Controlling HVAC noise in schools

The ability to hear properly, especially in preschool and elementary school classrooms, is one of the most important factors in a child's ability to process and learn new information.

But according to the US Institute for Enhanced Classroom Learning, children in today's classrooms have difficulty understanding 20% to 30% of what their teachers say because of excessive ambient background noise, reverberation, and a poor signal to noise ratio (SNR). Current solutions to the problem of classroom hearing, and the related technology associated with these solutions, often suggest using classroom amplification equipment to solve ambient noise problems. And while this approach can help it is not the preferred approach according to a position statement by the Acoustical Society of America

Ambient noise can include the students themselves, ceiling fans, hallway noise, the hum of lights and computers, outside lawn mowers, and HVAC equipment. The SNR is the most important consideration within a classroom's acoustical environment. Reverberation is also relevant but can be compensated for – and for a relatively low cost – with minor environmental or structural changes if overall ambient noise levels can be reduced.

In the case of a classroom environment, SNR is basically how much louder the teacher's voice is above other noises within the room. In a classroom environment the teacher is the S, or signal, in SNR. And if the teacher's voice is at 65 decibels (dBA), a normal level for speaking, and all other background noises (students, HVAC systems, mowers, outside traffic noises, etc.) are at 55 dBA, the SNR is 10 dBA. The higher the SNR, the better the learning environment for children. Ambient noise and reverberation affect SNR. Increased ambient noise, including HVAC equipment, will lower the overall SNR making it harder to hear, teach and learn.

In any environment, children with normal hearing require an SNR of +15 dBA. Therefore a teacher must speak at least 15 dBA louder than the ambient noise in the classroom in order for students to fully understand what is being taught.

In the example mentioned above, it means that the teacher would have to talk very loudly at a 70 dBA level in order to be heard by the students. Speaking at this decibel level is a common source of voice fatigue for teachers

One of the biggest contributors to classroom ambient noise level has traditionally been the school HVAC system, regardless of whether it is roof- or wall-mounted. Most HVAC systems currently on the market today operate at ambient noise levels that are considered to be too high for most classroom instruction. But what if a school's HVAC system could be removed as a factor in ambient classroom noise levels?

In 2002, due to the increasing realisation of the problem regarding classroom acoustics, the American Standards Institute (ANSI) along with the Acoustical Society of America (ASA) set out to create a lower overall ambient noise national standard for acoustics in the classroom. The result came to be known as S12.60-2002, which set an acoustical standard of 35 dBA for all background sound (ambient) levels. Unfortunately, while ANSI's new standard was significant, when it came to new construction, it did not take into effect relocatable classrooms which are harder to insulate and therefore can have more ambient noise, especially for older models still in operation.

Relocatable portable classrooms have been around and in use by school districts all over the country since the late 1960's. Factory built and often modular in size, they are used to provide additional classroom space when there is a shortage of capacity. modular in size, they are used to provide additional classroom space when there is a shortage of capacity.

Shortly after the 2002 ANSI standards were developed, one HVAC manufacturer, Bard Manufacturing began to consider development of a new HVAC unit to try to meet the stricter ANSI acoustical standard. Although not a mandatory standard and therefore not enforceable, Bard became convinced that development of new equipment was both technologically possible and fulfilled a need that existed within the marketplace. Bard Manufacturing then teamed up with Geary Pacific Supply, its product distributor for the western United States, to develop this new product.

"Many in the industry thought that ANSI's new standard would be nearly impossible to meet, especially with a vertical wall mounted unit," said Irv Derks, Bard's vice president of engineering. Bard, however, agreed with the intent of the standard, which was to help improve the learning environment in schools. Therefore, Bard embarked in the development of an acoustically improved HVAC system.

Shortly thereafter, in early 2004, Geary Pacific organised a meeting of industry stakeholders, including representatives from the California Air Resource Board, the U.S. EPA, the California Department of Health Services and the California Department of Education, in Sacramento, to discuss the idea of what features the next generation of classroom HVAC equipment should include.

What came from that meeting was that the next generation of HVAC units needed to be more energy efficient, environmentally friendly, green, and provide an ambient noise level of no more than 45 dBA. However Bard, in conjunction with Geary Pacific, was not satisfied to simply meet the requirements that were discussed in the Sacramento meeting. They planned to adopt them, but also work to develop the equipment to exceed all minimum requirements, including the more stringent ANSI acoustical standard of 35dBA.

So in conjunction with the Lawrence Berkeley National Laboratory (LBNL), Bard and Geary Pacific began a multifaceted approach to developing a quieter, more energy efficient unit with better ventilation capability and one that used next generation refrigerants—or "green' refrigerants—as its base. They decided that the unit not only had to work well with new construction but also be easily retrofitted to older construction, including portable classroom units.

Involvement by LBNL included a two-step testing process of a prototype unit designed and constructed by Bard at their manufacturing plant in Bryan, Ohio. "Over a series of many months, LBNL compared the energy efficiency and the ventilation capability and did the acoustical comparisons to a standard wall mount in an actual portable classroom at their facility," said Irv Derks with Bard. What they found was that the new Bard Quiet Climate ll unit not only was more energy efficient but it also ventilated better.

From there, LBNL and Bard, in a concerted effort with Geary Pacific, employed a field test program in which 10 prototype units were shipped and installed by Geary Pacific in two different California schools—five in Fontana and the other five in Modesto. Ultimately, the field tests backed up the original tests conducted by LBNL. However, Bard was still not completely satisfied with the acoustical improvements and continued in the development of additional acoustical; enhancements to drive the sounds levels down as far as technically feasible. Once developed, some of the 10 classrooms were retrofitted with the improvements which resulted in significant additional reduction in the ambient sound level

Around the same time that LBNL was wrapping up the field tests, Geary Pacific decided they needed to find out how the unit would function in a real-world portable classroom environment. Using space at their branch located in Riverside, California, Geary Pacific acquired and set up an older, portable classroom, complete with desks and the other accoutrements found in a typical classroom. Then they replaced the existing wall mounted HVAC unit with Bard's new Quiet Climate-2 unit.

"We wanted to put in place an older classroom, like those developed around 1992, to demonstrate what the new unit could do in a practical application," said Maury Tiernan, Geary Pacific's Bard Product Manager. "The older classrooms are more typical of what's in service at many schools and so we wanted to demonstrate how the Bard unit would do when retrofitted to an older, existing classroom."

Shortly thereafter, Geary Pacific decided to bring in two of the original co-authors of the ANSI standard to conduct their own tests within the classroom and see how the Bard unit performed acoustically.

Louis Sutherland, who served as the chief scientist and deputy director for the Acoustic Research Group of Wylie Laboratories, and as the co-chair—along with David Lubman—of the large ANSI Working Group that wrote the Classroom Acoustics standard, was one of the acousticians who conducted tests within the classroom at Geary Pacific's Riverside location. "We took measurements at a number of selected positions of the ambient sound level before the air conditioning unit was turned on, and just as an anecdote, the reps from Geary Pacific said, 'okay, now it's on', and I said 'you're kidding', said Sutherland. The unit was on and by my own hearing I couldn't tell any difference between when it was on and when it was off."

Sutherland's more scientific tests essentially backed up what he heard, or in this case didn't.

"When we reviewed our test results they showed that the lowest ambient noise level with the HVAC system turned off was about 33 dBA, said Louis Sutherland. When we then turned on the HVAC system at three different power levels of operation, the noise levels ranged from 35 to 39 dBA.' What Sutherland quickly realised was that in most instances, Bard's Quiet Climate ll unit ultimately met the 2002 ANSI standard of 35 dBA.

Geary Pacific's success in a practical application test of the Bard Quiet Climate lead them to convince Val Verde Unified School District in Perris, California in the early Spring of 2007 to purchase a unit for their audiology lab that tests students for hearing disabilities.

According to the school's audiologist, Randy Lerner, the environment for testing and evaluating students has improved by 20% due to a considerable reduction in ambient noise from 58 dBA to 37 dBA.

"With the old unit I used to have to turn it off during a testing session because it was so loud. Now my students comment on how quiet the lab is and that's when the unit is on," said Lerner.

Geary Pacific's goal is to convince more school districts of the benefits of the Bard unit. "It's difficult, because in some instances many schools don't have it within their budget to retrofit classrooms for the new units," said Tiernan. "However, we feel that the two main things the Quiet Climate ll unit delivers on are, it uses 44% less energy than standard units on the market today and it's 10 to 15 dB quieter.

NOISE BARRIERS ON ELEVATED ROADS

Shanghai plans to install more noise-insulation screens on elevated roads this year, city officials said. "It's crucial to tackle the noise pollution as the city develops rapidly," Cai Yifeng, a senior engineer of Shanghai Transportation Planning Institute, said. According to the commission plan, the government will install 2.8 kilometers of noise-insulation screens along the South-North Elevated Road and 2.6 kilometers along the Yan'an Elevated Road. The new screens will reduce the noise for the increasing number of residential highrises that are being built along the elevated roads. In past years, the government has spent millions of yuan to install noise screens along the elevated roads, particularly the Inner Ring Road. However, the noise problem remains one of the major areas that residents complained about to the government, officials said.

AIRPORT SAFETY INCREASES NOISE FOR NEIGHBOURS

Thousands of residents will be forced to endure up to 69 additional planes flying over their homes every day because of a major safety upgrade to Sydney airport. Daily flights over Sydney's inner-western suburbs could increase by 48 per cent from 143 to 212 and by 70 per cent from 97 to 166 over northern suburbs, a major draft development plan reveals. And the disruption will last until mid-2010 because of work with the safety area at the western end of the east-west runway. Homeowners will not qualify for noise insulation because the works are not permanent.

WASHINGTON REGULATION

Washington DC's council has given final approval to a significantly tweaked noise bill in a 9 to 4 vote after a hard-hitting lobbying campaign by labour unions. The Noise Control Amendment Act was so changed from its initial draft that the main supporters abandoned it. Under the amended legislation, noncommercial public speech during the day would be restricted to no more than 80 decibels, or 10 decibels above the ambient noise level when measured from inside the nearest occupied dwelling in low-density residential zones. That means people can still get really loud with amplified noise. The vote marked a significant turn of events for a bill that began year. Initially seeking relief from street preachers for residents in the H Street neighbourhood. David Klavitter, the H Street area resident who started his "Quest for Quiet" blog to push for the legislation, quickly posted a message that said, "The District of Columbia has a new and toothless noise bill."

KIDS (VERY) ALOUD

A shouting contest, held by Merstham Beaver Cubs group, proved noisier than expected with one young member's yell measuring louder than a jumbo jet. The contest, organised by the club leaders to celebrate Noise Action Week (running 19th to 23rd May), took place at the Merstham Beaver's 'tin' Nissan hut in Battlebridge, Surrey. Using a sound level meter and microphone to record the results, the 24 Beavers took turns in making their loudest noise. Despite some ear splitting noises, they failed to tip the sound level meter until 7-year old Theo Harrison won the competition with his massive 137 decibels shout. "The Beaver Hut was very reverberant and this coupled with very excited kids made for some very high and impressive measurements," said John Gregory, a Technical Engineer from noise monitoring specialist Bruel & Kjaer UK, whom supplied the sound level meter. "When the kids were playing the game we got an LAmax of 105dBA, so I believe you could make a case for some sort of hearing protection for the Cubs leaders."

QUEBEC CEMENT WORKS

The Supreme Court of Canada is hearing a case involving a Quebec City cement factory and a group of neighbours who sued the company in an environmental class action lawsuit. The neighbours, who lived near the St. Lawrence Cement factory, sought compensation for damages caused by the factory's operation – which they claimed included decades of noise, odour and dust problems. A Quebec Superior Court ordered St. Lawrence Cement to pay $15 million in damages to the neighbours but said the company was not involved in any wrongdoing. The Quebec Court of Appeal later ruled that nuisance claims could not be brought as a class action proceeding. Instead, the appeal court said the right to bring such claims was limited to property owners, not tenants or the spouses and children of owners. Still, the court found the company was at fault since it was obligated to keep its pollution control equipment in "optimal" working order. St. Lawrence Cement appealed the ruling to the Supreme Court, saying it had consistently met regulatory emission standards. The case marks the first environmental class action from Quebec to be heard before the SCC.

EASTBOURNE

An Eastbourne resident has accused noise pollution officers of not dealing with his complaints about a noisy neighbour. David Hudson said he is being driven 'round the bend' by what he has described as the council's failure to deal with the excessive noise from his neighbour's flat. Mr Hudson moved into his flat on December 3 and said that within a week he was being woken up at 4am by a newly installed water pump next door. He said, "It's because of the way it's bolted on that it's vibrating through the wall. It comes on whenever water is used at all times of the day and night. I can't get a decent night's sleep and it's making my life unbearable. The lady downstairs has also complained about it. My landlord spoke to my neighbour but his response was quite negative." After an initial visit by a council officer Mr Hudson was told an evening sound check would be carried out but he says he has not heard anything since. He added, "I'm thinking I'm going to pack up and move as I've had enough. lf it was a man with a stereo they'd deal with this straight away. You just can't get away from the noise. I don't think that it's ever going to be sorted. It's driving me round the bend."

WEIGHTLIFTER

Giran Jobe, 36, was charged with 47 breaches of a noise abatement order after neighbours complained that his two-hour training sessions with dumbbells left them unable to sleep. A council team investigating complaints about noise from his top-floor flat in Margate, Kent, found that at times the level hit 100 decibels. The 6ft 2in, 15-stone carpenter was warned by officials last summer to stop using his weights. But after just one month neighbours again complained to Thanet council, which fitted flats on lower floors with noise recorders. In the following six months neighbours recorded 47 breaches of the noise abatement order - citing "grunting and noise from the weights hitting the floor" as the major irritants. Doris Fox, 68, said she was so fed up with the grunting, and screaming and the noise of weights being slammed down that she couldn't sleep properly. She told Thanet magistrates court: "The noise was so loud that I thought that he had an angle grinder up there." Jobe admitted the 47 breaches but, speaking after his court appearance he said: "I don't play loud music, I don't have parties and I don't stamp around. All I do is exercise and work out with my weights. I am trying to keep fit. I cannot believe I got taken to court for exercising."

IT HAPPENED IN MONTEREY

Construction workers in Scottsdale Arizona, will be spared from having to start work later in the hot summer day. But they may have to be more considerate about their dawn work habits. The City Council voted unanimously to discuss new policies and procedures that could reduce the irritation level for residents near construction sites. Neighbors of the Villa Monterey neighbourhood complained that the city's years-long downtown construction boom has become unbearable. "I'm asking that the human element be put in this equation," said resident Linda Ross. "It might be restrictive for contractors but it would certainly be respectful of us." And it's not just the noise, she added. It's the hours More than 100 residents signed petitions asking the construction hours be limited to the hours of 7 a.m. to 8 p.m. Currently, the city's law says work can happen between sunrise and sunset. In the summer, that means that backup beeping, radio-playing, hammering and yelling can begin before 5 a.m. Council members said that forcing construction workers to labor during the heat of the day was too big a hardship. "People are out there working in the heat of summer and those workers need protection, too," said Councilman Tony Nelsson, who has worked in the construction industry. The council agreed to consider policies that could lower the noise level but still leave traditional working hours in place.

FORESTRY BY FLOODLIGHT

Shocked residents were jolted awake at 2.30am on a recent Monday morning to the grating noise of chainsaws. And the torturous din didn't go away, it sounded all night long as contractors worked till dawn hacking down dozens of trees. Residents on The Grove, Chorley, are suffering a week of sleepless nights as Network Rail clears the trees on the railway embankment just yards from their homes. Grove resident Mick Mills, 54, said: "I was woken by a terrible din in the middle of the night. When I looked out of the window I saw a contractor in a harness under floodlights chopping down a tree with a chainsaw. To say I was shocked is an understatement, it was almost laughable. None of us in the house got a wink of sleep as the work went on till around 5.30am and to make matters worse it was the day the clocks went back." Mr Mills called the police but they said it was not a matter for them as the land belonged to Network Rail. A Network Rail spokesman said that they needed to work predominantly at night because that is when trains are not running. He added: "Felling trees is an emotive subject. If we don't take action and trains are delayed as a result, or if a tree comes down on a house or across the railway line and there is an accident, we will be held responsible. However, when we do something about it, local residents complain about the effect on wildlife. Either way, Network Rail is in a no-win situation

DOGS AND WINDOWS

A man smashed his neighbour's windows with a golf club because he was fed up with their dogs barking during the night. Stuart Jenkin 21, went to his neighbour's home to complain about the noise of the two rottweilers, Edinburgh. But he claimed he lost his temper after being "set upon" by the dogs, one of which bit him in the arm, a court heard. Jenkin went home before returning to the house with a golf club and smashing windows, causing £300 of damage. At Edinburgh Sheriff Court Jenkin pled guilty to a breach of the peace charge and maliciously smashing three panes of glass with a golf club. Sheriff James Scott warned Jenkin to expect a fine and a compensation order, and after hearing he had lost his job as a result of the incident, suggested he started up his own business. "You might want to consider self-employment, teaching people how to defend themselves from rottweilers," the sheriff added.