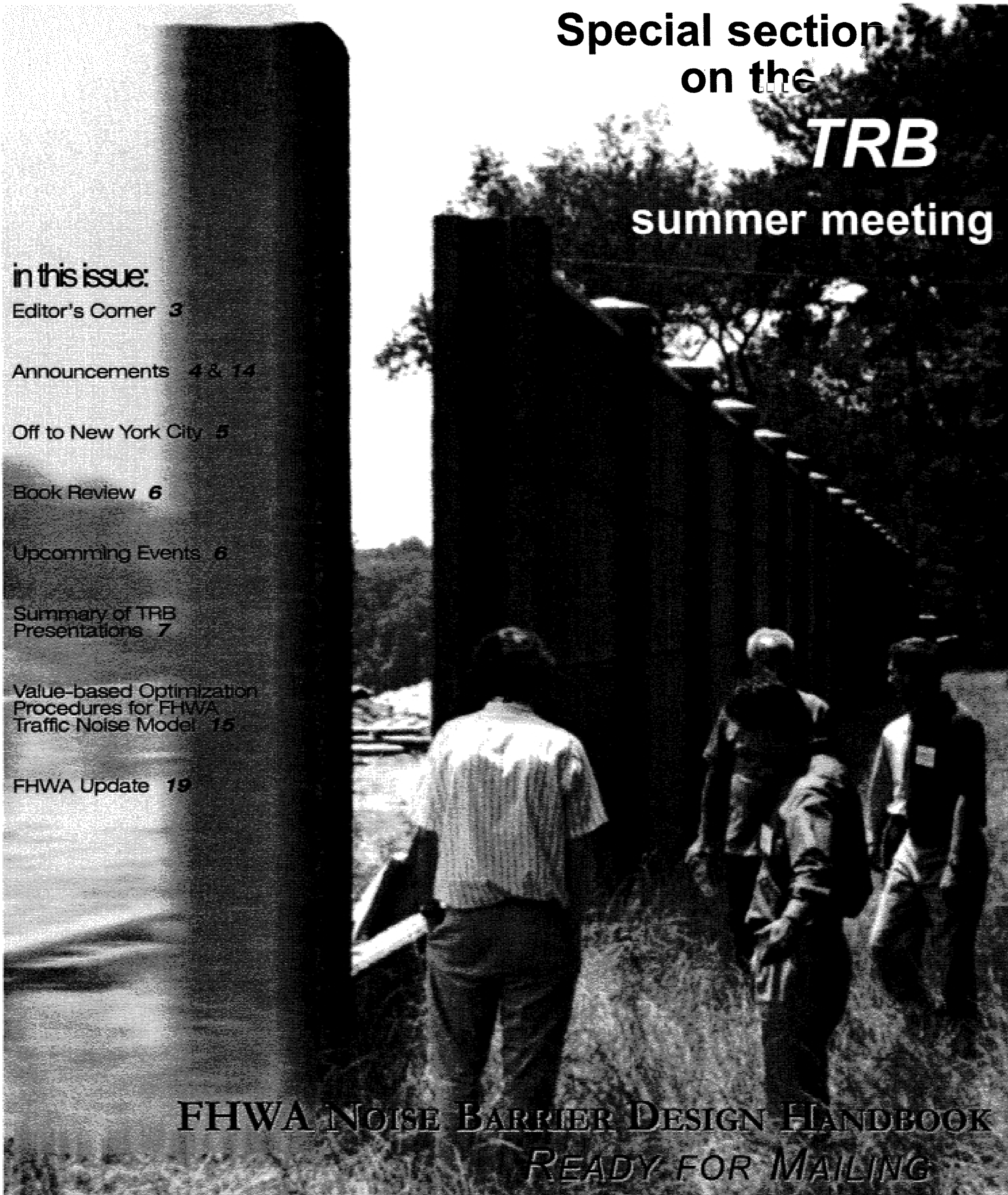
The Wall Journal™

Issue No. 40

Sept/Oct 2000

THE INTERNATIONL JOURNAL OF TRANSPORTATION RELATED ENVIRONMENTAL ISSUES



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The Wall Journal
Publication Philosopy and Policy

The Wall journal was established as a communications and recording medium for the affairs, technical information and activities of all those persons who are involved with transportation-related environmental noise issues. The Journal is an impartial observer and reporter of the timely intellectual and practical contributions to the state-of-the-art made by these persons. The Journal also preside as a bulletin board for the free interchange and distribution of ideas concepts, test reports, field experience and technical development.

The Wall Journal cannot exist without input from our readers. We cannot be at all places and times where intellectual achivement is being accomplished, nor will we publish fiction or contrived editorial fill. You, our readers, will be the sole source of all editorial material we publish. Therefore, if you wish The Wall Journal to continue, it is imperative that you all make a contribution. You deserve to have a forum for your technical achievements, and your fellow readers deserve to share that information. Your are our authors; the September/October 2000 issue is being mailed to more than 1800 readers with interests similar to yours. We are confident our readership will expand to 5,000 worldwide, with your help.

The Wall Journal is being distributed free-of-charge to federal, state/provincial and municipla engineers, designers, planners and administrative personnel. This is the only 'payment' we can make for your contributions. since The Wall Journal is not an eleemosynary institution, we must look elsewhere to recover the cost of publishing and distributing The Journal. We must look to consulting engineers, contractors and material to provide operating dunds from the sole of subscriptions and advertisements. Thus, we have a synergistic relationship between our readers who provide the editiorial material at no charge, and the private sector which pays the bills, but is the recipient of business generated by the work of the readers.

State simply, the more ditorial and news material we receive from readers, the greater the circulation we can develop, which makes The Journal more attractive as an advertising medium to the private sector, which in turn provides more funds and allows more improvement in the depth and quality of the publication, which in turn builds greater readership. The spiral continues □

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Circulation is made to government agencies, consultants, vendors and others with an interest in transporation-related environmental issues. Readership is primarily in the United States and Canada, with growing interest in Europe, Asia and the Pacific Rim.

Subscription and advertising inforamtion are shown on Page 19.

Well, it's been over a year since the last issue of The Wall Journal was published and a lot has happened since then.

As some of you are aware, my dear friend, El Angove, the Editor and Publisher of the Journal since it's inception in 1992, has had more than his share of health problems over the last few years. Because of this, he has decided to start enjoying his retirement while he can.

When I learned of El's plans, I became very concerned not only for El about for the future of The Wall Journal. I had watched this publication grow from a twinkle in El's eye to becoming a significant presence in the environmental noise community as a whole. I could not stand by to watch the publication disappear. So, after many lengthy discussions with El, I ended up as the new publisher of The Wall Journal.

If anyone wishes to send him a short note, I know he would love to hear from you. Please send any correspondence to:

El Angove
1183 Juanita Cir
Venice, FL USA 34292

Since the transfer of ownership in early January, it has been a long and difficult process of picking up the pieces where El had left off. I have never put a publication together before, and, I have never had to work with publishing software either. It's been quit an experience to get to this stage. But, I am finally at a point where I thing I have something that resembles The Wall Journal. If everything has gone well, you should have received this issue in September.

I will continue to honor all committements that El had made to the previous subscribers to The Wall Journal and to its advertisers.

I will, also do my best to continue to publish The Wall Journal under the same philosophy and policies as El did. However, The Wall Journal cannot exist without your participation.

I need articles.

In addition to the regular articles that most readers have become accustom to, I would like to start running articles highlighting projects from around the continent and world. These articles can be submitted by anyone; either government agencies (DOT's, etc.), researchers, consultants, contractors, manufacturers or anyone else who may have a particular interest in a project.

If you are interested in submitting any items, all I need is a relatively short article, ranging in length up to approximately 6 pages. The article should include some photos and, preferably, a recent photo of the author. Articles can be submitted in hard copy form. However, I would prefer them in either MS Word® or WordPerfect® format. Any graphics files should be either in TIFF, JPEG or GIF format.

Something New

There is also something new for The Wall Journal, to ensure that both feet are well planted in the new millenium, The Journal is on the web at ***www.thewalljournal.com.*** It will be moving rapidly forward in this media, with some exiting and innovative developments.

One of these new developments have already occured. It's the Noise Barrier Discussion Forum which is up and running and can be accessed from The Journal website. Please feel free to participate at any time.

Please be patient with us as we gradually develop and expand the site The current version was established strictly to generate feedback for improvements. Any suggestions would be greatly appreciated□

Cover Photograph
(taken July 18, 2000)
Site visit during the 2000 TRB Summer Meeting. Concrete noise barrier installation on I-684 New York State.

Faddis Concrete Products News:

Joining Faddis as of January, 2000, are Gary Figallo (formerly of Industrial Acoustics Company and Reinforced Earth Company) and Bob Hess (formerly of Concrete Safety Systems). The collective experience they bring to Faddis includes the supply of literally millions of square feet of noise barriers and retaining walls over the last twenty years.

Gary Figallo

Bob Hess

AcoustaCrete is the name for Faddis Concrete Products' sound absorptive noise barrier series. The sound absorptive concrete is made using a recycled wood fiber aggregate in a composite panel cast with a structural concrete core. One or both sides can be sound absorptive. Architectural patterns can be cast into either side of the panel. New forms allow rapid change of form liners. The use of different patterns within the same wall is now easier to do. It is our goal to introduce many new and innovative designs for AcoustaCrete noise barriers.

Faddis was originally (since 1949) a concrete lintel producer, and still makes the product on a daily basis. Expanding the product line into noise barriers was a natural fit. Improvements in mix design of the Faddis standard Hessian series barriers has resulted in a high strength concrete that deserves a new consideration for use in noise barriers due to its low life cycle cost and good looks.

The addition of new casting machinery and batching equipment has placed Faddis in the forefront of casting efficiency, with the capability of producing normal and low slump precast. New forms are being used to manufacture concrete posts for noise barriers in Ohio and Pennsylvania. Other new products will be introduced as development proceeds.

Architects and engineers can benefit from consultation with Faddis to determine the most economical configuration for noise barriers and retaining walls. With the experience we bring to the table with these systems, we can offer insight and innovation to solve unusual or difficult problems. We are trained in the use of TNM, the FHWA's new noise model. We also have experience solving industrial and architectural noise problems. We are available to travel and meet with you. Just give us a call to set up an appointment. We look forward to hearing from you□

So Off We Went to NEW YORK City

The Lights
The people
The traffic
The NOISE

by Soren Pedersen

Well, I finally managed to get back to New York City after 44 years, almost to the day. The occation was the 21st Annual Transportation Research Board Summer Meeting of the A1F04 Subcommittee on Transportation Noise and Vibration.

The meeting was held from July 18 to July 20, at the Roosevelt Hotel in midtown Manhattan. Our hosts were the New York State Department of Transportation, the New York State Thruway Authority, the Port Authority of New York and New Jersey, and the New York Transit Authority. Meeting chair, Bill McColl (NY DOT), promised an event to remember!

To start with, the hotel was magnificent and provided an excellent setting for this years conference. Opened in 1924, the Roosevelt Hotel has an impressive heritage being named after President Theodore Roosevelthash. Returned to magnificence by a two-year restoration, midtown Manhattan welcomes back the legendary Roosevelt Hotel. Boosting one of the few remaining traditional ballrooms in New York City, complete with encircling balconies and towering gold-gilded ceilings, the elegance of the Roosevelt Hotel is indisputable. Ideally situated in the heart of midtown Manhattan at 45th and Madison Ave. where the business district meets the shopping and theater districts, the Roosevelt Hotel was within easy walking distance of the Broadway Theaters, Central Park, Grand Central Station, Metropolitan Museum of Art and Fifth Avenue Shopping.

The reception, which was held the night before the start of the meeting, gave everyone an opportunity to socialize with new and old aquaintences. Good food and good company, what more could you ask for.

The meeting started at 8 sharp on Tuesday morning, with a traditional agenda: 6 presentations in the morning (see details of all the presentations on page 7) and guided noise related tours in the afternoon. The attendees were offered a choice of 2 tours, one was the Westchester Couny Noise Barrier Tour and the other was the Rail Noise ? Subway Tour.

The evening activities for the attendees and their guessts consisted of 3 choices:

- ***A baseball game with the Yankees vs. the Phillies at Yankee Stadium***
- ***The Broadway show "the Music Man"***
- ***Harbor Lights Cruise***

It was a hard choice, but we (the wife and I) choose the show. Wouldn't have missed it for the world.

After the show we did a "Midnight Cowboy" walking tour of Times Square and the theater district on our own. What a wonderful experience that was.

Next morning, it was back at it again, with another 6 presentations in the morning and 2 tours in the afternoon; The Long Island noise barrier tour and the Brooklyn/Queens area tour.

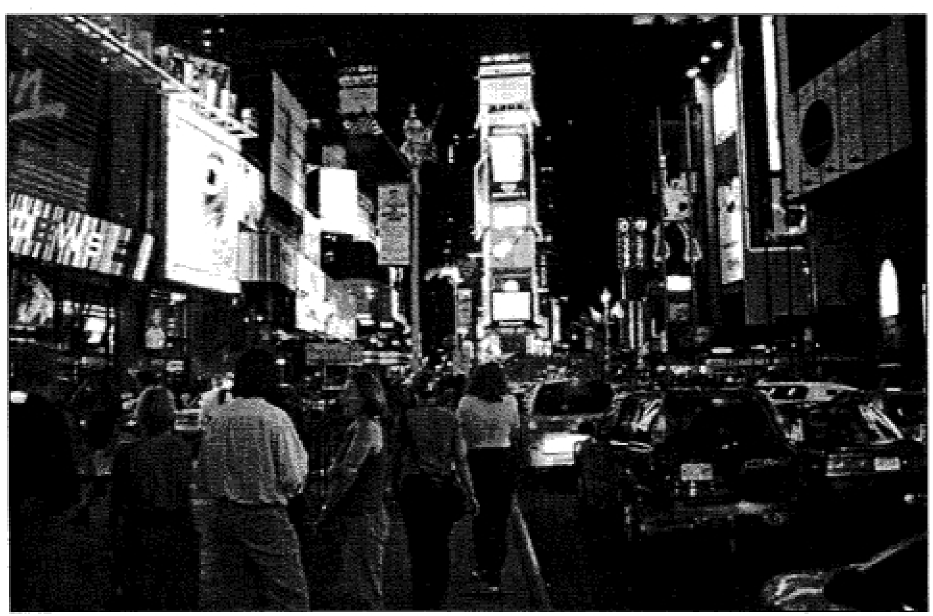
We had 3 choices again for the evening social program:

- ***A baseball game with the Yankees vs. the Tigers at Yankee Stadium***
- ***The Broadway show "Les Miserables"***
- ***Harbor Lights Cruise***

We just couldn't pass up a chance to see "Les Mis" on Broadway! So off we went again to Broadway.

On the last day, it was the same routine, with 6 presentations in the morning, but no more tours. Instead, a small group met for an hour after the closing cerimonies to discuss future research needs for the A1F04 committee. And so ended the 2000 Summer Meeting.

Thank you New York for a wonderful time□



Lights, sites and traffic of Times Square - New York City - during the "Midnight Cowboy" walking tour of Broadway.

BOOK REVIEW by Win Lindeman

Environmental Noise Barriers: A Guide To Their Acoustic And Visual Design

Benz Kotzen and Colin English

Routledge, 29 West 35th Street, New York, NY 10001
05/1999 - 184 pages with color illustrations
ISBN 0-419-23180-3 $85.00 (US) $128.00 (Canada)

Hey Win, have you read a good book lately? Glad you asked, because I sure have. Thanks to a landscape architect in my office, I was tuned into the availability of a new book, Environmental Noise Barriers: A Guide to Their Acoustic and Visual Design. After reading the review in the February, 2000 edition of Landscape Architecture Magazine, I felt it might be a welcome edition to my library. At the same time, I didn't want to waste time and money on a book that didn't offer anything new or significant. So I went on line to check it out at www.efnspon.com. Here I was able to review the annotated table of contents and get a better idea of how this book would be able to enhance my knowledge of noise barrier design. Once I had finished my review, I was confident that the book would indeed be a good investment, so I followed the ordering information found on the web, which for those of us in the United States and Canada are asked to order on line via www.routledge-ny.com

Waiting for the book to arrive was a challenge, but the brief wait (about a week) was well worth it. Here is a book chocked full of excellent photographs of noise barriers of many different designs, materials, sets, and visual treatments. The authors do not try to tell you how to design but rather guide you through the process by showing you how all of the various elements of design can (and should) be incorporated into a noise barrier that is both functional and aesthetically pleasing. This is not a catalog of noise barriers but rather an in-depth look at the importance of incorporating form and function within the environmental setting. A real plus in this book is the way the authors have taken the basic elements of acoustic theory, noise barrier design, and the locational landscape issues, and blended it so well that you feel compelled to follow their logic to the culmination of an excellent design.

But now for the real show stopper for me! I found the basic acoustic theory information so well discussed and illustrated that is should be required reading for all engineers and others involved in noise barrier design. This alone would have made the purchase price a bargain. Oh, can you tell that I really liked the book? You bet!, and I hope you enjoy it as much as I did.

Happy reading.

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UPCOMING EVENTS

August 27-30: *Inter-Noise 2000,* Nice, France, sponsored by the Internation Institute of Noise Control Engineering. For more information, contact: Societe Francaise d'Aceoustique, +33 14 788 9059; Email: sfa@loa.espci.fr

September 18-22: *FHWA Traffic Noise Model (TNM) Training* Burlington, Massechusits, USA, course conducted by Harris Miller Miller & Hanson Inc. (HMMH). More information information available at: at: http://www.hmmh.com/training.html, (781) 229-0707, fax (781)229-7939 or email: info@hmmh.com

October 2-3: *Transit Noise and Vibration Training Course,* Burlington, Massechusits, USA, course conducted by Harris Miller Miller & Hanson Inc. (HMMH). More information information available at: at: http://www.hmmh.com/training.html, (781) 229-0707, fax (781)229-7939 or email: info@hmmh.com

October 23-24: *American Society for Testing and Materilas (ASTM) Environmental Acoustics Committee Meetting,* Orlando, Florida, USA. For more information, contact: Steve Mawn, (610) 832-9726

January 7-11: *80th Transportation Research Board Annual Meeting,* Washington, D.C. USA. For more information, contact: (202) 334-2934 or Fax: (202) 334-2003

Construction Noise Control Program and Mitigation Strategy at the Central Artery / Tunnel Project

Erich Thalheimer
Lead Noise Control Engineer
Central Artery / Tunnel Project

My presentation will review the scope and magnitude of this mega-project which is rebuilding Boston's infrastructure from the ground down. The entire project is now expected to cost some $13 billion and construction operations may last some 12 years. The most politically-charged construction issue requiring successful mitigation is that of noise. Towards that end, the CA/T Project has devised and put into practice what is believed to be this nation's most extensive and innovative construction noise control program. Elements of our noise control efforts include work hour restrictions, required use of quieter equipment and noise barriers, a noise enforcement patrol, a comprehensive construction noise control specification 721.560, solutions for annoying backup alarms, provision of acoustical window treatments for qualifying abutters, and a vitally important community outreach and involvement process. I will discuss the pro-active and reactive abilities of the noise control program, all in the context of supporting construction progress to meet project milestones. I will also summarize the estimated costs directly attributable to the noise control program from start to finish.

FHWA Traffic Noise Model (FHWA TNM?) Software Development Update

Cynthia Lee
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Cambridge, MA
02142

In support of the Federal Highway Administration (FHWA) and the California Department of Transportation, the Volpe Center Acoustics Facility with assistance from Foliage Software Systems is completing development of the FHWA Traffic Noise Model (FHWA TNM) Version 1.1. This version is expected to be released in the second half of 2000. The most substantial enhancements to Version 1.1 will include the following:

- Implementation of 32-bit coding architecture;
- Substantial improvements to computational run-time;
- Updating of DXF import functionality with compatibility to AutoCAD? 2000;
- Implementation of new barrier design table;
- Implementation of a single comprehensive receiver input dialog;
- Implementation of batch-mode capabilities;
- Addressing of additional bug fixes;
- Implementation of additional error-catching mechanisms; and
- An addendum to the User?s Guide.

The above enhancements will be discussed in detail along with a brief look at what?s to come in Version 2.0, scheduled for release well before the FHWA mandated phase-in of TNM in December 2002.

FHWA Traffic Noise Model (FHWA TNM?) Validation Update

Judith L. Rochat
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02142

Since the summer of 1999, the Volpe Center Acoustics Facility, supported by the Federal Highway Administration (FHWA) and the California Department of Transportation, has been conducting a highway noise measurement study for the purpose of validating the FHWA?s Traffic Noise Model (TNM). The validation study as a whole spans several years with multiple phases, each phase requiring noise measurements at numerous sites around the country. The first phase of the study consists of sites with one or more of the following features: open field, wall or berm noise barriers, acoustically soft ground, and acoustically hard ground. As of May 2000, Phase 1 noise measurements are nearing completion. Measurements have been performed at 15 sites around the country: 4 in the New England area, 6 in Southern California, and 5 in Northern California. Five to six more sites are planned for measurement in Pennsylvania. At all measurement sites, a sophisticated instrumentation set-up is utilized including acoustic instrumentation (third-octave band A-weighted equivalent sound pressure levels), meteorological sensors (wind speed and direction, temperature, etc.), and video cameras (traffic counts, categorizations, speeds). The 5 or more hours of data acquired at each site are then analyzed and compared to TNM-predicted results. Preliminary analysis results will be presented, with the complete analysis of the Phase 1 data expected to conclude in late 2000 / early 2001.

Using Railway Noise Model (RWNM) For Detail Noise Ananlysis at Some Interesting Receptor Locations

Weixiong Wu & Stephen Rosen
Allee King Rosen & Fleming Inc.

This study presents the use of the RWNM model, developed by University of Central Florida, for prediction of noise impact in some interesting receptor locations from operation of proposed Long Island Rail Road (LIRR) in New York City. The project?s preferred alternative will allow the LIRR to increase train service throughout Long Island and Queens in 2020. The new service network would increase train passbys along most branches, creating a potential for adverse noise impacts at sensitive locations along the right-of-way in Queens, Nassau, and Suffolk counties. The RWNM model was applied to determine the existing noise levels and noise levels generated by the proposed project at the receptor locations such as: very dense urban area, elevated tracks; horns at grade crossing; and house shielding. The study was performed by the following steps: noise-sensitive receptor sites were selected using Geographical Information Systems (GIS), aerial photographs, and field studies; existing noise levels were established by site noise measurements and compared to noise levels calculated using the RWNM model; the project noise levels were calculated using FTA methodology and the RWNM model; noise levels which would result in impacts or severe impacts were determined using FTA noise criteria; project RWNM noise level results were compared to FTA noise criteria to determine locations where impacts or severe impacts would occur; and, finally, at locations where impacts or severe impacts were predicted to occur the feasibility and effectiveness of implementing mitigation measures was explored. The study examines the implications of relatively modest increases in rail service in urban areas with high existing noise levels due to noise from existing rail service and other nearby activities, using the RWNM model and FTA impact criteria.

Value-Based Barrier Optimization Procedures for FHWA Traffic Noise Model

Paul Burgé
Senior Consultant
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33 Moulton Street
Cambridge, MA 02138
617/499-8012

See page 15 for full details of Paul Burgé's presentation.

Interstate 290 Noise Barrier Evaluation Study

Kenneth R. Avery, P.E.
Bergmann Associates, Inc. P.C.
200 First Federal Plaza
28 East Main Street
Rochester, New York 14614

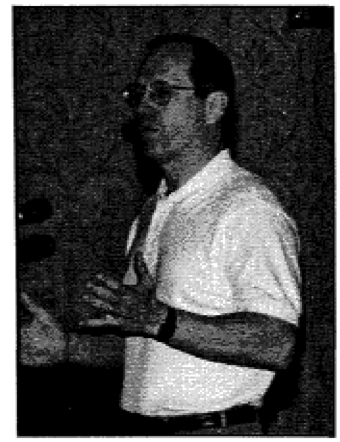
In response to residents' concerns, the NYSDOT investigated seven (7) noise barriers with a composite length of approximately 4 miles to determine whether or not the barriers are providing substantial noise reductions as required by State and Federal regulations. The methodology included simultaneous and incidental noise measurements using Type II integrating sound level meters. Simultaneous noise measurements were made with one noise meter microphone set 3 to 5 feet above the top of noise barrier, and the second microphone set in the back yards of residences. The measurement data and source-barrier-receptor geometry were used to calculate noise barrier insertion losses at 8 locations. Incidental noise measurements were performed at another 8 locations to measure the effects of flanking, and determine noise barrier effectiveness at the second and third rows of houses. Although noise barrier insertion losses at 7 of the 8 noise barriers were substantial, ranging from 12 to 14 dBA, noise levels in the shadow zone equaled or exceeded the FHWA Noise Abutment Criteria for residential land use at 5 of 8 noise barriers.

Noise Propagation Through and Around Highway Noise Barriers

Courtney B. Burroughs and
Anthony Bontomase
Graduate Program in Acoustics
The Pennsylvania State University
State College PA 16804

A 14-foot-high, 80-foot-long wooden highway noise barrier was built for the detailed study of insertion losses, and propagation paths through and over the barrier. Prior to building the barrier, measurements were conducted of the noise propagation losses over the grass-covered site. These measurements were used with measurements conducted after the barrier was built to determine the insertion losses for the barrier with and without gaps between the wood planks, and with and without a "T" on the top edge of the barrier. Comparisons of these measured insertion losses to insertion losses estimated from measurement made only with the barrier in place are made. An array of microphones is being used to separate the contributions to the overall noise on the receive side of the barrier made by transmission through the barrier, diffraction at the edges of the barrier, and scattering by atmospheric turbulence created by wind. Preliminary results from these measurements will also be presented, along with plans for future measurements and analyses designed to improve in-situ insertion loss measurement methods.

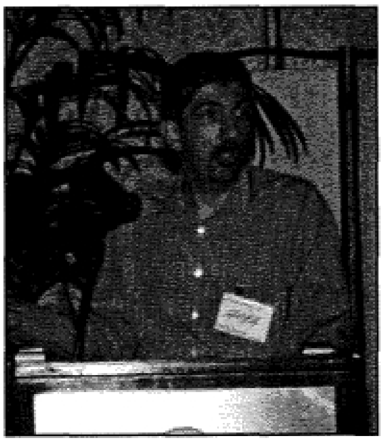
In-Situ Evaluation of Sound Absorbing Traffic Noise Barriers Using Test Signals



Lloyd Herman, Jeremy Ghent, and
Elvin Pinckney

A test system using computer generated test signals was used to identify and characterize reflections for single and parallel traffic noise barriers before and after the installation of sound absorbing panels to the west barrier. The results confirmed the presence of reflections from both single and parallel barrier configurations in the project area. The contribution of the reflections to sound levels was found to increase with increasing receiver distance from the highway. The sound-absorbing panels substantially reduced the contributions of first order reflections for receivers on the east side of the highway. Second order reflections were substantially reduced for receivers on both sides of the highway.

Noise vibration issues of the I-15 Reconstruction Project



Areg Gharabegian
Parsons Engineering Science, Inc.

The reconstruction of I-15, approximately 16.5 miles of freeway in Salt Lake City, Utah, includes widening the corridor to include an additional general purpose and an HOV lane. This design-build project is the largest public works project underway in US. Over 5 million cubic yards of fill material used to widen I-15 and more than 140 bridges will be replaced. Due to the special nature of this project, a project specific noise and cost effectiveness criteria was developed using Utah Department of Transportation and FHWA noise abatement criteria.

Noise measurements were conducted at various sensitive receptor locations to establish the background noise levels. Detailed noise studies were conducted to determine the final location and heights of more than 25 sound walls to mitigate future noise impacts. Color and engraved pattern of all soundwalls were designed to match the looks of Wasatch mountains.

Pile and sheet driving are used extensively for this project. There also has been concrete and asphalt breaking as well as demolishing existing bridges and viaducts. Noise and vibration monitoring are conducted regularly at sensitive sites next to the construction activities. There are concerns about structural damages and vibration impacts to different operations, which are located adjacent to the construction activities. If high vibration levels are recorded, the appropriate corrective actions are taken to minimize the construction vibration at the sensitive sites. Parsons ES engineers and scientists are in daily contact with contractor's Health and Safety Officer and the three segment construction managers to stay abreast of the pile driving and other major construction schedule.

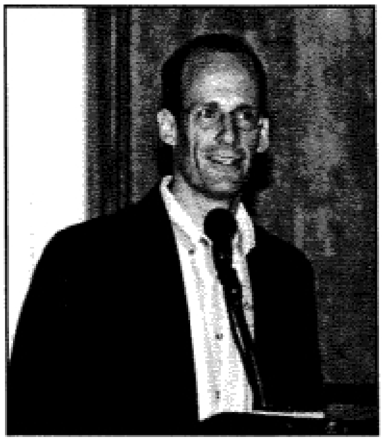
Hundreds of vibration measurements were conducted at various distances. Results of the monitoring data were analyzed and assessed with project vibration criteria, and they were graphed for different activities. These graphs can be used to determine anticipated vibration activities at different locations and for other projects. Results of these measurements were also uses to assist the project insurance agent to evaluate building damage claims and determine their validity.

Lateral Attenuation of Aircraft Sound Levels Over an Acoustically Hard Water Surface: Logan Airport Study

David A. Senzig, Gregg G. Fleming, John-Paul B. Clarke

The National Aeronautics and Space Administration (NASA), Langley Research Center (LaRC), sponsored the Acoustics Facility at the United States Department of Transportation's John A. Volpe National Transportation Systems Center (Volpe Center) and the Massachusetts Institute of Technology (MIT) to conduct a noise measurement study at Logan International Airport in Boston, Massachusetts, during the summer of 1999 to examine the applicability of currently available mathematical models of lateral attenuation. Analysis of the data collected revealed that lateral attenuation is a function of aircraft geometry. Lateral attenuation for aircraft with tail-mounted engines was found to agree with the published literature, as well as that included in existing aircraft noise models. Lateral attenuation for aircraft with wing-mounted engines was found to be less than documented in the literature. This lower lateral attenuation for aircraft with wing-mounted engines results in a general under-prediction of side-line noise in the existing noise models. This presentation will overview the findings of the Logan Study.

Comparison of STAMINA2.0 to TNM Results on Long Island Expressway Noise Barrier Analysis



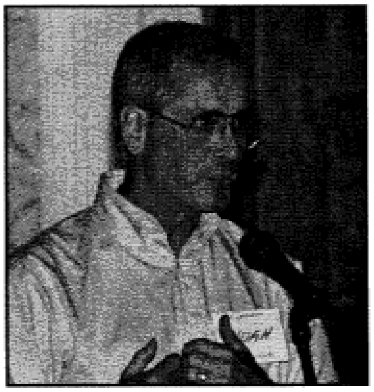
Douglas E. Barrett Senior Consultant
Harris Miller Miller & Hanson Inc.
15 New England Executive Park
Burlington, MA 01803

For the New York State Department of Transportation, Harris Miller Miller & Hanson Inc. conducted noise barrier evaluations using both STAMINA2.0 and TNM (Ver. 1.0a) for six areas along the Long Island Expressway in Nassau and Suffolk Counties. Although the same roadway/barrier/ receiver geometries and traffic data were used for both the STAMINA and TNM evaluations, the analyses with the two different models were conducted independently.

The comparison provided the following results:

- In all of the modeled no-barrier cases, the loudest-hour sound levels computed by the two traffic noise prediction models were in close agreement to each other (generally within one to two decibels).
- In all of the with-barrier cases, TNM predicted somewhat greater average noise reduction than did STAMINA.
- In general, STAMINA predicted more additional incremental benefit with increased barrier height than did TNM. Analysis of the models? output indicated that noise generated by traffic on the unshielded frontage road contributed to this result.

Noise Impacts from Train Horns at Highway/Rail At-Grade Crossings



Hugh Saurenman
Harris Miller Miller & Hanson Inc.
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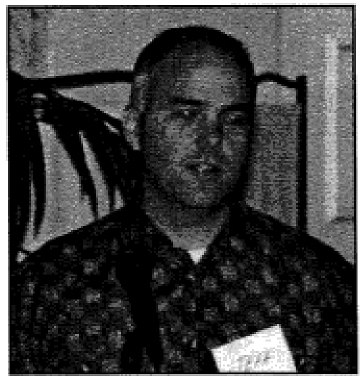
Most states presently require locomotive horns be sounded starting 1/4 mile prior to all public highway/rail grade crossings. For residential communities located near grade crossings, the horn noise is usually the major source of noise exposure. There are many communities where train horn "bans" are in effect because of the impact caused by the horns. The Draft Environmental Impact Statement, "Proposed Rule for the Use of ocomotive Horns at Highway-Rail Grade Crossings" (Federal Railroad Administration, December 1999), demonstrated that the existing grade crossing horn bans reduce noise impact for a large number population across the United States. Noise studies in support of the new regulations have shown that eliminating all horn bans would expose approximately 350,000 additional people to noise impact and that controlling the location where horns are mounted on locomotives and modifying the train horn systems to focus the warning noise at the grade crossings would substantially reduce noise impacts at more than 150,000 grade crossings in the US.

Coherence in Groundborne Vibration Propagation Testing - How Bad is Good Enough?



Jeffrey A. Zapfe
Acentech, Inc.
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Cambridge, MA 02138

The transfer mobility (TM) method can be used to measure the propagation of vibration through the ground. To evaluate TM, a known force is imparted to the ground while the resulting ground vibrations are measured some distance away. Transfer mobility is defined as the transfer function relating the ground vibration velocity to the applied force. In urban environments, like we encountered on Manhattan during the EIS for the LIRR East Side Access Project, it can be difficult to obtain accurate estimates of TM because of poor signal to noise ratios.

The coherence function is a measure of the quality of the TM transfer function. In this presentation, we investigate the relationship between the coherence measurement and the quality of the TM estimate.

CSA International - CAN/CSA Z107.9-00 Standard for Certification of Noise Barriers

Soren Pedersen
Chair, CSA International,
Subcommittee on Transportation Noise
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Specifying a noise barrier just became a lot easier with the release of the CSA International CAN/CSA Z107.9-00M Standard for Certification of Noise Barriers. Based on the commonalties of well established regional noise barrier specifications and input from numerous agencies in North America, the standard sets out the requirements for certification of barrier systems and installations as meeting the three fundamentals of any specification, which are: safety, performance and durability.

The majority of the provisions of this standard form an integral part of the new FHWA Highway Noise Barrier Design Handbook. ANSI (as an affiliate of CSA International) is currently in the process on adopting this standard specifically for the US market.

The standard provides guidance and establishes minimum requirements for all aspects of the physical design, the materials used, the manufacturing process, installation and inspection requirements and acceptance and rejection criteria. The presentation will describe how the standard was developed and the fundamentals it was based on. In addition a detailed description of all the various components of the standard will be presented, including details of the critical 4 part certification process.

Three-Dimensional GIS Modeling of Train Induced Vibration in Manhattan East Side Access Project

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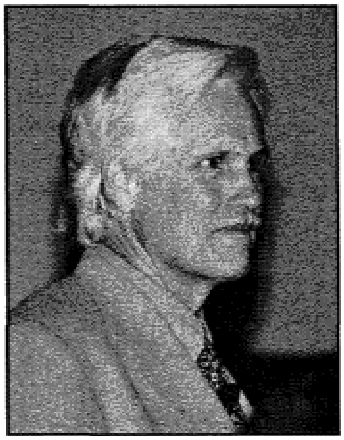
The East Side Access Project proposes to build new tunnels in Manhattan and Queens connecting to the existing 63rd Street Tunnel to provide service between the LIRR's Port Washington Branch and Main Line to Grand Central Terminal. Acentech evaluated the vibration impacts associated with this project in support of the Environmental Impact Statement. Acentech developed a Geographic information System (GIS) model that calculates train-induced vibration levels as a function of train speed, tunnel depth, slant distance, and building response. Given a complex array of tunnels at various depths, numerous buildings of varying size and foundation types, as well as several operational scenarios to evaluate, the GIS model provided an efficient and consistent way to evaluate impacts.

Vibration Response of Buildings to Ground-Borne Rail Transit Vibration



Richard A. Carman
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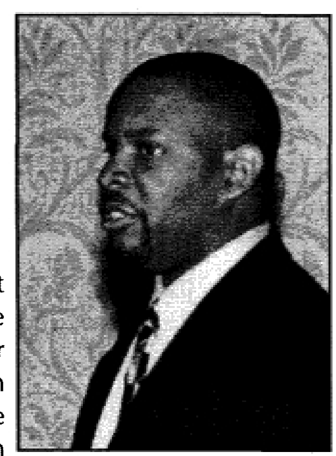
The FTA guidelines for detailed analysis and prediction of ground-borne noise and vibration generated by rail transit systems are based on an empirical method developed by Nelson and Saurenman (TRR 1143, ?87). This approach relies on quantitative characterization of the vibration source, path and receiver under consideration by system-specific field measurements. The procedures for measurement of vehicle/track system source strength, and the attenuation of vibration as it propagates with distance through the ground are more or less generally accepted practice at this time. Whereas, the receiver effects of building structures on vibration are open to debate, due in part due to the wide array of buildings encountered in practice. Detailed measurements of the source and path characteristics are important, but an engineering analysis based on insufficient knowledge of the specific effects of the buildings encountered along a new transit alignment is lacking and can lead to substantially inaccurate conclusions when making design decisions regarding track vibration isolation requirements. Measurement data were presented in the Nelson and Saurenman paper based on previous WIA measurements. Subsequent measurements obtained by WIA over the last decade are presented and discussed. After numerous measurements, there is a similarity in the data that emerges in particular for smaller residential building structures. Preliminary conclusions based on the currently available data are drawn regarding the response of this type of structure to ground-borne vibration from rail transit systems.

MBTA Old Colony Commuter Rail Ballast Mat Performance Study



Herb Singleton, Consultant
Harris Miller Miller & Hanson Inc.
15 New England Executive Park
Burlington, MA 01803

The Massachusetts Bay Transit Authority installed ballast mats at various locations as a vibration mitigation measure during the reconstruction of the Old Colony commuter rail lines that opened in the fall of 1997. Post-installation measurements were carried out early in 1998 to assess the effectiveness of the ballast mats in controlling vibration from revenue-service trains. The measurement results indicate that ballast mats were marginally effective in several locations. The study concluded that careful consideration of ballast mat placement and ground propagation conditions is necessary for ballast mat mitigation to be successful.

U.S. Department of Transportation

Federal Highway Administration

NOISE SPECIALIST POSITION

PROFESSIONAL DEVELOPMENT PROGRAM

On Monday September 11th, the FHWA will announce a noise specialist position in the Professional Development Program (PDP), a 2-year entry-level training program designed to prepare individuals for a professional career with the Federal Highway Administration (FHWA). Three announcements will be posted for this position - a GS-09 Civil Engineer (Master's Degree - $42,091), a GS-09 Environmental Protection Specialist (Master's Degree - $35,310), and a GS-07 (Bachelor's Degree - $34,408). The position location is in the FHWA Headquarters Office in Washington, D.C. The following information explains this employment opportunity.

The FHWA is one of the major organizations within the U.S. Department of Transportation and has its headquarters office in Washington D.C. It also has a field office in each State across the country. The mission of the FHWA is to provide the necessary expertise, resources, and information needed by our partners and customers so that, collectively, we can continue to improve the quality of our nation's highway system and its intermodal connections. We are charged with undertaking this mission to promote the country's economic vitality, improve the quality of life of our citizens, and enhance the environment.

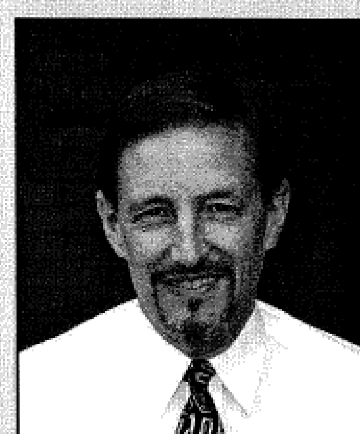
A noise specialist in the FHWA serves as an authoritative advisor on a national basis for developing and promoting standards and policies related to highway traffic noise, developing procedures and techniques to assess and mitigate highway-related noise impacts, and providing advice, counsel, and interpretation of FHWA noise policies, procedures, and regulations. Examples of specific work activities include the following: (1) develop regulatory policies and procedures; (2) provide assistance to staff from FHWA offices and State departments of transportation in the development and implementation of written State noise policies; (3) implement a new-generation highway traffic noise prediction model, the FHWA Traffic Noise Model; (4) develop informational brochures to discuss various aspects of highway traffic noise; (5) develop technology transfer papers, such as a triennial noise barrier listing and a noise barrier construction trend discussion; (6) teach a noise fundamentals training course and provide lectures, seminars, workshops, etc. on highway traffic noise analysis and abatement to staff from FHWA offices and State departments of transportation, local governments, and the private sector; and (7) provide assistance to FHWA personnel, State departments of transportation, local governments, and the general public on analyses and inquiries related to highway traffic noise.

Participants in the PDP will progress through a comprehensive and structured set of learning experiences, which include on-the-job training, developmental assignments, and participation in a professional development academy. These learning experiences will be formally described in a development plan prepared for each individual entering the program. The participant will work under the guidance of a coach, who, as an experienced professional, will provide the direction and instruction necessary for successful learning and development. Full details of the PDP may be found at www.fhwa.dot.gov/aaa/pdp/index.htm.

We are planning to announce the noise specialist position on Monday September 11th. The announcement will appear at the U.S. Office of Personnel Management's website at the following address - www.usajobs,opm.gov under DOT Federal Highway Administration. You may also access the announcement by going to FHWA's website at www.fhwa.dot.gov/index.html, clicking on Jobs in the Federal Highway Administration, and then clicking on FHWA Jobs Listing (you may also find additional information about FHWA at our website). Applications should be submitted in accordance with the instructions found in the vacancy announcement. If individuals have any questions or would like to discuss this opportunity further, please do not hesitate to contact **Bob Armstrong at (202) 366-2073** □

Harris Miller Miller & Hanson Inc. (HMMH)

is pleased to annouce the September 1, 2000 opening of our Richmond, Virginia office. Cary Adkins, who will manage the office, brings to HMMH 23 years of experience conducting and overseeing highway noise studies for the Virginia Department of Transportation as their Noise Program Manager. Cary and the Richmond office will enable HMMH to provide the highest level of service and responsiveness to our clients throughout the mid-Atlantic and southeast.



Cary Adkins
Noise Program Manager
HMMH Richmond, Virginia Office

Value-based Optimization Procedures for FHWA Traffic Noise Model

by: Paul Burgé Senior Consultant Acentech Inc., Cambridge, MA

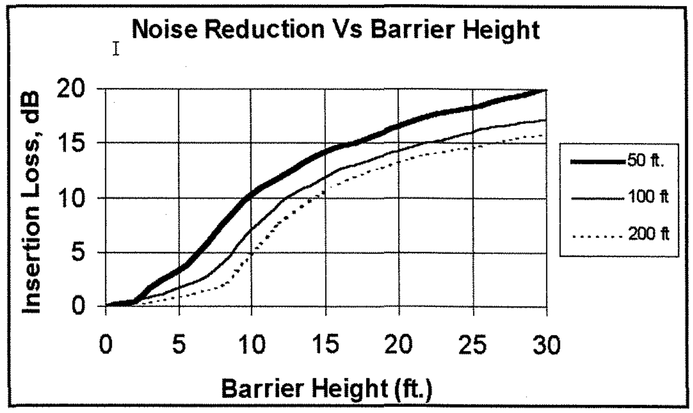


Figure 1. Simple TNM barrier, Height vs. Noise Reduction

Introduction

The practice and policy of highway noise barrier optimization are changing as we move from the use of STAMINA to TNM as the primary tool for highway noise barrier design. This is principally due to the fact that while STAMINA had a built-in systematic approach to noise barrier optimization (via its sister program OPTIMA), TNM does not. Noise barrier optimization can certainly be performed as part of a TNM design task, but it requires the designer to develop and carry out an optimization scheme on his own. This paper discusses the rationale behind noise barrier optimization, and offers some suggested procedures for performing a value-based analysis.

What is Optimization?

The most general definition of "optimization" is a process to determine the most effective use of something: money, time, material, effort, etc.; or a way to identify the maximum return on an investment. From an engineering standpoint, optimization involves determining the conditions for maximum performance, often by finding the maximum (or minimum) of some characteristic non-linear equation. The assumption of a non-linear relationship between input and output is essential to the concept of optimization.

Some non-acoustical examples of optimization:

- ☐ The optimum angle of elevation of a cannon muzzle or gun barrel for maximum projectile range is, not surprisingly, 45 degrees (neglecting air resistance). A fraction of a degree more or less and the projectile will not go as far.
- ☐ Snow-making technicians will tell you that there is an optimum temperature for making "perfect" artificial snow. At the elevation for a ski resort near my home, the optimum temperature is 248 F. At 238 the snow starts getting icy; at 258 it starts getting moist.
- ☐ The new hybrid automobiles that are now being marketed with mileage claims of 60 to 70 miles per gallon are products of optimization. They use a small gasoline engine designed to operate only at its most efficient optimal operating conditions (rpm, load) to supply energy to an electric motor that can operate much more efficiently over a wider range of operating conditions.

Why Perform Noise Barrier Optimization?

The best reason to optimize a barrier design is that a noise barrier *can* be optimized. That is, the relationship between barrier cost and performance is non-linear. Some point can be identified in the relationship where the barrier produces the best balance of cost and performance.

Figure 1 shows a basic example of the relationship between barrier cost (expressed in wall height) and performance (noise reduction). The values for this graph were generated from TNM for a simple barrier case. This figure shows that noise reduction generally increases as a function of barrier height. However, a close inspection of the non-linear relationship (for three different receiver distances) reveals that beyond some point, further increases in barrier height result in smaller and smaller increases in noise reduction: the infamous *point of diminishing returns.*

Figure 2 shows the differentiation of the data in Figure 1, or the increase in barrier noise reduction for a unit increase in barrier height (of one foot). Here the point

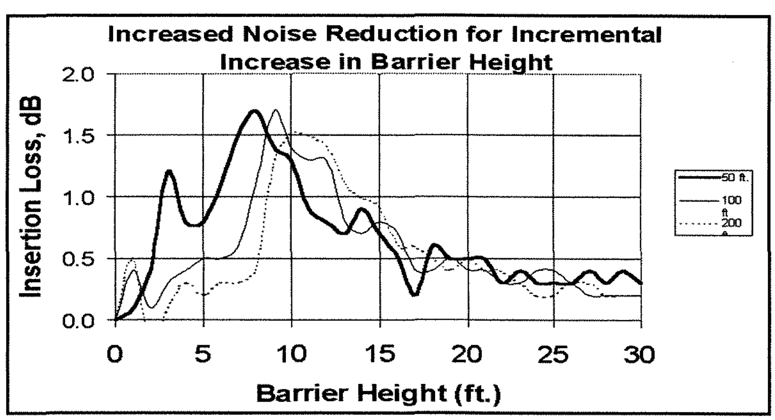


Figure 2. Simple TNM barrier, Incremental Height vs. Noise Reduction

of diminishing returns is more obvious. Barriers designed to this height (around 10 feet for this example) could be said to have the best ratio of performance to cost.

Basis for Barrier Optimization: Value, Cost and Benefit

In order to optimize a barrier it is required to define a parameter or variable to maximize (or minimize). If our goal is to maximize the return on investment (where the investment is the construction cost of the barrier and the return is the benefit that the barrier provides) then we would seek to maximize the ratio of benefit to cost.

This ratio of benefit to cost is really what most people think of as value. The value of something is its benefit, or worth, divided by its cost (in money, time, lost opportunity). Is a certain coast to coast airline ticket a good value? It depends on how much you paid for it (and if it requires you to connect through Juneau). Is a $5,000 used car a good value? It probably is if it's a mint-condition, late-model Mercedes, but probably not if it's a 25 year old Ford Pinto.

The estimated cost of a noise barrier is usually expressed in terms of cost per unit area, typically around $20 per square foot, but may range between $10 and $30 per square foot depending on a number of factors. You may also find it appropriate to use a higher cost for special installations, such as barriers built on structure. You may also use an additional cost per unit length to account for construction expenses not related to barrier height, such as traffic controls and landscaping. It is probably best to use whatever figures are specified in that particular state highway agency's barrier reasonableness policy, unless it can be clearly demonstrated that the costs for the specific barrier are expected to be substantially different.

Noise Reduction, dB(A)		Benefit
from:	to:	(change in %HA)
85	75	35
80	70	28
75	65	22
70	60	16
65	55	11
60	50	7
55	45	4
50	40	1

Table 1. Benefit Derived from 10 dB Noise Reduction

Benefit is more difficult to nail down. A simple approach would be to sum up the barrier noise reduction at each receiver position (as predicted by TNM) times the number of residential units represented by that modeled location. However, this approach neglects the concept that the absolute noise level together with increases or decreases in noise level affects people's reaction to changes in noise exposure. For this reason we suggest basing barrier benefit on reduced annoyance as defined by the Community Noise Annoyance Curve, or "Schultz Curve," as shown in Figure 3 (Schultz, JASA 1969). For example, the Schultz Curve says that at a noise exposure of 65 dBA (Ldn) approximately 15% of people would rate their response to the noise as "highly annoyed." Using the Schultz Curve we can define the barrier's benefit as the reduced annoyance in terms of reduction in the percentage of people highly annoyed. When using the Schultz curve, you must remember to convert levels from Leq to Ldn. For highway noise sources we've found Ldn to generally be between 2 and 6 dB greater than loudest hour Leq.

Why use reduced annoyance instead of noise reduction? Because the relationship between noise level (in Day-Night Noise Level, Ldn) and the "Percentage of people highly annoyed" is not linear. Specifically, a given level of noise reduction will provide a greater benefit at higher noise levels than at lower ones. Table 1 shows a comparison of the benefit for a 10 dB noise reduction for a variety of different unmitigated noise levels. This shows that, according to the Schultz Curve, a noise reduction from 75 dBA to 65 dBA, (Ldn) will produce twice the benefit as a 10 dB noise reduction from 65 dBA to 55 dBA, and three times the benefit as a noise reduction from 60 dBA to 50 dBA. A "noise reduction only" assessment of barrier benefit would (misleadingly perhaps) count all of these equally.

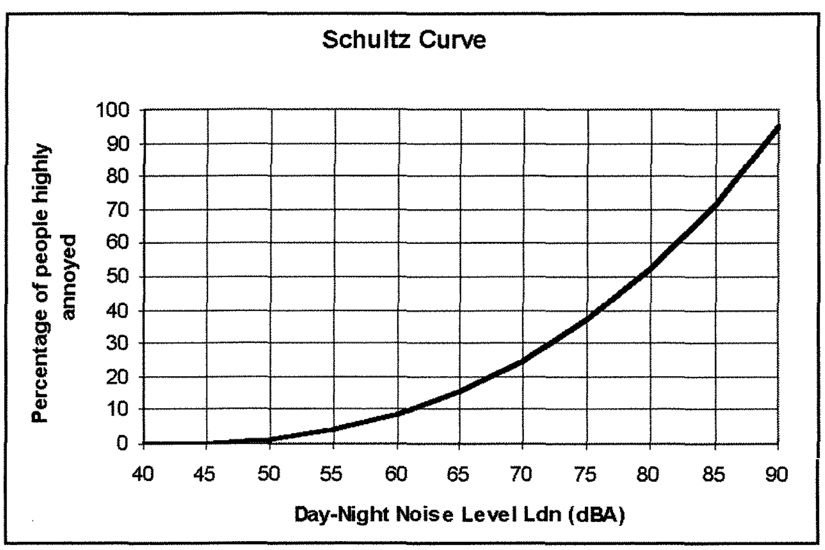


Figure 3. Community Annoyance Due to Noise

Using these criteria, we can now define barrier benefit and barrier value as follows:

$$\text{Benefit}^* = \Sigma(\%\text{ Highly Annoyed}_{\text{wo/barrier}} - \%\text{ Highly Annoyed}_{\text{w/barrier}})$$

*sum benefit for all nearby units, not just impacted units

$$\text{Value} = \text{Benefit/Cost}^{**}$$

**for convenience, cost is usually expressed in millions of dollars

The parameter of "Value," calculated in a spreadsheet program for various barrier designs can now be used as the optimization parameter.

Other design considerations

Of course, other design considerations must be taken into account apart from blindly maximizing the calculated barrier value. These other considerations include:

- Maximum cost per protected dwelling unit
- Maximum and minimum allowable barrier heights
- Minimum allowable noise reduction
- Barrier aesthetics

Barrier Optimization Procedures

We use a number of procedures to help develop an optimized barrier design. These include setting receiver-specific design goals; analyzing barrier segment values, and comparing the values of different candidate barrier designs.

Receiver-Specific Design Goals

The easiest way to develop a "first-stab" candidate barrier design with good value is to establish achievable, receiver-specific noise reduction goals and then adjust barrier segment heights so that they are no higher than is required to meet those goals. Examples of some reasonable design goals are presented in Table 2. These goals might have to be tailored to the requirements of an individual project, but we have found them to be generally reasonable. A candidate noise barrier designed to meet these goals can then be saved for comparison to other candidate designs.

Receiver Type	*Noise Reduction Goal*
First Row, Impacted, Non-shielded	10 dB
First Row, Impacted, Partially Shielded	5–7 dB
Second Row, Impacted	5 dB
Non-impacted	0 dB

Table 2. Receiver-Specific Noise Reduction Goals

Barrier Segment Value Analysis

This tool utilizes TNM's "Diagnosis by barrier segment" table to estimate the optimum height for individual barrier segments using these steps:

1. In TNM, calculate receiver noise levels for number of uniform height barrier designs including zero (say 0,8,10,12,and 14 feet high).
2. For each barrier height, export the "diagnosis by segment" table, and import into a spreadsheet.
3. Re-sort the tables by barrier segment and calculate the value for each segment over all reported receivers.
4. Compare the calculated segment values for all heights and select the height with the highest value (as shown in bold type in Table 3). This analysis will produce another candidate barrier design that can be compared to others.

This method will likely not produce the best final barrier design, but it will serve as a good candidate design for the sake of comparison and also help the designer to identify the general shape of the optimized noise barrier. It will also help to identify the individual barrier segments that really contribute the most, or least, value to the overall barrier.

Be aware that there are potential rough spots with this technique. First, the re-sorted TNM "Diagnosis by Barrier Segment" table (from step 3, above) does not always report results for the exact same set of receivers per barrier segment for all uniform barrier height designs. When the lists of important receivers in this table do not match up from one barrier height to the next, the designer must either delete the mismatches or make an educated guess for missing receivers. However, the mismatches, if they exist, are usually pretty far down the list, and not making much of a contribution anyway. Second, the TNM "Diagnosis by Barrier Segment" table reports a "partial" Leq for each receiver. So, in addition to adding 2 to 6 dB to correct for Leq to Ldn, it is necessary to add another 7 to 10 dB correction to adjust for the difference between partial Leq and total Leq before applying the results to the Schultz curve.

Barrier Value Spreadsheet

This step is really the essence of any value-based optimization. The procedure involves the development of a spreadsheet that calculates the overall value for each barrier design candidate. This overall value, together with other important parameters, can be used to compare all candidate design and select the best overall candidate.

Barrier Segment	*height (ft) length*	*8 value*	*9 value*	*10 value*	*11 value*	*12 value*	*13 value*	*14 value*
B6-1	100	**1705**	1643	1644	1620	1622	1588	1555
B6-2	100	3158	3241	3276	3265	**3291**	3256	3182
B6-3	100	3900	4072	4195	**4214**	4194	4143	4057
B6-4	100	4876	5089	5241	**5252**	5250	5202	5157
B6-5	100	4532	4933	5082	**5135**	5115	5104	5029
B6-6	100	4608	5029	5143	**5194**	5174	5150	5076
B6-7	100	6614	**6929**	6920	6801	6688	6507	6319
B6-8	100	6292	**6576**	6567	6419	6243	6011	5816
B6-9	100	5414	**5467**	5331	5194	5013	4858	4733
B6-10	95	**4405**	4379	4273	4116	3963	3815	3661
B6-11	100	2698	2778	**2779**	2697	2633	2542	2454
B6-12	76	3314	**3384**	3284	3205	3102	2963	2842
B6-13	100	**7839**	7800	7611	7407	7132	6830	6530
B6-14	42	12177	12902	**12915**	12823	12578	12248	11882
B6-15	100	6451	6954	7214	7364	**7378**	7222	7004
B6-16	100	6168	6816	7019	**7118**	7007	6824	6595
B6-17	100	7104	7568	7816	**7877**	7734	7485	7206
B6-18	100	7838	8536	**8747**	8674	8550	8204	8005
B6-19	84	8574	9385	**9546**	9435	9266	8921	8719
B6-20	100	8250	**8623**	8475	8152	7841	7479	7263
B6-21	100	4004	**4182**	4077	3821	3626	3469	3327
B6-22	50	**3654**	3175	3032	2901	2744	2608	2479
total barrier		123574	129462	**130187**	128682	126145	122429	118892

Table 3. Barrier Segment Value Analysis Example

Important parameters to calculate in the spreadsheet can include the following:

- □ Overall Barrier Value (as previously defined)
- □ Overall Barrier Cost
- □ Cost Per or Number of Protected Dwelling Units (as defined by SHA policy)
- □ Average Noise Reduction
- □ Remaining Impacts (as defined by SHA policy)

Table 4 shows an abbreviated example of a Barrier Value Spreadsheet. Note that both the Receiver Specific Noise Reduction Goal (RSDG) design, and the Best Segment Value (Seg Val) design have a substantially better overall value than any uniform height design. Additional designs represent minor adjustments attempting to further maximize positive properties and minimize barrier costs. In this example, we have chosen a Best Overall Design (Opt7) that offers a very high value, while still retaining a high average noise reduction and low remaining impacts. Note that the selected Best Overall Design represents a 25% cost saving over more rudimentary designs.

Barrier Optimization and Aesthetics

We've occasionally heard the opinion that "optimized" noise barriers are aesthetically unattractive. This can be true, but it doesn't have to be. Obviously, optimization exercises can be taken too far. Noise barriers with segments that rise and fall like a Coney Island roller coaster can be visually distracting, and are probably overly designed with respect to artificially discrete modeled receiver locations. On the other hand, long, uniform height barriers tend to suffer from poor overall value, unless both topography and population density are highly uniform. We have found that limiting the allowable rise and fall between adjacent barrier panels (e.g., no more than a one-foot change in elevation per 100 feet) is a promise that can yield a high value barrier that is also easy on the eyes. However, even uniform height barriers can and should be optimized, as one particular uniform height will have a greater value than any other.

Conclusion

Noise barrier optimization is an important consideration in any final barrier design process. Using a step-by-step approach for optimization can extend the functionality of TNM, and provide crucial data for validating design decisions. The typical 20% construction cost savings justifies the relatively small cost involved in conducting the analysis. It helps to achieve better "Bang for the Buck" designs that elected policymakers, agency officials and taxpayers can all appreciate. But most importantly, it lends a systematic approach to the final barrier design process that is generally lacking in most state highway agency policy □

design	**8' uni.**	**10' uni.**	**12' uni.**	**14' uni.**	**RSNRG**	**Seg Val**	**opt1**	**opt2**	**opt3**	**opt4**	**opt5**	**opt6**	**opt7**
benefit	497.64	685.02	811.34	892.98	838.19	690.66	687.59	719.34	740.45	754.13	772.72	775.20	777.37
cost	294768	368460	442152	515844	439800	363600	349200	361500	372000	377800	387600	389800	389400
value	1688	1859	1835	1731	1906	1899	1969	1990	1990	1999	1994	1989	1996
Average IL	5.0	7.3	8.9	10.0	9.3	7.3	7.3	7.7	8.0	8.1	8.4	8.4	8.4
CPPDU	$10,164	$6,952	$7,369	$8,320	$7,330	$6,860	$6,589	$6,821	$7,019	$7,128	$7,178	$7,219	$7,211
impacts	27	19	4	0	5	15	18	14	7	6	5	5	5

Table 4. Barrier Value Spreadsheet Comparison

Did you know that . . .? Through the end of 1998, forty-four State departments of transportation and the Commonwealth of Puerto Rico have constructed over 2,610 linear kilometers of barriers at a cost of over $1.4 billion ($1.9 billion in 1998 dollars). Six States and the District of Columbia have not constructed noise barriers. Ten States account for approximately seventy percent (70%) of total barrier length and cost.

'Yep, that's right! The long-awaited "Summary of Noise Barriers Constructed by December 31, 1998," is being printed and should be available by the time you read this. The companion paper "Highway Traffic Noise Barrier Construction Trends" should also be available, as well as an updated brochure, Highway Traffic Noise in the United States: Problem and Response. For additional information, contact **Bob Armstrong** at (202)-366-2073 or **Steve Ronning** at (202) 366-2078, respectively.

Insulation of private residences as a routine noise abatement measure . . .?

FHWA intends to publish an Advance Notice of Proposed Rulemaking in the Federal Register to solicit views on allowing Federal participation in the noise insulation of private residences when a traffic noise impact occurs, i.e., when predicted traffic noise levels approach or exceed noise abatement criteria or when predicted traffic noise levels substantially exceed the existing noise levels. Currently, such participation is allowable only when a severe traffic noise impact occurs, e.g., absolute noise levels are 75 dBA Leq(h) or more, or noise levels increase 30 dBA or more over existing noise levels. For more information, contact **Bob Armstrong at (202) 366-2073.** Stay tuned . . . . □

FHWA Highway Noise Barrier Design Handbook

Cynthia Lee unveils the FHWA Highway Noise Barrier Design Handbook products during the TRB July meeting held In New York City.

Cynthia Lee, from the Volpe Center, Acoustics Facility, proudly announced the release of the FHWA Highway Design Handbook. The announcement was made at the 21st Annual TRB Summer Meeting of the A1F04 Subcommittee on Transportation Noise and Vibration held in New York City.

The handbook, which took 3 years to produce, is a culmination of efforts by Gregg Fleming, Cynthia Lee, Harvey Knauer and Soren Pedersen. The handbook is being distributed in both hardcopy and CD versions along with a short video as a companion to the handbook.

Copies are available from FHWA. The NTIS product numbers for each are as follows:

-HANDBOOK: PB2000-105872
-VIDEO: AVA20862VNB1
-CD-ROM AVA20863CDRM

The CD version has also been posted on the FHWA website in their list of Highway Traffic Noise Products at **www.fhwa.dot.gov/environment/ab_noise.htm.** The direct link to the CD is **www.fhwa.dot.gov/environment/noise/Manual.htm.**

The CD can also be accessed directly from The Wall Journal website at: **www.thewalljournal.com**□

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