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

By E. A. Lamberson, P.E.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(Ed. Note: The next issue of The Wall Journal will carry an article on the various test methods currently being used to certify the weatherability of absorptive noise barrier materials.)
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A Sound-Absorptive Traffic Corridor
The I-80/94 Borman Expressway in Indiana — A Case Study

By E.A. Lamberson, P.E.

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

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

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

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

Trucks represent 20% of vehicles in a 24-hour period, or 37% after midnight. Note the local streets running parallel with the Borman Expressway on both sides.
status was granted. Only the post-bid full technical submittal by the successful general contractor using a selected system was reviewed for compliance with the technical requirements of INDOT.

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

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

The INDOT Borman Expressway corridor carries 150,000 vehicles per day. (Continued on page 8)

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

Photo below shows emergency crew access and motorist escape was provided by overlapping sound wall sections. Pressed-in ashlar stone wall texture faces local streets and residences, while vertically fluted texture side faces traffic. 500-foot sections of wall contained full-height sectors of light and dark brown color chosen from the INDOT presellected color alternatives.
This Michigan/Indiana truck/train corridor is believed to be the busiest in the nation. INDOT Environmental Specialist Robert Buskirk used the Stamina II program to model the project with an expected 192,000 vehicles per day by the year 2016. To reduce the predicted 80-85 dBA sound level to the desired 67 dBA maximum, a sound wall of 26 to 28 feet high would have been required.

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

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

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

The approved Durisol design solution utilized the maximum allowable post spacing of 15 feet. This post spacing was dictated by the structural capacity of the traffic barrier sleeper slab which was part of a Reinforced Earth® (mechanically stabilized earth) retaining wall system designed by INDOT and constructed under earlier contracts. For the ground-mounted section, anchor bolts were installed in the drilled caissons. Galvanized and painted wide flange steel posts were bolted to the anchor bolts as a second phase of construction.
The typical 3'-6" high by 15'-0" nominal horizontal dimension Durisol panels, and other panel heights needed to achieve the project requirements, were stacked one panel at a time between adjacent wide flange posts. The traffic barrier-mounted wide flange units were bolted to the traffic barrier using a special detail which was devised by the contractor to allow attachment to a variable sloping surface but yet obtain the required verticality of the posts. The precise post spacing was not called for in the design/build requirements.

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

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

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