channel 13, that the Belt Line Railroad Bridge is closing for river traffic. In each of these three announcements, the bridge/train controller will request all concerned river traffic to please acknowledge on marine channel 13.

(5) The bridge shall only be operated from the remote site if closed circuit visual and radar information shows there are no vessels in the area and no opposing radio communications have been received.

(6) While the Belt Line Bridge is moving from the full open position to the full closed position, the bridge/train controller will maintain constant surveillance of the navigational channel to ensure no conflict with maritime traffic exists. In the event of failure of a camera or the radar system, or loss of marine-radio communications, the bridge shall not be operated by the off-site bridge/train controller from the remote location.

(7) If the off-site bridge/train controller's visibility of the navigational channel is less than ¾ of a mile, the bridge shall not be operated from the remote location.

(8) When the draw cannot be operated form the remote site, a bridgetender must be called to operate the bridge in the traditional on-site manner.

(9) The Belt Line mid-channel lights will change from green to red anytime the bridge is not in the full open position.

(10) During the downward and upward span movement, a warning alarm will sound until the bridge is seated and locked down or in the full open position.

(11) When the bridge has returned to its full up position, the mid-channel light will turn from red to green, and the controller will announce over marine radio channel 13, ''Security, security, security, the Belt Line bridge is open for river traffic.'' Operational information will be provided 24 hours a day on marine channel 13 and via telephone (757) 543–1996 or (757) 545–2941.

* * * * *

Dated: May 20, 1998.

Roger T. Rufe, Jr.,

Vice Admiral, U.S. Coast Guard Commander, Fifth Coast Guard District.

[FR Doc. 98–14394 Filed 5–29–98; 8:45 am]

BILLING CODE 4910–15–M

ARCHITECTURAL AND TRANSPORTATION BARRIERS COMPLIANCE BOARD

36 CFR Chapter XI

[Docket No. 98–4]

Petition for Rulemaking; Request for Information on Acoustics

AGENCY: Architectural and Transportation Barriers Compliance Board.

ACTION: Request for information.

SUMMARY: The Architectural and Transportation Barriers Compliance Board has received a petition for rulemaking from a parent of a child with a hearing loss requesting that the ADA Accessibility Guidelines be amended to include new provisions for acoustical accessibility in schools for children who are hard of hearing. Several acoustics professionals, parents of children with hearing impairments, individuals who are hard of hearing, and a consortium of organizations representing them have also urged the Board to consider research and rulemaking on the acoustical performance of buildings and facilities, in particular school classrooms and related student facilities. The Board seeks comment on the issues outlined in this request for information. After evaluating responses to this request for information, the Board will determine a course of action. Alternatives under consideration include research, rulemaking, and technical assistance on acoustical issues.

DATES: Comments should be received by July 31, 1998. Late comments will be considered to the extent practicable.

ADDRESSES: Comments should be sent to the Office of Technical and Information Services, Architectural and Transportation Barriers Compliance Board, 1331 F Street NW., suite 1000, Washington, DC 20004–1111. E-mail comments should be sent to acoustic@access-board.gov. Comments sent by e-mail will be considered only if they include the full name and address of the sender in the text. The petition and comments are available for inspection at the above address from 9:00 a.m. to 5:00 p.m. on regular business days.

FOR FURTHER INFORMATION CONTACT: Lois Thibault, Office of Technical and Information Services, Architectural and Transportation Barriers Compliance Board, 1331 F Street NW., suite 1000, Washington, DC 20004–1111. Telephone number (202) 272–5434 extension 32 (voice); (202) 272–5449 (TTY). These are not toll-free numbers. Electronic mail address: thibault@access-board.gov.

SUPPLEMENTARY INFORMATION:

Availability of Copies and Electronic Access

Single copies of this publication may be obtained at no cost by calling the Access Board's automated publications order line (202) 272–5434, by pressing 1 on the telephone keypad, then 1 again, and requesting publication C–11. Persons using a TTY should call (202) 272–5449. Please record a name, address, telephone number and request publication C–11. This document is available in alternate formats upon request. Persons who want a copy in an alternate format should specify the type of format (cassette tape, Braille, large print, or computer disk). The petition and this request for information are also posted on the Board's Internet site at http://www.access-board.gov/rules/acoustic.htm.

Background

The Architectural and Transportation Barriers Compliance Board [1] (Access Board) is responsible for developing accessibility guidelines under the Americans with Disabilities Act of 1990 (ADA) to ensure that new construction and alterations of facilities covered by the law are readily accessible to and usable by individuals with disabilities. The Access Board initially issued the Americans with Disabilities Act Accessibility Guidelines (ADAAG) in 1991. The guidelines contain scoping provisions and technical specifications for designing elements and spaces that typically comprise a building and its site so that individuals with disabilities will have ready access to and use of a facility.

Although ADAAG contains a number of provisions for access to communications, including requirements for text telephones, assistive listening systems, and visible alarms, it does not include provisions for the acoustical design or performance of spaces within buildings and facilities.

[1] The Access Board is an independent Federal agency established by section 502 of the Rehabilitation Act (29 U.S.C. 792) whose primary mission is to promote accessibility for individuals with disabilities. The Access Board consists of 25 members. Thirteen are appointed by the President from among the public, a majority of who are required to be individuals with disabilities. The other twelve are heads of the following Federal agencies or their designees whose positions are Executive Level IV or above: The departments of Health and Human Services, Education, Transportation, Housing and Urban Development, Labor, Interior, Defense, Justice, Veterans Affairs, and Commerce; General Services Administration; and United States Postal Service.

The Department of Justice (DOJ) regulations implementing titles II and III of the ADA contain additional requirements for communications with individuals with disabilities and for auxiliary aids and devices to aid in communication.[2]

On April 6, 1997, the Access Board received a petition for rulemaking from a parent of a child with a severe to profound hearing loss requesting that the Board address ''architectural acoustics in schools'' and develop ''new rules'' for children who are hard-of-hearing. The petition argues that children who have hearing and other disabilities, including learning, auditory processing, speech and language, and developmental disabilities, face numerous communications barriers in schools because of poor acoustics and that these barriers may prevent them from receiving a meaningful education. The petition requests that the Board develop ''acoustical guidelines * * * [to] ensure adequately low noise and reverberation so that the speech-to-noise ratio and speech-to-reverberation ratio allow satisfactory communication and learning.''

A consortium of organizations representing persons with disabilities (Alexander Graham Bell Association for the Deaf, Inc., the American Speech-Language-Hearing Association (ASHA), Auditory-Verbal International, Inc., the National Center for Law and Deafness, the National Cued Speech Association, and Self Help for Hard of Hearing People (SHHH)) submitted comments to the Board in previous rulemakings asserting that a poor acoustical environment is as significant a barrier to individuals with hearing, speech, and language impairments as stairs are to persons who use wheelchairs.

The consortium's comments included a position paper on acoustics in educational settings developed by ASHA in 1994. The paper cited data on the increasing prevalence of hearing loss, particularly among children and young adults, and reported on research that identified children with mild hearing losses as more at risk for general psychosocial dysfunction and lags in academic progress than were children with normal hearing. Other cited studies showed the relationship between poor room acoustics and low speech comprehension in children with hearing, learning, and developmental disabilities. Reverberant classrooms with high ambient noise levels were identified as significant contributors to communications difficulties. The position paper included a number of recommendations for the acoustical performance of classrooms to improve conditions for listening, hearing, and understanding speech.

Other commenters to ADAAG rulemakings noted that the acoustics of many restaurants adversely affected the ability of individuals who are hard of hearing to communicate with companions and with service staff. In response, the Access Board contracted with Batelle, a research organization in Columbus, OH, to study improved speech communication for persons with hearing impairments in dining areas. A literature study, post-occupancy evaluations of several facilities, and recommendations were developed by Batelle engineers and reviewed by an eight-member advisory panel. The authors identified background noise levels and reverberation as the acoustical characteristics most subject to design and construction manipulation and most significant for adequate speech communication. Several panel members suggested that other facility types, particularly schools, could benefit from the application of such acoustical requirements.

Hearing Loss and Other Disabilities

Government health statistics document that more Americans report a hearing loss than any other disability, and the incidence of hearing loss has increased significantly in the last 25 years. A recent assessment by the Centers for Disease Control and Prevention (CDC) found that 13% of a representative sample of children between the ages of 6 and 19 had a high frequency hearing loss and 7% a low frequency hearing loss of 16 dB or more, a level at which perceiving and understanding words would be affected.

Increasing numbers of young children experience mild temporary and recurring hearing loss caused by otitis media, an inflammation of the middle ear that is the most frequent medical diagnosis for children. Research also shows that children with learning, speech, and developmental disabilities have a higher incidence of abnormal hearing and of repeated instances of ear problems. ''Hearing Loss: The Journal of Self Help for Hard of Hearing People'' reported in 1997 that one-fourth to one-third of the students in typical kindergarten and first-grade classrooms will not hear normally on a given day.

Speech Communication

Effective speech reception—understanding, not just hearing—is the primary educational issue for people with auditory disabilities. A Cornell University study published in the journal ''Environment and Behavior'' indicates that excessive classroom noise impedes the acquisition of language and cognitive skills by all children. The acquisition of language is necessary for brain and intellectual development. Research with children who are deaf has shown that the mastery of a system of communication is essential to future learning and that failure to acquire effective language skills by the age of six cannot be fully remediated.

Language acquisition is dependent in large part upon exposure to an organized system of communication, such as a signed, voiced, or tactile language. For children who will use voice communication, the intelligibility of the spoken language is a critical factor. Speech intelligibility is a measure of the proportion of the spoken message that gets through to the listener, and is affected by signal volume, the distance between the speaker and listener, and the acoustic characteristics of the room, including background noise levels and reverberation time.

A large body of clinical and scientific research supports the particular need for good acoustics in teaching environments. The Acoustical Society of America (ASA) has established a Classroom Acoustics Subcommittee of its Architectural Acoustics Committee that has held four symposia on classroom acoustics issues. At an ASA conference held in June 1997, researchers presented evidence that excessive noise levels impair a young child's speech perception, reading and spelling ability, behavior, attention, and overall academic performance.

Because the ability to understand speech does not mature in children before the age of 15, children are less effective listeners generally than are adults. Additionally, children have less experience in deriving meaning from context. A representative sample of children without hearing loss or other audiological disability, even when tested in above-average listening environments, could make out only 71% of a teacher's words. Those in the worst environments ''got'' only 30% of the message directed at them.

The listening abilities of children with hearing impairments, particularly those with mild to moderate hearing loss, are even more affected by poor acoustics than are those of children whose hearing falls within normal

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[2] Under the ADA, the Departments of Justice and Transportation are responsible for issuing regulations to implement titles II and III of the Act. The regulations must include accessibility standards for newly constructed and altered facilities. The standards must be consistent with the accessibility guidelines issued by the Access Board. The Department of Justice and the Department of Transportation regulations currently include ADAAG 1–10.

ranges. A 1997 study of children with minimal sensorineural hearing loss showed lower scores for basic skills and communications testing and a high rate—37%—of retention in grade. In addition, these students functioned below normally hearing children in evaluations of behavior, energy, stress, social support, and self-esteem. Other studies have shown that children with learning and developmental disabilities perform less effectively in noisy spaces.

In their chapter on ''Speech Perception in Specific Populations'' (from the book ''Sound-Field FM Amplification''), Drs. Carl Crandell, Joseph Smaldino, and Carol Flexer have identified at-risk populations as young students generally (less than 13–15 years of age); children who have a history of otitis media, children for whom English is a second language, and children with auditory disabilities, including those with hearing loss, central auditory processing deficits, learning disabilities, developmental delay, and attention, speech, and language disorders.

Acoustical Performance of Rooms and Spaces

In analyzing how effectively an individual can hear and understand in a given space, an acoustician or audiologist will consider three criteria: Distance from the sound source (the 'signal'), the level of background sound (noise), and the effects of reverberation. By controlling background noise levels and room reverberation time, designers can provide good speech intelligibility, measured by the signal-to-noise ratio. The signal-to-noise ratio is the relationship between the loudness of the message and the background sound it must overcome to be heard and understood. A significantly positive signal-to-noise ratio is necessary for maximum performance where room sound levels are high; children with hearing impairments require a higher signal-to-noise ratio than do children with normal hearing.

Distance from the source has a significant effect on signal-to-noise ratio, since the loudness of a direct sound falls off in proportion to the distance between the speaker and listener. Children with hearing impairments and other disabilities affecting listening need to maintain a consistent and close relationship with the sound source. Speech intelligibility can be enhanced by delivery and performance styles, by the use of reflective surfaces at the speaking location, and by amplification.

Background noise—whether from heating, ventilating, and air conditioning (HVAC) systems, other noise generated within the space, or outside noise—also interferes with effective listening because it competes with the spoken message. High background noise values across the frequencies of speech (500 to 2000 Hz) require louder speech signals to overcome. Background noise (or ambient sound) design criteria are typically expressed as a range between two noise criteria (NC) curves, which plot sound levels across 8 standard frequencies. Sound levels in existing spaces can be tested at these frequencies using a sound meter. The NC rating for a room is typically between 5 to 10 points below the dBA reading. Design engineers can specify HVAC equipment with low noise ratings and limit sound generated by system operation in a variety of ways. Rooms and spaces can be protected from unwanted exterior sound by mass, insulation, and isolation in wall and slab construction and by minimizing (or sound protecting) openings.

Reverberation—reflected sound that persists within a room or space—also masks the sound of the spoken message and increases background sound levels. The longer the reverberation time, the greater the effect. Reverberation is expressed in seconds (R60), measured as the time it takes for sound to decay 60 dB after the source has stopped producing it. Reverberation is a function of the physical properties of the room and can be calculated if the volume, surface area, and surface absorbencies of a space are known. Reverberation can be controlled by a manipulation of the absorbency of surfaces within a space and the proportions and volume of the space.

When reverberation time and background noise are controlled, speech effort and sound levels decline, leading to a reduction in room noise. It has been estimated that over 90% of those who have a hearing loss have usable residual hearing and would benefit from an enhanced speech environment. Where classrooms and child care centers do not provide acceptable listening conditions, even amplification will not achieve maximum effect in improving speech communication. Poor acoustics can also compromise the effectiveness of personal hearing aids and devices and limit the usefulness of auxiliary aids and services. Good acoustics can enhance the usefulness of such aids and improve listener reception of unamplified speech, as may occur in group interchange. Because most mild hearing losses in children are not diagnosed, children with such losses (15–25 dB), including those with temporary hearing loss due to otitis media, will not generally be using amplification devices.

Many groups concerned with the acoustics of educational environments recommended that new implementing regulations for the Individuals with Disabilities Education Act (IDEA), currently being developed by the U.S. Department of Education, require that services for covered students be delivered in an acoustically appropriate environment. Two cases have been reported to the Board in which IDEA or Rehabilitation Act decisions directed that the room acoustics in existing school classrooms be improved to accommodate children with hearing loss. Requirements that students with disabilities be educated in the least restrictive environment mean that every classroom is likely to have a youngster with a diagnosed auditory disability in attendance; additionally, during the course of a school year, many children will be temporarily affected by mild and possibly recurring hearing loss associated with otitis media and other illnesses.

Classroom Acoustics

Studies of classrooms around the country and test data submitted by parents and acoustical consultants indicate that classrooms and day care facilities are not being designed to provide adequate speech intelligibility even for children without auditory impairments. Research on seven child-care facilities in Canada documented noise conditions in four centers that exceeded the 75 dB limit considered safe for day-long exposure for adults by the World Health Organization. Open plan centers had particularly excessive noise levels and were reported to have more health problems among children and staff as well as other disadvantages. Acoustical treatment that reduced reverberation time in the noisiest setting from 1.6 seconds to .6 seconds resulted in a 5 dB decrease in sound level and staff assessments of substantial improvement in comfort. A 1994 survey of school facility conditions conducted by the General Accounting Office (GAO) reported that poor acoustics were ranked by administrators as the most significant problem affecting the learning environment. Twenty-eight percent of responding schools identified acoustics for noise control as being unsatisfactory or very unsatisfactory. Eleven million children were estimated to be affected. Of these, CDC estimates suggest, more than a million and a half children may have a temporary or permanent hearing loss.

Acoustical Design Standards and Guidelines

Reverberation and background noise limits are common elements in existing acoustical standards, recommendations, and good-practice guidelines for classroom design and construction. Audiometry rooms and educational classrooms designed specifically for persons with auditory impairments have short reverberation times and very low background noise levels. Similar requirements are applied to rooms such as broadcast and recording studios, including teleconferencing facilities, where speech communication is the primary function, and in sound testing facilities such as anechoic chambers. Low background noise and short reverberation times contribute to positive sound-to-noise ratios, maximal sound transmission indices, and high speech intelligibility values.

Achievements in the design of concert hall acoustics and specialized environments for materials testing and measurement demonstrate that good hearing environments can be accomplished with current design, modeling, construction, and testing procedures. It appears that a consensus on the general scope and content of acoustical performance criteria for classrooms is developing among audiologists, acousticians, and consumers and that existing acoustical guidelines for educational and other facilities may be adaptable for incorporation into ADAAG.

While some factors—for instance, a rise in exterior noise levels due to a change in nearby noise sources—are beyond the control of the design professional, 'bad' acoustics are largely architectural problems, solvable by architectural means. Architects and other design professionals routinely practice simple acoustical design procedures in specifying floor, wall, and ceiling finishes. Acousticians are regularly retained for the more demanding design and engineering of music and performance facilities. Several software programs are available to model the acoustical performance of spaces that have been designed but not built. Criteria for the acoustical design of spaces are widely available in textbooks and technical publications.

Acoustical testing protocols are developed and maintained by several private sector organizations. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) issues standards that include the acoustical performance of equipment installed in buildings and facilities. The American National Standards Institute (ANSI), in conjunction with the ASA, has established several protocols for the measurement of room sound levels, including ANSI S12.2 Criteria for Room Noise Measurement. ANSI has recently established a committee to develop a classroom acoustics standard. Foreign and international standards also exist. Model codes contain both standards and requirements for sound-rated construction components in multi-family housing and other occupancy types. The developers and operators of hotel, medical, and housing facilities typically establish similar acoustical standards for sound transmission through floors, walls, structure, and HVAC systems.

''Architectural Acoustics'', by M. David Egan (McGraw-Hill, Inc., 1988), a standard reference work for design professionals, recommends a background noise level of less than 20 dB (NC–20) for critical music performance (including broadcast and recording studios) and audiological spaces; a range of NC–20 to NC–30 for less demanding, speech-focused halls and rooms, and NC–30 to NC–35 for classrooms. Recommended reverberation limits range between .6 and .8 seconds. The author notes, however, that NC curves to provide satisfactory listening environments for persons with hearing impairments need to be lower by 5 (resulting in a recommendation of NC–25 to NC–30 for classrooms serving adults with hearing loss). Egan recommends that reverberation time in such rooms should not exceed .5 seconds.

The ASA recommends an average reverberation time in classrooms between .6 seconds minimum and .8 seconds maximum; ambient room noise, when measured without occupants, between 30 dBA minimum and 35 dBA maximum; room criteria (RC) curve—used to measure HVAC and equipment-generated noise—should not exceed RC–25, and the signal-to-noise ratio should be able to achieve +15 dB. The ASA has recently established a multi-committee initiative to work on the development of guidelines for acoustics. A workshop seminar was held in Los Angeles in December 1997 to begin the process of developing consensus recommendations.

The ASHA recommends that noise levels in unoccupied classrooms not exceed 30 dBA (or a NC–20 curve) and that reverberation time not exceed .4 seconds across speech frequencies. Signal-to-noise ratios (measured at the student's ear) should exceed +15 dB.

Dr. Crandell et al. recommend that elementary and secondary school classrooms for 'at-risk' students should have unoccupied ambient noise levels that do not exceed NC–25 or a sound pressure level of 35 dBA and a reverberation time that does not exceed .4 seconds in the speech frequency range.

Portugal's classroom noise standards, adopted in 1988, limit reverberation time in general classrooms to .6–.8 seconds and in special classrooms to .6 seconds; equipment background noise may not exceed 35 dBA. Wall construction between classrooms must have a sound transmission class (STC) rating of at least 50 dB. The Swedish Board of Housing, Building and Planning has adopted Building Regulations BBR 94, with amendments, that include detailed guidelines for protection against noise for several building types, including schools, by means of specified areas of sound absorbent surfaces within classrooms, acoustical isolation between classrooms, and limits on background noise from building systems and equipment.

The State of Washington Department of Health rules, WAC 248–64–320 Sound Control, include a limit (NC–35) on background noise in classrooms. The Los Angeles County Unified School District—the largest in the world in numbers of students enrolled—has recently adopted a similar standard for the noise output of classroom HVAC equipment. ANSI S12.2–1995 suggests an NC range of 25–30 for classrooms and an RC in the same range. A tabular comparison of values for acoustical criteria in classrooms is presented in Table 1.

Other bases for prescribing and testing acoustical characteristics, including values for speech-to-noise ratio and the speech transmission index (STI), may be applied to diagnose existing acoustical conditions in classrooms, but do not appear useful in a new construction standard. The STI takes into account the effects of noise and reverberation and can be adjusted to obtain values for listeners with hearing impairments. Both rely on in-use measurements.

Cost

High-performing acoustical environments are achieved at some premium in construction cost. Knowledgeable design, construction, and materials specification, an investment in high-quality HVAC equipment, and careful installation and workmanship are required to ensure that design values are reflected in performance. Special consideration of room configuration, proportion, and location may also be necessary. Furthermore, the measures necessary to control sound in classrooms may raise other issues affecting cost. For instance, carpeting is recommended to add absorbency for reverberation control and to minimize the self-noise of student movement. However, carpeting may require a change in maintenance procedures. Controlling ambient noise in many urban schools may require that windows be kept closed even in pleasant weather, when HVAC systems might operate at lesser capacities. Students with moderate to severe hearing impairments may also require the use of amplification systems to increase speech intelligibility to effective values.

ADAAG Criteria

To be useful, acoustical recommendations and standards should employ design techniques, data, and sound measurement protocols available and familiar to architecture, engineering, and construction practitioners and applicable during design phases. Like a building code, ADAAG is intended for use in new construction and alterations of buildings and facilities. It contains provisions for construction elements, items, and finishes that are fixed to the building structure. Furniture and equipment, including portable communications devices, are covered by the DOJ regulation, not ADAAG.

The Board recognizes that amplification technologies may be required for effective communications in some rooms and spaces and for some individuals. Such solutions, including those that use portable assistive listening systems and sound field technology, are beyond the scope of the building and facility provisions in ADAAG. However, such technologies cannot be fully effective in noisy environments; amplification in highly reverberant environments will exacerbate listening and hearing problems. Furthermore, the effectiveness of personal devices, particularly hearing aids, is also compromised in noisy environments. And, because the learning environment includes interaction with peers and other individuals in classrooms and other settings, instructor amplification only may not fully remove barriers to hearing, listening, and learning where acoustical design is flawed.

Based upon public comments to this notice and on information already available and outlined in this notice, the Board will consider whether it is appropriate for ADAAG to include criteria for such acoustical performance characteristics as reverberation time and background noise. Several non-rulemaking options will also be considered, including additional research, the development of advisory materials, and guidance and technical assistance for design professionals.

In response to the petition, the Board wishes to focus this request for information on the acoustical performance of classrooms and related spaces used by children, including day care settings for pre-primary ages. However, the Board will consider comments and recommendations on the scope and technical provisions of acoustical criteria appropriate for buildings and facilities and other occupancies, as well.

The Board seeks relevant research, standards, data, test reports, analyses, and recommendations from acoustical engineers and consultants, design professionals, educators and educational administrators and counselors, audiologists, specialists in hearing impairments, parents of children with disabilities and persons with hearing, speech, and language disabilities, including learning and developmental disorders, and the organizations that represent them. Commenters are encouraged to address their responses to the issues outlined below.

Question 1: Implementing acoustical guidelines in educational facilities for children may be necessary for youngsters with auditory and related disabilities to function effectively in school. (a) Should all rooms and spaces within a school setting be included in coverage? Some comment has identified gymnasiums, pools, and cafeterias as particularly problematic for students with hyperacusis, a heightened sensitivity to noise, and for those with learning and auditory processing disabilities. Such facilities are often highly reverberant due to their large areas of hard, sound-reflective surfaces. (b) Should acoustic guidelines include coverage of these spaces? Would a less stringent standard be appropriate in non-classroom school facilities? What acoustical properties are appropriate in multi-purpose spaces that accommodate recreation, performance, and food service activities at different times during a school day? (c) In view of the importance of early language acquisition, how should child care settings be covered? Are there acoustical criteria in current health and safety standards for child care facilities? (d) Should the Board consider the development of guidelines for a wider range of facility types for a more universal range of users? If so, what facilities might be included?

Question 2: The Board has received information on several cases in which the acoustical environment was an issue in an Individualized Education Plan prepared by a school system for a child with a hearing impairment. Would a common standard for the acoustical design of educational facilities be helpful to design professionals seeking to provide acoustically satisfactory environments and to school systems seeking to comply with educational mandates for children with disabilities? Are current design manuals, recommendations, and other technical assistance on acoustical design sufficient?

Question 3: There is considerable research that shows that controlling classroom noise and reverberation will benefit student learning. However, it is not clear at what levels effective listening by children with mild, moderate, severe, or profound hearing losses and other disabilities is compromised and whether such conditions can be achieved in some classroom environments, where ''self-noise'' and student activity also contribute to a poor listening environment. (a) Is there research that identifies the specific acoustic requirements necessary for effective listening by children with various hearing, speaking, and learning disabilities? What acoustical performance and testing standards are appropriate for classrooms in which children with auditory disabilities are integrated? Are there data that relate specific acoustical criteria to the usability of buildings and facilities by children with learning disabilities, developmental disabilities, and other disabilities that affect speech reception, learning, and communication? (b) What are the relative contributions of low reverberation values and low background noise values to effective communication for people with hearing loss? (c) Can the acoustical environment be improved sufficiently through design and construction measures for children with hearing and other impairments to receive significant communications benefit?

Question 4: The Board also seeks information on the acoustical environment necessary for effective use of assistive technology, including hearing aids and assistive listening devices, by children with hearing loss. Because assistive technologies will be part of many student accommodations, the Board is interested in the extent to which poor acoustics compromise the effectiveness of technologies such as sound field enhancement (in which the amplified voice of a teacher fitted with a microphone can be distributed to speakers placed around the perimeter of a classroom) and direct broadcast to children with hearing loss through personal assistive listening devices. At what thresholds of background sound and reverberation will children with various degrees of hearing loss be able to participate in meaningful classroom listening if aided by amplification technology?

Question 5: The GAO report on school conditions highlighted the multimedia classroom as the educational facility of the future. The Board is interested in understanding the nature and characteristics of such a classroom, particularly the extent to which it may be interactive, with small group listening and discussion, multiple inputs from speakers and media devices, frequent changes in speaker-listener relationships, and other audio source conditions that may not be fully adaptable to amplification technologies.

Question 6: The Board recognizes that decisions made by building design professionals during the design phases of a project affect the ultimate acoustical performance of a room or space. Determinations of building siting, overall facility planning, and individual room volume and proportion, floor, wall and ceiling assembly construction and finishes, equipment specification, and HVAC system design all contribute to the acoustic functioning of a room or space. However, most recommendations for acoustical performance measure the results of such design decisions, setting limits on reverberation and background noise. (a) Can good speech listening conditions be achieved by setting standards for reverberation time and background noise only? (b) Should other design variables, for example, room configuration or proportion, ceiling height, or size, be considered? The Swedish guidelines specify wall and ceiling construction types and values in addition to limiting background noise. Are these a useful model for possible guidelines? (c) How might considerations of speech intelligibility, speech transmission indices, and other measures that rely on in-use testing be incorporated in acoustical design? What are the margins of error in acoustical equipment, testing, simulation, and construction? (d) What are effective means of acoustically retrofitting an existing classroom or other space that performs poorly for speech perception? How successful can such corrective action be in correcting perceived hearing and listening problems?

Question 7: What is the square foot cost for new classroom construction today? What additional square foot cost would be necessary to meet average industry recommendations for reverberation time (R .6—.8 seconds) and background noise (NC 35–40) for classrooms? What would be the added cost, per square foot, of achieving values within the ranges suggested by ASA (R .4—.6 seconds; NC 25–30)? What are the relative costs of meeting reverberation limits as opposed to background sound limits? What data are available on the costs of alterations to existing environments to improve acoustical conditions?

Question 8: The Board also seeks information on the non-capital costs and savings associated with constructing and maintaining acoustically-appropriate classrooms and related educational facilities. What are the cost implications of such design and finishes decisions and operating procedures as room location and configuration, window operability, and carpeting? What savings might accrue from the elimination of some special education environments?

Question 9: How can compliance with acoustical design criteria be assessed prior to facility occupancy and use? How can time and physical variations in equipment manufacture, construction, and outside noise conditions be accommodated in a guideline? What testing and compliance practices have been used where standards are already in place?

Question 10: Many teachers and administrators have had experience with open classrooms, in which several teaching groups may work concurrently in a single large space, and with enclosed classrooms of smaller size. (a) The Board is particularly interested in comments offering a comparison of the effects on students and teachers, in particular those with disabilities, of classroom acoustics in such situations. (b) Do noisy classrooms exacerbate teacher stress? Are there data available on the effects of classroom noise on teacher health, comfort, or performance? (c) Do schools and systems have information on student behavior and performance after acoustical improvements, including the partitioning of open classrooms into more discrete units, have been made?

Question 11: What approaches other than regulation under the ADA might be successful in achieving good acoustical design? What organizations and interests should be consulted in the Board's consideration of acoustical issues?

Dated: May 26, 1998.

Thurman M. Davis, Sr.,

Chair, Architectural and Transportation Barriers Compliance Board.

Table 1 on recommended/required acoustical criteria for classrooms follows:

BILLING CODE 8150–01–P

Table 1: RECOMMENDED/REQUIRED ACOUSTICAL CRITERIA FOR CLASSROOMS

[Shaded cells contain values recommended for students with hearing loss]

	Reverberation	Background Noise Level				Other
	(R-60)	Room		Equipment		
		NC	dBA	RC	dBA	
ASHA/Consortium Recommendations*	.4 seconds	20	30			Signal-to-noise ratio >15 dB
ASA Recommendations	.6 - .8 seconds		30-35	25		Signal-to-noise ratio +15 dB
ANSI S12.2-1995		25-30		25-30		
Acoustic Guidelines, Swedish Board of Housing, Building and Planning (1994)	equivalent to .6 seconds	30			30	90% ceiling area absorbent; walls provide 44 dB sound reduction
School Standard, Portugal (DIN 254/87)						New schools not permitted where sound level (exterior) >65 dBA
--classrooms generally	1 - 1.3 seconds	30				Walls permit <50 dB sound transmission
--classrooms for students with hearing loss	.4 - .6 seconds	25				Walls permit <45 dB sound transmission
Equipment Standard, Los Angeles County Unified School District				25-30	35	
Washington State Health Department WAC 248-64-320			35			
Architectural Acoustics, Egan**						
--classrooms generally	.6 - .8 seconds	30-35	38-42	25	34	Walls permit <50 dB sound transmission
--classrooms for students with hearing loss	< .5 seconds	25-30		20		Walls permit <35 dB sound transmission
Soundfield Amplification, Crandell et al.	< .4 seconds	25	35			
Range of classroom recommendations from 18 acoustics textbooks***			30-47			

KEY

Sound is a complex product of frequency and intensity. Nevertheless, it is common to express sound energy as a single-number rating measured in decibels (dB). A-weighted sound levels (**dBA**) approximate human hearing by suppressing the contribution of low frequency sound. Noise limits are usually specified in dBA.

Noise criteria curves (**NC**) plot sound levels across the frequencies between 63 and 8000 Hz (the speech perception range). The NC curve of a room is the lowest curve that is not exceeded by sound levels measured at each frequency. NC criteria are often expressed as a range in specifying acceptable background noise levels. Equivalent dBA values typically exceed NC values by 8-10 units.

Room criteria (**RC**) curves were developed for background noise from heating, ventilating, and air conditioning systems. NC criteria curves are adjusted at very low and very high frequencies to avoid annoying mechanical sound.

The signal-to-noise ratio (**SNR**) is the difference between source loudness and background sound. Child listeners need an SNR of approximately +15 dB for good hearing conditions.

Noise reduction (**NR**) is the difference in background sound level between a source on one side of a wall and a receiver on the other. Transmission loss (**TL**) is a wall rating (both are expressed in decibels) for noise reduction.

Sound transmission class (**STC**) is a wall or other assembly rating for sound isolation.

NOTES

* Egan classifies a Noise Criteria range of less than 20 as necessary for excellent listening conditions, as in concert halls, broadcast and recording studios, recital halls, large auditoriums, and churches. An NC range between 20-30 produces ‘very good’ listening conditions, appropriate for theaters, small auditoriums, large meeting rooms, teleconferencing facilities, executive offices, courtrooms, chapels, and large meeting rooms. An NC range of 25-35 is recommended for sleeping rooms. NC 30-35 will produce ‘good’ listening conditions for offices, small meeting rooms, libraries, and classrooms.

** A consortium of organizations representing persons with hearing, speech, and language impairments (Alexander Graham Bell Association for the Deaf, Inc., the American Speech-Language-Hearing Association (ASHA), Auditory-Verbal International, Inc., the National Center for Law and Deafness, the National Cued Speech Association, and Self Help for Hard of Hearing People (SHHH)) organized to submit consensus recommendations on classroom acoustics in comment to the Board’s proposed rule on access to State and local government facilities.

*** Taken from Rettinger, Michael, ***A Handbook of Architectural Acoustics and Noise Control: A Manual for Architects and Engineers***, TAB, Blue Ridge Summit, PA, 1988 (pps. 232-233).

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