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School Builders Design For Better Acoustics

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By **ALEX FRANGOS**
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From *The Wall Street Journal Online*

Amid the largest U.S. school-construction boom in a generation, designers and architects are worrying about more than just how classrooms look. They are also concerned about how the rooms sound.

The usual hard-surfaced finishes in classrooms have always created an echo-chamber quality. But recent changes have made matters worse. Indoor air-quality requirements force schools to install noisy heating and cooling equipment. Suburban sprawl brings roads and schools closer together, making traffic noise a problem. And even modern teaching methods, which emphasize group work over lectures, add more voices and more acoustic clutter to the environment.

More than an annoyance, the increasing classroom clatter can be a detriment to education. According to educational experts, poor acoustics are one of the biggest treatable obstacles to learning. Studies have found that students, regardless of hearing ability, perform worse in noisy classrooms than those in quiet ones, even within the same school. And teachers feel it, too, by having to lecture above the racket. They miss an average of two days per year due to vocal fatigue, according to the National Center for Education Statistics.

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Spending on U.S. school construction
 \$25 billion

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The effect of poor acoustics is particularly acute among those without full command of speech, including young children and students whose first language isn't English. People in the early stages of language acquisition, be it as a

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second language or young children, don't have the ability to "fill in the blanks" when they miss a syllable or hear a word incorrectly, says Donna Ellis, head of Washington, D.C.'s efforts to improve acoustics in its classrooms.

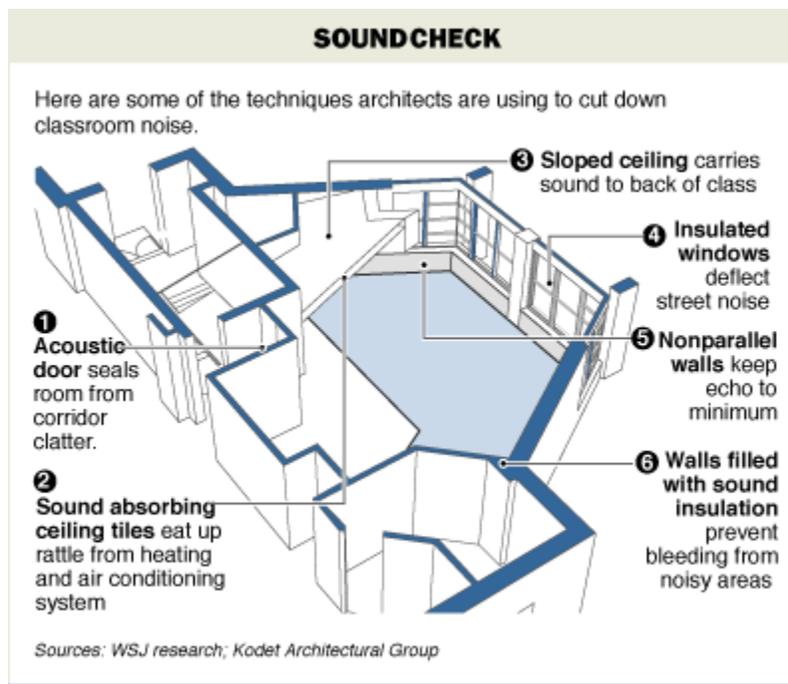
Also, the movement to mainstream hearing-impaired students into regular classrooms means there are more pupils with lower baseline auditory ability. And the increased incidence of middle-ear infections means many more grade schoolers experience temporary hearing loss at some point during the school year. "If in that time they teach something like long division, you might miss something crucial," says David Lubman, an acoustical consultant in Westminster, Calif.

One of the fastest-growing school districts in the country, Clark County, Nev., home to Las Vegas and 13 new schools a year, has had stringent acoustical standards since the mid-1980s. The district uses carpeting, suspended acoustical ceilings and walls that go all the way to the roof deck to prevent sound from oozing from one classroom to the next. But in many parts of the country, the acoustical movement is only now starting to take place, in large part advanced by new standards in construction and design guidelines.

Last year, the American National Standards Institute, a Washington nonprofit that administers thousands of voluntary standards, approved acoustical benchmarks to limit background noise and reverberation in schoolhouses. The states of New York and Washington already have similar sound standards. Los Angeles Unified School District, in the middle of a \$3.63 billion construction program, has acoustical guidelines for its designers. And it's not just a U.S. movement. The United Kingdom recently adopted standards on classroom noise, and the World Health Organization devised its own guidelines for nations to adopt.

"Acoustics are a critical factor now whenever you are looking at classroom design," says Tim Dufault, principal at Cuningham Group Architecture, a Minneapolis architecture firm.

The new standards have their critics, who say schools can't afford to make every classroom as quiet as can be. And even the staunchest supporters of creating adequate classroom sound acknowledge it adds 0.5% to 2% to an overall construction budget -- at a time when local governments are gushing red ink. But thanks to an avalanche of funding measures passed by states and school districts when times were good, schools are one of the few strong spots in the construction industry.



"You have a combination of money already voted on, money not yet spent, and new money that the public seems willing to spend -- plus there's simply the pressure of more kids," says Paul Abramson, an educational consultant in Larchmont, N.Y., He predicts school-construction spending will stay near or above \$20 billion a year for at least the next few years.

The Burroughs Elementary School in Minneapolis, set to



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open this fall, will be the first in that city to meet sound-quality targets adopted for new construction in November 2001. Edward Kodet, the architect on the project, says the goal is that the "student who sits in the back can hear as well as the student who sits in the front."

He has done things like add ceilings that slope from front to back so sound "carries, but doesn't echo." The footprint of the rooms, more trapezoid than rectangle, reduces the tendency of sound to reverberate. In terms of materials, the classrooms have double layers of sound-absorbing ceiling tiles, insulated glass windows, and thicker walls where they abut raucous spaces such as stairwells.

Some of the biggest noise culprits in schools are the more-robust heating and air-conditioning systems required in many states for indoor air quality -- exactly what spurred Minneapolis to think about sound.

"We had been doing a lot of HVAC [heating, ventilation, air conditioning] renovations, and getting noisy systems that drove us to where we needed to make acoustics a priority," says Lee Setter, environmental specialist for Minneapolis schools.

Such was the case at the Downtown School, a magnet facility in Minneapolis. It was built in 1999 and immediately drew the ire of teachers and parents because of the noise coming from its climate-control system, combined with its open-classroom design. "Not everybody can filter it out," says Lee Fertig, the school's director.

Modifications including larger walls, additional carpeting and sound-absorbing panels, solved the problem. "The noise-interference level went way down," says Mr. Fertig.

Clanging air conditioners are hardly the only problem. Sound bleeds from one room to the next and from outside sources such as highways and airplanes. One design strategy in the fight against noise is to plug holes, as on a ship.

"Sound is like water," says Matt Ciaglo, an architect with Fletcher Thompson Inc. in Hartford, Conn. "It finds the smallest gap." As a matter of course, his firm uses soundproof caulk along seams between drywall and the floor and adds sound-attenuation blankets in the walls.

Further techniques include using different drywall thicknesses -- one of them five-eighths of an inch, the other three-quarters of an inch -- on either side of a wall. The two widths absorb different sound frequencies and together prevent both low- and high-pitched sounds from getting through. Also, staggering doors in a hallway so classroom entrances aren't directly across from each other and installing carpeting to reduce foot noise can reduce unwanted din.

If acoustic standards for schools were in place nationwide, the additional spending could equal \$100 million to \$400 million a year, based on current construction spending budgets. As it is, the growing movement has a number of beneficiaries in industry.

Heating and air-conditioning manufacturers, already reaping the benefits of indoor air-quality rules that require their products, now have an additional service to sell -- keeping the equipment muffled. "In all types of buildings, as you move to quieter spaces, typically the cost does go up," says Gary Luepke, applications engineer for Trane, a subsidiary of American Standard Cos. that makes indoor climate-control systems.

Also, manufacturers of materials such as acoustic ceilings, carpets, and sound absorbing insulation will see increased demand for their wares. The Carpet and Rug Institute, an industry trade group, puts acoustics at the top of the list in promoting its products to schools. Armstrong World Industries Inc., Lancaster, Pa., has set up an "acoustic calculator" to assist school designers and architects in selecting its products.

The strongest opposition to the new standards comes from the modular-classroom industry, which call them too onerous. "It's not that we don't want quieter standards," says Susan Stewart, a lobbyist for the modular-classroom industry in Sacramento, Calif. "But the cost in some of these areas would be exorbitant."

Not all sound-abatement tactics are costly. Teachers in Washington are known to put old tennis balls on the end of chair legs to eliminate squeaking on the floor when students fidget at their desks.

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