# The Wall Journal™

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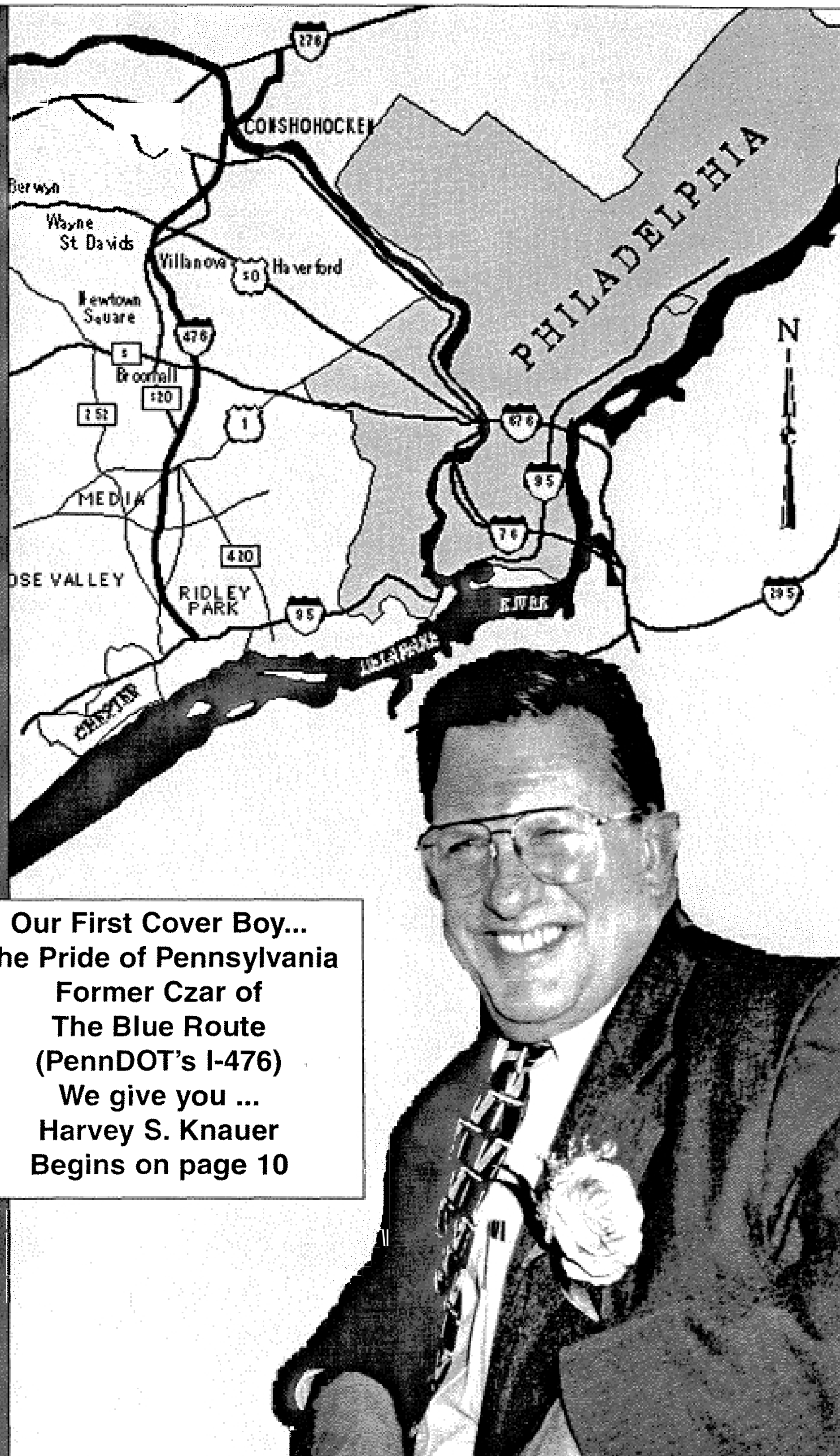
THE INTERNATIONAL JOURNAL OF TRANSPORTATION-RELATED ENVIRONMENTAL ISSUES


## In This Issue:



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**We give you ...**
**Harvey S. Knauer**
**Begins on page 10**

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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 23.

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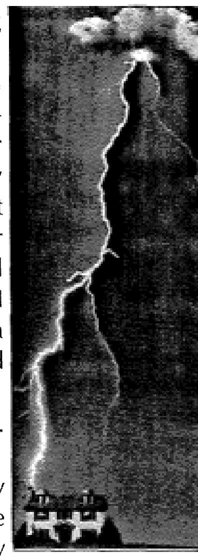
## Editor's Corner

by El Angove

I suppose that you're all going to be pretty crabby because you didn't get your July/August Wall Journal until sometime in September. Well, just hold your horses. You don't want to say nasty things to the old editor that you just might be real sorry for later on. I might have been real sick — then you'd be sorry. Or, I could have been run over by a nice little old lady — then you'd be sorry.



But, none of that happened. What **did** happen was **this** ➡ Yes, lightning. Or I should say **lightning!** Nobody told me before I moved to Florida for my long-term health, that my short-term health could be affected by the stunning statistic that Florida is **THE LIGHTNING CAPITAL OF THE WORLD!** Ye Gods and little fishhooks! No wonder they call Florida God's waiting room. It's not because of all the seniors, it's all this lightning energy which makes the state a great launching pad into the heavens.

Well, back to the delay in getting The Wall Journal in the mails. On a day in late July, at about 4:00 in the afternoon, I was at my computer putting the layout for this very issue together, when I saw the black clouds beginning to gather over the horizon and heard the faint rumble of thunder. That was my warning signal to shut down my old Mac and take a break until the storm rolled over — that's the only good thing about the thunderstorms — they come roaring in, throwing lightning around, blowing torrents of rain against the house, waving the palm trees around, flooding the streets — and then, in about fifteen or twenty minutes from when they first hit, they just disappear over the horizon, and the sun comes out, the birds fly around making happy noises, and the little kids are out riding their bikes again. In fifteen minutes more, the streets are dry and you would never guess that a big, ugly storm just passed through for a short visit.

As I was saying, I shut down my computer, threw a couple of frozen White Castle hamburgers in the microwave (remember, I'm from Missouri) before the power outages started so that I could at least have lunch. Then I walked around in the house watching the thunderstorm come whistling in. We don't have any sissy lightning here in Florida — we have the Big Bubba kind, like you see in the picture at the left. These babies gather together up above the clouds and then they start popping down in a march line across the open areas and right up to your neighborhood. And, when they hit the ground in your neighborhood, you'll think an artillery shell fell in your back yard.

There I was, hanging out in my kitchen, watching the storm and the lightning and eating my White Castle hamburgers, when all of a sudden.... **SMASH! BAM! ALAKAZAAM!**

Man, you can't believe how much noise and sheer power you can feel when a lightning bolt hits close in to your space. I must have come up off the floor at least six inches. Talk about startled! I was petrified! Which turned out to be a blessing, since all of my bodily orifices froze shut instantly and spared me any embarrassment.

At the moment of the strike, I heard "crackling" noises and "smelled" electricity in the room. But, after investigation, all that I could find damaged was the television sets. It turned out later that lightning had struck the telephone pole across the street from my house, and had come over to my house on the cable TV wire. The lightning then got turned around and went back over to the telephone post, where it promptly fried everything in the cable box.

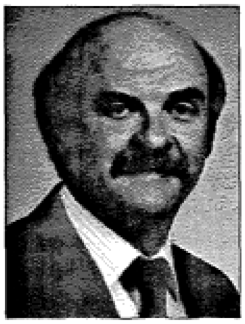
Comcast Cablevision had to replace their box on the post, and my TV sets were not damaged. However, despite lightning arrestors on my house and the electric panel in the garage, and surge arrestors on the TV and computer power supplies, and the lack of any observable lightning damage anywhere, the lightning had left its calling cards.

The cable connection to my house is very close to the power and phone

*(continued on page 22*

# FHWA — What's Happening...

By Robert Armstrong, Office of Environment and Planning, Federal Highway Administration



Wait... there's more... The last issue of The Wall Journal highlighted the Federal Highway Administration's (FHWA's) second biennial Environmental Excellence Awards, specifically the award for Excellence in Noise Abatement. However, it should be noted that the awards program also recognized three additional awardees for Excellence in noise Abatement — the Judges' Recognition for Special Concept: Use of Recycled Materials in noise Walls.

**Transportation Research and Development Bureau, Landscape Architecture Bureau, Materials Bureau, Environmental Analysis Bureau, Design Quality Assurance Bureau, and Structures Division, New York State Department of Transportation (NYSDOT).**

The NYSDOT has developed design standards and specifications for the use of recycled plastic in noise barrier construction. These standards represent an alternative solution to the environmental problems of noise pollution and plastic waste. Initial investigations focused on walls constructed from custom-made plastic shapes. However, cost of these shapes was found to be prohibitive. Another less expensive, more readily available recycled-plastic product, plastic lumber, was selected instead. A barrier 330 feet long and 16.5 feet high requires the use of approximately 40,000 pounds of recycled plastic material.

**Carsonite International and Paul R. Schubring, National Product Manager, Sound Barrier**

Carsonite and Sound Barrier, working with the Virginia Department of Transportation, developed a sound barrier that utilizes a substantial amount of recycled rubber from scrap tires for the I-95 HOV Lane Project in Fairfax and Prince William Counties. A mile of Carsonite barrier, ten feet in height, will use approximately 250,000 pounds of scrap rubber (or 20,800 tires). The I-95 project barriers totalled 15,250 square feet and utilized 72,200 pounds of scrap rubber (or approximately 6,000 tires).

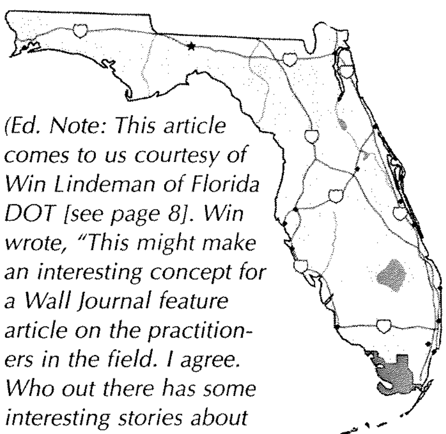
**Construction, Environmental Planning, Landscape Architecture, and Local Streets and Local Project Development Departments, California Department of Transportation (Caltrans), District 12**

Caltrans installed its first plastic sound wall made from recycled plastic materials (RPM) on I-5 at the Grand Avenue off ramp in the City of Santa Ana. The RPM wall is approximately 100 feet long. As a construction material, recycled plastic is extremely beneficial as it offers: less cost than a concrete or masonry sound wall; 2,367,000 recycled plastic containers used per mile of sound wall; 31,000 ground tires used per mile of sound wall; and easier constructibility than masonry walls (one third less time to install). ■

*(If you wish further information, you may reach Bob by phone at 202 366-2073 or by fax at 202 366-3409).*

# A Day in the Noise Study of a Highway in Florida

Reprinted from ***T-NEWS***, a publication of the Public Information Office of the Florida Department of Transportation



*(Ed. Note: This article comes to us courtesy of Win Lindeman of Florida DOT [see page 8]. Win wrote, "This might make an interesting concept for a Wall Journal feature article on the practitioners in the field. I agree. Who out there has some interesting stories about the troops in the trenches Send 'em in).*

Using a Hewlett Packard Real Time Octave Band Analyzer, Ken Campbell identifies specific kinds of noise on this roadway.

For some residents, living near an interstate or limited access highway means being exposed to high levels of noise, everything from the roar of large trucks to the sounds of road building. As part of sustaining the quality of life in Florida, the department constantly evaluates the impact of noise caused by building or expanding roads. While noise has become a part of progress, progress has also brought a way to curb it. This month, On the Job** talks to District Four Noise Specialist Ken Campbell and learns that although good fences make good neighbors, good noise walls make better communities.

You've seen them standing tall and sometimes adorned with concrete shapes and patterns, they're noise walls. While many of us already know the purpose of a noise wall, some of us may not know who determines whether or not one is needed and where it should go. Enter Ken Campbell, Ph. D. "District noise specialists evaluate levels of sound caused by traffic and construction and often recommend the building of noise walls to ensure that neighborhoods aren't being negatively impacted," Campbell said.

But noise is noise is noise, right? Wrong! Using a Hewlett Packard Real Time Octave Band Analyzer, Campbell is able to identify the frequencies of particular sounds in a selected area. Separating these frequencies allows Campbell to identify the levels of specific kinds of noise. After each sound and level has been identified, Campbell is able to determine which is emitting the most intense decibel levels.

Determining the intensity of the decibels of different sounds allows noise specialists to make effective recommendations. These recommendations are usually to build a barrier wall or noise wall, or to control the speed and mix of traffic. "We've built about 25 miles of noise walls in District Four that have curbed significantly the level of noise affecting neighbor hoods," Campbell explained. "And, based on all the information we've collected over the years, we have a better under standing of the effects of noise walls. Information like this allows us to offer neighborhoods and communities the best protection possible." he added. But, do you need a good "ear" to do all of this?

"There is nothing difficult about doing a noise study; you just need to have a basic understanding of the laws of physics. Noise is much different from light because it travels in much broader wave patterns and is measured differently," Campbell voiced. "I really like the analytical part of this job. Getting into the various kinds of frequencies and understanding the basic parameters of the creation of sound is exciting," he answered.

The saying "good fences make good neighbors" is certainly true, but for some, walls that keep unwanted sound out is even better. So, the next time you drive by a noise wall in District Four, think about Ken Campbell and his role in the development of that wall, but perhaps more importantly, think about the communities behind the wall whose quality of life has been preserved. ~

**On the Job is a regular column in **T-NEWS**, written by Ian Smith. On the Job helps readers learn more about the different people and offices in DOT. If you have story ideas, call Ian Smith at (904) 488-3111 or Suncom 278-3111, or e-mail at I0912IS.

***More about Florida's Noise Walls on pages 8 and 9***

Gregg G. Fleming
Chairman

Following are the abstracts of the papers presented at the Conference by members and guests for the information of those who were unable to attend the Conference. We will have more to tell you in the next issue (September/October). The unfortunate lightning attack on El's computer, and Soren Pedersen taking the month (yes, the month) of August for a vacation, have slowed things down, but we hope to have a lot of Canadian noise barriers and events to show you in No. 31.

# ABSTRACTS OF THE PROFESSIONAL PAPERS
## Presented at theTransportation Research Board, Committee A1F04 on Transportation Related Noise and Vibration Summer Conference in Toronto, Canada, July 20 to 23, 1997

### THE B.C. MINISTRY OF TRANSPORTATION & HIGHWAYS' NOISE IMPACT MITIGATION POLICY AND ITS APPLICATION TO THE WESTVIEW INTERCHANGE DESIGN/BUILD PROJECT, NORTH VANCOUVER, B.C.

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Until recently, the intersection of Westview Drive and the Trans Canada Highway (TCH) in North Vancouver, British Columbia confronted motorists with the only remaining stop light between Kamloops in the province's interior and the Horseshoe Bay Ferry Terminal near Vancouver on its west coast. The completion in the spring of 1997 of the Westview Interchange removed this last obstruction and with it the major traffic congestion that had existed during morning and afternoon rush periods. The construction of this diamond interchange involved the twinning of the nearby Mosquito Creek Bridge and the significant encroachment of the highway southward towards and into neighbouring residential areas. This project was constructed under a design/build contract – the first such contract entered into by the B.C. Ministry of Transportation & Highways (MoTH) on a major highway project. It also was the first major interchange project constructed in a highly developed urban setting under the MoTH's revised noise impact mitigation policy of November 1993.

Due to the encroachment of the widened TCH into residential areas, the increase in average vehicle speed facilitated by the removal of the stop light at Westview Drive and the expected growth in traffic volumes over the next decade, mitigation was warranted under the MoTH policy in many locations along the length of the project. Due to the siting of the project on the lower slopes of B.C.'s Coast Mountain Range overlooking Burrard Inlet and downtown Vancouver, at many residential locations developing mitigation measures which were effective while not obstructing scenic views was a challenge. In other areas residences overlooked the highway from the tops of cut slopes or from the banks of Mosquito Creek. Because of the steepness and variability of the terrain, it was necessary to consider and employ a variety of noise barrier configurations. The project's prime contractor, with the assistance of both the acoustical and the public relations consultants, held several public meetings with area residents to, as much as possible, reach consensus on the locations and types of mitigation which, while meeting the requirements of the MoTH noise policy, would be effective in both reducing noise and addressing the many non-noise related concerns of the residents. In some situations the prime contractor, in fulfilling its obligations to be responsive to community concerns and resolve issues, took the initiative to pursue mitigation outside the official limitations of the MoTH noise policy.

This presentation will discuss the B.C. MoTH's noise policy, the challenges that were faced in applying it to Westview Interchange Design/Build Project and the nature and effectiveness of the highway noise mitigation measures carried out on the project. ■

### USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) FOR DETERMINING TRAIN NOISE = IMPACTS

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Geographic Information Systems technology is well-suited as a tool for = the evaluation of environmental noise impacts. Many environmental noise = impact assessments incorporate the use of computer-generated noise = contours. These contours typically are used to determine which = geographic areas are impacted by noise. In some limited cases, drawing = noise contours by hand on paper mapping can be the most efficient way of = determining impacts. Other cases, including projects that may impact = large geographic areas, or require the evaluation of many project = alternatives, can benefit by the use of GIS. =20

This presentation includes the use of GIS for two train noise evaluation = studies: 1 ) A commuter train noise mitigation study, and 2) a train horn = noise impact evaluation. These two case studies were selected to show = how GIS can be used for projects with substantially different study = objectives and extent of available data. ■

## THE TNM'S NEW FASTER ACOUSTICAL ALGORITHMS: THE APPROACH, THE SPEED, THE ACOUSTICAL RESULTS.

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Harris Miller Miller and Hanson Inc.
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The Traffic Noise Model's acoustical algorithms have been modified significantly to increase processing speed. Substantial ground simplification has been combined with a new approach to establishing a reflection coefficient over ground of varying impedance (hardness) based on the work of Boulanger, Attenborough and Hothersall (which has been validated through scale-model measurements). Ground-impedance averaging allows far fewer propagation paths to be computed than before, resulting in substantial speed increases, particularly for the more complex cases. The details of the ground impedance averaging approach are discussed. Where ground is too complex to be processed quickly and accurately, ground simplification is accomplished by regression fit, then impedance discontinuities are projected onto the regression ground line.

The speed of the faster TNM is discussed, and the minimal differences in acoustical results relative to the earlier versions are discussed.

Also discussed is the calibration procedure developed for the TNM's multiple-reflections module, based on HMMH's RayVerb. The module's algorithms have been calibrated to predict values very close to those values measured along highways in Maryland and California. Details of the agreement between measured and predicted values are presented. ■

## RAIL TRANSIT WHEEL SQUEAL - THE TORONTO EXPERIENCE

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A Prevalent noise by-product of rail transit systems such as subways and streetcars, its wheel squeal due to rail/wheel interaction. Most environmental noise guidelines do not address this noise source which due to tonality and high sound pressure levels generated, often results in noise complaints. Discomfort to passengers and unacceptably noisy environments for neighbouring land uses often results.

This presentation examines some of the characteristics of wheel squeal, its causes and potential environmental noise impact. Retrofit mitigation of existing systems to address wheel squeal can be very difficult. Using the Toronto experience as an illustrative case, the focus of this presentation is therefore to review the potential environmental noise impacts of wheel squeal and retrofit mitigation measures which have been tried to date with varying degrees of success. ■

## PREDICTING STOP-AND-GO TRAFFIC NOISE: Utilizing Report 311, Or Is It Time For Something New

Sharon Paul Carpenter
PAUL CARPENTER ASSOCIATES, INC.
48 Circle Road, Florham Park, NJ 07932
tel: (201 ) 822-8221

The conventional method of predicting mobile source noise levels utilizing the FHWA's STAMINA 2.0 model, is appropriate in locations where vehicles remain at constant "cruise" speeds of 30 mph and over. To predict noise levels due to stop-and-go vehicles, it is proper to employ the National Cooperative Highway Research Program's, Report 311 entitled, "Predicting Stop-and-Go Traffic Noise Levels" in conjunction with Bill Bowlby Associates, Inc.'s, STAM2VU1 computer model.

The New Jersey Highway Authority operates the Garden State Parkway, in which mainline toll plazas stretch the entire width of the roadway. All traffic in both directions must stop, pay a toll, then proceed. The premise of this presentation is based on noise monitoring and the comparison of computer modeling results in association with a proposed widening project.

Dual noise monitors were placed just north and south of the toll plaza and ran simultaneously. Twenty-four (24) hour noise monitoring, documented hourly "A-weighted" Leq noise levels. Four "peak noise hours" were selected for calibration to evaluate how well STAM2VU1 with inputs from Report 311 performed, at this particular study area.

"Successful" calibration is described, when field measured noise levels are within 3 dBA (Leq) of modeled results. Utilizing these modeling techniques along with "user experience", resulted in a surprising difference of less than 1 dBA (Leq) in comparison to field measured results. These accurate Report 311/STAM2VU1 modeling results, surpassed "user" expectations. ■

## MEASURING THE SOUND ABSORPTION OF TRAFFIC NOISE BARRIERS

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It has become quite common to require that traffic noise barriers have sound absorbing faces to maximize their effectiveness. This paper will discuss the merits of several different procedures for measuring the sound absorbing properties of these barriers. Sound absorption is most commonly measured using a reverberation chamber method, such as that described in the ASTM C423 standard, that provides random incidence sound absorption coefficients. However, these results are not unique but depend on both the sample size and the procedure used to mount the sample in the test. One can also question whether random incidence is representative of road traffic noise striking noise barriers. These issues will be discussed with the aid of reverberation chamber measurements of several different samples. This will include approaches to ensuring that measurements are more consistent and representative of the performance of actual noise barriers, as well as areas in need of further research. ■

*Continued on page 12)*

# 1997 Florida Noise Barrier Status Report

Prepared by: Win Lindeman
Statewide Noise Program Administrator
Florida Department of Transportation

The purpose of this report is to document the noise abatement efforts that are complete at this time. A special thanks goes to the FDOT District Noise Specialists for keeping me abreast of the many projects going on throughout the state. While additional barriers are planned or about to start construction, the final dimensions and/or costs are unknown and therefore not included in this report.

The report contains information on physical dimensions of each barrier; the cost of each barrier and the percentage of the total construction project cost; job number and location; the contractor; existing background levels without the wall and predictions related to future noise levels with and without the wall; construction dates; measured effectiveness (where known); and any general information of value.

To date we have built 64 noise barriers with a total length of approximately 40788.7 m (133,744 ft), or 40.8 km (25.3 miles), at a total cost of approximately $29,378,448. A "typical" FDOT noise barrier is a precast concrete structure about 4.1 m (13.4 ft) high, 637 m (2,090 ft) long, costs $193.14/m² ($17.96/ft²) and averages $459,038. The cost per square meter of installed barrier has ranged from $19.68 to $960.48 ($1.83 to $89.33/ft²). This and other information can be found in Tables 1-4, the noise barriers statistics listing, and the text of this report (*Ed. Note: The full Report is 131 pages long, complete with project noise barrier data and project photos, which we obviously cannot include here*).

For cost projection purposes over the past year, FDOT has been using a figure of $190.26/m² ($17.65/ft² ) installed price, regardless of the material type.

Based on the most recent data, this number appears to be low. Beginning July 1,1997, the cost figures to use will be $215.28/m² (S20.00/ft²).

As additional data becomes available, this number may change. If you find any errors in this material or have any questions related to the interpretation of this report, please contact me at (904)488-2914, or E-mail: win.lindeman@dot.state.fl.us.

*(Editor's Note: This Status Report is basically prepared by Win for the information of the Department's engineers within the state. Win has been kind enough to furnish us with a copy so that the rest of the country can learn what's happening with highway traffic noise abatement in Florida. A big thank you, Win. Now, if only more of you with similar responsibilities in your own states could provide this kind of material to us, The Wall Journal would finally become the national communicator I want it to be. Incidentally, if you find any errors in this report, you may be sure thay occurred in my computer and not in Win's report. If you wish to correspond with Win, his mailing address is: State of Florida, Department of Transportation, Environmental Management Office, 605 Suwannee Street, Tallahassee, FL 32399-0430).*

| Contractor | Year Built | Barrier Material |
|---|---|---|
| State Paving | 1991 | Precast Concrete |
| State Paving | 1991 | Precast Concrete |
| State Paving | 1991 | Precast Concrete |
| State Paving | 1991 | Precast Concrete |
| State Paving | 1991 | Precast Concrete |
| State Paving | 1994 | Precast Concrete |
| State Paving | 1994 | Precast Concrete |
| State Paving | 1994 | Combination |
| State Paving | 1994 | Precast Concrete |
| State Paving | 1994 | Precast Concrete |
| State Paving | 1994 | Precast Concrete |
| State Paving | 1994 | Combination |
| State Paving | 1994 | Precast Concrete |
| State Paving | 1994 | CombinationO |
| State Paving | 1994 | Precast Concrete |
| Recchi | 1995 | Precast Concrete |
| Recchi | 1995 | Precast Concrete |
| Recchi | 1995 | Combination |
| Odebrecht | 1997 | Concrete Block |
| Ranger Co. | 1993 | Concrete Block |
| Webb | 1982 | Concrete Block |
| Hardaway | 1994 | Precast Concrete |
| Murphy | 1996 | Precast Concrete |
| Murphy | 1996 | Precast Concrete |
| Murphy | 1996 | Precast Concrete |
| Murphy | 1996 | Precast Concrete |
| Murphy | 1996 | Precast Concrete |
| Bergeron | 1992 | Precast Concrete |
| Bergeron | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Recchi | 1992 | Precast Concrete |
| Haynes | 1995 | Cast-in-place Conc |
| State Contr. | 1996 | Cast-in-place Conc |
| Spec, Inc. | 1997 | Cast-in-place Conc |
| Redland | 1994 | Cast-in-place Conc |
| Redland | 1994 | Cast-in-place Conc |
| Redland | 199S | Cast-in-place Conc |
| State Paving | 1988 | Precast Concrete |
| State Paving | 1988 | Precast Concrete |
| State Paving | 1988 | Precast Concrete |
| Triple R | 1991 | Precast Concrete |
| Capeletti | 1989 | Precast Concrete |
| Capeletti | 1989 | Precast Concrete |
| Capeletti | 1989 | Precast Concrete |
| Hubbard | 1983,96 | Comb. Berm/Wall |
| Leware Hill | 1979 | Cast-in-place Conc |
| Leware Hill | 1979 | Cast-in-place Conc |
| Cone Bros. | 1990 | Cast-in-place Conc |
| Cone Bros. | 1980 | Concrete Block |
| Overstreet | 1995 | Cast-in-place Conc |
| Cone Bros. | 1980 | Cast-in-place Conc |
| Couch Co. | 1984 | Precast Concrete |
| Leware Hill | 1977 | Cast-in-place Conc |
| Cone Bros. | 1978 | Cast-in-place Conc |
| L & A Cont. | 1987 | Steel |
| 64 NOISE BARRIERS | | TOTALS |
| | | AVERAGES |

| District | Length (m) | Length (ft) | Height (m) | Height (ft) | Area ($m^2$) | Area ($ft^2$) | Total Cost ($) | Cost ($) ($m^2$) | Cost ($) ($ft^2$) | Insertion Loss Predicted | Insertion Loss Measured |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Four | 1049 | 3440 | 4.73 | 15.5 | 4945 | 53173 | 1,035,273 | 209.34 | 19.47 | 7 | 10 |
| Four | 1472 | 4825 | 4.73 | 15.5 | 7009 | 75365 | 1,467,357 | 209.34 | 19.47 | 9 | 11 |
| Four | 644 | 2110 | 4.88 | 16 | 3184 | 34236 | 666,575 | 209.34 | 19.47 | 6 | 7 |
| Four | 641 | 2103 | 3.97 | 13 | 2616 | 28126 | 547,613 | 209.34 | 19.47 | 9 | 9 |
| Four | 165 | 540 | 3.97 | 13 | 514 | 5531 | 107,689 | 209.34 | 19.47 | 9 | 10 |
| Four | 162 | 530 | 5.34 | 17.5 | 839 | 9020 | 133,500 | 159.14 | 14.80 | 8 | 8 |
| Four | 1525 | 5000 | 5.49 | 18 | 8480 | 91180 | 1,349,500 | 159.14 | 14.80 | 9 | 8 |
| Four | 999 | 3274 | 2.44 | 8 | 2494 | 26810 | 333,912 | 133.87 | 12.45 | 7 | 7 |
| Four | 125 | 410 | 6.41 | 21 | 820 | 8820 | 109.814 | 133.87 | 12.45 | 7 | 7 |
| Four | 1017 | 3335 | 5.49 | 18 | 5555 | 59735 | 884,000 | 159.14 | 14.80 | 8 | 7 |
| Four | 491 | 1610 | 5.19 | 17 | 2643 | 28420 | 420,600 | 159.14 | 14.80 | 7 | 7 |
| Four | 199 | 653 | 2.44 | 8 | 362 | 3889 | 51,900 | 143.49 | 14.11 | 7 | 7 |
| Four | 1292 | 4235 | 5.03 | 16.5 | 6468 | 69545 | 1,029,000 | 159.14 | 14.80 | 7 | 6 |
| Four | 163 | 533 | 2.44 | 8 | 397 | 4264 | 47,970 | 120.95 | 11.25 | 7 | 6 |
| Four | 345 | 1130 | 6.10 | 20 | 2078 | 22340 | 330,632 | 159.14 | 14.80 | 8 | 7 |
| Four | 639 | 2095 | 5.19 | 17 | 2992 | 32176 | 618,423 | 206.88 | 19.22 | 9 | 10 |
| Four | 2641 | 8660 | 3.66 | 12 | 6384 | 68644 | 1,353,144 | 206.88 | 19.22 | 8 | 8 |
| Four | 479 | 1570 | 2.44 | 8 | 2754 | 12560 | 174,512 | 149.51 | 13 89 | 6 | 6 |
| Four | 273 | 893 | 3.66 | 12 | 999 | 10716 | 175,874 | 167.10 | 15.54 | 7 | NA |
| Four | 336 | 1102 | 3.05 | 10 | 1025 | 11020 | 135,421 | 132.40 | 12.30 | 7 | 4 |
| Four | 490 | 1606 | 3.66 | 12 | 1793 | 19272 | 263,148 | 146.93 | 13.65 | 9 | 8 |
| Four | 640 | 2100 | 5.49 | 18 | 3520 | 37800 | 622,500 | 176.84 | 16.47 | 7 | 7 |
| Four | 1113 | 3650 | 6.70 | 22 | 7454 | 80300 | 1,059,157 | 142.00 | 13.19 | 6 | 7 |
| Four | 625 | 2050 | 5.50 | 18 | 3436 | 36900 | 486,711 | 142.00 | 13.19 | 6 | 7 |
| Four | 671 | 2200 | 6.10 | 20 | 4091 | 44000 | 580,360 | 142.00 | 13.19 | 8 | 9 |
| Four | 756 | 2480 | 6.10 | 20 | 4611 | 49600 | 654,224 | 142.00 | 13.19 | 9 | 9 |
| Four | 731 | 2398 | 6.10 | 20 | 4459 | 47960 | 632,592 | 142.00 | 13.19 | 5 | 6 |
| Four | 220 | 720 | 4.27 | 14 | 938 | 10080 | 232,949 | 248.76 | 23.11 | 9 | NA |
| Four | 572 | 1875 | 3.36 | 11 | 1922 | 20625 | 374,174 | 248.76 | 23.11 | 7 | NA |
| Four | 839 | 2750 | 4.42 | 14.5 | 3704 | 39831 | 581,533 | 157.15 | 14.60 | 6 | 11 |
| Four | 333 | 1090 | 4.58 | 15 | 1563 | 16804 | 245,338 | 157.15 | 14.60 | 5 | 6 |
| Four | 1588 | 5205 | 4.73 | 15.5 | 7507 | 80720 | 1,178,512 | 157.15 | 14.60 | 6 | 8 |
| Four | 1342 | 4400 | 4.88 | 16 | 6618 | 71164 | 1,038,994 | 157.15 | 14.60 | 7 | 11 |
| Four | 589 | 1930 | 4.27 | 14 | 2477 | 26632 | 388,827 | 157.15 | 14.60 | 9 | 9 |
| Four | 785 | 2575 | 4.88 | 16 | 3849 | 41384 | 604,206 | 157.15 | 14.60 | 6 | 7 |
| Four | 351 | 1150 | 4.88 | 16 | 1649 | 17726 | 258,800 | 157.15 | 14.60 | 8 | 10 |
| Four | 1261 | 4133 | 4.88 | 16 | 6167 | 66314 | 968,184 | 157.15 | 14.60 | 8 | 10 |
| Four | 863 | 2830 | 5.49 | 18 | 4579 | 49236 | 718,846 | 157.15 | 14.60 | 6 | 6 |
| Four | 464 | 1520 | 3.97 | 13 | 1797 | 19319 | 282,057 | 157.15 | 14.60 | 8 | 5 |
| Four | 1132 | 3710 | 5.03 | 16.5 | 5857 | 62981 | 919,523 | 157.15 | 14.60 | 9 | 8 |
| Five | 66 | 216 | 2.75 | 9 | 175 | 1944 | 170,642 | 975.65 | 87.88 | 6 | NA |
| Six | 211 | 691 | 3.20 | 10.5 | 674 | 7256 | 221,288 | 328.37 | 30.50 | 10 | NA |
| Six | 172 | 564 | 3.05 | 10 | 516 | 5640 | 149,333 | 289.40 | 26.48 | 9 | NA |
| Six | 70 | 230 | 2.59 | 8.5 | 182 | 1955 | 49,462 | 272.43 | 25.30 | 9 | NA |
| Six | 116 | 380 | 2.59 | 8.5 | 300 | 3230 | 81,720 | 272.43 | 25.30 | 9 | NA |
| Six | 196 | 643 | 2.59 | 8.5 | 508 | 5466 | 574,368 | 1129.98 | 105.08 | 9 | NA |
| Six | 1727 | 5661 | 4.58 | 15 | 7907 | 84912 | 1,177,663 | 134.55 | 12.50 | 9 | 8.9 |
| Six | 1220 | 4000 | 5.03 | 16.5 | 6137 | 66000 | 912,450 | 134.55 | 12.50 | 6 | 6 |
| Six | 585 | 1917 | 4.06 | 13.3 | 2374 | 25496 | 327,600 | 134.55 | 12.50 | 7 | 12.6 |
| Six | 1197 | 3925 | 3.66 | 12 | 4381 | 47100 | 485,130 | 110.87 | 10.30 | 8.4 | NA |
| Six | 868 | 2849 | 3.66 | 12 | 3178 | 34188 | 352,136 | 110.87 | 10.30 | 8.4 | NA |
| Six | 184 | 602 | 3.66 | 12 | 672 | 7224 | 74,407 | 110.87 | 10.30 | 8.4 | NA |
| Six | 205 | 671 | 3.66 | 12 | 749 | 8052 | 82,936 | 110.87 | 10.30 | 8.4 | NA |
| Seven | 410 | 1345 | 4.58 | 15 | 589 | 6330 | 308,867 | 434.86 | 40.44 | 8 | NA |
| Seven | 269 | 882 | 1.83 | 6 | 492 | 5292 | 14,116 | 28.71 | 2.67 | 11.2 | NA |
| Seven | 163 | 535 | 2.30 | 7.5 | 374 | 4013 | 57,750 | 154.73 | 14.39 | 7.3 | NA |
| Seven | 455 | 1492 | 2.44 | 8 | 1110 | 11936 | 163,018 | 146.89 | 13.66 | 6 | NA |
| Seven | 275 | 901 | 2.44 | 8 | 671 | 7208 | 13,2Q0 | 19.68 | 1.83 | 6 | NA |
| Seven | 381 | 1250 | 2.44 | 8 | 930 | 10000 | 291,603 | 313.67 | 29.16 | 6.1 | NA |
| Seven | 589 | 1930 | 2.44 | 8 | 1436 | 15440 | 223,878 | 161.94 | 15.08 | 5 | NA |
| Seven | 406 | 1331 | 2.44 | 8 | 990 | 10644 | 185,206 | 187.10 | 17.40 | 6.1 | 7.5 |
| Seven | 373 | 1223 | 2.44 | 8 | 910 | 9784 | 146,842 | 215.16 | 20.01 | 6 | NA |
| Seven | 543 | 1780 | 3.05 | 10 | 1656 | 17800 | 204,284 | 154.30 | 14.35 | 5.3 | 11 |
| Seven | 90 | 235 | 2.44 | 8 | 220 | 2360 | 47,200 | 215.05 | 20.00 | 4.2 | 7.2 |
| | **40,789** | **133,744** | **253.3** | **854.5** | **177,860** | **1,895,393** | **29,378,448** | **12,361.06** | **1149.38** | **472.8** | |
| | **637.3** | **2,090** | **4.07** | **13.4** | **2,779** | **29,616** | **459,038** | **193.14** | **17.96** | **7.4** | |

# The Retirement of Harvey S. Knauer

By James Byers

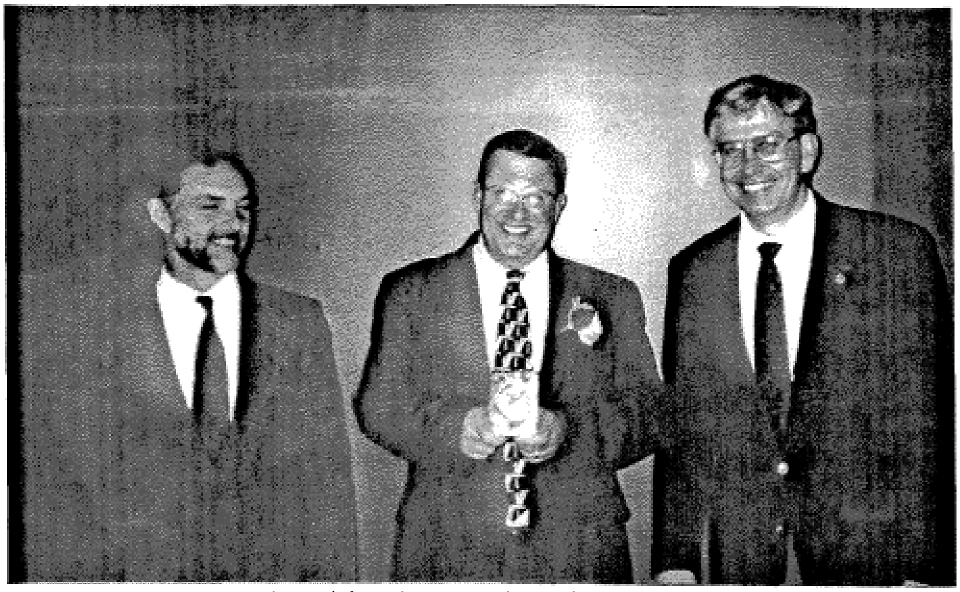
"Thirty years of dedicated service." Just what does that mean? Coming to work every day? Accepting every assignment, no matter what it is? It's that and much, much more.

On March 7th, I attended Harvey's retirement luncheon at the Waynesborough Country Club. The theme for the affair was 'More than a job, an adventure' and Harvey's career in PennDOT was certainly that.

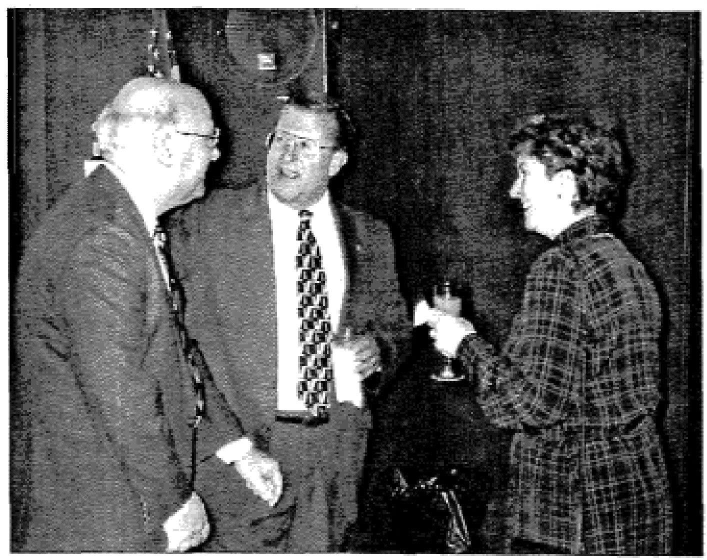
I came to know Harvey when I joined the Department in October 1984. Harvey had just moved back to District 6-0 in Philadelphia as an Environmental Engineer after a sojourn as the Central Office Noise Person for several years. My assignment was to become the Central Office Noise Person in the Environmental Quality Division which would eventually become the Bureau of Environmental Quality. To do this, Harvey became my mentor and I worked with him on various highway projects with noise impacts. Harvey would go to District or consultant offices early and stay until the job was finished no matter how long it took to do the job right.

Because of his dedication to high principles, the Pennsylvania Association of Environmental Professionals presented Harvey with the Karl Mason Lifetime Achievement Award as part of the retirement ceremony. Wayne Kober is pictured presenting the award to Harvey. Karl Mason served the Department of Health from 1952 until his death in 1966 and is regarded as the Commonwealth's first environmental administrator. The award was created to commemorate his vision of a strong, well managed environmental program. The award is given to a Pennsylvania person, organization or project that has made a significant contribution to the betterment of Pennsylvania's environment.

Up until I joined the Department as an Environmental Planner, I thought environmentalists only cared about the bugs and bunnies. Harvey taught me that there is much more involved. Mainly, that there are people impacted by our projects and we would be disrupting their lives, sometimes temporarily, sometimes permanently. And 99 percent of the time the first thing they wanted to know was "Are you going to make it louder at my house?" Harvey understood this and did not hide behind the numbers or shy away from going out and meeting with individuals, communities, or elected officials to patiently explain what the Department was doing and what he would be doing to try to help them.



Bert Cossaboon (left) and Wayne Kober (right) congratulate Harvey upon the presentation to him of the Karl Mason Lifetime Achievement Award



Retired District Engineer Steve Lester and Harvey's wife Ruth share in Harvey's celebration

As an example, Harvey's contribution to the completion of the Blue Route (now signed I-476), a western bypass around Philadelphia from I-95 in the south to the Pennsylvania Turnpike in the north cannot be measured. The Blue Route was a new highway on new location through the suburbs of one oldest cities in this country. This project had been in the works for over 30 years and tied up in the courts for most of them. Noise was one of the major environmental issues and Harvey met with every community that was impacted many times to work out the problems and arrive at solutions that helped the most people. Harvey earned their trust through his honesty and hard work and convinced them that the highway could be a good neighbor. Harvey's work on the Blue Route did not stop when the environmental clearance was obtained. He continued to work with the impacted communities to incorporate their desires and views into the final design and construction of the noise barriers with even more meetings.

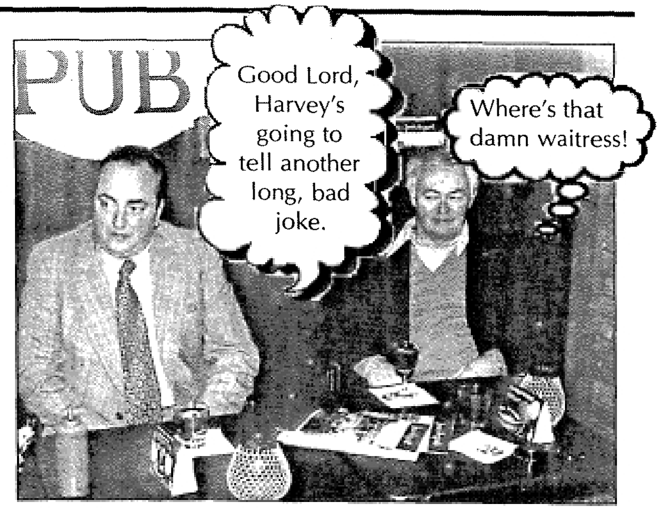
Following his work on the Blue Route, Harvey was given more management responsibilities These culminated with his final assignment to coordinate the rehabilitation of I-95 through Philadelphia. This project was a major engineering problem because of the fact that it has to be done while maintaining the traffic on a major urban interstate. As usual Harvey worked long and hard on both the engineering and environmental problems of this project.

So, what is Harvey doing in his 'retirement?' As you might imagine with someone who really likes their work, he is now working for Gannett Fleming in their Environmental Acoustics subsidiary and enjoying getting back to the basics of noise analysis.

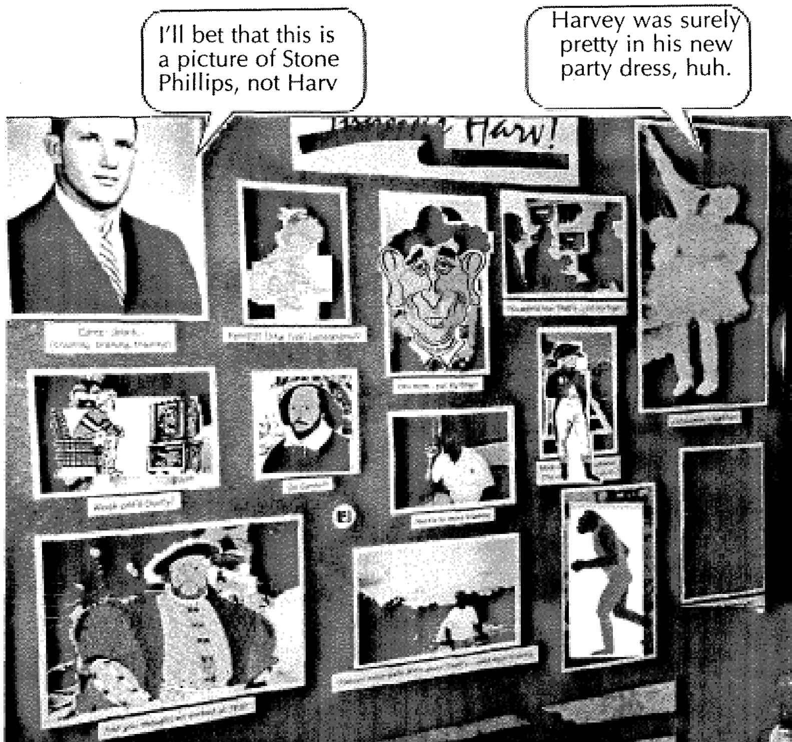
We wish you well Harvey! ■

# This is the ROASTMENT of Harvey S. Knauer

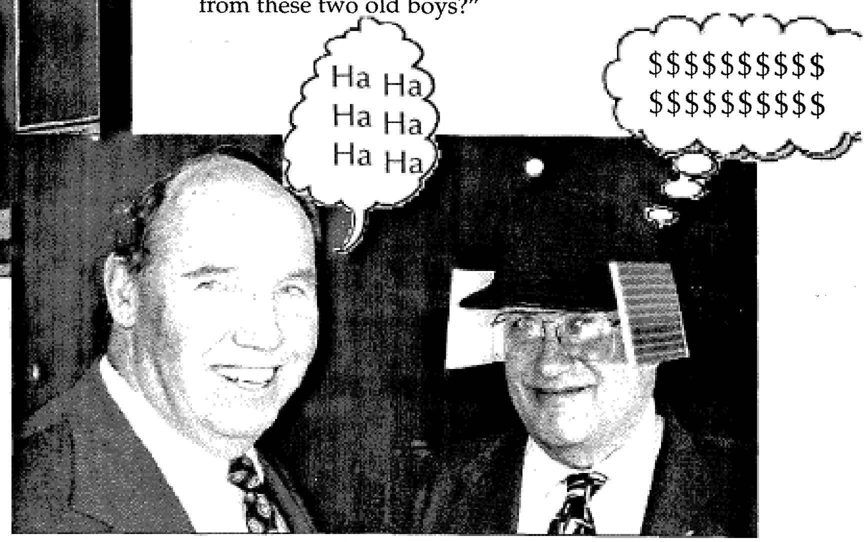
Well, it's all sweet talk and honey over there on the other page, and I suppose Harvey has mostly earned the kudos, but we just can't let him stumble off into retirement without a few parting shots. I was getting pretty much tired of hearing him calling me "Father Time," and every time he called me in the afternoon, he always said, "I hope I didn't get you out of bed." Outside of that, I really love Harvey, but I am going to have to give it to him for all the people he gave it to. Surf's up, baby.



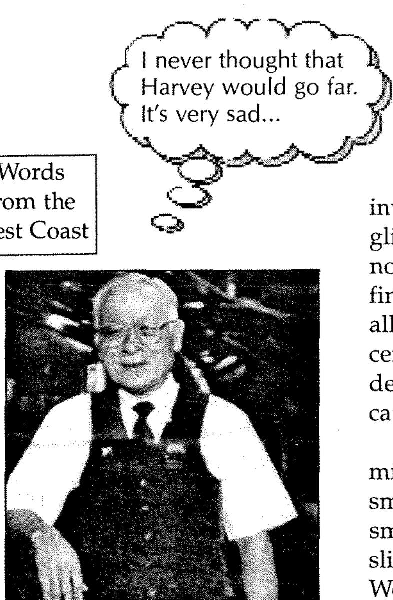

Most of you probably won't recognize the two chaps above, and I'm not going to help you, but for the readers who know them, this candid shot was made by Charlie Adams of Maryland DOT at some A1F04 Awards Dinner where Harvey, as was his wont, was boring the members with his endless after-dinner speech and jokes. While Charlie had caught the exact flavor of the audience's boredom with this shot, he spoiled it for the two chaps in the picture when he sent them a copy of the photo with a caption pasted on, which read: "Would you buy a bridge from these two old boys?"




This is a display board they made to exhibit Harvey in his childhood years (or whatever).




Words from the West Coast




Mas Hatano
Chairman Emeritus, A1F04

As a young boy in Pennsylvania, Harvey had always dreamed of someday becoming a respected inventor, like Rube Goldberg. He wanted patents, and royalties, and big cars, and babes, and all that glitters. Well, nothing came to him but ashes and hard work. But, after years and years of working with noise barriers and going to community meetings, and sweating and groping for the ultimate solution...it finally happened. Harvey awoke one night in a pool of light that radiated from his own head. It flashed all around the room like a police car, and each revolution showed a different kind of noise barrier on the ceiling of his room. His brain was projecting images of every noise barrier design known to man. Suddenly, the lights became dazzlingly bright, and Harvey's brain began spewing out drawings and specifications on the ceiling...and the "World's Ideal Noise Barrier" was born in a sheer stroke of genius.

Harvey had wisely concluded that it was ridiculous to spend millions of dollars to build miles and miles of noise barriers to protect the hearing of the highway abutters, when all that was needed was a small "personal" noise barrier for each impacted taxpayer. His ultimate invention was comprised of two small, sound-absorbing panels which were mounted on ear muff frames for easy on/off use (optional slip-on heating pads are available for winter use). Harvey was to name it the Personal Portable Teeny-Weeny Noise Barrier Beanie. Casually, he called it his PeePeeBeanie, which caused some people to roll their eyes and chuckle (see photo), but Harvey could only dream of the millions to come. Watch for the announcement of his upcoming Web Site, where you can order a pair at the introductory price of $1.00

( **Professional Paper Abstracts**, *from page 7* )

## TNM REMELS ARE PLUS/MINUS 0.2 DB -- HOW DO WE KNOW? ...
and Are Your Project REMELs That Precise?

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The FHWA Traffic Noise Model (FHWA TNM) contains newly measured noise-emission levels, which are nicknamed REMELs (Reference Energy-Mean Emission Levels). Because many vehicles were measured during TNM development, over many sites in many states, these REMELs are known very precisely: approximately plus/minus 0.2 decibels, depending upon vehicle type. This paper first summarizes TNM A-level REMELs for cruise-throttle vehicles on average pavement, and shows how their measurement precision was determined.

On individual highway projects, community noise measurements are sometimes compared to computer calculations, to assess the accuracy of the computer program at individual sites. With such highly precise REMELs within the TNM, it might be thought that mismatches would be always due to propagation anomalies at the site, or perhaps to propagation inaccuracies within the TNM, itself. However, nationwide precision of TNM REMELs does not guarantee their precision at individual sites. In fact, vehicle noise emissions vary significantly from site to site, according to the REMEL database. This paper quantifies the site-to-site variability of TNM REMELs and discusses what this variability means to measurement/calculation comparisons at project sites. ■

## COMPARISON OF LIGHT-RAIL AND BUS TRANSIT IMPACT ESTIMATES PER FTA AND APTA NOISE CRITERIA

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A Transitway has been proposed in suburban Maryland near Washington, D.C. for an abandoned railroad right-of-way. The proposal generated considerable public response, both for and against, and work was begun then halted, then resumed over a period of time. The initial environmental noise evaluation was performed using the American Public Transit Association (APTA) Guidelines. When work resumed, the Federal Transit Administration (FTA) Guidance Manual was available. Consequently, noise impacts were assessed via methods from both documents to not only maintain continuity with previous work but also to use the latest procedures.

The APTA Guidelines consider adjacent land uses and existing ambient sound levels in defining appropriate community-noise design sound levels. Noise guidelines for train operations are specified for land-use categories in terms of train-passby maximum sound levels ($L_{max}$) for single-family and multi-family dwellings, and commercial buildings. The FTA criteria are based upon comparison of the existing outdoor ambient noise to the future outdoor sound levels from the proposed project. They incorporate both absolute criteria, which consider the transit project alone, and relative criteria, which consider the change in the noise environment caused by the transit project. FTA identifies two criteria curves: An upper curve describes "severe impact" and a lower curve describes "no impact," i.e., the onset of noise impacts. (In this paper, exposures above the "no impact" limit also will be referred to as having "some impact.") The FTA noise criteria and the sound level descriptors used are a function of land use. Depending upon land-use category, the recommended noise metric is either the average sound level for the noisiest hour of transit-related activity during hours of noise sensitivity, $L_{Aeq1hr}$, or the nighttime-weighted, 24-hr average provided by the day-night average sound level, $L_{dn}$.

The Transitway was proposed to be serviced by one of three alternative vehicle types: light-rail vehicles, conventional articulated diesel buses, or dual-propulsion (electric motor/diesel engine) articulated buses (the dual-propulsion bus operates under electric power while on the Transitway.) Passby noise measurements were performed to quantify or verify the noise emissions of each of the vehicle types. In-service light-rail vehicle emissions were measured and compared to FTA Guidance Manual data. Passby tests also were performed on a late model articulated diesel bus at 30 and 60 MPH in powered/constant-speed and unpowered/coast-by operations and compared to other available data for diesel and electric buses, respectively. At 50 ft and 35 MPH, the diesel bus is noisiest with the light-rail vehicle slightly quieter. The electric bus is significantly quieter although its emissions are known with the least confidence.

Line operation sound levels were predicted for each of the vehicle types for the entire length of the proposed project. The predictions were both in terms of maximum passby sound levels for comparison to the APTA criteria and day-night average sound levels for comparison to the FTA criteria. (A survey of existing ambient noise enabled the definition of FTA criteria levels.) Vehicle noise generation varies with speed and guideway characteristics; therefore, wayside sound levels were computed as a function of position along the transit route. For the local land use and ambient noise condition, the distances for the unmitigated passby noise exposures to attenuate to the APTA and FTA criteria limits were estimated and the numbers of included dwellings counted. The resultant affected residential structures were: electric bus-22 per APTA, 2 per FTA "severe" and 60 per FTA "some"; diesel bus-106 per APTA, 101 per FTA "severe" and 233 per FTA "some"; and light-rail vehicle-118 per APTA, 81 per FTA "severe" and 242 per FTA "some." Consequently, for the Transitway project and proposed vehicle alternatives, the FTA "no impact" criterion curve yields significantly greater noise to exposed areas while the APTA criteria yield results intermediate to those from the FTA "no" and "severe"impact curves. ■

## PASSBY NOISE TESTING OF PAVEMENTS IN TEXAS

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Efforts to mitigate traffic noise in state highway departments tend to focus on the use of noise barriers and their associated insertion losses. Barriers can be effective but they are expensive and can have associated problems with aesthetics, safety and maintenance. Because tire/pavement interaction is significant contributor to automobile noise at highway speeds is an investigation of using "quiet" pavements to reduce tire/pavement interaction noise, and thus attenuate traffic noise at the source, has been undertaken by the Center for Transportation Research. Using the trailer method, onboard and roadside digital recordings of passby noise from a test vehicle have been collected for fifteen different pavements in the state of Texas, as well as six pavements in the Westem Cape and Gauteng provinces of South Africa in order to evaluate the effect of pavement surface on roadside noise levels. Results obtained with a test vehicle speed of 100 kph show that there are significant differences, approximately 10 dBA, in the roadside noise levels associated with the various pavements tested. Therefore, the potential exists to mitigate noise annoyance by utilizing specific road surfaces. Preliminary analysis of the data shows a good correlation between the onboard trailer data and the roadside data. This is encouraging for using trailer method data collection techniques.

Work supported by the Texas Department of Transportation. ■

*(continued next page)*

(Paper Abstracts, *from page 13)*

## PREDICTION OF AIRCRAFT ENGINE RUNUP NOISE IMPACTS AT PORTLAND INTERNATIONAL AIRPORT, PORTLAND, OR

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The project consisted of measuring and modelling aircraft engine runup noise for representative aircraft (Boeing 727-200, Fokker F28 and De Havilland Dash 8) at Portland International Airport (DPX). The objective of the project was to assist the Airport Noise Advisory Committee (ANAC) in assessing the extent of aircraft engine runup noise impacts around the Airport and in determining the best location and aircraft orientation to be used during runups. ANAC volunteers were utilized to maximize the number of off-airport noise monitoring sites and to increase the credibility of the study. A total of three (3) on-airfield and seven (7) off-airfield noise measurement sites were employed. Each aircraft was runup in four different directions to assess the effects of aircraft orientation. Radio contact between a Port of Portland staff member on board the aircraft and persons at each monitoring station was maintained to ensure all study participants were aware of when runups occurred. On-airfield noise measurement data, including sound pressure levels at 1/3 octave band center frequencies, were utilized as input to the Environmental Noise Model (ENM) to predict runup noise levels in the area surrounding the Airport. Additional inputs to the ENM included source directivity, atmospheric conditions, topography and ground surface characteristics.

The noise levels predicted by the ENM were validated by comparing measured and predicted noise levels for the atmospheric conditions observed during the measurements. Generally, predicted values were found to be within n 5 dB of measured values. The ENM was used to prepare contours representative of typical maximum runup noise levels for various combinations of wind, humidity, temperature and temperature inversion. The most important atmospheric factors were determined to be wind and whether or not there was a temperature inversion. The ENM was not able to accurately account for topography in the vicinity of the Airport. The noise exposure information developed during the project is presently being used by the Port of Portland in the design of a ground runup noise attenuation facility at the Airport. ■

## IMPROVEMENTS IN ACOUSTICAL IDENTIFICATION OF AIRCRAFT AT MONITORING SITES

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A primary objective of a noise monitoring system arrayed around an airport is to separate aircraft noise events from all others and analyze them. This process has been improved recently by better defining noise events using only A-weighted sound pressure level time histories. This has been done through use of dynamic event thresholds, elastic event duration limits and automatic background correction. Events are filtered to eliminate large fluctuations and transient sounds. Then, short and long duration events as well as low rise events are filtered out. Multiple events, within a defined event, are segregated into sub-events where possible and each is analyzed separately. The probability that the event was caused by the passby of a vehicle is assigned and the probability that the passby was due to an aircraft is assigned.

Recent work has made use of 1/3 octave band spectral time histories to classify the event into broad categories of aircraft type. ■

## PROJECT APPLICATIONS OF RAYVERB — TNM'S PARALLEL-BARRIER MODULE

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RayVerb is a ray-tracing model developed by Harris Miller Miller & Hanson Inc. (HMMH) to evaluate degradation to noise-barrier insertion loss caused by multiple reflections between parallel noise barriers or retaining walls. The Federal Highway Administration's new Traffic Noise Model (TNM) includes RayVerb as an independent module to assist in evaluation of parallel-barrier geometrics. Because STAMINA 2.0/OPTIMA does not address these geometrics, HMMH has used RayVerb for several years to augment STAMINA's computations, when necessary.

Past applications of RayVerb on two projects are discussed to illustrate uses of the model, typical results, and some of the model's limitations. In the first project, a typical parallel-barrier geometry, RayVerb was used to evaluate different alternatives to counteract degradation caused by reflections including additional height and use of absorptive materials. The second project, which demonstrates the flexibility of the model, was an evaluation of a noise barrier along the lower deck of a partially enclosed double-deck bridge. ■

## ACCURATE GEOMETRIC MODELING OF BARRIER ATTENUATION WITH ATMOSPHERIC EFFECTS

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www: http://faramir.mece.ualberta.ca/fyfe.htm

Wave based solutions of noise barrier geometries accurately model the complex direct, reflected and diffracted sound field interactions. However, these solutions are very computer intensive and thus are not practical as a design tool. Improved diffraction based methods, that include phase, now yield wave-like accuracy with trivial calculation times. These results, however accurate, typically over-predict the actual performance of noise arriers, because atmospheric effects such as wind, tem-

*(continued on next page )*

(**Research Needs**, *from page 15)*

perature gradients and turbulence have not been considered.

To overcome this limitation, a new acoustic modeling tool has been developed that combines the new diffraction based sound barrier performance model with a heuristic atmospheric model. The results of this new model are in good agreement with accepted wave-based solutions, namely the Parabolic Equation method (PE) and the Fast Field Program (FFP). Applications of this model yield the expected sound barrier performance degradation due to the acoustic medium non-homogeneity. ■

## LOS ANGELES METRO RAIL SYSTEMWIDE NOISE & VIBRATION CRITERIA

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The Systemwide Criteria is intended to provide design standards for all noise and vibration control problems relating to the construction and operation of the Los Angeles Metro Rail system. The basic goals of these criteria are to:

1. Provide transit system patrons with an acoustically comfortable environment by maintaining noise and vibration levels in vehicles along the way and in stations within acceptable limits.
2. Minimize the adverse impact of system operation and construction on the community by controlling transmission of noise and vibration to adjacent properties.
3. Provide reasonable and feasible noise and vibration control consistent with economic constraints.

This paper discusses the changes that have been implemented to the Systemwide Criteria over the past years based on the lessons learned from the construction and operation of the Long Beach Metro Blue Line, Metro Red Line (MRL) Segment 1, and the Metro Green Line. Both the Blue and Green Lines are light rail transit systems. The Red Line is an underground heavy rail system. ■

## EDUCATING THE PUBLIC ABOUT TRANSPORTATION NOISE

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Most of us have either been, or probably will be, confronted by people outside of our field who have some misunderstandings about transportation noise. In addition to making our jobs more challenging, these people have the potential to delay (if not cancel) our projects. It is also accepted that, not only is noise the most common of environmental stressors that people are exposed to, but that transportation vehicles are the most common noise sources affecting the most people. The general public is frustrated and angry about noise issues as it is. The misinformation they are receiving complicates the process even more. In an effort to alleviate these problems, the purpose of this presentation is to propose the development of a public educational program to help people to understand how transportation noise is generated, how it is regulated, and how it can be controlled (on a practical level). A key premise behind this educational program is that it must be as nontechnical as possible to favorably reach the general public. It is in our best interests to deal with an informed, rather than a misinforrned, public. Examples from other training programs that have been favorably received by people outside of the acoustical field will be used as a basis for the proposed program. This will hopefully spark an interactive discussion with the audience to develop the best program possible. ■

## DETERMINATION OF REASONABLE AND FEASIBLE FOR SPECIAL LAND USES

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Before noise abatement is provided for highway situations, it must be determined if the abatement is both reasonable and feasible. Feasibility is understood if it is even possible to provide abatement. Reasonable has been taken to mean if there are practical limitations to providing abatement such as cost. A survey conducted for this project showed that while most States and Canada have guidelines to handle residential settings, special land uses are usually considered on a case-by-case basis. This leads to arbitrary decisions and little continuity.

Based on the results of the survey, discussions with knowledgeable professionals, guidance by the Florida Department of Transportation, and the authors personal experience, a methodology has been derived to handle these special land use cases. The methodology allows a systematic procedure to be used that eliminates arbitrary decisions. In this way, continuity exists in the program and all analyses result in the same decisions for similar circumstances.This presentation will discuss the survey results, the derivation of the methodology, and present example situations. ■

## A CASE STUDY IN PUBLIC PERCEPTION OF NOISE BARRIER EFFECTIVENESS

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Andrew B. Smith
McCormick, Taylor & Associates

US Route 50 and 1-97 are the two major interstate highways that connect Washington D.C. and Baltimore to Annapolis (Maryland's state capitol). Three communities situated along US 50 and at the interchange with I-97 were considered for Type I

(continued on next page)

(**Research Needs**, *from page 17)*

Noise Barriers as the result of proposed widening and ramp additions to the highway network. Ultimately, pre-cast concrete noise barriers were constructed in five sections on both sides of the highway in the area.

Located just west of the US 50/I-97 interchange is the retirement community of Heritage Harbour. During the development and construction of the community through the early and mid-1980's, the developer constructed two non-contiguous earth berms along the highway right-of-way line. The design concept developed for this project incorporated these exisitng earth berms into the overall US 50/I-97 barrier system. Barrier wall sections were designed to tie into both ends of the berms to mitigate flanking noise, and to ultimately provide a "closed system" for the adjacent communities. STAMINA 2.0/OPTIMA modeling identified that the noise barrier construction would provide an additional 3-7 dBA insertion loss for homes situated near the berms.

Following construction of the US 50/I-97 noise barrier system, community members living directly behind the berms claimed that the new barrier walls were now "funneling" noise over top of the berms and causing the noise to be louder than it was prior to the barrier constnuction. The Md State Highway Administration monitored post-barrier noise levels in response to the community's request. The monitored levels confirmed OPTIMA predicted noise levels and did not support claims that noise levels had become worse following barrier construction.

Under "pre-barrier" conditions, it was hypothesized that noise particularly from heavy vehicles unshielded by the existing berms was substantial enough that vehicle noise passing over the berms was being masked, so that the source direction was not always discernable. Once the "flanking noise" was abated by the barrier walls, vehicle noise passing over the berms dominated. The results of the noise monitoring and an explanation of identified phenomenon were successfully presented to the community.

The case study presents the US 50/I-97 berm/barrier public perception issues, discusses the project's applicability to previous "public noise perception" research and, suggests public involvement techniques that could prepare communities for unique acoustic situations. ■

## TRANSIT STATION ACOUSTICS - STANDARDS AND MEASUREMENTS

Terry Gerritsen, Tim Kelsall
Hatch Associates Ltd.
2800 Speakman Dr.,
Mississauga Ontario L5K 2R7
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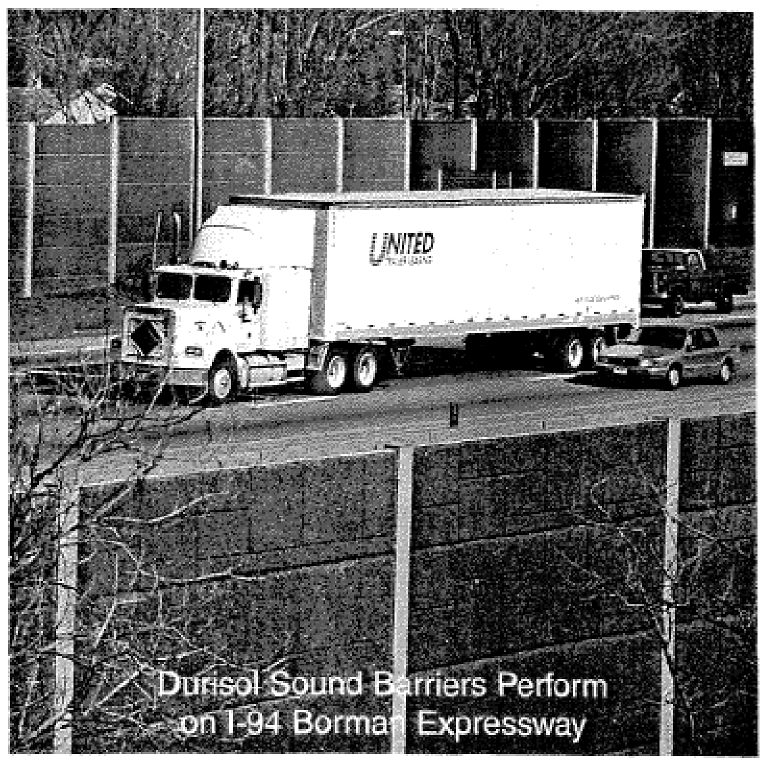
The Toronto Transit Commission, as part of its expansion programme, has written new design standards for their stations. The acoustics of the stations has been examined in some detail and new design guidelines developed. The primary criterion is that the reverberation time of the station allow the paging system to be understood at all times. Because the paging system is part of the emergency response system, this is a safety concem.

The degree to which paging can be understood depends on





two factors: the reverberation within the station and the design of the paging system, especially the speaker placement. Because these components are done by separate design teams, a common understanding is necessary. The design standard asks the station designer to provide sufficient sound absorbing material in the station to provide a reverberation time of 1.5 seconds. The paging system is to be designed to provide at least Fair intelligibility or an articulation index of at least 0.46 when installed in the station.

Measurement of the reverberation time and articulation index in existing stations were carried out and are presented. They confirm that a reverberation time of 1.5 seconds is achievable in a station with a sound absorbing ceiling. They also show that this is required to achieve an articulation index of 0.46. Stations without sound absorption were found to have reverberation times over 1.5 seconds and paging with an articulation index of 0.46. Listening confirms that unlined stations generally have paging which is more difficult to understand.

This paper will be followed by a tour of several TTC stations to listen to announcements. They will include both lined and unlined station platforms. ■

FAX

From: Vincent Russo, Jr., Assistant Environmental Engineer
Louisiana Department of Transportation and Development
Tele: (504) 929-9195 Fax; (504) 929-9188

Date: July 2, 1997

Dear El:

Reference is made to your request for opinions (everybody has one) on a Wall Journal website.

I must say that I am plugged in (i.e, have internet service) and personally think that a Wall Journal site would be an excellent idea. While I don't think that it would or should eliminate paper copies of your interesting publication, it would provide a central forum for those of us who are involved in this industry, something that (as far as I know) is currently lacking on the Net.

The page could probably be supported by advertisers, who would certainly want links to their own business sites. It could include discussion forums between noise specialists, who could converse at the click of a button on topics of concern to all. It could provide the latest breaking technologies and abatement project details.

It is understood that <u>all</u> this will take is a lot of hard work and money. But if you can put all the pieces together, I would be very excited about http://www.thewall.com (or whatever it is called).

*(Ed. — Thanks very much for the nice letter, Vincent, but please read the editorial on page 3.*

**JOSEPH C. LU ENGINEERING**
**PENFIELD, NEW YORK**

To The Wall Journal

As per the subscription renewal notice of December 1996, my last issue is number 29. Therefore, I am requesting that my subscription be renewed for another year. Enclosed is a check for $20.00 to cover the cost of the one year subscription.

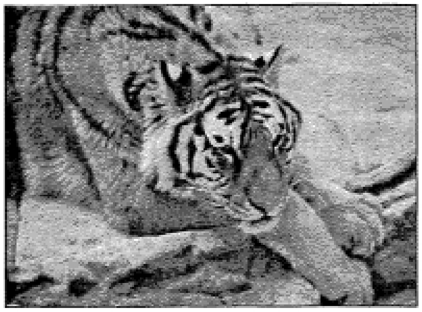
It should be noted that if The Journal becomes "wired," that I hope to be the first to register a "hit" on The Wall Journal website.

Sincerely,
Dale D. Dimick

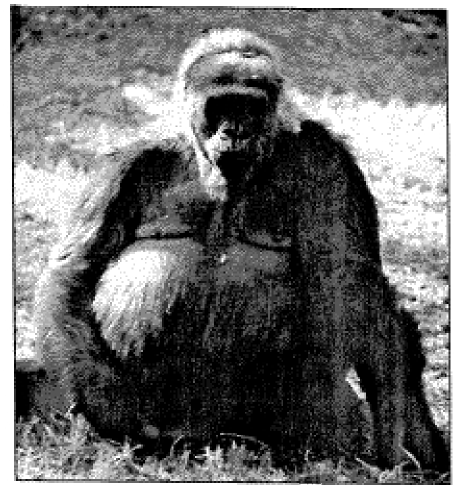
CORRECTION

In the last issue of The Journal, we printed a letter from David W. Schnell, Engineer for the Snohomish County Public Works in Washington, but with an incorrect fax number. We herewith print his **correct** fax number: **206 388-6670**. Sorry.

## In the Back Issue Room with Tiger Jack and Gus the Gorilla's Mama



*No, Mama, I haven't seen your boy Gus in a while. Last I heard, he got fired from The Wall Journal. He'd been in town drinkin' and came back and shaved off all of Walrus's whiskers. Walrus quit on the spot and headed out to sea. Gus got caught emptying the petty cash box and that's how he got fired. Last I saw him, he had his really mean face on and was headed for town. I hope it's still there.*



*Well, Jack, you and me been gettin' along purty good all these years. Gus was a real good boy while he was only a hundred fifty pounds or so, but when he passed 500 pounds and started up drinkin'and all, there was no holdin' him. I thought workin' at The Journal would straighten him up, but havin' to work with numbers just messed up his head. I found one of those little cards in his bed. It said Wide World Wrestling on it, Wonder what that means...*

### In the Back Issues:

- Noise Barrier Construction Forecast
- Summaries of Professional Papers
- Noise Barrier Project Reports
- Fundamentals of Sound
- New Product Press Releases
- TRB A1F04 Committee Meetings
- State DOT Noise Barrier Programs
- FHWA Noise Model Updates
- Noise Abatement in Other Countries
- Airport Noise Control
- Construction Trends in Noise Barriers
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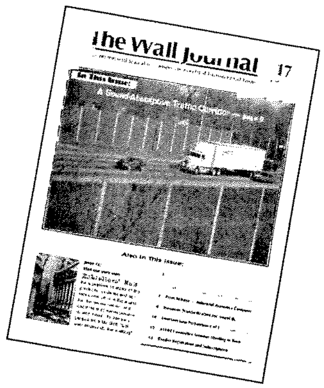
- FHWA History of Barrier Construction
- Materials Test Standards
- Rail Transit Noise Control
- And a Bunch More


The Wall Journal 17

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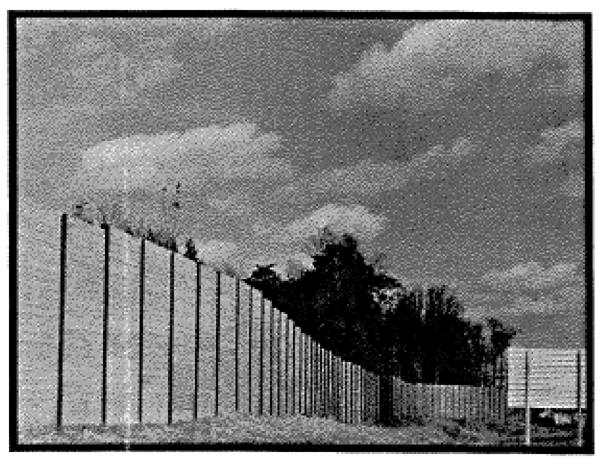

(**Editor's Corner**, *from page 3)*
connections, and to the electric panel and automatic sprinkling timing panel which are mounted on the garage wall, just inside the cable location.

Without going into great detail, the sprinkler timer became corrupted and went crazy, causing the pump starters to beat themselves to death. Cost to replace: $335.00.

A lot of little things have gone bad: the new fluorescent tubes over the stove flickered and died; half of the undercounter stick of mini-lights have quit; a wall switch that used to turn on a fan doesn't any more (the fan is O.K.); stuff like that.

But,I digress. It is now approaching the last week in July, and I must deliver my Wall Journal films to the printer by August 1, to be on schedule. I sit down at my trusty old Mac and knock off a couple of fast games of solitaire to loosen up my fingers and sharpen my wits

I am on the home stretch. Everything is pretty much in place and I just need to proofread and tweak a little here and there, and we are ready to go to press. I had already done my editorial (which is now in the waste basket) and was going to touch up the front cover.

I pulled up the file, which is laid out like pages in a magazine, and on the first page checked out the **In This Issue** stuff for accuracy. Moving along, I noticed that Harvey had a cowlick in his hair that I had missed, so I put him back in Photoshop for some clean-up. When I had him fixed, I brought him back up and placed him in the spot where you now see him on the front cover.

*(continued next page)*

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## INDEX OF ADVERTISERS

*(**Editor's Corner**, from page 22)*

With that, my work was done. I directed the cursor to the **Save** menu and <u>KAZZAAM!</u>...HARVEY HAD <u>SPLIT</u>, and took the whole file with him. That was just the beginning of a bunch of weird things Old Mac had gone bonkers. It wasn't virus — Dr. Norton (of Norton Utilities) checked Mac out. But, it sure acted like virus. It hit some applications and ignored others. It obeyed some commands and dumped the file on others.

After much examination by highly-paid technicians, they determined that the logic board was corrupted, most likely by the wandering lightning that knocked out the sprinkler, clothes dryer, fan switch, light bulbs, etc.

So, I had to buy a new computer (a Mac clone by Power Computing) and clean out the old Mac I downloaded old Mac's hard drive onto 135 Mb SyQuest disks, which I opened side-by-side on the Power computer with the Power's System Folder. From there, with the help of a good friend from the Virginia days, Mrs. Doni Wright, who lived in the same community and who owned a business called The Wright Stuff, and was a Macintosh expert technician and networker, and drove a car with the license plate MACS 4EVER.

Doni has a Power Computing computer similar to mine. We had an open telephone line and a modem connection for communication. Doni opened her System Folder on her screen and instructed me in what items to trash, what to drag into the new computer, and basically how to set it all up. It took two hours, but we wound up with a clean, well-organized, lightning-fast (did I just say that?) new computer.

However, I only had bits and pieces of the Issue No. 30 which were usable. I had to start from the beginning on this one, and patch in a piece or two where I could. I am sorry for the delay, but I discovered that there are not many expert technicians available around here. This is Sunday, August 31 as I write this, and as soon as I get this issue to the printer on Tuesday, September 2 I will begin the Sep/Oct Issue. ■

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