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ABSTRACT

This paper explores the issues associated with poor acoustics within schools. Additionally, it suggests remedies for existing buildings and those under renovation, as well as concerns for new construction. The paper discusses the effects of unwanted noise on students in terms of physiological, motivational, and cognitive influences. Issues are addressed for both the regular learner and the special needs student. The cost of inadequate or inappropriate acoustical control is also described. Included is a technical discussion relating to the appropriate levels of signal to noise ratio, articulation loss of consonants, noise criteria rating, and reverberation. (Contains 15 references.) (Author/EV)

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Acoustics in Schools

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Abstract

This paper explores the issues associated with poor acoustics within our schools today. Additionally, it suggests remedies for existing buildings and those under renovation as well as concerns for new construction.

The researcher discusses the effects of unwanted noise upon students in terms of physiological, motivational, and cognitive influences. Issues are addressed for both the regular learner and the special needs student. The cost of inadequate or inappropriate acoustical control is also referenced.

Included in this work is a technical discussion relating to the appropriate levels of signal to noise ratio, articulation loss of consonants, noise criteria rating, and reverberation.

Acoustics in Schools

When one thinks of school design, the general areas which come to mind are the building itself and its furnishings and finishes. In terms of the building, architects, school planners, and administrators generally look at size and configuration with an eye towards instructional use and safety. Furnishings and finishes fall into a realm that looks at aesthetics and maintenance. One area that stands out is the area of acoustics. Acoustics, however, is far from being a silent partner in education. This paper presents information related to acoustics as it pertains to educational attainment and performance, basic technical information on the subject of acoustics and noise, and acoustical problems within schools. It concludes with some recommendations for addressing these issues in new construction and older buildings.

There are sounds all around us all time. Some of these sounds are desirable and sought out. They are referred to as signal sounds. Other sounds are undesirable in that they are not what we plan to hear. These are called noise. Noise, technically, does not refer to the loud sounds such as car horns or garbage trucks (although these may contribute to noise levels,) but may include such benign sounds as wind, a hissing radiator, a hallway conversation. or the hum of a fluorescent light fixture. Noise is any sound which may interfere with the reception of the (desired) signal sound, such as the teacher's voice. Additionally, noise has nonauditory effects encompassing physiological, motivational, and cognitive domains.

Impact of Acoustics in Schools

Americans have become extremely sensitive to the educational needs of our children. We have gone through multiple rounds of thought and legislation as to how to provide our students with the best possible education whether it be for the normal child, the gifted, or the educationally challenged. Special education has addressed the issues of individualized instruction, support services, and inclusion. Both the United States Department of Education and the individual state education departments have addressed the issues of standards. Barrier free schools are not a new concept. However, the one barrier which has not been adequately addressed and for which standards are just being explored is classroom acoustics.

> Many of our children, and especially those with hearing or learning disabilities, are being deprived of a clear communication channel in educational environments because of inferior classroom acoustics. Poor classroom communication acts as a barrier to learning, stunting intellectual growth, lowering self esteem, and serving to diminish the potential for the child to grow into a productive citizen. (NPC Quietnet, 1997)

The question with which all school administrators should be familiar is what impact does the acoustical environment have on learning. Poor acoustics affects both students and teachers, and its effects are not limited to the hearing impaired.

Young children, particularly those in early childhood progams, have not fully developed their language skills. They are still acquiring vocabulary, learning to focus, and learning to follow directions. These are the children who must absorb and process words and ideas. Young children do not yet have the ability to draw upon their knowledge and experience to fill in missed words when the teacher is giving instruction. These children are extremely vulnerable in an environment with poor acoustics. Research shows that "in representative conditions, normal-hearing first grade students would recognize only 66% or so of the words being spoken by the teacher." (Picard and Bradley, 1997) Not only do they miss out on instruction, but those who come from culturally deprived environments lose the opportunity to narrow the gap. In fact, children who miss instruction at an early age find themselves in a widening gap as they grow.

A second vulnerable group includes those for whom English is a second language. These are the students who are struggling to simultaneously learn both a new language and the subject(s) being taught. If they have to strain to understand, the natural instinct is to tune out.

Educators see a similar problem with students who have learning disabilities which may include attentions deficit disorder (ADD). These children already have a problem holding their focus. When the teacher is unintelligible, or classroom discussion becomes a muddled sound, instruction in an inclusional setting is defeated.

Teachers as well suffer from poor acoustics in the classroom. If a teacher has to raise his/her voice, it puts a physical strain on the teacher. Teachers who compete with noise suffer fatigue and vocal strain. Citing Gould's research, Education World reports an estimation that teachers lose about two days per year for vocal fatigue which, in turn, costs $567 million annually in lost time (Dunne, 2000). In a report given at the Acoustical Society of America's 133rd Meeting, Jiang (1997) discussed a case study of a physical education teacher who suffered a hearing loss from reverberation in the gymnasium and exposure to whistles capable of delivering sound energy as high as 130dB. The same paper references noise-induced hearing loss in music teachers.

The nonauditory effects of noise can go largely undetected until it is too late (Maxwell and Evans, n.d.). Physiological effects include elevated blood pressure. This is particularly dangerous, because the body does not habituate itself with continued exposure. Additionally, the condition continues into adulthood. Motivational effects manifest themselves in the form of learned helplessness and lower tolerance for frustration. Cognitive effects have been studied in the areas of memory, attention, and academic achievement. Memory seems only to be affected when the task requires special attention. Research suggests that children exposed to chronic noise may suffer in the area of attention. While younger children seem to be able to tune out the distractions, this advantage is lost as children get older. While school age children can tune out noisy environments, they often tune out important auditory stimuli as well. In other words, their auditory discrimination process is impaired. Further, chronic noise has been shown to have a negative effect on children's reading skills.

Hearing loss is an invisible condition which interferes with learning and social development. In addition to children with permanent hearing loss, there are those who have transient loss due to colds, allergies, and ear infections. The National Center for Health Care Statistics estimates that there are 70 cases of otitis media (ear infection) for every 100 children under 5 years of age and 14 case annually for every 100 children ages 5-17 (Schappert, 1992). Hearing loss in these temporary conditions may result in a hearing loss up to 20dB (decibels).

Design and Technical Discussion

Sources of noise and measurement.

The acoustical goal in any educational facility is to provide speech intelligibility. In order to achieve this, noise must be controlled. The three sources of classroom noise are 1) reverberation, 2) heating, ventilating and air conditioning system noise (HVAC), and 3) noise from outside the classroom. The acoustical requirements differ for the various parts of the school building, e.g., classrooms, gymnasium, auditorium, cafeteria, and music room. There are, of course further differentiations with shops, art studios, and laboratories. In a study of 32 classrooms in Ohio (Ohio State University, 1999), only two met the standards recommended by the American Speech-Language-Hearing Association (ASHA). These findings held across economic boundaries.

In discussing the three major sources of classroom noise, there are a number of technical terms which need to be defined. Reverberation is the bouncing back and forth of sounds off the walls, floor, ceiling, and any other hard surface. It causes an echo. The concern in a classroom is the length of time it takes for this reverberation to die down. Because a teacher may be lecturing or a class may be having a discussion, any echo, even a small one, can blur future speech.

Sound, in general, is measured in decibels (dB), a measure of power. McSquared System Design Group (n.d.) addresses the issue of voice as a source by modeling a 40'x40'x10' classroom with three different acoustical conditions to show the effect of reverberation time on speech intelligibility. Typically, a teachers voice at one side of the room has a level range or 51dB-78dB. This represents a range of 27dB. When there is no reverberation, such a range is intelligible. With a moderate reverberation time of 1.2 seconds, the total range runs from 65dB-81dB with a range of 16dB. The range of sound energy is reduced from 27dB to 16 dB. The problem occurs because of a factor called the signal to noise (S/N) ratio. In order for speech to be intelligible, the speech signal must be at least 15-25dB above the ambient noise. With such a reverberation, the room approaches the lower limit of acceptance. This scenario has not taken into account the effects of HVAC noise or external noise.

Another factor to be considered is a number referred to as %ALCons or percent articulation loss of consonants. This number is used to describe the percentage of consonants that will be missed or misunderstood. Again, this value helps us to assess background noise levels. With a 25dB S/N ratio, a 10% ALCons is considered acceptable. Again, this does not take into account a student for whom English is a second language, a young child who is still acquiring language, or an individual with a hearing impairment. Therefore, in an educational setting, the criteria for %ALCons should be reduced to 5%. If we return to the scenario above in a 40'x40'x10' room, the ALCons range from 0%-26%, far above the acceptable level.

The Acoustical Society of America (ASA) explains

> There are many methods for measuring the loudness of mechanical noise. A good guideline is that the noise level in classrooms should not exceed NC 25 to 30. The NC, or Noise Criteria, rating is determined by measuring noise levels at certain frequencies, plotting these levels on a graph, then comparing the results to established NC curves. (2000, p.8)

The size of a room has a major affect on reverberation as do the materials used to construct and finish the room. We frequently think of gymnasia or cafeteria as the rooms which echo the most. The reality of the physics shows that in a "small room, the reverberant sound level is quite high compared to the source sound level, and the reverberant level builds faster and is loud enough to significantly mask subsequent syllables or words" (McSquared). The two characteristics of sound waves which are of particular importance in architectural acoustics are intensity and frequency. Intensity can be understood as the perceived volume or loudness of the sound. Frequency is understood as the pitch of the sound (higher and lower or deeper.) Rarely is a sound made up of a single frequency (Acoustical Society of America, 2000, p.3).

As mentioned earlier, there are other sources of background noise besides reverberation. One of the biggest culprits of background noise is the HVAC system. The noise generated might be due to the fans, resonance within the ductwork, or the system motors themselves. Each of these problems can be avoided in new construction by careful planning. In older building which are being retrofitted, most of these issues can also be reasonably addressed.

Fluorescent lighting produces a hum which most people consider to be a "white noise," that is, an unobtrusive background sound. In and of itself, this may be innocuous, but when added together with other noise factors, it contributes to the speech intelligibility problem. If the classroom has an aquarium, the filter and pump will add to the background noise. Even the gentle fan of classroom computers must be taken into account. Children cough, sneeze, crinkle paper, and scrape chairs on the floor. Some classroom clocks actually "tick" audibly.

The third source of noise comes from outside the classroom. Some of this noise can be controlled and some cannot. Again, there will be a discrepancy between new construction and existing buildings. Location is of great concern. Urban schools, especially those which are already in use have the ambient street noise which includes traffic, garbage collection, rescue vehicles (sirens,) voices from the outside, and even the crackle which sometime accompanies high voltage lines. Additionally, older schools may not be outfitted with modern HVAC systems. As such, the teachers rely on opening windows for fresh air exchange. Even opening the door to the hall allows external noises to enter the classroom.

While considered acute noise, those schools situated near airports or in a major flight path may experience fly-over noise peaking at 90dB as frequently as every 6 minutes. Schools located near a fire house or ambulance squad may be disturbed by sirens several times a day. This would be particularly true in an urban setting. Schools such as McKinley in Newark, NJ abut a major highway which is yet another source of external noise.

Another school, YKOM, situated in a 100 year old, landmarked building in New York City, has relied on open windows for air exchange, particularly in the fall and spring. Students in this school contend with car horns, bus rumbling, and the inevitable car alarm which may sound for as long as 10 minutes before shutting off. Two years ago, this school installed room air conditioners where the compressors were located outside on extended mid-building roofs (essentially window wells on the second, third and fourth floors.) In literature (Acoustical Society of America, 2000, p.16), describing a similar unit installed in an older building, the acoustical results were mixed. The wall-mounted unit contained a two speed fan/coil unit. With the fan on high, the noise in nearby seating registered at NC-47 and when the fan was on low, NC-36. On the opposite side of the room the noise registered NC-43 and NC-33 respectively. At low speed this is close to acceptable, but at high speed, it exceeded acceptable limits.

Standards.

The United States has yet to set firm acoustical standards for classrooms. There is a currently an initiative to address the issues. (Acoustical Society of America, 1997).

"According to a Swedish standard, an acoustically satisfactory classroom should have an unoccupied environmental noise level of not more that 30dBA," (A weighted scale) "and a dining room or gymnasium not more than 40dBA."

The American Speech and Hearing Association (ASHA) recommends a reverberation time not to exceed 0.4 seconds in a classroom. This is significant reduction in reverberation as compared to McSquared's 1.2 second experimental reverberation time. Castaldi (1994, p.247) suggests optimal reverberations times for selected educational spaces. Upon close examination of his numbers and review of more current literature which cites the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) (Scott, 1999) as well as the Acoustical Society of America and the American Standards Institute (ANSI) (Johnson, 2001), some of Castaldi's numbers seem high. For example, Castaldi recommends a reverberation time in classrooms from 0.60-0.63 seconds where ASHRAE recommends a maximum of 0.6 seconds with a preferred reverberation of 0.4-0.5 seconds. Where ASHRAE recommends a maximum 0.6 second reverberation in cafeterias and 0.8 seconds for an auditorium, Castaldi recommends 0.76 second and 1.13 second respectively. In his favor, Castaldi recommends that the gymnasium not exceed a 0.84 second reverberation. This standard would meet or exceed all other recommendations explored for this paper.

In comparing recommendations for classroom noise levels, different organizations (understandably) have slightly different standards. What is somewhat confusing is that the different standards, at times use different criteria and therefore different scales making it difficult to compare the acceptable values. ANSI has proposed new standards to cover background noise from both outside and inside the classroom. Noise levels (in unoccupied rooms) should not exceed 30-35dB and the reverberation time will not be more than 0.6 seconds. Currently, the average American classroom registers 50dB and gymnasia even higher. RC or Room Criterion is another method used to specify sound goals from HVAC systems. Here, ASHRAE recommends an RC-40N (neutral) for classrooms up to 750 square feet and RC-35N for larger rooms. ANSI recommends RC-30N and RC-25N for the same spaces (Herbert, 1999). The difference is due to the way in which the two organizations look noise. ASHRAE uses annoyance as its criterion where ANSI uses intelligibility.

Recommendations and Design Implications

The question now becomes what can architects, building planners, and administrators do in planning for new construction? Further, what can be done within existing construction? The first part of the answer is that those involved in school facilities planning must be aware that acoustics pose a very real concern and need to be addressed seriously. Second, these same planners must consider the fact that it is far easier and less expensive to address the issues in original (new) construction than to try to fix a problem later.

With good planning, new construction can easily address the issues of noise control and acoustical acceptability. Any purchase of land for a new building should take into account the location relative to noise sources such as those mentioned previously. Classrooms should be segregated according to their type. That is to say, shops, art rooms, music rooms, gymnasia and the like should be separated from "quiet rooms," those where lectures and quiet work take place. HVAC systems should be distanced from learning spaces. The ductwork should have low speed blowers and should be lined with a sound absorbent material. Main ducts can run down the hallways but should not go over classrooms.

Classrooms should have ceilings not to exceed 9 feet high. While acoustical tile on the ceiling is helpful, it is not sufficient and many rooms will need absorbent material (panels) placed high on the walls. These panels should be spaced and located particularly at the corners of the room. They should also be staggered on opposite walls. As for acoustical tiles on the ceiling, it is more effective to place these tiles around the edges of the ceiling and to leave the center with a hard surface to help speech sounds reflect evenly throughout the room. Some rooms (larger lecture halls) will benefit from an angled reflective panel over the "podium" area allowing the teacher's voice to be angled out towards the students. Carpeting may be helpful to absorb the sounds of scraping chairs and feet, but it does not muffle or absorb much ambient sound or speech. Book cases, cork boards and such on the walls helps to absorb and alter sound reflections.

Walls made of gypsum board (GWB) with two layers of GWB, two sets of studs, fiberglass insulation, and another two layers of GWB is best between classrooms. The GWB seams should be staggered to prevent sound leakage and the seams should be well taped. Walls (partitions) should extend above the ceiling to the structural deck above. Doors of the classrooms should not be opposite each other or next to each other as one walks down the hall. Windows of double glazed glass should be considered as they are a more effective sound barrier from the outside than single glazed panes of glass.

All furnishings including tables, chairs, desks, bookcases and such have an NRC or noise reduction coefficient assigned to them. A good acoustical engineer can make recommendations based on the size of the room and its planned usage for appropriate furnishings. Lighting is also a potential source of noise from two aspects. The first is the hum of the lighting itself. The second it the caulking around the fixtures so that sound does not leak through the ceiling at these points.

Vocational classrooms, laboratories will need extra attention in their location within the building and their particularized needs. An expert should be consulted regarding what materials will withstand the chemicals and dust while still providing sufficient sound absorption. Cafeteria are large rooms which have additional sound control problems. Health department regulations in various states may prohibit the use of acoustical ceiling tiles. Nonetheless, school planners must consider ways of reducing reverberation time (RT). Baffles and banners are commercially available and may be hung from the ceilings and or walls to help address the issues.

Gymnasia also pose a problem. Because of high ceilings, a flutter echo (ringing) is produced by bouncing balls, whistles, and general shouting. A reverberation time not to exceed 1.2 seconds should be the goal. Interestingly enough, some of the reverberation time can be addressed by splaying the walls. Even a slight angle of 8° can be effective. Hanging padding on the walls lower down and sound absorbing panels high up along with banners and baffles on the ceiling should work well.

An auditorium requires the consultation of a sound engineer. Even then, there may be difficulties. In the auditorium, intelligibility is important, but so is the concern for music transmission. As a comparative note, when Avery Fisher Hall in Manhattan first opened in the late 1950s as Philharmonic Hall, it was shut down after the first performance because of significantly less than desirable acoustics (actually, the results were scandalous) – this despite the significant contribution of the acoustical engineers during the original planning and design. The Kimmel Center in Philadelphia, opened Winter 2002, was designed "with a moveable concert ceiling above the platform and acoustics adjustment chambers surrounding the audience seating which can be opened or closed selectively for different types of musical performances" (Kimmel Center for the Performing Arts, 2001).

The concern in retrofitting older construction is one of both cost and aesthetics. The goal should be to come as close to new construction acoustical standards as possible. In some classrooms this may be quite difficult due to high ceilings, cinderblock walls, tile or cement floors, and existing placement of HVAC systems. The school should look into adding dropped ceiling tiles or baffles, sound absorbing shades or curtains, caulking windows, doors and walls seams (including along the ceiling and floor.) Many of the acoustic panels are lightweight and easy to install so that the regular maintenance crew can do the work themselves in a short time. Some schools have hung ceiling tiles. However, if there are no partitions above the tiles between rooms, the sounds from another classroom seep into the room in question and add to the distracting noise. Poor caulking around windows, doors, ceiling fixtures, and wall seams can also allow noise to leak in and out of a classroom. Sound insulating material can be added into some existing ductwork. Sound absorbing panels can be installed on cinderblock walls. There is also the possibility of adding a layer of glass fiber insulation covered by GWB on certain walls.

The addition of a sound system can be considered, particularly if there are hearing impaired students, but there is a concern that some of these systems amplify ambient noise as well as signal sound.

In a discussion with Paul I. Pressel, a retired engineer who specialized in wave propagation, this researcher was advised that when dealing with noise reduction, the offending components should be addressed one at a time beginning with the biggest (loudest) problem. By attacking the areas of concern this way and eliminating the noisiest components first, there may be less need to address smaller issues. Mr. Pressel was questioned about installing noise reduction panels, the concern being that these panels would also absorb the signal sounds. He explained that the absorption is a percentage issue.

Perhaps the best recommendation that can be made is to hire a reputable acoustical engineer with a proven track record who has significant experience specifically with school buildings. For new construction, this person or firm should be part of the earliest planning phase. With existing construction, an acoustical engineer should be engaged to make an assessment of the building before attempting any renovations. By doing so, less drastic and less expensive retrofitting might be suggested.

As far as standards are concerned, school planners should consult the recommendations made by ANSI, ASHRAE, and ASA. Each of these organizations publishes a handbook with its respective standards and recommendations along with NC curves. School administrators in particular should keep an eye open for future rulings related to the Americans with Disabilities Act (ADA) as they, too, are becoming involved with the setting of acoustical criteria.

It seems quite clear that acoustical issues in schools are significant enough to warrant attention. Michael Nixon (Dunne, 2000) warns us of the devastating effect that excessive noise and reverberation have on hearing and the ability to understand correctly what is being said in the classroom. He has an interesting response to school administrators who claim that there is not enough money to address acoustical issues while there was money for landscaping and a student parking lot. "I never saw a tree yet that contributed anything to the academic achievement." Sarcasm aside, it might be advisable for a good school administrator to do a walk-through in his/her building while classes are in session. The purpose of such a site visit would not be to observe instruction per se, but rather to listen in a variety of educational spaces, and to audibly observe whether the appropriate signals can be heard (from the developmentally appropriate perspective of a student.) If many students seem tuned out, it could be due to poor acoustics. Reduction in noise is a sound idea.

References

Acoustical Society of America. (1997). America's need for standards and guidelines to ensure satisfactory classroom acoustics. Retrieved February 14, 2002 from http://www.acoustics.org/press/133rd/2paaa1.html

Acoustical Society of America. (2000). Classroom acoustics. Retrieved February 14, 2002 from http://asa.aip.org/classroom/booklet.html

Castaldi, B. (1994). Educational facilities: Planning, modernization, and management (4th ed.). Boston: Allyn and Bacon.

Dunne, D.W. (2000). New standards should help children in noisy classrooms. Education World. Retrieved February 14, 2002 from http://www.education-world.com/a_admin/admin158.shtml

Herbert, R.K. (1999). Poor marks for classroom acoustics. Retrieved February 14, 2002 from http://www.facilitiesnet.com/fn/ns/ns3b9kb.html

Jiang, T. (1997). Can noise levels at school gymnasia cause hearing loss: A case study of a physical education teacher. Popular version of paper 2pAAa7 presented June 17, 1997 at the Acoustical Society of America. Retrieved February 14, 2002 from http://www.nonoise.org/quietnet/qc/workshop/2paaa7_1.htm

Johson, E. (2001). Let's hear it for learning. Retrieved from IndustryClick website February 14, 2002 through www.edfacilities.org/rl/acoustics.cfm also available from http://industryclick.com//magazinearticle.asp?magazinearticleid=111873&magazineid=134&mode=print

Kimmel Center for the Performing Arts. (2001). Building the center: Project description & specs. Retrieved February 15, 2001 from http://www.kimmelcenter.org/building/description.php

Maxwell, L.E. and Evans G.W. (n.d.). Design of child care centers and effects of noise on young children. Retrieved February 14, 2002 from http://www.designshare.com/research/maxwell/noisechildren.htm

McSquared System Design Group, Inc. (n.d.). Classroom speech intelligibility. Retrieved February 14, 2002 from http://www.mcsquared.com/classrooms.htm

NPCQuietnet. (1997). Guidelines for classroom acoustics in new construction. Delivered December 1997 Workshop on Acoustics and Learning. Retrieved February 14, 2002 from http://www.nonoise.org/quietnet/qc/workshop/dec97shp/guide.htm

Ohio State University. (1999). Many classrooms have bad acoustics that inhibit learning. Retrieved February 14, 2002 from http://www.sciencedaily.com/releases/1999/12/991224090246.htm Original news release can be found at http://www.acs.ohio-state.edu/units/research/archive/rmsound.htm

Picard, M. and Bradley, J.S. (1997). Revisiting speech interference by noise in classrooms and considering some possible solutions. Popular version of paper 2pAAa3 presented June 17, 1997 at the Acoustical Society of America. Retrieved February 14, 2002 from http://www.acoustics.org/press/133rd/2paaa3.html

Schappert, S. (1992). Office visits for otitis media: United States, 1975-1990, Advance Data from vital and Health Statistics, no.214, pp.1-15

Scott, E. (1999). Sound decisions improve learning. Retrieved from IndustryClick website February 14, 2002 through www.edfacilities.org/rl/acoustics.cfm also available from http://industryclick.com//magazinearticle.asp?magazinearticleid=33096&mode=print

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