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On Highway Noise Barriers, the Science Is Mixed. Are There Alternatives?

The massive walls are supposed to reduce highway traffic noise, but they're not very effective — and sometimes make matters worse.

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9 COMMENTS 

DRIVE DOWN THE interstate highways bisecting many busy cities and suburbs, and you'll likely no longer see the homes, buildings, or vistas that used to be a staple of roadway views. That's because in most populated places, massive sound walls have been installed. These noise barriers, typically made of concrete and standing an average of 14 feet, turn the backs of neighborhoods into prison-like yards, and, on narrower

stretches of road, encase drivers in roofless tunnels. Since the 1970s, when the barriers first started sprouting, nearly three thousand linear miles have been erected. According to Department of Transportation officials, California alone has 760 miles of sound walls; Florida, 252 miles.

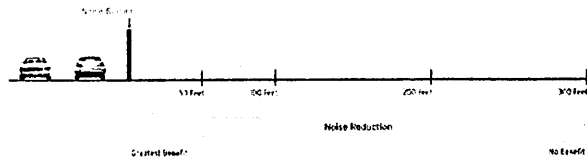
By and large, residents say they want these walls. California has a waiting list for them. And at meeting last June with representatives of the Florida Department of Transportation (FDOT), which this journalist attended, many residents of Boca Raton were eager to know whether sound walls would be erected to buffer their homes from a planned turnpike expansion.

One man's concern, however, stood out at that meeting. He talked about his prior house, which he claimed was quiet until a highway noise wall was installed a few blocks away — and it turns out that this isn't so unusual. For homes several streets from the barriers, or for those uphill of sound walls — and for everyone in certain weather conditions — the walls don't effectively block the sound, and may even help to amplify it. And what's worse is that these aren't new insights. Engineers and acousticians have known for years that the sound barriers bracketing America's urban and suburban highways are only marginally useful, and that a variety of better technologies could be developed.

The problem: Nobody has an incentive to get them on the road.

"Walls are not a very effective solution," said Robert Bernhard, vice president for research at the University of Notre Dame and an expert on noise control. Because the federal government pays for noise walls — and only noise walls — as part of highway expansion projects, he said, there is little incentive for researchers to keep testing and perfecting the alternatives.

Noise Barrier Effectiveness



Sound moves in not-so-mysterious ways, meaning that typical sound barriers have only limited effectiveness.

Visual: Wisconsin DOT

NOISE THAT BOTHERS a community must be at least considered for mitigation thanks to the Noise Control Act of 1972. It was passed as part of the federal government's efforts to better protect the environment — noise being one of many pollutants coming under scrutiny. Typically, when an interstate is widened or newly built, and in a small number of cases, when no additional construction is done, the state highway agencies determine whether they should mitigate the ruckus to area neighborhoods.

That ruckus tends to come from three separate elements: the roar of the vehicles — primarily the exhaust and engine; the whooshing aerodynamics around the vehicles; and the slapping of the tires against the road. At highway speeds, the predominant sound for cars is that of tire-pavement; for trucks, engine and stack sounds are also a factor — at least for now.

States use a specific noise model to predict the sound once the road will be expanded, and for several decades after. The complex formula includes the mixture of cars and trucks expected on the road; the buildings and vegetation in the area that would block some sound; the configuration and ground quality of the land between the road and the homes; the ways the sound is expected to diffract around the wall; and other key factors.

Based on the formula, if the noise is projected to go over the government threshold of approximately 67 decibels (dB) during the noisiest hour of the day — and it is “reasonable and feasible” to reduce it at least 5 dB for some percentage of homes — the government requires that walls be included if the surrounding community wants them. Just what constitutes “reasonable,” of course, is interpreted in different ways by each state, which is why the use of sound walls varies greatly from one state to another.

Even with the sound reduction, however, roadside residents are unlikely to hear crickets chirping. A dishwasher running in the next room is 50 dB, as are the ambient sounds of a laid-back city. The noise criteria aim to allow people to talk over their backyard picnic table, or shout at someone several feet away. “It’s not a situation where meeting the standard makes for a great backyard environment,” Bernhard said.

Of course, some of our ability to process sound is psychological: If people can see the tops of trucks over the wall they say it’s noisier, something people in the field call “psycho-coustics,” explained Bruce Rymer, a senior engineer at the California Department of Transportation. Just by ensuring a wall breaks that line of sight, “we achieve a reduction of 5 decibels,” said Mariano Berrios, environmental programs coordinator at FDOT.

But because noise travels in waves, not straight lines, sounds can and do go over the walls. This is why even with barriers standing 16 feet, homes several blocks away can hear the highway. Part of the sound wave is absorbed, part is reflected away from the wall, and part is transmitted through, Berrios explained. “Most of it goes above the barrier and gets diffracted, and gets to the receiver,” — that is, to a resident’s ears — he said.



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Visual: Virginia DOT

This is especially problematic during certain weather conditions. When the consulting firm Bowlby & Associates, in Franklin, Tennessee, measured sounds around a highway in a yet-to-be-published study, they found that residents hundreds of feet from the highway could hear sounds some 5 decibels louder if the wind was blowing towards them, said Darlene D. Reiter, the firm's president.

Weather, however, isn't taken into account by the regulations. The noise model "assumes neutral conditions — no wind and no temperature effects — when in reality that happens only occasionally," Reiter said. In the early morning, if the ground is cool but the air warms up, for instance, sound that would normally be pushed up is refracted downward, causing homes some 500 or 1,000 feet from the road to hear it loudly.

Those living up on hills or near freeway openings sometimes find the noise actually worsens once walls are built nearby. It was a gap in the barrier near his suburban New Orleans home — partially to accommodate a highway exit — that substantially increased noise in the backyard of attorney Harry

Molaison. Although his house is roughly 500 feet from the service road leading to the interstate, “you have all this rebounding sound from one parallel wall to another,” he said.

“We don’t have the same peacefulness we had before,” he added.

IT’S WITH THESE problems in mind that the University of Pittsburgh recently received a grant to study whether walls could be made of materials that absorb, rather than reflect, more of the noise. But even if new materials were developed — in addition to the popular concrete, sound walls are currently made of everything from masonry and steel to wood and plastic — the question would remain: Is this the best use of taxpayer money?

Highway walls are expensive, running more than \$2 million per linear mile — for one side of the highway, Rymer said. The total spent on sound walls through 2013, the most recent government figures, tops \$6 billion. Each state has a different threshold for what triggers the need for a “reasonable” intervention. According to Rymer, in California, which has one of the lowest thresholds, walls are justified when they cost federal taxpayers as much as \$92,000 per impacted home. This is money that isn’t spent on mass transit, or fixing ailing tunnels or bridges, or other transportation needs.

“Three miles of sound barriers on both sides of an interstate would buy another M8 railcar for Metro-North [train service], and take 100 passengers off the state’s highways” wrote Jim Cameron, the founder of a Connecticut-based commuter advocacy group, in a newspaper editorial earlier this year.

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Mammoth barriers also block small animals — frogs, turtles, snakes — from getting from one habitat to another, said Elizabeth Deakin, professor emerita of city and regional planning at the University of California, Berkeley. This may affect wildlife communication, migration, and even reproduction.

Of course, it's understandable why neighbors whose homes border a highway want something that mitigates the noise. Loud traffic interferes with the enjoyment of your yard. Having cars so close to a home can even cause health issues. According to a 2011 World Health Organization report, environmental noise leads to heart disease, hypertension, and cognitive impairment in kids. But if the bulk of the noise is caused by the tires and the roadway, some experts suggest that attacking the commotion at the source — or testing other methods that might absorb it — could be a more effective and less costly approach.

Some tire companies have done research on making tires quieter, but the bulk of their efforts are in keeping the noise from penetrating the inside of the car, not in silencing them outside, Bernhard said. And while electric cars are far quieter than cars with internal combustion engines, at highway speeds car engines aren't much of a factor — though trucks could be a different story. Tesla's recent introduction of its electric semi-truck will undoubtedly alter highway sounds going forward, since the engine and stack noises will be eliminated.

Companies in some European countries are experimenting with unconventional methods that could ultimately block highway sound. One, a luminescent solar concentrator (LSC), features colorful translucent sheets that not only don't obstruct views and sunlight, they generate electricity to nearby homes. Another is researching whether dense bamboo or other plant species can be coaxed to form an effective vegetation wall.

But altering the pavement is where most of the potential seems to lie. Several states — Arizona, California, and Florida in particular — have experimented with such changes. These “quieter pavements” involve adding more porous surfaces to asphalt or altering the configuration of the tiny grooves in concrete. “When there is texture on the surface of the pavement, the trapped air inside the tire’s tread pattern doesn’t make the same clapping noise,” Bernhard explained.

Some states have laid thousands of miles of these road surfaces, and have seen results of up to a 9dB reduction in noise. Dana M. Lodico, a senior consultant with Illingworth and Rodkin, said engineers have been studying its effects since the 1990s. Her firm alone conducted four major decade-long studies and many shorter ones. “There’s tons of research” showing its effectiveness, she said, especially in states with warmer climates. (The studded tires some drivers use in snowy states can break down the road surface more quickly.) One major report that her firm worked on examined the cost-benefit of sound walls versus pavement changes, and found many scenarios where a combination of lower walls — or no walls — were more effective and less expensive than a barrier by itself, she said.

Despite all of these potential innovations, however, the current structure of federal highway subsidies is likely to keep them from widespread use anytime soon. As it stands, the Federal Highway Administration has not approved pavement as an accepted form of noise abatement. “We have uncertainty about how long the reduced noise level from the pavement will last, and there is no guarantee that the reduction can be achieved on a consistent basis nationwide,” said agency spokesperson Doug Hecox.

That means states that currently change their pavement still have to put up walls as part of their highway projects. And because maintenance of the pavement to keep it quiet — resurfacing perhaps every 15 years, Lodico said — would fall to the states, many state officials undoubtedly prefer the more-permanent walls, which are built almost exclusively with federal funds.

When it comes to mitigating highway noise, Bernhard noted, “The predominant culture is cost avoidance.”

Meryl Davids Landau is a Florida-based journalist whose work has appeared in a variety of publications, including U.S. News & World Report, Glamour, Vice Media, Parents, Reader’s Digest, Good Housekeeping, and Prevention, among others.

Top visual: Connecticut DOT

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