The National Institutes of Health | Division of Technical Resources | Office of Research Facilities

Design Requirements Manual **News to Use**

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The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U_j U_i)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U}_j\overline{U}_i)=-\frac{\partial\overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial\overline{U}_i}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\overline{U}_i\overline{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial\overline{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ biomedical research facilities.

Demising Partition Acoustic Requirements

The 2016 Design Requirements Manual (DRM) requires that demising partitions between functionally separate areas achieve a Sound Transmission Class (STC) of 50 per ASTM E90. Additionally, construction separating enclosed rooms and non-public corridors shall achieve a minimum Noise Isolation Class (NIC) of 45 per ASTM E336.

As measured under ASTM E90, STC provides an estimate of the sound transmission loss through space-dividing elements of all kinds including operable partitions, floor-ceiling assemblies, doors, windows, roofs, and panels. The STC rating is an invaluable tool when designing a space; however, it represents sound transmission loss under ideal laboratory conditions and does not consider sound transmission along indirect paths or flanking paths. ASTM E336 determines the NIC and provides test methods and procedures to assess the sound isolation between two rooms separated by a common partition and includes both direct and flanking paths for sound.

Virtually all partitions contain a mix of construction, e.g. doors, convenience outlets, windows, etc. within a partition; so consideration for flanking paths of sound is immensely important. A hairline crack will decrease a partition's transmission loss by about 6 decibels (dB). A 1 in^2 opening in a 100 ft^2 gypsum board partition can transmit almost as much sound as if the entire partition did not exist.[1] The entire construction assembly should be appropriately detailed to ensure sound does not transmit across two acoustically isolated spaces. See Figure 1 for an example of high sound isolation construction.

Acoustic Design

Designers should recognize the acoustical needs of each space as well as communication needs within a space with the users and / or project stakeholders. Functionally separate spaces may be a conference room adjacent to a public corridor, an office adjacent to an auditorium, or a classroom adjacent to a noisy mechanical room. Acoustical design should consider the noise to signal ratio, which is the determination of whether a signal (speech, music, etc.) is audible or intelligible above the ordinary background noise of the environment. Unless required by programmatic needs, some level of noise is desirable to avoid an acoustically "dead" space. Additionally, a quiet environment with little to no background noise requires a higher degree of sound separation to achieve the same privacy versus an environment with more background sound. In order to help determine the type or use of a space to the acceptable level of background noise, maximum noise criteria levels are established within Table 6.5.2 of the DRM.

Certain areas within NIH facilities may require greater STC ratings and acoustic considerations, such as spaces within an Animal Research Facility due to some species' sensitivity to noise and vibration. Section 4.3.3.9 requires partitions separating cage wash areas, large animal areas, and other functions that generate undesirable noise to achieve a minimum STC of 60.

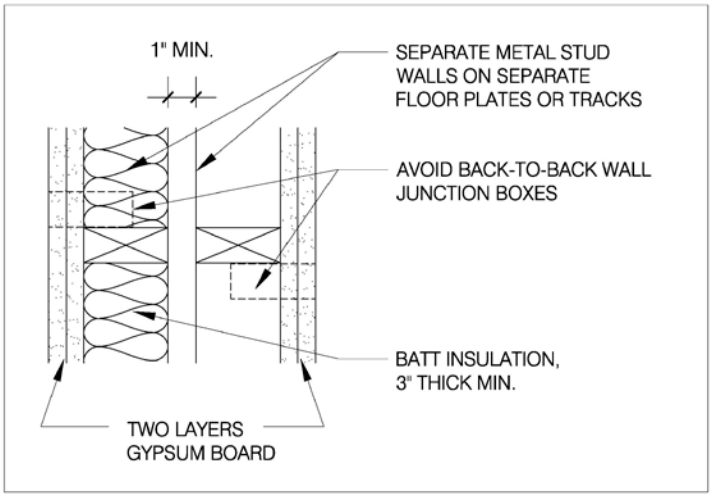

Figure 1: High Performance Acoustic Wall Construction

Design Considerations

No matter the size or scope of a project the following considerations must be evaluated by the design professionals to determine the appropriate acoustical treatment. Each room or space should be evaluated by:

- The type of space and its function within the facility.
- The level of communication needed or acceptable articulation index within each space.
- The level of privacy or isolation necessary from other spaces.
- All surrounding spaces and their potential for creating unwanted noise.

As with other aspects of design and construction there is no one size fits all solution to controlling and mitigating noise; however, through years of experience and testing with metrics such as STC and NIC, designers have many tools available to them. Good design must incorporate the acoustic requirements of a space into both its architecture and building systems.

References

1. Ballast, David Kent, and Steven E. O Hara. *ARE Manual.* PPI, 2016.

'Design Requirements Manual (DRM) News to Use' is a monthly ORF publication featuring salient technical information that should be applied to the design of NIH biomedical research laboratories and animal facilities. NIH Project Officers, A/E's and other consultants to the NIH, who develop intramural, extramural and American Recovery and Reinvestment Act (ARRA) projects will benefit from 'News to Use'. **Please address questions or comments to:** shawm@nih.gov

Further details on this month's topic are available on the DRM website DRM Section 1.15 Common Engineering Systems' Requirements
https://www.orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManual2016