

MONROE COUNTY CONVENTION CENTER

Exhibit Hall

Acoustic Design Review – 100% CD Drawings



IMEG #24005009.00

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INTRODUCTION & EXECUTIVE SUMMARY

Introduction & Executive Summary

Introduction

Monroe County Convention Center is an 80,000 ft² addition and renovation of an existing historic convention center. Project features for major design and renovation include the Exhibit Hall, Prefunction, meeting spaces and offices, a new connecting skybridge, and mechanical equipment replacements in the existing building.

This document provides our 100% CD review and recommendations for the new expansion spaces and evaluates the predicted acoustic performance for reverberation time, airborne sound isolation, and background sound levels.

Executive Summary

Two options for room acoustics are described in subsequent slides for the Exhibit Hall:

- **Baseline** – Room acoustics are designed to control room reverberation time and attenuate late sound reflections (aka echoes) for a multipurpose room where the room layout is expected to be in different configurations frequently.
- **Enhanced** – Room acoustics are designed to address a lecture/performance-focused room program where auditorium seating is expected to be used frequently for large, lecture-style events.

Airborne sound isolation criteria is provided to promote acoustic separation between adjacent spaces.

Background sound has been evaluated based on the current HVAC system design. The design intent to include internal duct lining to lower the levels of background sound in the Exhibit Hall is evaluated and compared to the system without duct lining.

Documents Reviewed

- Architectural 100% CD Review Set dated May 14, 2025
- Interior 100% CD Review Set dated May 14, 2025
- Mechanical progress 95% CD set dated May 16, 2025
- WaterFurnace Versatec 500 WSHP performance data dated July 28, 2014

DESIGN CRITERIA

Room Acoustics – Design Criteria

Programming

The rooms acoustics will be designed to support speech clarity and point-to-point communication. The Exhibit Hall is a multiuse space with typical events including banquets, large assembly with AV presentation, dining, sports, and commercial business use for gatherings with speeches.

Design Criteria

LEED v4.1 limits the reverberation time in large-capacity spaces with speech amplification to 1.5 seconds. The room acoustic design criteria is based on LEED v4.1 for the 'baseline' approach, with ANSI s12.60 and NRC-CNRC Update No. 51 for rooms greater than 20,000 ft³ for the 'enhanced' approach as outlined in the tables below.

Table 1a. Room acoustic and background sound level design criteria of Exhibit Hall

Programming Option	Reverberation Time (RT ₆₀ , mid-freq, avg, seconds)	Maximum Background Sound Levels
Baseline	1.2 – 1.5	NC 25 – 30
Enhanced	0.8 – 1.2	

Table 1b. Room acoustic and background sound level design criteria of other spaces

Room Type	Reverberation Time (RT ₆₀ , mid-freq, avg, seconds)	Maximum Background Sound Levels
Prefunction	1.0 – 1.5	NC 40 – 45
Offices	< 0.6	NC 30 – 35
Meeting Spaces	< 0.6	NC 30 – 35

Sound Isolation – Design Criteria

Design Criteria

Strategies will align with criteria based on LEED v4.1 and ANSI s12.60 for as outlined in the table below:

Table 2. Airborne sound isolation design criteria for other room adjacencies

Room Type	Adjacent Room	Minimum STC
Exhibit Hall	Prefunction / Hallway	35
	Office	45
	Meeting Space	50
	Mechanical Room / Service Corridor	60
	Operable Partitions	55
Office	Office	45
	Prefunction / Hallway	35
	Exhibit Hall	45
Meeting Space	Meeting Space	50
	Prefunction / Hallway	40
	Exhibit Hall	50
	Operable Partitions	55

ROOM ACOUSTICS

Overview – Current Design

Overview

The predicted room acoustic of occupied spaces including the Exhibit Hall, offices, meetings spaces, and Prefunction are summarized in Table 3 below:

Table 3. Room acoustic and background sound level design criteria of other spaces		
Room Type	Design Criteria (RT _{60, mid-freq, avg} , seconds)	Predicted Reverberation Time (RT _{60, mid-freq, avg} , seconds)
Exhibit Hall – Enhanced	0.8 – 1.2	1.25 – 1.35
Exhibit Hall – Baseline	1.2 – 1.5	1.25 – 1.35
Prefunction – 1 st Floor	1.0 – 1.5	1.05 – 1.15
Prefunction – 2 nd Floor	1.0 – 1.5	1.85 – 1.95
Offices	< 0.6	0.35 – 0.45
Meeting Spaces	< 0.6	0.45 – 0.55

Color Code Legend

Meets criteria

Does not meet criteria

Exhibit Hall – Current Design

Overview

The Exhibit Hall is a 26,000 ft² room with a volume of 1.1M ft³. The room includes operable partitions that can divide the room into smaller event spaces. The furniture layout and expected programming will fluctuate depending on the event.

Design Elements

- 31' AFF ceiling system. Approximately 10 – 12' above ceiling system to structure
- Assuming 50% occupancy (approximately 1500 occupants)
- GWB walls. Sound absorbing wall panels with Kinetics HardSide (6 – 7 PCF density, NRC > 0.95) as the basis of design
- Thin carpet floor finish

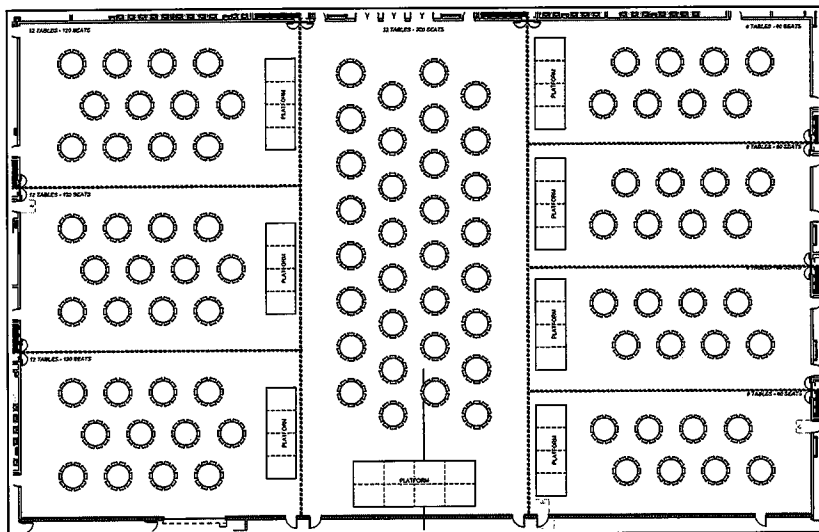


Figure 1. Example layouts for Exhibit Hall

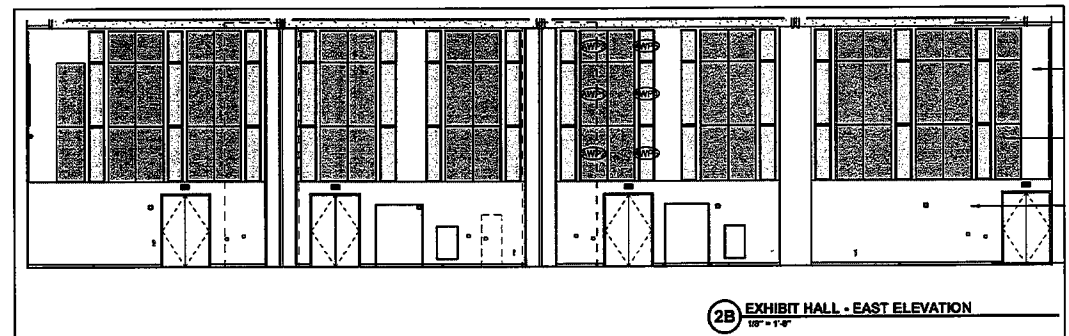


Figure 2. Wall panel layout on East Elevation

Exhibit Hall – Analysis Method

Room Acoustic Analysis Method

To predict the room acoustic response of the Exhibit Hall, a 3D model of the space was developed as shown in Figure 3 with current wall panel and ceiling cloud locations. A standard Sabine reverberation time calculation was not chosen to analyze this space due to the coupled volume from the spacing between ceiling clouds.

Two sound sources were placed in the room acoustic response evenly and a single receiver source was placed in the center of the room. Figure 4 is the simulated RT_{60} of the Exhibit Hall. T20 indicates the amount of time it takes for sound to decay by 20 decibels and is multiplied by 3 to indicate the corresponding RT_{60} as shown in the bar chart.

Predicted Performance of Current Design

Based on the amount of wall panels and ceiling tiles in the Exhibit Hall, the predicted room acoustic response meets the 'baseline' criteria range. When the Exhibit Hall is divided into sub-rooms with the operable partitions, the predicted room reverberation time is predicted to meet the 'enhanced' criteria range as shown on Page 13.

The predicted low frequency resonance at 125 Hz and below can lower the performance of the AV systems in the Exhibit Hall. See Page 12 for recommended strategies to enhance the room acoustic response in the Exhibit Hall.



Figure 3. 3D model of Exhibit Hall

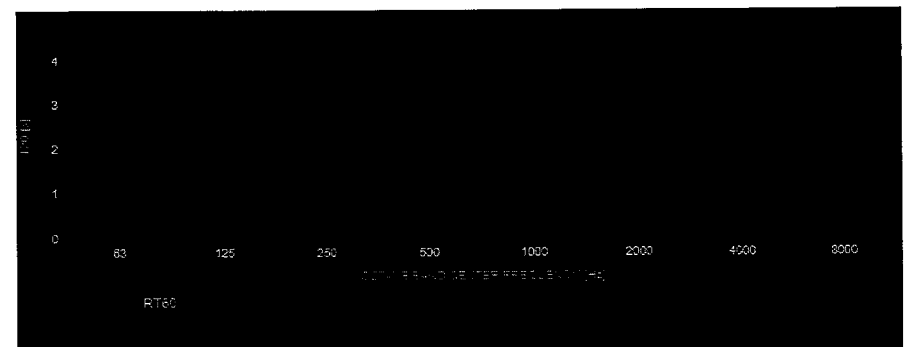


Figure 4. Simulation results for T20 reverberation time

Exhibit Hall – Design Strategies

Design Strategies

To enhance the room acoustic performance of the Exhibit Hall when the operable partitions are not in use and the entire room area is opened and improve the performance of the AV systems, a sound absorbing finish above the ACT clouds or in the plenum space should be installed to lower the low frequency resonance in the room. We recommend the following strategies:

Option 1: Cellulose Spray on Deck – Spray the structure above the ceiling clouds with a minimum of 1.5” of cellulose spray (e.g. K-13) across the entire ceiling area.

Option 2: Fiberglass Backing on ACT – Backload ACT tiles with a minimum of 2” thick fiberglass insulation with a minimum 3 PCF density. Basis of design is Owens Corning SelectSound Black Acoustic Board, MBI Shadow-Coustic 1000P-2075-N or equal.

Table 4. Predicted room reverberation time of recommended options

Design Strategy	Mid-Frequency Room Reverberation Time (RT _{60, mid-freq, avg} , seconds)	Criteria Range
Current Design	1.25 – 1.35	Baseline
Option 1	0.75 – 0.85	Enhanced
Option 2	0.85 – 0.95	Enhanced

Exhibit Hall – Summary

Overview

Figure 5a below compares the room acoustic performance of the Exhibit Hall with the current design to the Exhibit Hall with the recommended options. Figure 5b demonstrates the effect of room volume by comparing the room acoustic response of the entire Exhibit Hall to a smaller sub-room when the operable partitions are in use.

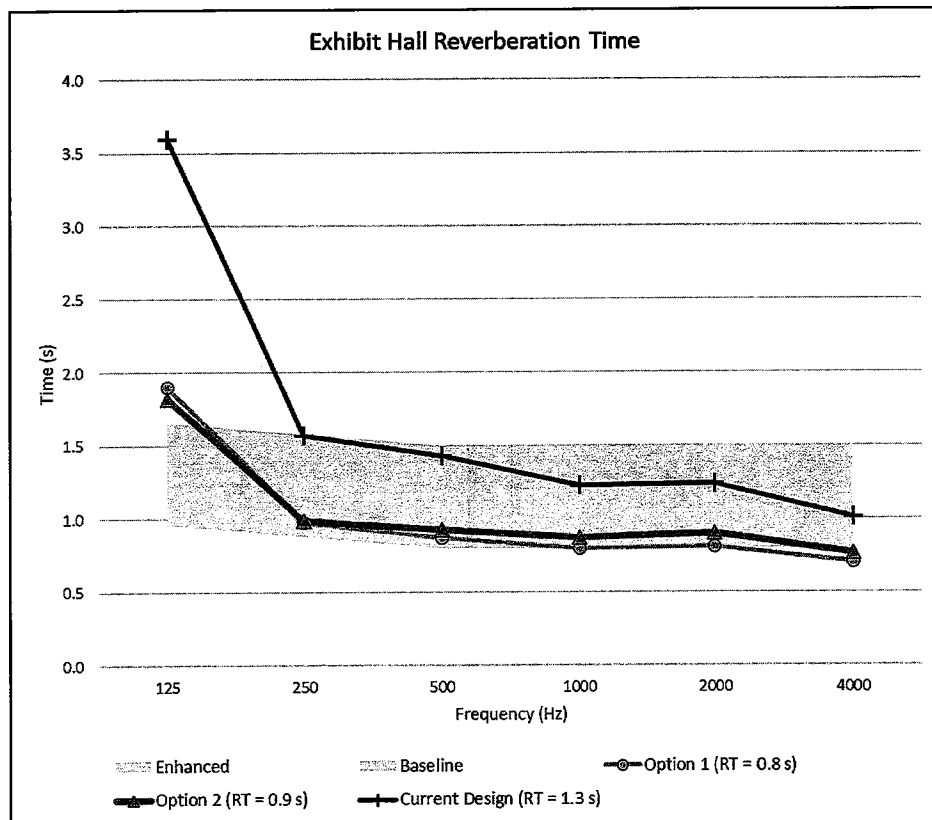


Figure 5a. Calculated RT_{60} for the Exhibit Hall, assuming 50% occupancy

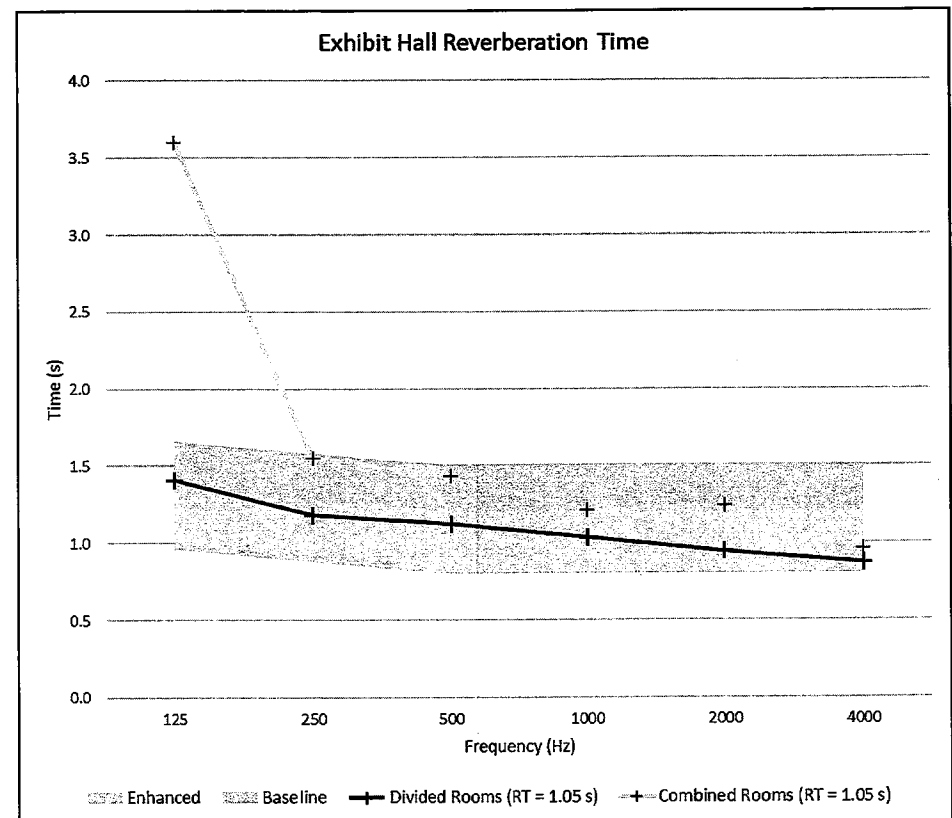


Figure 5b. Calculated RT_{60} for the Exhibit Hall sub-rooms, assuming 50% occupancy

2nd Floor Prefunction – Current Design

Overview

The Prefunction space wraps around the Exhibit Hall. The ceiling height on plans is higher than the 1st floor which increases the room reverberation time proportionally.

Design Elements

- 31' AFF wood veneers ceiling
- 30' AFF GWB ceilings
- Assuming 50% occupancy (approximately 20 occupants per 20'x20' area)
- GWB walls with glass windows
- Thin carpet floor finish

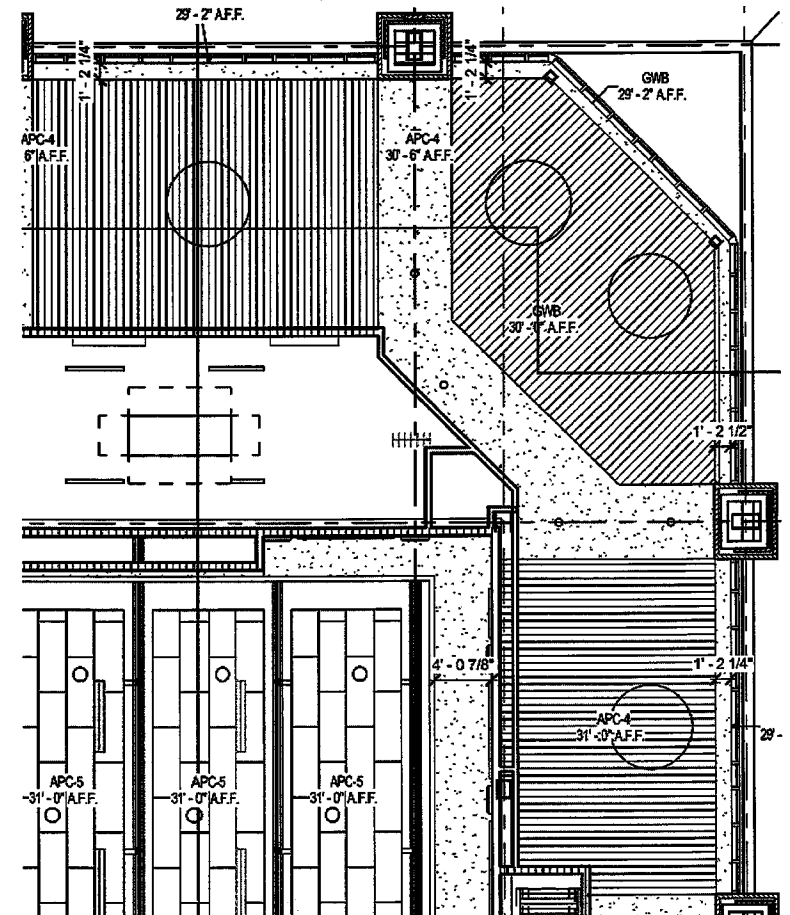


Figure 6. RCP view of plan northeast for the Prefunction space.

2nd Floor Prefunction – Design Strategies

Predicted Performance of Current Design

The high ceilings lead to high room reverberation times that can increase the sound levels in the space. This “build-up” of sound can flank into adjacent rooms such as the meeting spaces and the Exhibit Hall.

Design Strategies

To enhance the room acoustic performance of the Prefunction Space, we recommend the following strategies:

Option 1: Calla Infill Panel – Include Calla infill panel above wood veneer ceiling as provided by the manufacturer.

Option 2: Fiberglass Backing on Wood Veneer – Backload wood veneer with a minimum of 2” thick fiberglass insulation with a minimum 3 PCF density. Basis of design is Owens Corning SelectSound Black Acoustic Board or equal.

Table 5. Predicted room reverberation time of recommended options

Design Strategy	Mid-Frequency Room Reverberation Time (RT _{60, mid-freq, avg} , seconds)
Current Design	1.85 – 1.95
Option 1	1.15 – 1.25
Option 2	1.10 – 1.20

Color Code Legend

Meets criteria

Does not meet criteria

2nd Floor Prefunction – Summary

Overview

Figure 7 compares the current room acoustic performance of the Prefunction space to the recommended options.

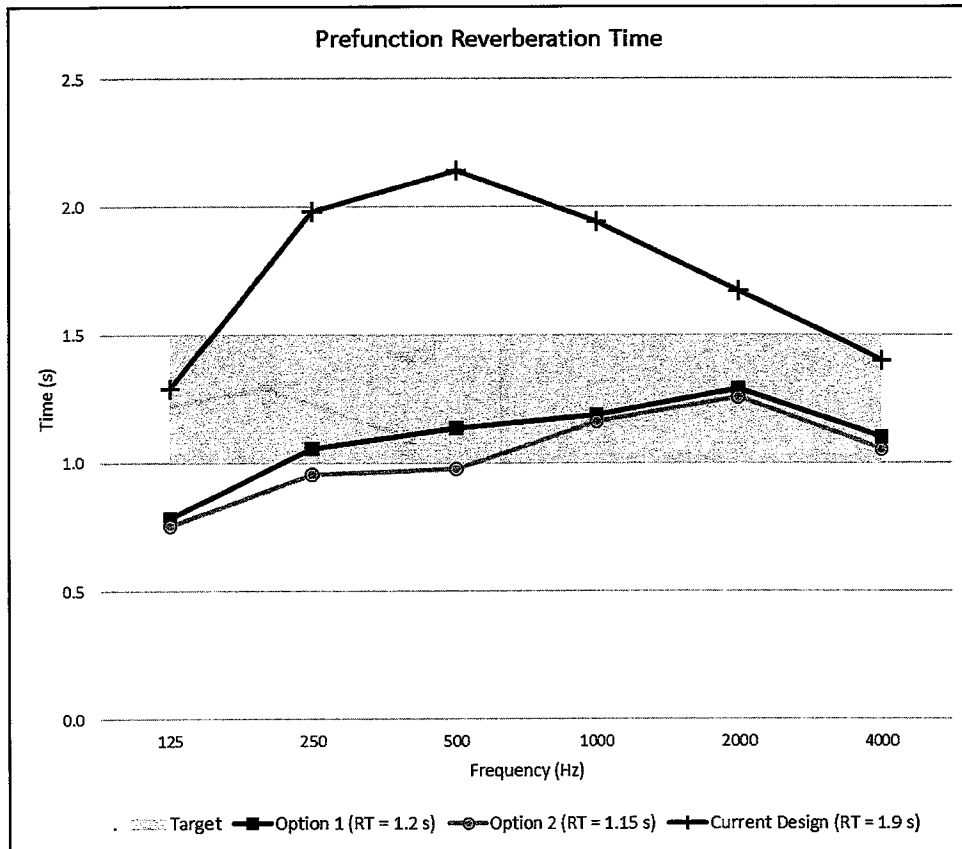


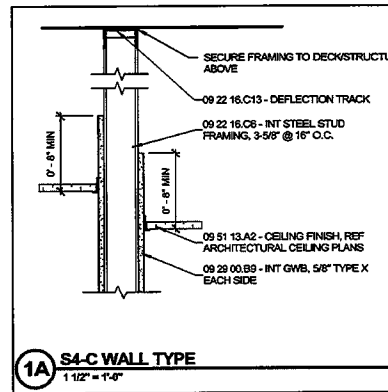
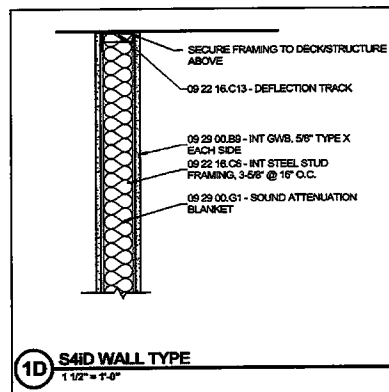
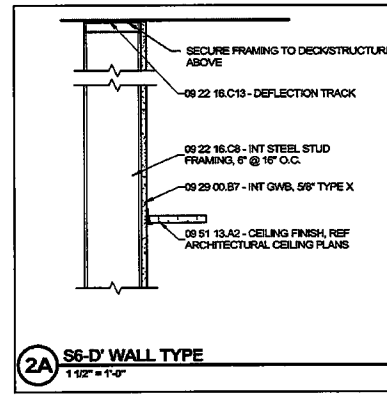
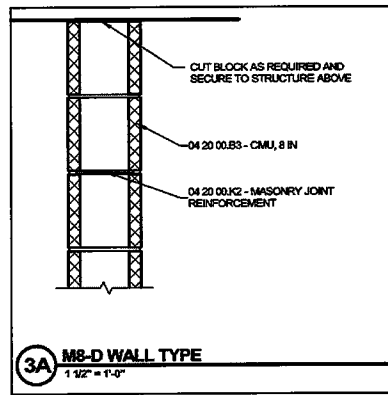
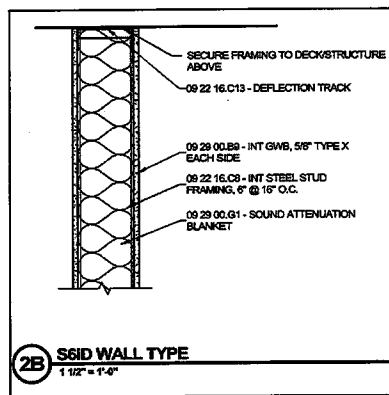
Figure 7. Calculated RT_{60} for the 2nd floor Prefunction Space, assuming 20 occupants per 20'x20' area.

SOUND ISOLATION

Partition Types on Plans

Overview

STC estimates of partition types on plans assume EQ 20 (18mil) studs at 16" o.c. with minimum 2-3pcf density insulation.



Current Design

The predicted airborne sound isolation of demising wall types is summarized in Table 6 below:

Table 6. Predicted airborne sound isolation				
Room Type	Adjacent Room	Design Criteria (STC)	Wall Tag	Predicted Sound Isolation (STC)
Exhibit Hall	Prefunction / Hallway	35	S6iD	45 – 48
	Office	45	S6iD	45 – 48
	Meeting Space	50	S6iD	45 – 48
	Mechanical Room	60	S6iD	45 – 48
	Service Corridor	60	S6iD'/M8-D	60 – 63
	Operable Partitions	55	Modernfold Encore 56	55 – 58
Office	Office	45	S4-C	40 – 43
	Prefunction / Hallway	35	S4-C	40 – 43
	Exhibit Hall	45	S6iD	45 – 48
Meeting Space	Prefunction / Hallway	40	S4-C	40 – 43
	Exhibit Hall	50	S6iD	45 – 48
	Operable Partitions	55	Modernfold Encore 56	55 – 58

Color Code Legend

Meets criteria

Does not meet criteria

See Notes

Notes

Walls highlighted in yellow are walls that meet the design criteria for lab rated sound isolation, but do not extend to the deck.

When walls do not extend to the deck and a barrier ceiling (e.g. GWB ceiling, high CAC ceiling tiles, etc.) is not present in both spaces, sound can readily flank over the wall into the adjacent space, reducing the levels of airborne sound isolation in the field.

First Floor – Recommendations

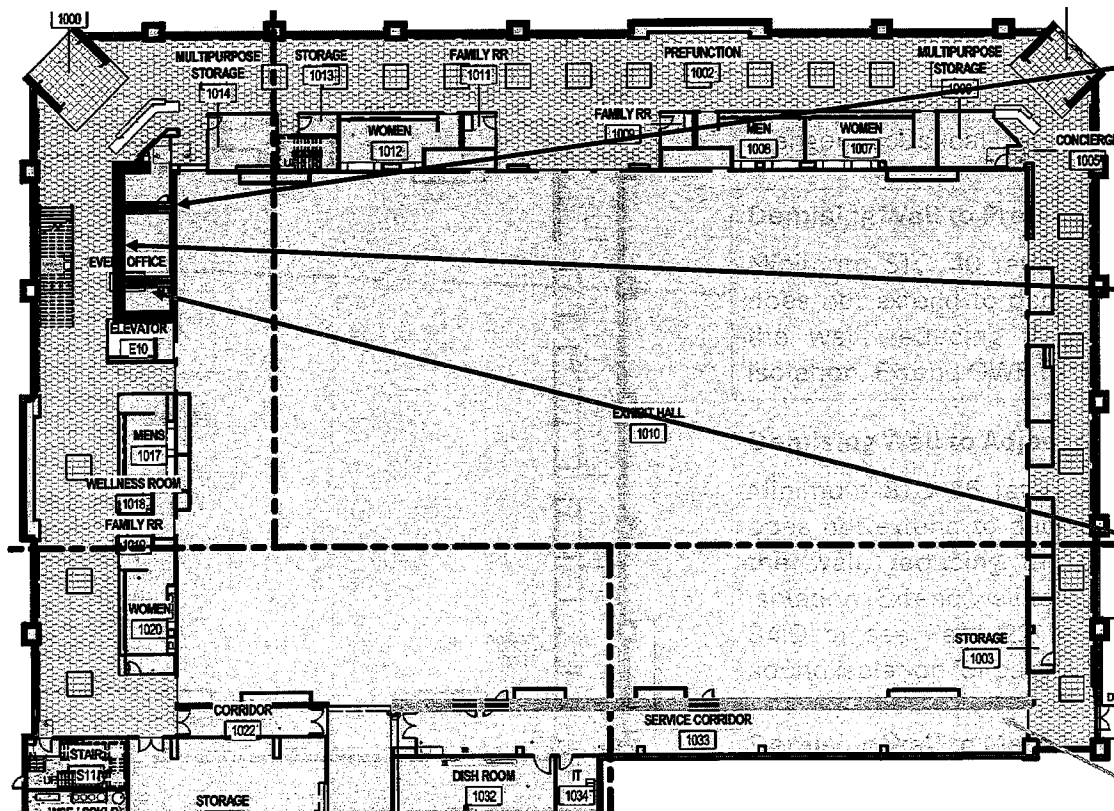


Figure 8. Recommended wall type and door enhancements to meet the design criteria.

Door Seals

Baseline: Solid core double door with fill perimeter seals.

Enhanced: Minimum STC 40 rated double door. Basis of design is IAC Noise-Lock, Noise Barrier QuietSwing, Wenger Acoustical Door, or equal.

Demising Wall to Prefunction

Minimum STC 40 rated wall. Current wall type (S4-C), does not extend to deck and allows sound to flank over the wall, reducing the level of field airborne sound isolation. Extend GWB to the deck.

Demising Wall to Adjacent Office

Minimum STC 35 rated wall. Current wall type (S4-C), does not extend to deck and allows sound to flank over the wall, reducing the level of field airborne sound isolation. Extend wall to the deck and use wall type S6iD / S4iD or see Page 22 for design strategies to maintain sound isolation for partial height walls.

Demising Wall to Mechanical Corridors

Minimum STC 60 rated wall. Use wall type S6iD'/M8-D or reference Page 33 or 34 in the Appendix for minimum STC 60 rated wall assemblies. See Page 29 for more information.

Second Floor – Recommendations

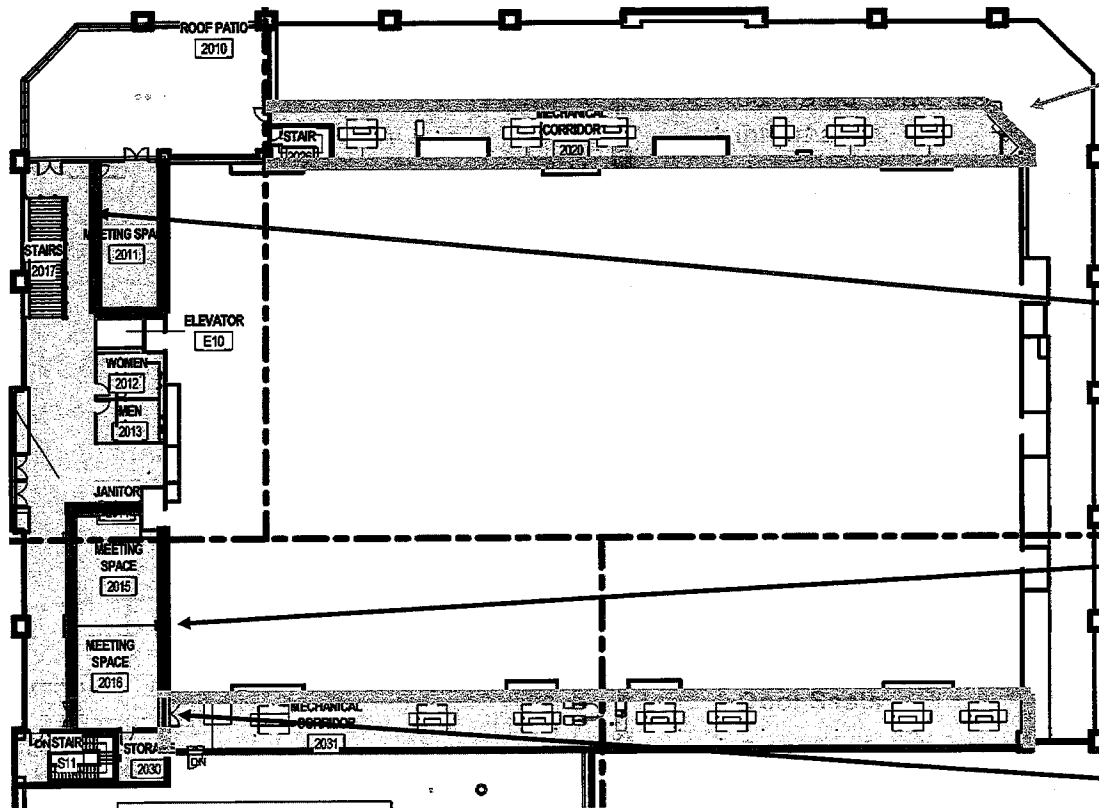


Figure 9. Recommended wall type and door enhancements to meet the design criteria.

Demising Wall to Mechanical Corridors

Minimum STC 60 rated wall. Use wall type S6iD' – M8-D or reference Page 33 or 34 in the Appendix for minimum STC 60 rated wall assemblies. See Page 29 for more information.

Demising Wall to Prefunction

Minimum STC 40 rated wall. Current wall type (S4-C), does not extend to deck and allows sound to flank over the wall, reducing the level of field airborne sound isolation. Extend wall to the deck and use wall type S6iD / S4iD or see Page 22 for design strategies to maintain sound isolation for partial height walls.

Demising Wall to Meeting Spaces

Minimum STC 50 rated wall. Add one layer of GWB to wall type S6iD or reference Page 33 or 34 in the Appendix for minimum STC 50 rated wall assemblies.

Door Seals

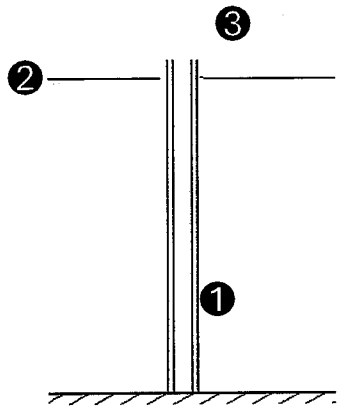
Baseline: Solid core double door with full perimeter seals.

Enhanced: Minimum STC 40 rated double door. Basis of design is IAC Noise-Lock, Noise Barrier QuietSwing, Wenger Acoustical Door, or equal.

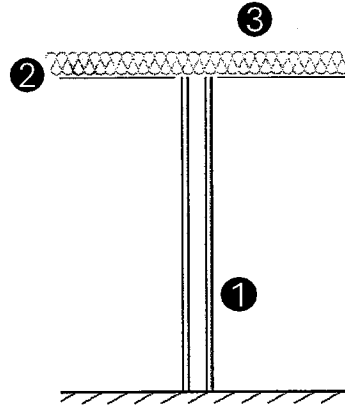
Partition Height Evaluation – Wall type S4-C

Low Attenuation

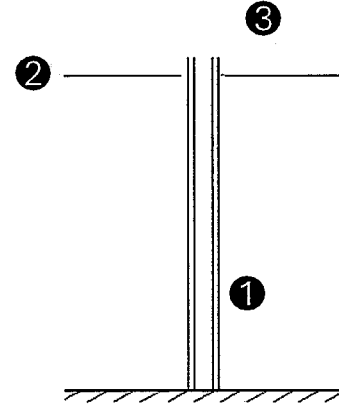
Increased Attenuation



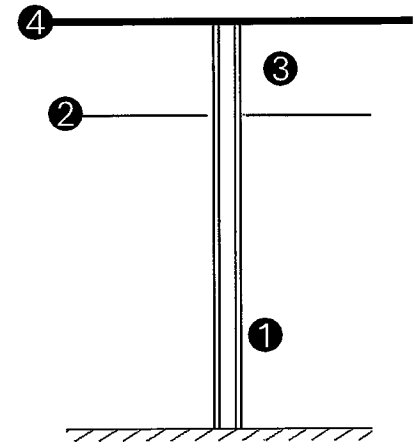
Tag	Description	Rating
1	Wall Type S4-C	STC 40-43
2	ACT - Armstrong Calla	CAC 35
3	Open Plenum	-
Composite STC		STCc 30-32
Estimated Field Performance		NIC 25-27



Tag	Description	Rating
1	Wall Type S4-C	STC 40-43
2	ACT - Armstrong Calla	CAC 35
3	Batt insulation 4' beyond each side of wall	+5
Composite STC		STCc 35-37
Estimated Field Performance		NIC 32-34



Tag	Description	Rating
1	Wall Type S4-C	STC 40-43
2	ACT - Armstrong Calla Privassure	CAC 50
3	Open Plenum	-
Composite STC		STCc 39-42
Estimated Field Performance		NIC 36-39



Tag	Description	Rating
1	Wall Type S4-C	STC 40-43
2	ACT - Armstrong Calla	CAC 35
3	Walls to Gyp cap	-
4	Gyp Cap	-
Composite STC		STCc 40-43
Estimated Field Performance		NIC 37-40

Operable Partitions

Overview

The basis of design for the operable partitions is Modernfold. We recommend Encore 56 as the basis of design to maintain acoustic separation. Access doors in the operable partitions typically low the levels of airborne sound isolation, and we recommend avoiding them to maintain acoustic isolation. Where access doors are required, they should include full perimeter seals as specified by the manufacturer.

Sound can flank over the top of operable partitions and lower the levels of airborne sound isolation. To eliminate flanking paths, a header soffit should be specified to “seal” the operable partition track to the structure. Figure 10 is an example detail of a header track for an operable partition.

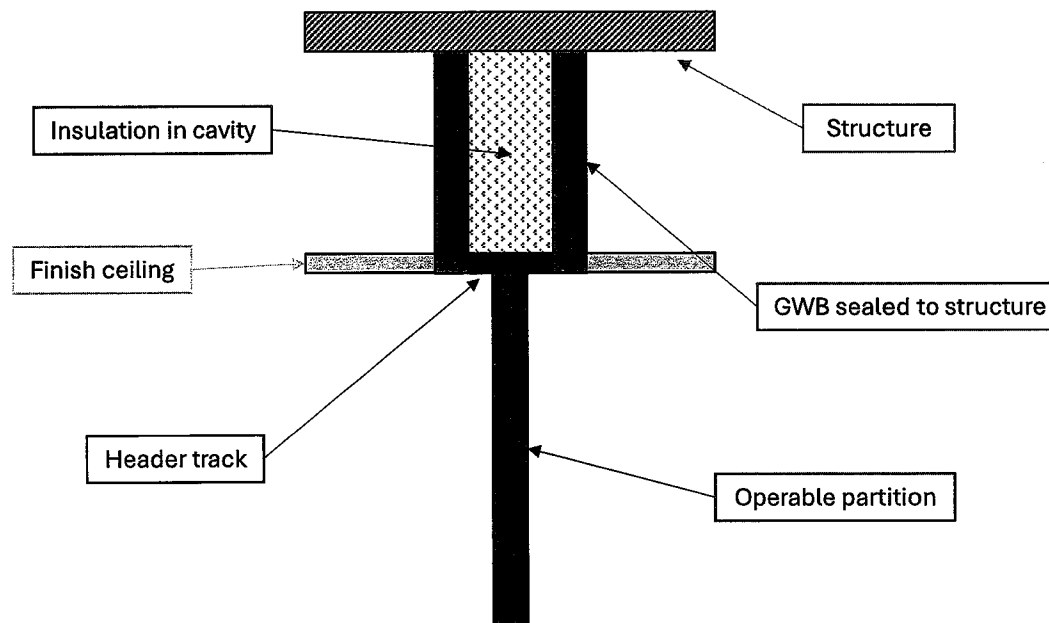


Figure 10. Example header track soffit for operable partitions to maintain acoustic isolation.

Rainfall Sound Analysis

Rainfall Noise

The loudness of rainfall sound through a steel deck ceiling-roof assembly depends on several factors, including the roof’s construction, insulation and ceiling materials. The size of the room can also provide some attenuation for rainfall noise. Below is an analysis of typical rainfall levels in Bloomington, Indiana:

Assumptions

- Moderate rainfall is 0.2 in/hr, 7 ft/s rain velocity, and droplet diameter of 0.04 inches
- Intense rainfall is 0.6 in/hr, 13 ft/s rain velocity, and droplet diameter of 0.08 inches
- Heavy rainfall is 1.6 in/hr, 23 ft/s rain velocity, and droplet diameter of 0.20 inches
- Room volume of 1.1M ft³ and average mid-frequency reverberation time of 1.2 second
- Exposed steel roof deck with suspended acoustic ceiling tile clouds

Table 7. Predicted rainfall sound in Exhibit Hall with current design		
Rainfall Intensity	Design Criteria (NC)	Predicted Rainfall Sound (NC)
Moderate	25 – 30	15 – 20
Intense	25 – 30	15 – 20
Heavy	25 – 30	25 – 30

Color Coding Legend
Does not meet design criteria
Within design criteria range
Meets design criteria

BUILDING SERVICES NOISE CONTROL

Overview – Current Design

Overview

The predicted background sound levels of occupied spaces including the Exhibit Hall, offices, meetings spaces, and Prefunction are summarized in Table 8 below:

Table 8. Predicted background sound levels of regularly occupied spaces		
Room Type	Design Criteria (NC)	Predicted Background Sound Level (NC)
Exhibit Hall	25 – 30	27 – 30
Offices	30 – 35	32 – 35
Meeting Spaces	30 – 35	33 – 36
Prefunction	40 – 45	39 – 42

Color Coding Legend

Does not meet design criteria

Meets design criteria

Mechanical Schedules

Current mechanical schedules do not include octave band sound power data for mechanical equipment and NC ratings for grilles and diffusers. We recommend adding all sound data to mechanical schedules.

Exhibit Hall – Current Design

Supply

Air is supplied to the Exhibit Hall through a distributed ceiling diffuser layout from heat pumps located in the mechanical mezzanines. Ceiling slot diffusers are selected to not exceed NC 20.

Return

The return duct paths are supplied from heat pumps in the mechanical mezzanines. Custom perforated metal grilles are located along the wall of the Exhibit Hall in 8 locations.

Internal Duct Lining

The basis of design for duct paths serving the Exhibit Hall is to utilize duct lining to reduce the background sound level. A minimum of 25' of 1" internal duct lining is recommended downstream of all heat pumps for the supply and return paths.

Total Background Sound Level

The total predicted background sound level in the Exhibit Hall is NC 28 when a minimum of 25' of 1" internal lining is downstream of the heat pumps.

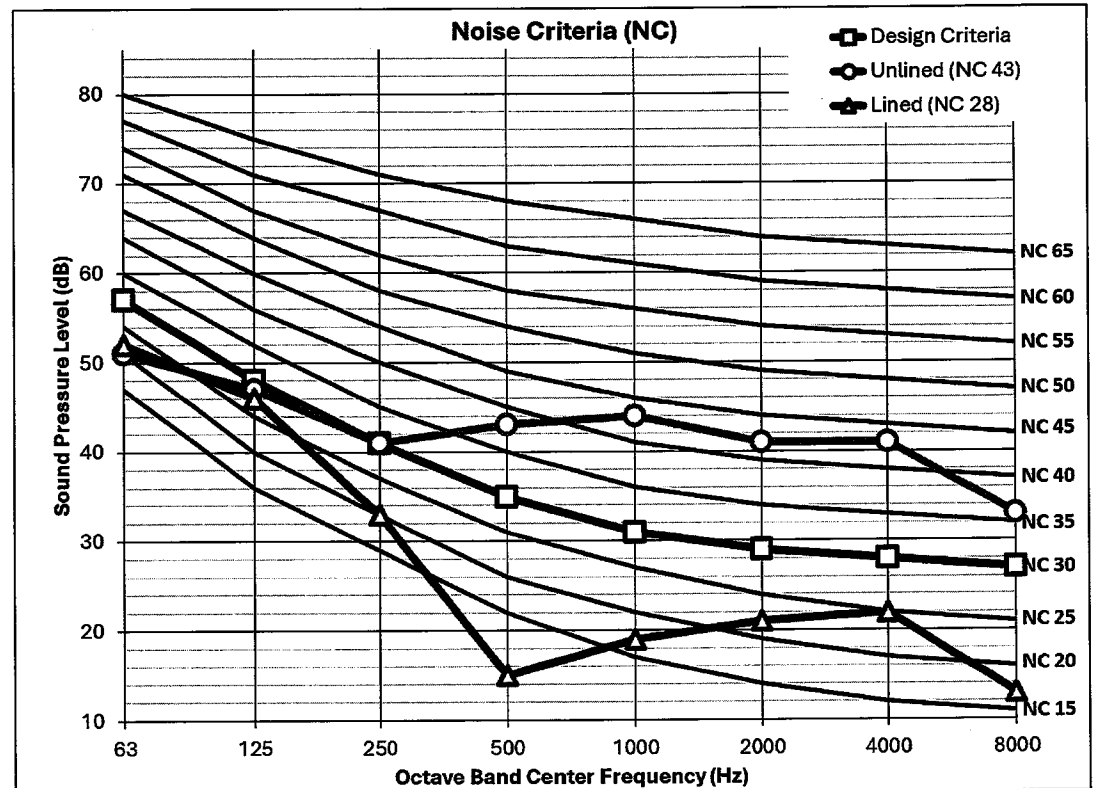


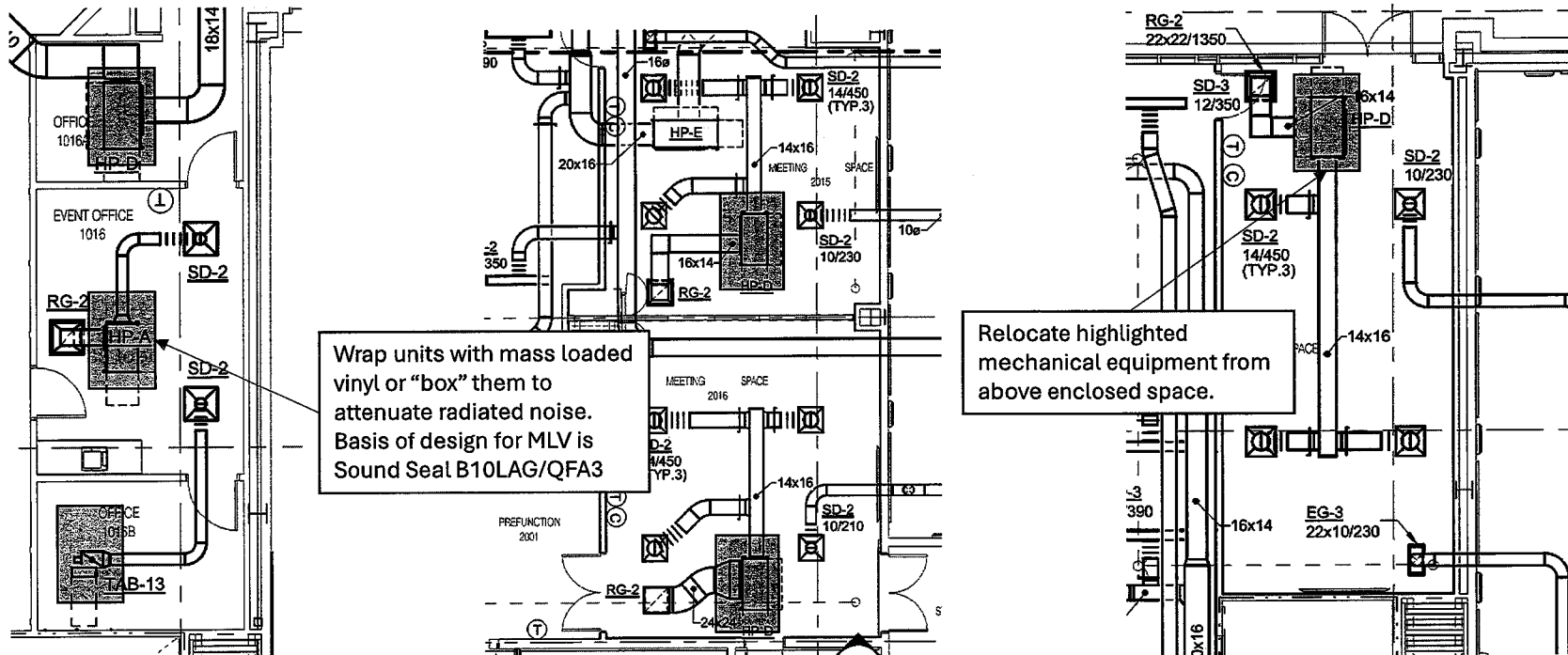
Figure 11. Calculated background sound levels for the Lecture Hall, summing supply air, return air, radiated noise, and duct breakout noise.

Mechanical Equipment Locations

Overview

Radiated sound from equipment such as heat pumps and terminal air boxes can be audibly localized in enclosed spaces and increase the background sound levels in the receiving space. We expect the radiated sound from the heat pumps located above the enclosed meeting and office spaces to be **NC 40 – 45**. This is perceptively **2-times louder** than the design criteria (NC 30 – 35).

We recommend relocating mechanical equipment from above enclosed spaces to non-sensitive spaces (e.g. corridors, prefunction, restrooms, etc.) or “box” the units to attenuate radiated noise from intruding on the enclosed spaces below.



Mechanical Corridor to Exhibit Hall

Overview

The predicted sound levels in the Mechanical Corridors is based on the quantity of equipment in the corridor. This sound level transmits through the dividing wall to the Exhibit Hall. Table 9 below compared the predicted sound level of the Mechanical Corridors flanking into the Exhibit Hall with the current design and the recommended minimum STC 60 (NIC 55) wall. See [Full-Height Partition Type Options](#) for partition options.

Table 9. Mechanical corridor sound flanking into the Exhibit Hall

Option	Exhibit Hall Design Criteria (NC)	Predicted Sound Level in Mechanical Corridor (NC)	Wall Tag	Predicted Sound Isolation (NIC)	Predicted Sound Level Flanking in Exhibit Hall (NC)
Current Design	25 – 30	80 – 85	S6iD	40 – 42	40 – 43
Recommended			-	55 – 60	25 – 30

Color Coding Legend

Does not meet design criteria

Meets design criteria

Airflow – Basis of Design

Overview

High airflow velocities can lead to turbulent airflow within the ductwork and distribution devices. Turbulence generates sound in the system. Airflow velocities should be limited to reduce turbulence to lower generated noise and achieve the design criteria in the Lecture Hall.

IMEG references ASHRAE Ch 49. *Noise and Vibration Control, 2023* for recommended maximum airflow velocities in ductwork and distribution devices as shown in Table 10 and Table 11. ASHRAE Ch. 49 is also referenced by LEED v4.1 as the basis standard for background sound levels.

Table 10. Recommended maximum airflow velocities in ductwork

Main Duct Location	Design Criteria (NC)	Maximum Airflow in Rectangular Ducts (fpm)	Maximum Airflow in Circular Ducts (fpm)
In shaft or above drywall ceiling	25 – 30	2,100	3,000
Duct located within occupied space		1,200	2,150

Table 11. Recommended maximum airflow velocities through grilles and diffusers

Grille / Diffuser Type	Design Criteria (NC)	Maximum Free-Area Airflow Velocity (fpm)
Supply	25 – 30	425
Return		500

APPENDIX

Definitions

Sound Levels (dBA): Human hearing is not equally sensitive across all frequencies. We tend to perceive mid-frequencies (speech) better than high or low frequencies. To account for human hearing response at typical listening levels, sound pressure can be expressed in units of A-weighted decibels (dBA).

Noise Criteria (NC): Background sound levels in unoccupied rooms from mechanical and exterior sources are typically specified in terms of Noise Criteria (NC) ratings. The NC is a single-number rating derived from the decibel levels in octave bands from 63 Hz to 8000 Hz

Reflection: Sound reflection can be either beneficial (support) or detrimental (echo) to room acoustics depending on the magnitude, direction, arrival time, and the intended function of the room.

Reverberation Time (RT_{60}): The time it takes a sound to decay 60 decibels and is frequency dependent. When reverberation time is reported as a single number, it is the mid-frequency time, which is the average of the 500, 1000, and 2000 Hz octave bands.

Echo: A reflective sound from an impulse that is very destructive. It is not part of the reverberation in a room but perceived to be so on occasion. It is a distraction often stemming from a long axis of a room with hard rear walls or a series of hard reflections in a boxy room shape, or with concave surfaces.

Noise Reduction Coefficient (NRC): A simple metric for room absorption. It is the arithmetic average of 1/3 octave absorption coefficients at 250 Hz, 500 Hz, 1,000 Hz, and 2,000 Hz. A value of 1.0 is considered perfect absorption while a value of 0 is considered perfect reflection.

Sound Transmission Class (STC): STC is a single-number ratings of the effectiveness of an assembly at isolating airborne sound. A higher number corresponds to a higher degree of acoustical isolation.

Noise Isolation Class (NIC): Field STC measured rating under the given existing conditions of a space, including furnishings and reverberation time. NIC is typically 3 – 5 points lower than STC.

Ceiling Attenuation Class (CAC): A single-number rating representing airborne sound reduction due to the ceiling system for sound passing up through a ceiling, over an adjoining partial-height partition, and down through another ceiling of an adjacent space.

Subjective Perspective: A 3-point difference in dB and NC rating represents a just-noticeable difference, a change of 5 – 6 points is clearly noticeable, and change of 10 points is perceived to be twice as loud.

Full-Height Partition Type Options

Overview

The following table provides Minimum STC ratings for steel stud partition types.

STUD GAUGE/ MIL THICKNESS	Minimum STC 40	Minimum STC 45	Minimum STC 50	Minimum STC 53	Minimum STC 55	Minimum STC 60
EQ25 (15mil)	2+2 GYP (no batt) Two-layers gyp Minimum 3-5/8" stud Two-layers gyp	1+1 GYP One-layer gyp Minimum 3-5/8" studs One-layer gyp	2+2 GYP One-layer gyp Minimum 3-5/8" stud Two-layers gyp	2+3 GYP Two-layers gyp Minimum 3-5/8" stud Three-layers gyp		
EQ20 (18mil)	2+2 GYP (no batt) Two-layers gyp Minimum 3-5/8" stud Two-layers gyp	1+2 GYP One-layer gyp Minimum 3-5/8" stud Two-layers gyp	2+2 GYP Two-layers gyp Minimum 3-5/8" stud Two-layers gyp	3+3 GYP Two-layers gyp Minimum 3-5/8" stud Three-layers gyp		
Heavy Gauge (30-33mil)	2+2 GYP Two-layers gyp Minimum 3-5/8" stud Two-layers gyp					
All steel stud partitions assume the following unless otherwise noted: • Full height walls extending from floor to deck • Steel studs, spaced 16-inches on center • 5/8-inch Type X gypsum board • Batt insulation with minimum 2 – 3 pcf density Isolation clip basis of design is Pac Intl RSIC-1 and Pliteq GenieClip with 7/8" (18mil) hat channel				ISOLATION CLIP	1+1 GYP One-layer gyp Minimum 3-5/8" stud Isolation clip One-layer gyp	1+2 GYP Two-layers gyp Minimum 3-5/8" studs Isolation clip One-layer gyp
				DOUBLE STUD	1+1 GYP One-layer gyp Minimum 2-1/2" stud Minimum 1" airspace Minimum 2-1/2" stud One-layer gyp	1+2 GYP One-layer gyp Minimum 2-1/2" stud Minimum 1" airspace Minimum 2-1/2" stud Two-layers gyp

Full-Height Partition Type Options

Overview

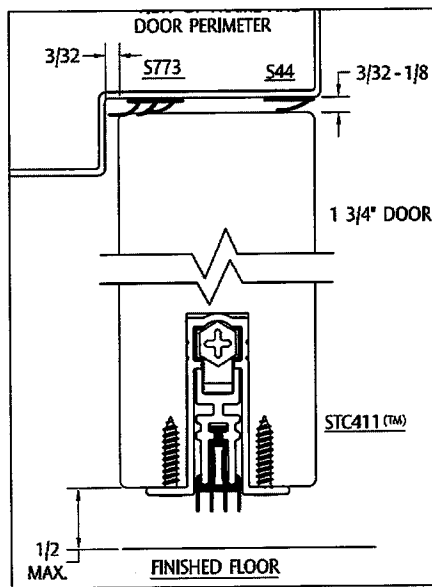
The following table provides Minimum STC ratings for CMU partition types.

CMU Thickness	Minimum STC 45	Minimum STC 50	Minimum STC 55	Minimum STC 60	Minimum STC 65
8" CMU	Hollow-core		Grout-filled Or Hollow-core w/furring	Grout-filled w/furring	
10" CMU		Hollow-core	Hollow-core w/furring	Grout-filled	Grout-filled w/furring
12" CMU		Hollow-core	Hollow-core w/furring	Grout-filled	Grout-filled w/furring
All CMU partitions assume the following unless otherwise noted: • Full height walls extending from floor to deck • Normal weight ($\geq 125\text{pcf}$) • Assemblies with furring are minimum 1.5" steel stud filled with batt					

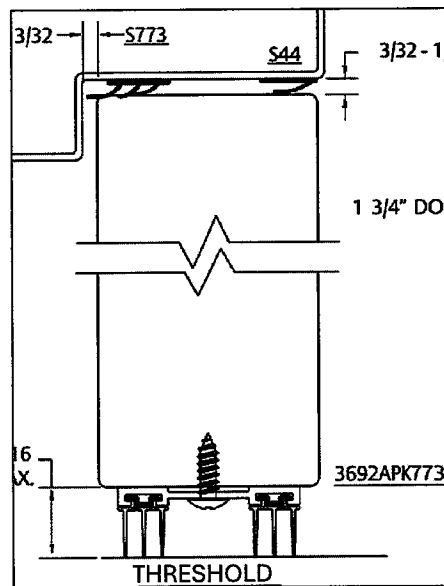
Door Seal Recommendations

Overview

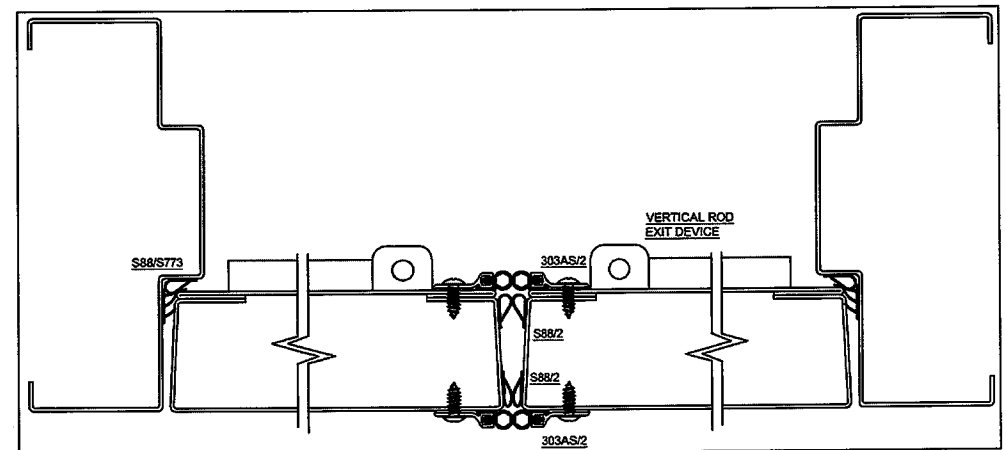
A main flanking path for noise ingress is around doors without seals. The following door seal options are provided for swing doors. Door seal model numbers in figures are by Pemko. Equals are by Zero International and NGP.



Drop bottom seal set



Sweep bottom seal set with threshold



Double door seal set

HVAC System Sound Power Data

SOUND APPLICATION GUIDE: DESCRIPTION AND RATINGS

Performance Data - Versatec 500 Large WSHP

Model	Cabinet	Mode	Free Air Inlet Combined with Casing (Cabinet) Radiated								Ducted Discharge							
			Octave Band Frequency, Hz								Octave Band Frequency, Hz							
			63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000
084	H	Fan Only	74	71	64	63	58	52	50	43	76	72	64	67	60	58	57	50
		Cooling: High Speed	75	69	65	63	57	57	55	50	78	74	69	73	67	65	64	59
		Heating: High Speed	77	71	66	64	58	56	54	51	77	73	68	72	65	63	62	57
096	H	Fan Only	78	72	68	65	60	59	58	53	81	76	72	76	70	68	67	62
		Cooling: High Speed	76	72	67	65	60	57	55	49	79	75	69	72	65	63	63	57
		Heating: High Speed	80	75	68	67	62	57	55	51	79	76	69	73	65	62	62	55
120	H	Fan Only	79	73	69	66	61	60	59	54	82	77	73	77	71	69	68	63
		Cooling: High Speed	79	73	69	67	61	61	59	54	82	78	73	77	71	69	68	63
		Heating: High Speed	80	76	69	67	63	59	57	54	80	76	71	75	68	66	65	60
150	H	Fan Only	80	74	70	67	62	61	60	55	83	78	74	78	72	70	69	64
		Cooling: High Speed	81	75	71	67	63	63	61	56	84	80	75	77	73	71	70	65
		Heating: High Speed	83	77	72	68	64	62	61	57	83	79	74	77	72	69	69	63
180	H	Fan Only	80	74	70	67	62	61	60	55	83	78	74	78	72	70	69	64
		Cooling: High Speed	82	76	72	68	64	64	62	57	85	81	76	78	74	72	71	66
		Heating: High Speed	84	78	73	69	65	63	62	58	84	80	75	78	73	70	70	64
084	V	Fan Only	73	70	63	62	57	51	49	42	75	71	63	66	59	57	56	49
		Cooling: High Speed	74	68	64	62	56	54	49	42	77	73	68	72	66	64	63	58
		Heating: High Speed	76	70	65	63	57	55	53	50	76	72	67	71	64	62	61	56
096	V	Fan Only	77	71	67	64	59	58	57	52	80	75	71	75	69	67	66	61
		Cooling: High Speed	75	71	66	64	59	56	54	48	78	74	68	71	64	62	62	56
		Heating: High Speed	79	74	67	66	61	56	54	50	78	75	68	72	64	61	61	54
HP-G 10-ton	V	Fan Only	78	72	68	65	60	59	58	53	81	76	72	76	70	68	67	62
		Cooling: High Speed	78	72	68	66	60	60	58	53	81	77	72	76	70	68	67	62
		Heating: High Speed	79	75	68	66	62	58	56	53	79	75	70	74	67	65	64	59
150	V	Fan Only	79	73	69	66	61	60	59	54	82	77	73	77	71	69	68	63
		Cooling: High Speed	80	74	70	66	62	62	60	55	83	79	74	78	72	70	69	64
		Heating: High Speed	82	76	71	67	63	61	60	56	82	78	73	76	71	68	68	62
180	V	Fan Only	79	73	69	66	61	60	59	54	82	77	73	77	71	69	68	63
		Cooling: High Speed	81	75	71	67	63	63	61	56	84	80	75	77	73	71	70	65
		Heating: High Speed	83	77	72	68	64	62	61	57	83	79	74	77	72	69	69	63
HP-H 20-ton	V	Fan Only	81	77	74	65	65	65	64	57	84	81	76	76	76	73	73	67
		Cooling: High Speed	83	77	74	66	66	65	64	58	87	82	78	75	75	73	73	67
		Heating: High Speed	86	79	75	67	67	65	65	60	86	82	78	75	75	72	73	66
HP-I 25-ton	V	Fan Only	82	78	76	64	67	66	66	59	85	82	80	75	77	75	75	68
		Cooling: High Speed	85	79	76	65	67	66	65	59	88	83	80	75	77	75	74	68
		Heating: High Speed	88	81	77	66	68	67	67	61	88	83	79	75	76	74	75	67
360	V	Fan Only	83	79	75	65	68	67	67	60	86	83	81	76	78	76	76	69
		Cooling: High Speed	86	80	77	66	68	67	67	60	89	84	81	76	78	76	76	69
		Heating: High Speed	89	82	78	67	69	68	68	62	89	84	80	76	77	75	75	68

SOUND APPLICATION GUIDE: DESCRIPTION AND RATINGS

Performance Data - Versatec 500 WSHP

Single Speed - Standard Construction - ECM

Octave Band Sound Power Level, dB, re 1 pica Watt

Model	Cabinet	Mode	Free Air Inlet Combined with Casing (Cabinet) Radiated								Ducted Discharge							
			Octave Band Frequency, Hz								Octave Band Frequency, Hz							
			63	125	250	500	1000	2000	4000	8000	63	125	250	500	1000	2000	4000	8000
015	V/H	Fan Only	58	60	55	51	45	42	38	33	69	70	57	57	54	50	47	40
		Cooling: High Speed	69	64	58	54	48	44	40	35	77	74	61	60	57	53	51	44
		Heating: High Speed	71	67	58	53	49	45	41	36	79	74	62	60	58	54	51	44
018	V/H	Fan Only	58	60	56	52	48	44	40	33	69	71	59	61	54	51	47	38
		Cooling: High Speed	67	65	58	55	50	47	42	35	76	74	61	63	56	53	49	40
		Heating: High Speed	69	70	58	55	51	47	42	36	78	74	62	64	57	53	50	41
022	V/H	Fan Only	49	44	45	42	37	32	29	31	68	58	50	53	48	41	36	31
		Cooling: High Speed	65	66	61	60	55	51	49	43	76	69	59	65	59	54	53	46
		Heating: High Speed	65	67	60	58	51	47	47	43	75	68	60	66	60	55	53	48
030	V/H	Fan Only	55	53	51	51	46	43	40	36	69	60	57	58	54	49	46	43
		Cooling: High Speed	71	63	60	58	56	51	47	42	77	68	65	66	63	59	58	52
		Heating: High Speed	71	70	60	59	56	51	47	41	77	69	66	66	64	59	57	50
036	V/H	Fan Only	60	57	54	52	47	44	41	37	70	60	52	53	49	43	39	32
		Cooling: High Speed	70	65	61	58	57	52	49	43	74	67	65	65	62	58	58	51
		Heating: High Speed	71	69	63	58	56	52	48	43	75	68	65	65	63	60	58	51
042	V/H	Fan Only	62	61	61	58	55	50	47	41	69	61	59	59	58	52	50	43
		Cooling: High Speed	71	67	64	60	58	54	51	45	75	69	66	66	62	59	59	51
		Heating: High Speed	72	67	66	60	58	53	50	45	74	69	66	66	64	60	58	51
048	V/H	Fan Only	67	63	59	55	52	48	46	43	71	62	54	54	51	46	42	34
		Cooling: High Speed	71	68	68	62	60	56	53	48	76	70	67	67	63	60	60	52
		Heating: High Speed	72	68	69	63	60	56	53	48	75	69	67	66	64	59	58	51
060	V/H	Fan Only	69	65	62	58	55	51	48	44	77	66	60	59	57	53	50	42
		Cooling: High Speed	85	75	72	67	66	65	63	58	77	74	75	72	74	70	70	65
		Heating: High Speed	82	73	71	66	64	62	61	56	79	75	75	72	73	69	68	63
070	V/H	Fan Only	70	68	64	61	58	53	50	45	82	69	65	64	62	60	57	49
		Cooling: High Speed	85	75	72	67	66	65	63	58	77	74	75	72	74	70	70	65
		Heating: High Speed	82	72	71	66	64	62	61	56	79	75	75	72	73	69	68	63

Data based on sound measurements made in a Reverberant room on representative units from each cabinet size in accordance with ARI standard 8722/17 260-2001