



The Value of Acoustic Performance in Occupied Spaces

Description of the Problem

In the design and build industries, architects are expanding their goals for indoor environmental quality (IEQ) to include acoustic performance. According to the Centers for Disease Control, IEQ is the quality of a building's environment in relation to the health and wellbeing of those who occupy the space. The EPA estimates we spend close to 90% of our life indoors, whether in a home, school, medical facility, or workplace; and noise levels in these settings impact the quality of living. Additionally, the International Building Code addresses acoustical comfort in all types of buildings as do the Green Building Rating System and WELL v2.

Impact of Poor Acoustics in the Workplace

Companies and workers in all work environments, whether office, housing, education, healthcare or other, are directly and indirectly affected by noise levels. Studies show that interactive, collaborative spaces augment noise in the workplace; and prolonged exposure to noise may have serious physiological effects on occupant stress levels, productivity, and mood.

Additionally, commercial workspaces with poor acoustic performance may cause issues with speech intelligibility and comprehension, distraction, loss of privacy, increased rate of errors, and loss of productivity. A study using a survey to evaluate occupant perceptions about acoustical quality in office workstations found that occupants were dissatisfied with acoustics citing problems with officemates talking on the phone or with each other, and speech privacy. More than 50% of respondents thought that noise in their workspace interfered with their ability to get their job done.¹

The evolving reduction of space allocated per worker is complicating acoustics in the workplace. In 2001, an average of 300 sf was allotted per worker. By 2010, space allocation was down to 225 sf - and by 2013, it had dropped to 150 sf or as little as 85 sf per person.² However, now that we are

experiencing COVID-19 issues, "a lot of companies will be focusing on de-densification and splitting offices. Average office space per person will go back to the levels of 120-130 sq. ft. seen" in the past.²⁰

Noise interferes with communication, causes distractions, affects occupants' cognitive performance and concentration, contributes to fatigue, and sleep deprivation.⁴⁻⁷ Research has shown that decreasing noise levels has a noticeable effect on building occupants' physical health by decreasing blood pressure, heart rate, and stress.^{8,9} Environmental stressors may have an adverse impact on occupants' physical and mental well-being that can, in turn, negatively affect an organization's bottom line.

Acoustical control is a critical problem confronting office planners. The American Society of Interior Designers recommends that solutions to noise in the work environment be focused on four design elements: ceiling systems, systems furniture, sound-masking systems, and carpeting.³

Acoustic Research Studies

- Open-plan offices and chattering colleagues contribute to an environment where concentration is virtually impossible. Office workers are 66% less productive in an open-plan office, according to Julian Treasure, Chairman of The Sound Agency and author of *Sound Business*.
- Employees waste 759 hours each year due to workplace distractions. A third of employees are distracted at work for up to three hours a day, blaming their lack of concentration on chatty colleagues, social media and even the weather. This adds up to 60 hours a month, or a total of 759 hours each year.¹⁵
- Removing "conversational distractions" by making specific adjustments to the acoustical conditions in open office environments with the goal of improving speech privacy may:¹⁶



- Increase the ability to focus on work tasks improved by 48%.
- Decrease distractions by 51%.
- Reduce error-rates – accuracy and short-term memory improved 10%.
- Reduce stress - physical symptoms of stress was reduced by 27%.
- According to Dynasound Collaborative Studies, research conducted with six major US corporations found that lack of speech privacy decreases employee satisfaction and productivity:
- 70% of employees say that noise in the open plan environment is the number one workplace distraction, affecting satisfaction and productivity.
- 52% of employees reported that they felt stressed at work – due to lack of ability to think and concentrate in the open plan environment.¹¹
- According to 2013 State of the Global Workplace Report, Gallup, office workers are interrupted as often as every three minutes by digital and human distractions. These interruptions carry a destructive ripple effect because, once a distraction occurs, it can take as much as 23 minutes for the mind to return to the task at hand.¹⁷

Gallup's Consequences of Distraction:

- When working on a project, employees are interrupted every 11 minutes (on average). When interrupted, it takes us up to 23 minutes to get back into FLOW — the state where we are deeply engaged.
- Longer interruptions cause a greater chance of error¹⁸
- Interruption of 2.8 seconds doubles the rate of errors.
- Interruption of 4.4 seconds triples the rate of errors

Employees undertake a variety of tasks during any day – some requiring a collaborative team approach and some solitary, requiring focus. A successful work environment is created when acoustic planning is done to anticipate types of work being done in the spaces, to minimize distraction, and to

create spaces where employees feel they are accomplishing their best work.

Impact of Poor Acoustics in Education

In educational learning environments, unacceptable noise levels can be directly correlated to student achievement and teacher stress.¹⁰ Chronic noise in the classroom is detrimental to both students and teachers. For teachers, it has been shown to cause a host of negative outcomes including vocal cord strain, increased cognitive fatigue, low job satisfaction, lack of energy, interest in leaving the job⁴, lack of motivation, and sleepiness.¹¹ “High levels of background noise affect speech intelligibility which interferes with students’ ability to learn and with their communication skills.”²¹

LEED for Schools has tightened the acoustic allowances from the 2009 version to v4. In LEED 2009 the Maximum HVAC background noise level in core learning spaces had to be 45 dBA in addition to some requirements for the ceiling area absorbency. In v4 the maximum HVAC background noise level is reduced to 40 dBA and the core learning spaces over 20,000 sf must have a reverberation time of = or less than 1.5 seconds per ANSI standard. For an Enhanced Acoustical Performance Credit in LEED v4 the background noise must be reduced from 40 dBA to 35 dBA.

The reverberation time of noise in open-plan classrooms which affects how clearly speech is understood, is as low as 50% in ‘normal’ classrooms, meaning students understand and absorb only half of information being presented. At an average noise level of 65 dB in the classroom, teachers’ heartrate increases to hit heart-attack levels. A study conducted by Finnish Institute of Occupational Health (FIOH) shows that unwilling listeners demonstrate a five to 10 percent decline in performance when undertaking tasks requiring concentration.¹⁹

How Acoustics Impact Healthcare:

Acoustics figure prominently in healthcare environments where patients and families require privacy and a quiet environment to heal. Additionally, healthcare workers require minimum levels of noise, to have clarity in their conversations about patients’ needs and instructions.¹² In the hospital setting, noise leads to unsatisfied patients. According to the American College of Health Care Administrators (ACHCA), noise disruption routinely receives one



of the lowest scores. Unsatisfied patients directly affect revenue for hospital.¹³ Flooring choices may have a substantial impact on noise and comfort.¹⁴

“Poor acoustic conditions may have a negative impact on patients’ physiological health, increase the length of their recovery and length of stay and increase their chances of being readmitted to the hospital. Acoustics can also impact perceptions of privacy, comfort, safety and security for patients and their families. Prolonged loud noises can lead to memory issues, impaired pain tolerance, and isolation perceptions. Sleep disruption and deprivation, which can be caused by excess noise, are frequently cited issues of concern in healthcare environments. Poor sleep can lead to longer healing times and even cause delirium. Disrupted and/or limited sleep has been demonstrated to have adverse impacts on several important health measures and outcomes including blood pressure, weight gain, heart disease, pain, stress levels, and inflammation.”²⁴

It is a common misperception that noise generated from machinery is the primary source of noise on the patient unit. Yes, noises are generated by these items noted on the slide. However, staff voices emanating from the nursing station are the greatest source of noise. Noise is generated by paging systems, alarms, bedrails moved up/down, telephones, staff voices, ice machines, pneumatic tubes, trolleys/carts, roommates & visitors.

Why are hospitals so noisy? Hard, sound-reflecting environmental surfaces (floors, walls, ceilings) create poor acoustic conditions. Noise spreads and travels down corridors, into patient rooms. Echoes, overlap, and lingering and long reverberation adversely affects all occupants.²² Hospital administrators continue to rank noise reduction as a top priority related to patient experience. Why? Only 60% of patients said the area outside their rooms was quiet at night. Noise receives the lowest satisfaction score on HCAHPS patient surveys regarding quality of care and Medicare reimbursement is based on quality measures.²³

In Summary

In all types of commercial environments, acoustics play an important role in satisfaction of occupants. Specifiers must understand the importance of their flooring selections and how sound blocking and absorption are measured in flooring and their overall benefit in building performance. They must also be adept at evaluating sound ratings for product selection best suited to budget and installation types.²⁵

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