Solving acoustical problems — Sound difficult? It's not.

Of the many problems that the facilities manager or office designer is asked to anticipate or correct, those relating to acoustics tend to be among the most ignored. This is true largely for two reasons: 1) acoustical problems are typically more of an annoyance than an overwhelming requirement, and 2) many charged with working out these problems are not sure how to solve them. The problem tends to "go away" because people tire of complaining, but the inefficiencies remain.

Acoustical design often takes a back seat to other design considerations in both new and renovated space. Major projects oftentimes employ more art specialists than acoustical consultants. The lack of data proving that good acoustics improve inefficiencies and productivity, the confusing language of the science, and the intangibility of sound make acoustics a low priority. On the other hand, many would argue with the subjective conclusion that a noisy, distracting environment has a negative impact on productivity in most work environments.

Sound and Its Measurement

Sound results from fluctuations in air pressure. These vibrations of the air vibrate our eardrums, and through a network of bone and nerves are transmitted to the brain. The number of fluctuations per second determines the pitch of sound. The more fluctuations, the higher the pitch.

The important quantitative measurement of sound is the decibel (dB). This is the sound level adjusted to reflect the sensitivity of the human ear to various frequencies. The decibel scale is logarithmic — hence confusing. Essentially, each 10 dB increase is perceived as a doubling of the sound level. Conversely, a 10 dB decrease is a reduction of one half. When a dB level goes from 60 to 50 dB, we experience a 50 percent rather than 20 percent reduction.

Sound gets From One Place to Another in Four Ways

An acoustically correct environment is created by dealing with the paths that sound takes between the sources (equipment and people) and the receivers (people). These four paths are: straight, reflected, diffracted (flowing over and around obstacles) and structural.

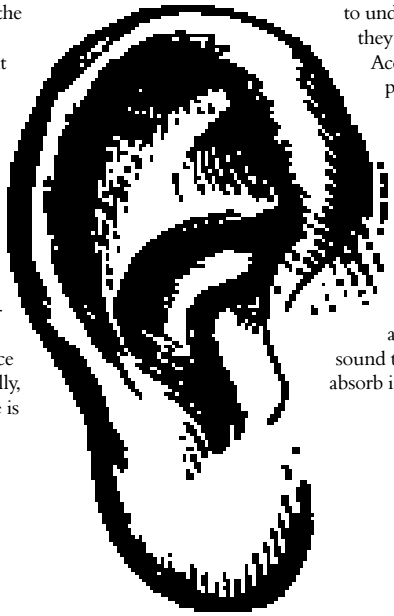
Blocking Sound

To stop the direct path of sound, we erect barriers (walls) which stop sound from passing through. The STC, or sound transmission class, is the ability of a barrier to stop sound from passing through it. A material with an STC of 45 will, on average, prevent 45 dB from passing through.

It should be noted that a very small opening in a barrier will allow a lot of sound to pass through it. A 0.3 percent opening, relative to the total square footage of the surface, in an otherwise 45 STC wall will decrease its STC to 25. Actually, its efficiency is diminished by 75 percent because of a 0.3 percent crack.

Absorbing Sound

There are an infinite number of reflective paths of sound. When sound hits hard surfaces, it reflects. When visualizing the various surfaces in the interior space as mirrors, it is easy to understand how they reflect sound. Acoustical wall panels, ceiling panels, partial height partitions, etc., absorb rather than reflect sound. The amount of sound these surfaces absorb is measured in a test which provides a noise reduction coefficient, or NRC. An NRC of 70 means that a material absorbs 70 percent of the sound that hits it. As in the case of the STC, the higher the NRC number, the more sound is diminished.



What Goes Wrong?

More than 90 percent of the acoustical problems in interior space is related to poorly designed or insufficiently sealed walls, hard surfaces that reflect sound and insufficient background sound level.

Leaks

While a poorly designed and constructed wall can fail to stop a sufficient amount of sound from penetrating through it, more frequently we find that well designed walls suffer from the "leak factor." Typical errors in construction which lead to leaking include:

- Poor seals where interior walls meet a window wall. Tight seals are crucial in these corners.
- Wall penetrations, especially where perimeter HVAC convector units are connected through common walls by simply punching a hole for the pipes or duct work. Air-tight seals, like lead, drywall and spackle, should be used at these points.
- "Over the top" which occurs when good barrier walls are out-flanked by sound which goes up through the ceiling, bounces off the slab above and down through the ceiling of adjacent office space. "Over the top" can be prevented by selecting ceiling products with a high STC equivalent to that of the wall system or furniture. Transmission loss backings are available on even very highly absorptive ceiling panels. This type of construction error can be corrected by adding barrier materials to the back of in place ceiling panels and mineral or glass fiber blankets in the plenum.
- Doors which don't fit tightly leak sound. These are alleviated by gasketing at jambs and "guillotine-like" closures at the threshold.

Bounces

The phenomena of sound bouncing off hard surfaces is called reverberation. When this happens, the sound remains as sound (or perhaps noise) and continues until it finds another surface which it may either bounce off of or be absorbed by. When sound continues to bounce, two things happen: 1) the place stays noisy longer, and 2) this "echoiness" creates a distortion in that sound which can be detrimental to the function of the space. Most people have been in an old railroad station, sports arena or airline terminal where announcements could be heard but not understood. The "echoiness" of the space allows sounds to remain audible, thus overlapping subsequent sounds (words, syllable, musical notes, etc.), so that several signals are heard at the same time. The addition of absorbent materials on wall and ceiling surfaces will prevent reverberation.

"It's So Quiet You Can Hear a Pin Drop"

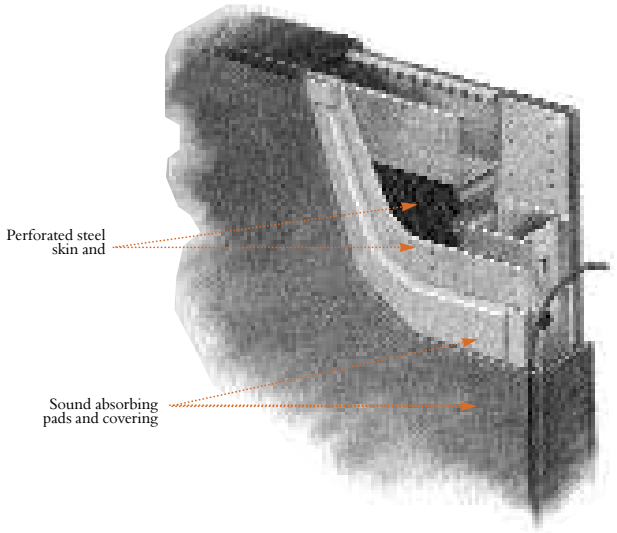
Sound flows over and around barriers. This is called diffraction. There is no such thing as a perfect "sound shadow"; you cannot stick your head in and out of sound. No matter how perfect the STC of partial height barriers are and how absorptive all the potential reflective surfaces are, you will still hear sound in the next work station. In addition, it is frequently uneconomical and impossible to totally isolate one private office from another. Consequently, even the slightest sound that does penetrate or out-flank a fairly well designed wall can provide a distraction or destroy confidentiality. It is very important to remember that silence is golden where speech privacy and overall comfort in the office are concerned. This is true of closed or private office space and especially true of open plan space.

Much of what we hear and are distracted by is not absolutely loud, but relatively loud. In other words, the distraction is louder than anything else in the environment at that particular time. Correction to this situation is to introduce a somewhat louder sound. This is typically done with electronic sound masking systems.

A well designed sound masking system will be uniform, of the correct volume and have a comfortable quality — a "hum" as opposed to a "hiss."

Quality office partitions, such as Haworth's PLACES® and UniGroup® panels with their "honeycomb" design, offer added acoustical protection.

Helmholtz Principle of Sound Control in a PLACES® Panel:



Reducing Noise in Your Office

A combination of the above solutions will solve most acoustical problems.

One of the most common concerns in office space is transmission of sound from one individual office to another or from an open-plan area to an office. The correction to this concern is frequently achieved by:

- Taking care of the obvious weak points in the common wall between private office space or offices in conference rooms and seeing that there are tight, solid door systems.
- Adding acoustical absorption to one or two of the interior walls of the office. This can be provided by many panel systems today. Absorption reduces the noise within that office so that there is less available to be transmitted through the walls, out the door or into the open air space. Acoustical absorption products also reduce the noise level of the sound from pathways and other shared office areas which does find its way into the office.
- Mask the sound.
- Review placement of equipment, departments and job functions which create noise levels that can distract other workers.
- Maintain records of products which have acoustical value and will help reduce noise levels. These products might include sound absorbent furniture, quieter equipment, and acoustical floor, ceiling and wall materials.

While the facilities manager or designer can address many of the obvious problems through an awareness of these causes, they may also seek the input of an acoustical consultant and knowledgeable suppliers and contractors.

Remember, approximately 98 percent of acoustical problems can be solved with less than five percent of the knowledge of architectural acoustics.

Arthur Barkman is president of Interior Acoustics, Inc., a firm specializing in the design, manufacture and installation of interior acoustical wall and ceiling treat-ments and sound masking systems. Barkman has more than 20 years experience in the field of acoustics and has conducted several professional seminars on acoustics.

Benchmarking facilities management: recent survey results

A recent survey of facilities management organizations conducted by Richard Muther and Associates had two primary goals: to compare business practices and concerns across a variety of industries, and to identify those practices in greatest need of improvement. Two-thirds of the respondents manage manufacturing facilities. The remaining third manage corporate offices, government agencies, education, healthcare and service facilities.

Most benchmarking surveys focus on quantitative measures and comparative statistics. They measure churn rates, population density, space utilization, maintenance and occupancy costs. Such comparisons are valuable but do not say much about the day-to-day performance of the facilities management organization. For this reason, our survey emphasized management practices and procedures, even though the resulting comparisons are fairly subjective. In the interest of brevity, the survey was limited to the following 12 dimensions of facilities management:

1. Strategic intent — existence and communication of mission statements for major sites
2. Planning horizon — for major buildings and facilities
3. Master site planning — scope or extent of formal land use planning
4. Readiness — anticipation of future needs
5. Frequency and integration of planning — link between facilities plans and business management
6. Participation and empowerment — employee input and control over workplace design and modification
7. Cycle time on typical projects — time required to plan and implement changes (and direction over the past five years)
8. Performance measurement — tracking of facilities utilization and effectiveness
9. Recent results — constant sales dollars per square foot of facilities owned or leased (and direction over the past five years)
10. Staff and skills development — for facilities planning and management
11. Computer support — for facilities planning and management
12. Major issues and concerns — respondents were asked to identify the three issues that would receive the most management attention in the following 12 months. Eight choices were predefined and others were permitted.

In this survey, the planning function was very important. No act of management is more discretionary and controllable by the facilities manager than planning and attempting to anticipate future needs. No activity is more critical to sound management of land, buildings, office furniture and equipment than planning. Quick response to events is certainly important and a hallmark of world-class facilities organizations. But in the absence of good plans, fast reaction leads to wasted efforts and compromised facilities investments.

Degrees of Performance

Performance was measured by using a five-level "maturity matrix" for each dimension or management practice. Respondents were asked to identify the stage of maturity that best described their organization. For example, practice number one, "strategic intent," had the following stages of maturity:

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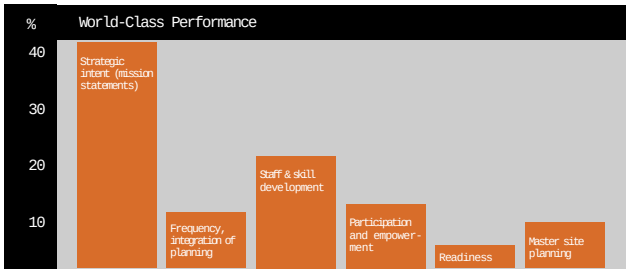
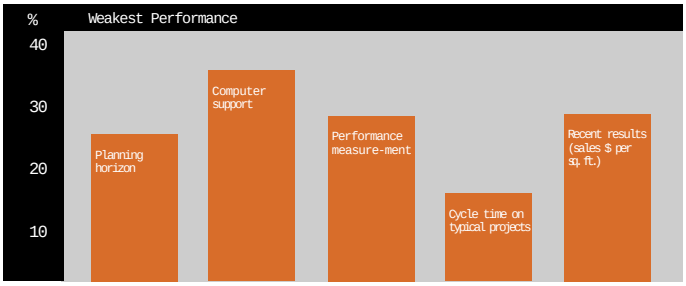


***Figure 1** This chart shows the percentage of respondents who ranked their facility management as level five or "world-class" in six specific management areas.*

Figure 2 indicates the percentage of survey respondents who ranked their facility management organizations as Level 1 or "weakest performance" in five practices.



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1. No thought to mission
2. Open disagreement
3. Unwritten but known to "insiders"
4. Written and available on "need to know" basis
5. Widely circulated and signed by a senior executive

Depending upon business circumstances, world-class performance requires a level four or five response. A level one or two response indicates poor or inadequate performance. Level three was defined to represent an intermediate, "neutral" state of affairs. Similarly, five-level maturity scales were developed for each dimension.

Plenty of Room for Improvement

While most organizations are good, or even world class on two or three practices, they are just adequate to poor on most others. On eight of the practices measured, the majority of respondents placed below the middle performance level. Those placing themselves at lower levels outnumber those at higher levels on every practice but one — strategic intent, as measured by the preparation and circulation of written mission statements for major sites.

Some progress has been made on the following facilities management practices: strategic intent (mission statements), frequency and integration of planning, staff and skill development, participation and empowerment, readiness and master site planning. (See Figure 1.)

But others are in serious need of improvement such as planning horizon, computer support, performance measurement, cycle time on typical projects and recent results. (See Figure 2.)

Key Findings

Looking beyond the percentages and assessing the correlations between various responses, the following observations and conclusions were reached:

- "Rethinkng manufacturing/logistics strategy" was rated a top management concern by 53 percent of those responding. Revising these strategies should be done with the active involvement of facilities planners. Yet only 10 percent have such integration of planning activities in place. Most facilities planners are still disconnected from the development of the strategies they are expected to support.
- "Rearranging for cells (manufacturing teams organized around products rather than functions) and continuous flow" was the greatest management concern, cited by 60 percent of respondents, including a number in government, insurance, health care and other nonmanufacturing facilities. Experience suggests that such rearrangements are most successful when planned and led by plant and office workers themselves. Yet only 31 percent have such levels of participation and empowerment.
- Many facilities organizations lack readiness. They are playing "one-move chess" with no plan beyond their next major project. Fully 20 percent just react to request. On the related issue of site planing, only half have a plan that shows their next major expansion. Less than 10 percent have contingency plans for the sale or purchase of businesses, products or properties. This is particularly troubling since today's strategic emphasis on restructuring and outsourcing will continue to drive acquisitions, divestitures, and consolidations of businesses and their facilities.
- Planning horizons are still too short among manufacturing organizations. The most common practice is still calendar-based — typically three to five years — rather than tied to industry cycles or the life cycles of key products and process technologies.
- In an age of time-based management, the facilities organization is stuck in neutral or reverse. Only eight percent report consistent cycle time reductions of 33 percent to 50 percent on typical projects. Nearly twice as many, 15 percent, report that their projects take longer than they did five years ago. Almost half say "no change."
- While much has been made of the need for continuous improvement, facilities organizations are failing to measure up. The majority make no regular reports on facilities utilization and effectiveness. Only about 10 percent regularly measure employee satisfaction with their workplaces and facilities.
- Virtually all facilities organizations are making use of computer systems and support. But this has not translated into speed on typical projects. To date, those with the most advanced computer tools are no faster than those with only modest support.

Achieving World Class Performance

Among those responding to our survey, the best indicators of world class facilities organizations are:

- Readiness and anticipation of future needs
- Cycle time reductions on typical projects
- Improvements in constant sales dollars per square foot of facilities

We believe that this percentage could grow substantially with greater commitment to readiness and cycle time reduction in the facilities planning and delivery process.

Lee Hales is president of Richard Muther & Associates, an industrial management and engineering firm.

Anticipating future space needs — and formulating strategies to deal with different scenarios — is a key facilities management challenge. Other important topics include indoor air quality and acoustics. Leading professionals provide insight into these areas in this issue of the **Office Journal**, Haworth's service publication for facility managers, architects, designers and related professionals.

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Haworth Office Journal
Office of Facilities Programs
Haworth, Inc.
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Holland, Michigan 49423
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