based on appearance, structural performance, acoustical performance and proven durability. Both states require ASTM C-672 (modified) salt scaling test results as part of prequalification submittals.

The ASTM C-672 modified tests utilize salt bath solutions and deep freeze cyclic testing to evaluate the durability of cementitious, porous, free draining absorptive barriers. The severe climatic condition illustrated at the sites of these two Great Lakes area projects seems to match the salt bath/salt scaling testing as prescribed in ASTM C-672 while not harming the sound absorptive behavior of the barriers. ■

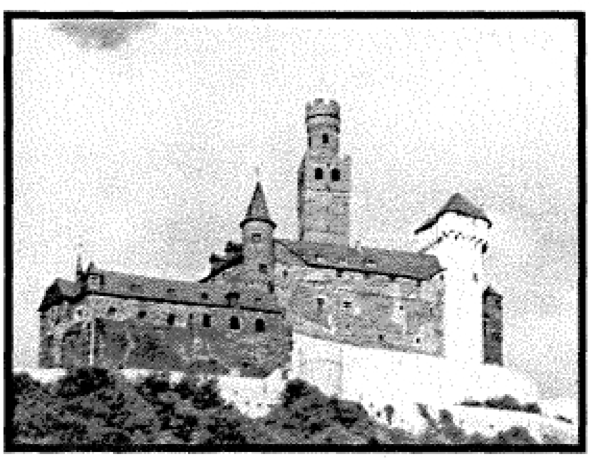
(Ed. Note: The next issue of The Wall Journal will carry an article on the various test methods currently being used to certify the weatherability of absorptive noise barrier materials).



2 I-94, Hammond, Indiana. Miscellaneous debris, earth, salt-laden snow and ice are impaled into the pores of the cementitious open-celled Durisol, temporarily clogging the normally free draining surface. Panel matrix is designed to resist forces caused by freeze salt bath.



3 I-94, Hammond, Indiana. Traces of salt-laden snow deposited by truck traffic and snow plows are visible nearly five meters above pavement after thaw.



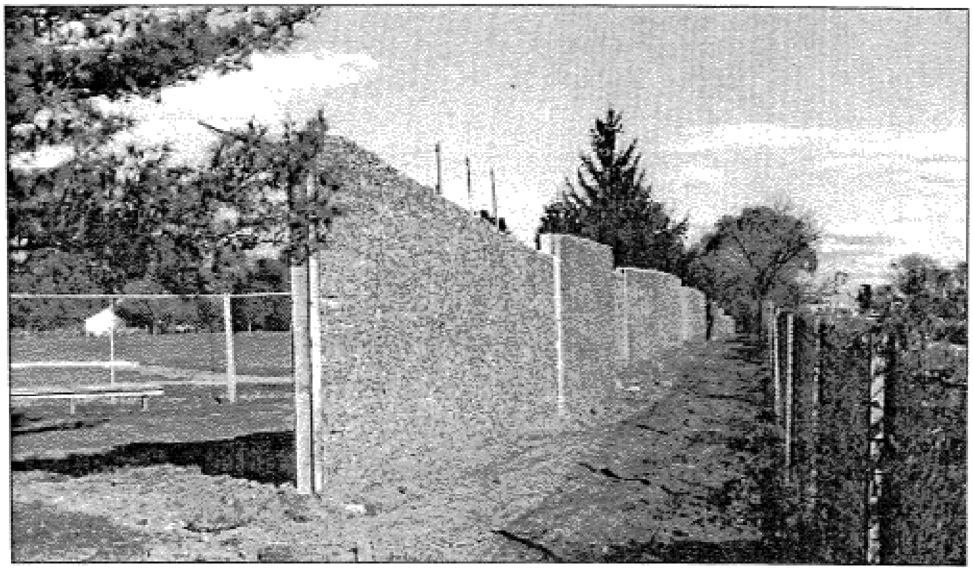
Salvaged highway noise barrier finds new home in community sports field in Pennsylvania

A manufacturing mishap by the precaster in the production of Fanwall noise barriers for a PennDOT project was turned into a welcome present to the Borough of Camp Hill across the Susquehanna River from Harrisburg.

The Maryland precaster was under contract to JTE Inc. (see ad below) to furnish 158,000 square feet (approx. 1,500 panels) of the Fanwall noise barrier system which is free-standing and does not require posts. JTE Inc. was under contract to Trumbull Corporation to furnish, deliver and install the Fanwall barrier system along S.R. 581 in Mechanicsburg.

During the installation phase, some of the panels were rejected by the inspector for dimensional tolerance errors and were required to be replaced by the precaster.

Following is a reprint of the article which appeared in the November/December 1995 issue of the Camp Hill Borough Newsletter.



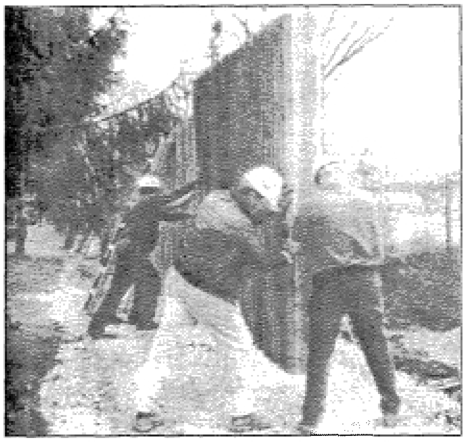
On 3 November 1995, the Borough of Camp Hill successfully completed the first phase of installing noise barriers along the southern edge of the Fiala Sports Fields.

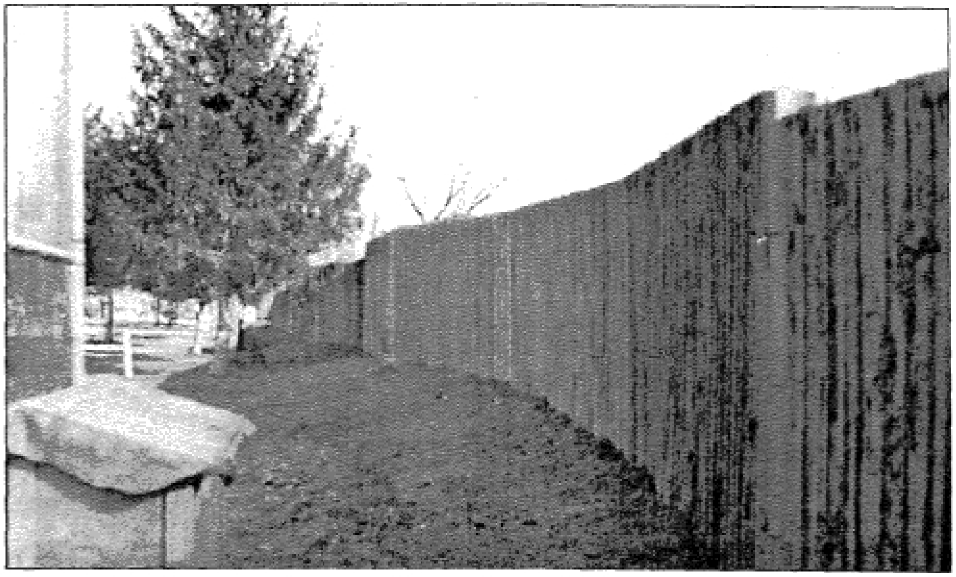
Early in lhe spring of 1995 Borough Officials in meetings with members of the Trumbull Corp., the General Contractor for the Rt. 581 project, discussed the possibility of obtaining surplus or otherwise usable noise barriers for installation along Rt. 581.

It became apparent since meetings in the fall of 1994 that PennDot and the Federal Highway Administration were not going to help in reducing the deafening noise occurring along Rt. 581. Noise that is expected to increase when the Rt. 81 connector is completed.

(continued next page)

(**Salvaged Barrier**, *from page 16*)





In meetings with Borough Officials, Jack Mauche, Project Manager for the Trumbull Corp., mentioned that there were noise barriers that PennDot had rejected for one reason or another, but each barrier was structurally sound. Many of the defects were not significant enough to justify destroying the concrete panels.

The Trumbull Corp. took the lead in arranging with JTE Inc and Reinforced Earth Company for the transportation and erection of the panels. On 24 October 1995, Jay Josselyn of JTE called to inform the Borough that everything was ready for the Borough to install the Noise Barriers on 3 November 1995. With this notice the Borough Public Works Dept. had only a couple of days to layout and prepare the site. A base over 400 feet long and a foot deep was dug and filled with engineered fill material and compacted.

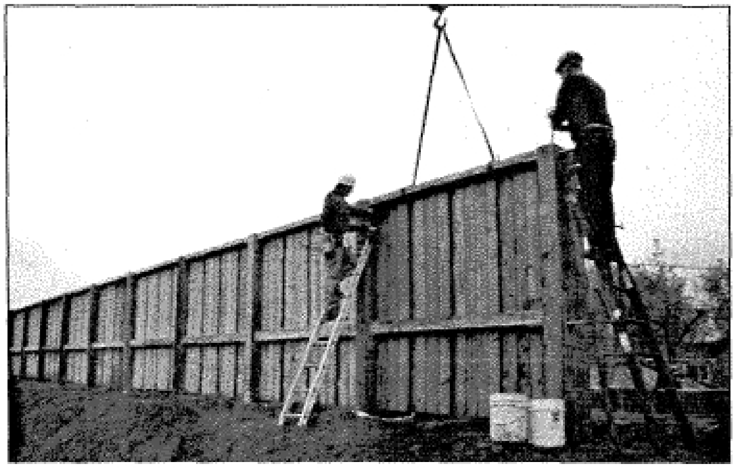
Arrangements for a 65-Ton Crane were secured and trucks to transport each panel, a maximum of four panels per truck was scheduled, and approximately forty panels were required to be moved from various sites along Rt. 581.

Starting at 7:00 AM, when the crane arrived on site and until 6:30 PM, all of the various parties worked togetheer through pouring rain and blowing wind to complete Phase 1.

The Second Phase is scheduled to begin in the spring of 1996, and will result in two new soccer fields, a parking lot and a 600 foot long earthen noise barrier (see September/October 1995 Camp Hill Borough Newsletter). ■

Wood Noise Walls Protect Neighborhood from Noisy Rail Yard

Wood highway noise barriers are rising along major interstate freeways across the nation to protect neighborhoods from the roar of highway traffic. Now, these sturdy noise abatement walls are being used to screen residential areas from other kinds of noise, as well .



Railroad Construction Company Inc./Damon G. Douglas Company, a joint venture in Paterson, New Jersey just completed 1,300 feet of noise barriers surrounding a railroad yard adjacent to a residential neighborhood. The owner, New Jersey Transit Corporation, (NJTC) specified glued laminated Southern Pine walls, penta treated to a retention level of .60. The rail yard is located in Landing, N.J. NJTC is a New Jersey state corporation — the state mass transit system.

Company spokesman Dennis J. Leahy said that four 22-1 /4" wide wall sections, varying in height from 8'6" to 21'4" were nailed to horizontal bracing members on the ground. They were then raised into place between laminated posts nine feet on center. All material was pressure treated Southern Pine.

The walls help to reduce the noise from diesel locomotives which operate in the yard 24 hours per day.

The individual boards were 1-7/8" thick and 7" wide. The base of the wall is enclosed in clean stone to provide storm water runoff.

Research among homeowners has shown that the wood noise walls are preferred to concrete or steel because of their natural appearance, and their aesthetic compatability with residential areas. And, treated Southern Pine laminated walls usually go up faster and

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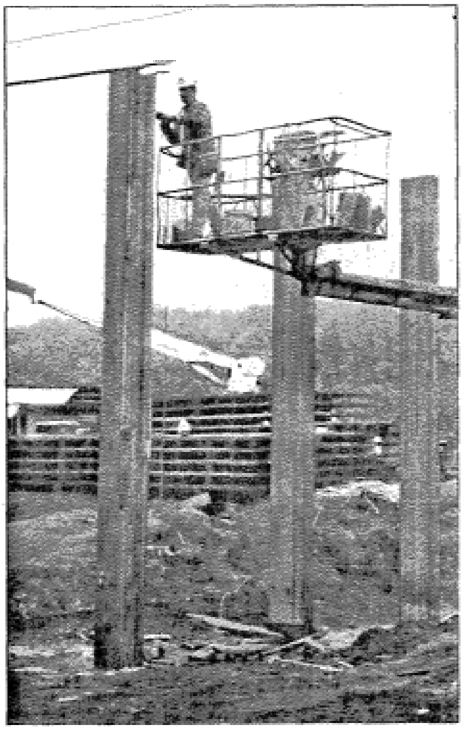
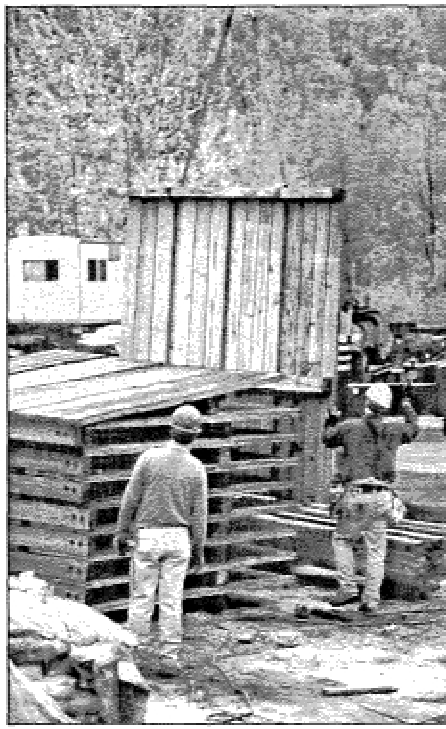
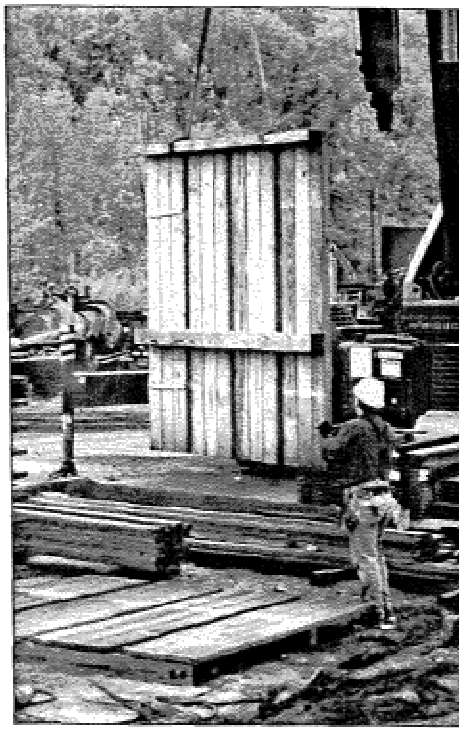






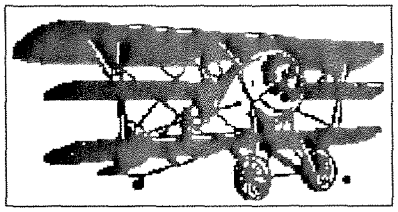
cost less than competitive materials.

Contractors also report that the flexibility of the wood system permits adjustment of wall and pole alignment an inch or two in difficult terrain to insure a snug fit, unlike concrete or steel which require precision engineering .

Most state and local regulations call for noise walls to be built so the diffraction of noise will achieve a reduction of 10 decibels (10dBA) or more.

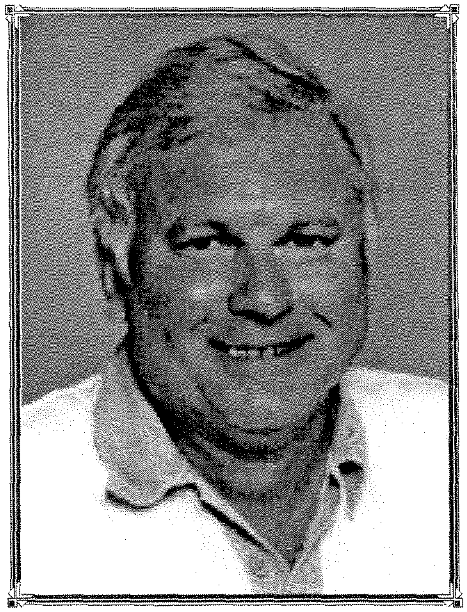
For more information contact:
Southern Pine Council,
P O Box 641700
Kenner LA 70064
Phone (504 443 4464) or
fax (504 443 6612.) ■

AcousticAce of the Month



The baron of Sacramento has done it again! Rudy Hendriks has earned his second AcousticAce Award from TWJ for his Shakespeare-inspired article "To Absorb or Not to Absorb — That is the Question" which appears on pages 8-10 of this issue.

Rudy won his first wings with his article on "Testing an Electronic Noise Control System Along a California Freeway" which appeared in the March/April 1994 Issue No. 12 of The Journal.



Rudy Hendriks

In this issue, Rudy's *opinion* article will hopefully motivate other experts of Rudy's caliber to openly express *their* thoughts and opinions on various other aspects of the noise abatement envelope for the greater edification of our readers. Often, more is learned about a subject in informal discussions than from formal presentations.

Congratulations, Rudy. Maybe we can put together a full squadron of Aces to follow in your prop wash. ■

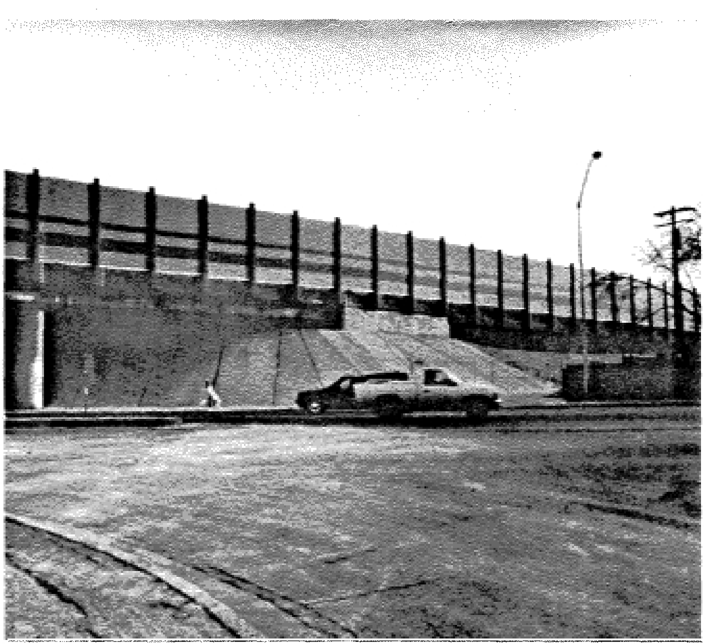


Photo features one of Carsonite's newest completed projects in Las Vegas, Nevada on I-15 southbound at the Sahara Blvd. exit.

The Compleat Scientific Observer —

A Man Who Knew His Own Mind

Thaddeus I. Putnam, Esq., PhD.

A most memorable man was this aged professor, whom we shall call Thaddeus I. Putnam, to protect his true identity and preserve the mystique of his incredible capability for absolutely clear thinking.

I first met the professor in the early Sixties, when I lived in the Boston area and had just embarked on my first entrepreneurial venture into the construction industry.

A friend of mine had invited me to accompany him to visit his son at M.I.T. We drove north across the Massachusetts Avenue bridge, turned west on Memorial Drive and parked in front of his son's dormitory.

I can still clearly recall it as being a beautiful June day, and across Memorial Drive, the Charles River was alive with sailboats and a number of Harvard crews silently and swiftly propelling their shells in trial racing heats. Ah, how wonderful it was to be alive on such a day as this.

We strode across the immaculate yard in the shade of the towering oaks, and entered the common room of the dormitory, where my friend's son sat talking with an older man. He leaped to his feet and rushed to greet us, smiling broadly as introductions were made.

It developed that the older man was the son's favorite professor (Thaddeus Putnam, as we shall call him), and that the professor's standout course was Scientific Observation, and that the son's father's specialty was Value Engineering, and that the son had arranged for the professor and his father to meet this day, to discuss mutual interests.

All of this seemed to me to be a bit too disingenuous, and more likely some sort of ploy to toady favor with the professor. But, as events proved me wrong, the professor and my friend soon became quite animated in their conversation, having found symbiosis in their mutual pursuits.

By this time, we had adjourned to the son's dormitory room, which was quite spacious and where the boy had prepared refreshments of various kinds. Also, the professor and the engineer had taken to clapping each other on the back at high points in their discussion, and occasionally shouted "AHA" or "Eureka" or something like that. The boy was developing a dreamy look in his eyes, apparently already in anticipation of receiving a high grade in the professor's course.

Amidst all the exultation, I was able to join in some of the discussion on value engineering, since I had designed and constructed several movable office partition systems myself, some of which I had sold to M.I.T. Value engineering was very much a part of the design, since cost was always a consideration in construction.

However, I wanted to learn more about Scientific Observation, and I asked the professor for an example.

Professor (Putnam) stood up, put his chin in his hand, looked down at the floor, then walked to the window (we were now on the second floor). He looked out at the boats on the Charles River for a while, then down at the traffic on the Memorial Drive.

Finally, he turned and called me to the window. He pointed down to the Drive and said, "Do you see that car parked at the end of the walk?'

There was a four-door, blue Buick parked at the curb. I told him I saw it.

The professor said, "What color is it?"

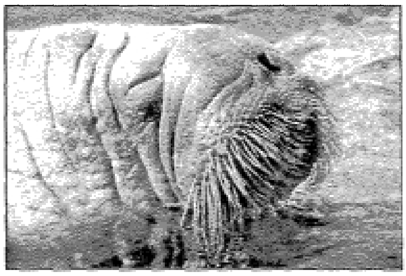
"Blue," I said.

"Not quite," said the professor. "The scientific observation of the color of the car is: This side of the car is blue." ■

I ask you, "Is that clear thinking or ***what***?"

Your Obedient Servant,
Your Editor

"The time has come," the walrus said, "to talk of many things."



No, Alice, he is not talking about sealing wax and that other stuff in Wonderland. He's talking about the real world of TWJ-Land. In case you've forgotten what he said in Issue No. 13 way back in May/June 1994, I'll reprint it below, but this time, the walrus would like to see a little more action, if you please.

Get ***involved***, folks. This is **your** communication medium. And (if you're government) you get it **free**! What we're trying to do here is to put together a compendium of the knowledge of the acoustical impact of transportation on the environment and the ways in which we can ameliorate that impact. You are the prime actors in this play; this is what you do every day. But, Bill or Sally over in West Overshoe doesn't have your experience, although they face the same environmental problems you work with (and mosttimes solve) every day.

The Walrus says: "Is there a community of people out there which will embrace, support and make a contribution of experience and knowledge? If so, it is time to stand up and be heard". **Your** work and experience are important to all of us. Get it published. Right here and now. You **must** have a project that has **something** about it that bears telling. Let **us** in on it. I wish all of you could attend some of our A1F04 Committee meetings. **Everybody** has something to say there. The stories fly thick and fast. What we are trying to do with **The Journal** is to provide that kind of access to information and experience, which you can use in your career. But we can't do it without your help. **We need more input**.

Now, why don't you sit down right now and call the old Walrus and find out how we can get you published. I'm at 941 369-0178. I'll leave the light on. ■

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Keep your files up to date for a unique chronology of the events and workings of other professionals in the field of transportation related environmental issues.

No, this is not the Editor's Corner, nor am I lost in the pages of my own publication. But, if you have read the Reader Subscription box above, you will notice that the price of a subscription has risen slightly. I figured that I ought to spin around in my chair and face the readers myself. When we started this venture in 1993, we were printing issues of four, eight and 12 pages, and figured $17.95 was O.K. But we are now up to 24 and 28 pages, and the increased costs of printing and mailing are simply not being covered. We considered raising the price to $19.95, but that makes us sound like cheap retailers. So we rounded it off to $20.00. Anyway, you can't even buy penny candy for a nickel any more.

Also, our Ad Rate Schedule is dated May, 1993. (Hmmmm.....) ■

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