CISCA
Ceilings & Interior Systems
Construction Association

Acoustic Considerations

A study conducted by Busch-Vishniac et al. in 2005 found that sound pressure levels in hospital environments have risen significantly and consistently since 1960. On average, daytime levels have risen 0.38 dB and nighttime levels have risen 0.42 dB—each year. Many sounds present in hospital environments can be severely irritating and at times harmful to patients, requiring acoustic solutions that are part of a careful, strategic design. Specific acoustical considerations in healthcare settings include supporting patient well-being and privacy; supporting communication among staff; and meeting standards and regulations (e.g., HIPAA).

Why Acoustics Matter

Creating a comfortable acoustic environment in healthcare environments can play an important role in supporting safety, health, healing, and well-being for all occupants.

PATIENTS

- Sudden noises can set off "startle reflexes" and can lead to grimacing, increased blood pressure, and higher respiratory rates for patients. Prolonged loud noises can lead to memory problems, irritation, impaired pain tolerance, and perceptions of isolation.
- Reduced noise levels in intensive care units (ICUs) may help patients sleep and foster a regular wake/sleep cycle.

HEALTHCARE PROFESSIONALS

- While patient care teams (PCTs) may be able to perform tasks in an environment with a high level of noise, they may have to exert more effort to do so, in turn causing more fatigue. When inadequate acoustic conditions exist, poor psychosocial conditions can occur even for highly-trained and educated PCTs that are prepared to handle stressful conditions.
- Speech intelligibility is very important to PCTs in healthcare environments. PCTs need to be able to understand and quickly respond to the many types of auditory signals (e.g., conversations, medical equipment, alarms) in hospital settings.

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FEDERAL REQUIREMENTS

- As part of the Health Insurance Portability & Accountability Act (HIPAA), the federal government requires pharmacies and healthcare providers in the United States to provide privacy for patient health information (e.g., medications, symptoms) in electronic, written, and oral forms. Privacy standards apply to both new construction and renovations of all types of healthcare organizations (e.g., hospitals, physicians' offices).
- Adequate speech privacy can be accomplished in open and enclosed spaces through the provision of single-occupancy patient rooms, private discussion areas, effective space planning, appropriate partition placement, room finish specification, and sound masking system selection.

Understanding the Primary Acoustic Issues

SOUND PRESSURE LEVEL (SPL): Sound pressure level (SPL) is the physical loudness of a sound on a decibel (dB) scale determined by the air pressure change caused by a sound wave. SPLs in many modern hospitals are high enough that they may interrupt sleep, impact speech intelligibility, and create occupant discomfort due to noise.

BACKGROUND NOISE: Background noise is any direct or indirect sound audible to the human ear that has the potential to interfere with wanted (e.g., medical equipment warnings) or unwanted (e.g., private conversations) sound signals. Background noise levels should meet the criteria set by established standards (e.g., the American Society of Heating, Refrigerating, and Air-Conditioning Engineers; ASHRAE) and should be identified at the onset of a project.

REVERBERATION TIME: Reverberation time is the time it takes for sound to decay by 60 dB once the source of the sound has stopped. Controlling reverberation in healthcare environments through appropriate finish selection is important for optimizing speech intelligibility, creating a restorative environment, and limiting noise transmission.

Design Considerations for Improved Acoustic Environments

General Considerations

DESIGN PROCESS: The acoustic environment is an important consideration at every stage of the design process, but also needs to be considered in the context of other important factors (e.g., lighting, hygiene, temperature). Employ an acoustical engineer at the early stages of the design process for healthcare facilities and regularly consult with this engineer through the post-construction stages to assist with mechanical system design, equipment and building construction specifications, and acoustical testing.

SITE DESIGN: Conduct site measurements to determine the impact of noise from the surrounding, external environment; plan the site and design the building's façade to mitigate any impacts.

SPACE PLANNING: Create single-bed (as opposed to multi-bed) patient rooms as they may reduce hospital-acquired infections, improve patient sleep and privacy, and facilitate better communication between parents and families and their caregivers.

Decentralize nurses' stations as this may minimize corridor traffic, in turn reducing noise generation and allowing nurses to see and hear their patients more effectively.

Specifying Materials and Finishes

Walls, floors, and ceilings should also be designed to support privacy and minimize noise transmission. When designing for acoustical privacy it is important to include the composite action of all adjacent building components. The composite sound performance of walls, ceilings, doors and floors will greatly impact the overall sound performance. The combination of individual components' acoustical performance and installation details will alter the overall performance.

CEILINGS: When space and logistical considerations permit, incorporate a suspended acoustical ceiling system with acoustical ceiling tiles (ACT) to promote a satisfactory acoustic environment. When this is not possible or feasible, consider mounting sound absorbing panels directly onto the ceiling and upper walls, as this may still provide significant noise reduction.

Understand the properties of specific types of ACT (i.e., glass fiber ACT, mineral fiber ACT, composite ceiling panels, and cast mineral fiber). See full white paper for more information on specific types of ACT.

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WALLS: Understand that the most effective way to achieve wall performance is to penetrate the ceiling membrane. Further improvement is obtained when the partition is non-demising, meaning it is continuous from floor to underside of the next floor's structural deck or concrete slab.

Identify details that may have negative impacts on the sound isolation performance of a wall (e.g., back-to-back outlet placement, lowered wall heights, air gaps, wall openings for services, direct duct runs).

Specify surface-mounted, one-inch thick wall panels or other sound-absorbing wall materials with a Noise Reduction Coefficient (NRC; measure of average sound absorption of a surface) of 0.70 or more to effectively absorb noise from common activities in healthcare environments, especially in large areas where noise tends to build up.

FLOORS: Be aware that of the most common floor surfaces in hospitals, some (e.g., rubber) create less impact noise than others (e.g., vinyl composition tile installed directly on concrete or terrazzo).

Specify carpet to effectively reduce impact noise (e.g., foot traffic, carts) in healthcare environments. However, understand that specifying carpeting in corridors may create problems related to efficient movement of computer carts and cleanability.

OTHER MATERIALS: Consider how movable furniture panels, glass partitions, and acoustically treated curtains can be used in open spaces to block noise.

Be aware that open doors significantly negatively impact the noise isolation capability of walls.

Minimizing Mechanical and Medical Equipment Noise

MECHANICAL EQUIPMENT: Mechanical equipment noise enters spaces through interior partitions, the façade of the building, ventilation ducts, and as a result of vibration from mechanical equipment. To mitigate these impacts, specify quieter equipment, acoustic silencers, louvers, barriers, and vibration isolators.

MRI SCANNERS: Improve sound isolation of walls, floors, ceilings, doors, and windows to contain noise in rooms housing MRI scanners and specify sound-absorbing finishes and materials to minimize airborne noise.

Designing for Privacy and Confidentiality

Speech privacy needs should be assessed in spaces in healthcare facilities where patient information is shared (e.g., consultation counters, pharmacies) to ensure that privacy and confidentiality are provided for patients, families, and PCTs. Both background noise levels and noise reduction created by barriers and sound-absorbing finishes need to be considered when addressing speech privacy issues in healthcare settings.

MEASURING ACOUSTICAL PRIVACY: Articulation Index (AI; a measure of speech intelligibility ranging from 0 to 1.00), Privacy Index (PI; a measure used to rate the speech privacy in a given space calculated based off the AI), Speech Transmission Index, and Speech Intelligibility Index (SII) can all be used to quantify the privacy levels in a space. More information on these measurement methods is available in the white paper.

SOUND MASKING SYSTEMS: Consider using sound-masking systems to minimize patient distractions and improve speech privacy. Sound masking incorporates ambient background noise into a space to mitigate distracting mechanical and other noises.

Specifying sound masking systems should be carefully considered with full knowledge of their impact on communication and the ability to hear and respond to other important stimuli (e.g., alarms) in healthcare environments.

OPEN AND ENCLOSED SPACES: Maintain a composite Sound Transmission Class (STC; a comparative value that indicates the efficiency of building materials in reducing sound transmission) and A-weighted background noise level of at least 75 dB(A) in both open and enclosed spaces where confidential speech privacy is required.

Specify floor-to-slab fixed walls with a minimum STC rating of 40 in enclosed rooms where speech privacy is required but flexibility and adaptability are not. In situations where flexibility, adaptability, and speech privacy are all required, specify fixed stud or relocatable walls with a minimum STC rating of 40. Specify walls in combination with a ceiling with a Ceiling Attenuation Class (CAC; a rating of a ceiling panel's ability to reduce sound transmission) of 35 or higher and door and glazing components that are pre-engineered for STC performance.

Maintain a composite STC and A-weighted background noise level of at least 75 dB(A) in open plan spaces where confidential speech privacy is required.

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Integrating Hospital Technology

PAGING: To reduce overhead paging, first identify the individuals and departments that are paged most often and then create alternative ways for them to communicate (e.g., reduced noise/noiseless paging systems, wireless communication devices, beeper systems).

ALARMS: Specify alarms with variable volumes, with loudness indicating the urgency of the problem.

Acoustic Requirements for Specialized Environments

NEONATAL INTENSIVE CARE UNITS (NICUS): Utilize specialized wall, floor, and ceiling assemblies to meet privacy needs. Special emphasis on acoustical finish should be used to stop noise transmission for rooms adjacent to NICUs.

Specify carefully-designed acoustical ceilings in NICUs, considering both the NRC and CAC, as they provide the largest area for incorporating sound-absorbing surfaces. Provide ceilings that have an NRC of 0.95 for at least 80% of the surface area or an average NRC of 0.85 for the whole ceiling, and a minimum ceiling CAC of at least 29. For partitions that do not continue above the finished ceiling, a CAC greater than 29 may be required.

Consider ways that space planning can be used to move noise from activities away from the primary infant care area to a more central, common area (e.g., prescribe and check-in drugs in a clean utility room).

EMERGENCY DEPARTMENTS (ED): EDs are highly susceptible to privacy breaches resulting from the many patients and staff present, severity of patient conditions, multiple conservations taking place that include private patient information, and frequent use of multi-occupancy patient rooms with only curtains separating beds. Consider providing acoustic ceilings with high NRC and CAC to stop transmission from one room to another and acoustical wall panels instead of curtained rooms to support ED patients' comfort and avoid privacy breaches.

MEETING THE STANDARDS

SOUND AND VIBRATION DESIGN GUIDELINES FOR HOSPITAL AND HEALTHCARE SETTINGS

The Sound and Vibration Design Guidelines for Hospital and Healthcare Settings is intended to guide the provision of satisfactory acoustics and privacy in all types of healthcare settings and was developed based on both technical standards and professional best practices in acoustics.

2010 FGI/ASHE: GUIDELINES FOR DESIGN AND CONSTRUCTION IN HEALTHCARE SETTINGS

The 2010 FGI/ASHE Guidelines for Design and Construction for Health Care Facilities addresses design considerations for healthcare settings. They serve as a guide for regulatory codes and laws, but also as a guide of best practices for those involved in the design of healthcare facilities. These guidelines address design and construction considerations for a wide range of healthcare facilities.

GREEN GUIDE FOR HEALTH CARE™ 2.2

The Green Guide for Health Care v2.2 includes a two-point credit for improving the acoustic environment in healthcare settings, recommending, at a minimum, that acoustical issues related to exterior noise, acoustical finishes, room noise levels, sound isolation, paging systems, and building vibration be addressed in healthcare facilities.

LEED® FOR HEALTHCARE

The LEED for Healthcare rating system, which is currently under development, responds to design issues that are under unique conditions in the healthcare industry using the five main areas of the traditional LEED rating systems (sustainable sites; water efficiency; energy and atmosphere; materials and resources; and indoor environmental quality).

To view the references for information presented in this synopsis please consult CISCA's Acoustics in Healthcare Environments full white paper. Please contact CISCA with any questions regarding sources.

Acoustics in Healthcare Environments is intended to be a tool for architects, interior designers and other design professionals who work to improve healthcare environments. Commissioned by Ceilings and Interior Systems Construction Association (CISCA) and prepared by the InformeDesign® Research Desk at the University of Minnesota, the white paper is an introduction to the acoustical issues commonly confronted on healthcare projects. Practical design responses to these issues are then presented in practitioner-friendly language. This is an abridged version of the white paper. To view the entire paper, including a glossary of terms and a listing of references, visit www.cisca.org.

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