THIS AIN'T YOUR DADDY'S LIBRARY – THE CHALLENGES OF MODERN LIBRARY ACOUSTICS

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The design of modern libraries is radically different from those we knew 10 and 15 years ago. Then, libraries were quiet, often with signs reading: "Quiet", places for refuge and learning. The modern library is more of a community space, for all ages, also for learning through media other than books. The resulting acoustic challenges are enormous.

Libraries designed in the years around 1900 followed the Carnegie model, because Andrew Carnegie provided construction grants to about 1700 libraries in the United States and Canada, most of which had imposing façades, two-storeys, many stairs, and various collections of books in separate rooms. These buildings were not "accessible" by various meanings of that word and certainly not easily adaptable to changing uses. Quiet was the order of the day and it was relatively easy because heating was hot water, none had air-conditioning, the rooms tended to be small, lined with bookshelves to heights sometimes requiring ladders. Thus the rooms were inherently quiet, very sound absorptive – though they did not contain any specific sound absorbing materials – and thus conducive to quiet study. Speech intelligibility would be excellent but it wasn't needed, speech privacy of no concern because people spoke softly, noise intrusion and distraction were minimal.

The modern library is anything but quiet. Starting perhaps 25 years ago reading circles appeared, where a librarian or teacher could read to elementary school children, often as semi-circular mini-amphitheaters. But necessarily, they were pushed into a corner or separate wing in order to keep the sound of voices and laughter from the other parts of the library. Within the last decade new libraries have been designed to be open and welcoming spaces, intended as much as a community space for all ages as for quiet study. They have grown to include areas dedicated to young children, teens, collaborative study, computer terminals for different age groups, multi-purpose meeting rooms, gallery/exhibit space, performance spaces, recording studios, even a reading oasis with fireplace.

In order to be more welcoming the modern library has larger rooms, encourages line-of-sight to distant parts of the library, low partitions rather than walls and includes fewer bookstacks. Contributing to the openness, more glass is used both to the exterior and between "rooms" to provide more daylight and the use of atria provides the sense of openness and connectivity between different floors. There is much more circulation within the building, from area to area and between floors so corridors are wider and finished, for maintenance, with hard surfaces. Similarly the stairs, also hard surfaces, which were once in stairwells, are in the open. Thus, footfall noise is common throughout the building. Mechanical systems are often exposed with local heat pumps and VAV boxes needed due to the open design.

Perfect Acoustic Storm

The result is a perfect acoustic storm. In this case, it is the intersection of 1) many more noise sources: voices from children and teens, discussion groups, casual spaces; footfall noise and mechanical noise and, 2) rooms which do not attenuate sound: they are very much larger, often inter-connected, have far less sound absorption, are finished with hard floors, with glass exterior walls and low divider walls. The result is much more noise from many more sources in rooms where the sound can propagate relatively easily, where there is low transmission loss between "spaces" and little attenuation of sound all along the way.

Halifax Central Library - an "open" library. Photo: Adam Mork Courtesy of Fowler Bauld & Mitchell Architects

Recognition of this trend is quite recent; in 2002 Salter[1] in his article "Acoustics for Libraries" reviews noise control, materials and techniques for libraries, however, does not address any of these recent trends other than to say that if there are competing uses, to try to separate them. On the other hand, Madziak[2] in 2004 looked at trends in libraries including the inaccessibility of Carnegie libraries, noted the "opening up of library interiors, lower shelving units, wide aisles, lots of clear, uncluttered space…". She noted also that there was "proportionately less collection space and more people space" and in a section on "Quiet Space and Attention to Acoustics" noted that "libraries are no longer eerily quiet, almost silent places …. but have worked… in favour of being a comfortable, welcoming place for all

people, including young children." Finally, she noted "It can be argued that no other issue more challenges library planners than designing a facility that allows for both noise management and the preservation of quiet spaces". Interestingly, this was foreseen years ago, in 1931 by Dr. Ranganathan[1] in his article "The Five Laws of Library Science" of which the Fifth Law is "The library is a growing organism" which means that "A library should be a continually changing institution, never static in its outlook. Books, methods and the physical library should be updated over time".

Other Factors

Is the traditional quiet space even needed? No doubt other factors have come into play: the GenX and millennial generations are used to multimedia, eg while studying they are simultaneously listening to music and intermittently texting friends. They also multi-task regularly. In their school lives collaborative work is highly emphasized; they are much less used to quiet study than previous generations. The Internet allows huge access to information, Wikipedia, YouTube how-to videos, TED talks, available at a terminal or sitting anywhere on the floor, even outside, with a laptop.

Design Criteria

The authors' experience would indicate that a new Index or measures are needed to estimate distraction and annoyance. The acoustic design criteria for a modern Library are limited: STI (speech transmission Index) and SII (speech intelligibility Index) which measure intelligibility and privacy are relevant but do not describe levels of intrusion, distraction or annoyance. Appropriate NC or RC are not available – there is not the experience to indicate whether a lower level which is inherently calming or a higher level which minimizes intrusion and aids in privacy is more appropriate. These overlap with STC and ASTC (Apparent Sound Transmission Class) for acoustic separation between spaces, but not for spaces which are acoustically coupled. There were indices in the past to measure startle or the rate of increase in sound level to predict distraction and community reaction. An index based on impulse sound and intrusion might be more appropriate. Different Indicies and values may be needed for the different Library areas.

Noise Control Techniques, Case Studies

The acoustic goals are well known: to reduce the noise sources as much as possible, isolate the noisy and quiet areas and to reduce the propagation of noise to spaces where more quiet and less intrusion is required. However, there are not many technique options available and compromises are inevitable; these are reviewed in the case studies.

Case Study 1: Renovation Two floors of a university library, connected by an atrium with a concave curved wall opposite the floors, were renovated. Many bookstacks and all of the acoustic ceiling tiles were removed and study tables added. Users complained of the overall noise level, and distractions caused by nearby conversations particularly because of the focusing of the curved wall. Options were limited: re-install high absorption ceiling tile and provide banners at the curved wall for sound absorption. These made a marked improvement but not a total solution.

Case Study 2: Collaboration Area Four collaboration desks of 8 seats each were beside a long five-storey atrium. Openings to the atrium served for air return. Study carrels were 15 m beyond the desks. Atrium noise and noise from adjacent desks was distracting to desk patrons. Raised voices between, vs within, the desks annoyed the carrels. Acoustic material was applied to the atrium roof and floor fascia to reduce reverberant levels. A high-absorption ceiling replaced the drywall above the desks and sound masking at 45 dBA added to the desk area, the sound level tapering off toward the carrels. With masking, atrium intrusion was much reduced. It was hoped that because speech intelligibility between the desks would be much more difficult, there would be fewer raised voices trying to converse between the desks. Sound absorption was added to the walls near the carrels and an intervening wall increased in length to increase barrier effect reduces transfer to the carrels. Users report satisfaction with the results.

Case Study 3 : New; Halifax Central Library

Some noisy areas can co-exist: collaborative areas were placed adjacent to the circulation desk because each has a fairly high tolerance for intrusion. Noisy spaces were placed at one end, with less noisy spaces adjacent, then a separation of bookstacks or collaboration areas, then study carrels and finally quiet reading areas. Low bookstacks were used as partial separations. A performance space was connected to the larger rooms with an operable partition, closed when the privacy is required for performance, open when the room is used for an unamplified reading or a small gathering. However, the meeting rooms have normal walls and the recording studio has STC 60 partitions and sound lock.

Rubber floor finishes on the main traffic areas and stairs reduced footfall noise. Mechanical rooms were isolated and VAV boxes selected for low sound power. Entrances to washrooms were acoustically lined to reduce washroom noise to public spaces, eliminating doors and closing noise.

A high absorption ceiling is essential to the reduction of noise propagation through the space – a cost-effective solution was a linear ceiling with 78% open area and above it, 25mm rigid glass fibre was adhered to the concrete deck. Sound absorbing material was placed on partitions where reflection from one area to another is significant. Curtains – often needed for sunlight or blackout – assist in reducing reflections from exterior glass.

The new Library is considered a success by Library staff and the architectural design has won multiple awards.

References

[1] Acoustics for Libraries 2002, C.M. Salter, US Institute of Museum and Library Services; California State Librarian
[2] 22 Recent and Enduring Trends in Ontario Public Libraries, Anne Marie Medziak, S. Ontario Library Service.
[3] The Five Laws of Library Science, S.R. Ranganathan.