ROSENTHAL FINE ARTS BUILDING ACOUSTICS STUDY

For

Fayettville State University

By

MHAworks Architects &

Stewart Acoustical Consultants

November 9, 2017

Rosenthal Fine Arts Building Acoustics and Sound Transference Study

Fayetteville State University,

1200 Murchison Road
Fayetteville, North Carolina, 28301

The study that follows is prepared by Stewart Acoustical Consultants and MHAworks Architects as part of the University's response to the National Association of Schools of Music "Visitors' Report" dated September 20. 2016. It is intended to help address concerns itemized in that report relating to guidelines and standards listed in the NASM Handbook and specifically, those relating to facilities, equipment, and technology. This study does not address issues such as administration, staffing, finance, governance, recruitment, or community involvement. Items listed below and mentioned in the NASM report can be addressed based on the results of the acoustical study:

- Assessment of the adequacy of space allocated to music unit functions.
- Study of appropriateness of acoustical treatments and room finishes for this music facility.
- Teaching and practice room functions as they relate to acoustic isolation effectiveness.

Facility Overview:

The building is located prominently on the corner of Murchison Road and the main campus entrance. The "Classroom Building for Music, Art and Social Science" was constructed in 1965. The original drawings list the building area as 25,600 gsf. The area of the building currently used for music rehearsal, musical performance teaching, practice, and music program administration totals approximately 18,400 square feet. Basement level art studios (8,400 gsf) and north art administration wing are not included in the acoustical analysis.

There are record drawings of the basement level ceramics addition and minor main floor renovations and alteration that took place is 1982.

The addition of the north fine arts administration wing (9,592 gsf), basement level elevator, and alterations to band director and choir director office areas appears to have taken place some time after 1982, but those record drawings are not available for this study.

The building is primarily a single story, but includes art studios in the walk out basement of the south wing. The building is a reinforced concrete block and brick bearing wall building with steel framing on the south wing. The ground floor structure is cast in place concrete and the main floor roof assembly is steel joists and corrugated metal deck. Corridor walls are concrete block faced with a common brick veneer and typically extend to the underside of the roof deck.

The principal plan feature of the facility is a 98'x 98' block of space consisting of a large hexagonal band practice and choir/auditorium central space (1600 sf each) surrounded by individual music practice rooms on the east and west sides of the block. Mechanical and music lab spaces are located on the north wall and office/practice rooms are located on the south side of the block.

The south wing was originally intended for music administration offices and teacher offices and includes five large classrooms ranging from 712 sf to 967 sf.

Over the years, the use of the classroom spaces appears to have expanded to include additional music teaching functions beyond what was originally intended so that all of the south wing classrooms currently have a music teaching/performance component that now requires room acoustics and sound isolation beyond what was originally intended.

Facility Inspection Existing Conditions:

MHAworks and Stewart Acoustical Consultants performed an inspection of the classrooms and practice rooms on August 31, 2017. Spaces were inspected including a sampling of conditions above the suspended ceilings to confirm if there are unsealed wall penetrations and if the tops of walls are sealed to the underside of the metal roof deck to prevent sound transfer.

The acoustical study attached is organized to addresses three key factors that comprise good acoustics:

- Room acoustics,
- Sound isolation, and
- Building systems noise.

Generally, the building was very well built and has been well maintained over the years. The building's solid masonry interior partitions provide a substantial amount of mass that helps prevent noise transmission between rooms. While most of the masonry corridor and classroom walls extend to the under side of the roof deck, these 6" and 8" thick masonry partitions are generally not sealed at the head of wall intersection with the underside of the metal roof deck. This creates an air gap "flanking path" for sound that degrades the potential isolation quality of the wall assemblies. (See the building floor plan and notes included with this report.)

Band & Chorus Rooms (north wing) :

These two large assembly type rooms have masonry perimeter walls that extend above the roof deck. (See building Sections attached) These rooms have some sound dampening panels on their perimeter walls. Room doors from the corridor are not adequately sealed, nor do they have door frame seals or drop seals at the sills. Doors that are pocketed at the south wall of the rooms (part of a later renovation) do not have continuous structure at the door head conditions creating a large sound transmission gap. Refer to the Stewart Acoustical report detailing concerns about room volume and floor area relating to maximum room occupancy.

Individual Practice Rooms (north wing):

The practice rooms were designed to be acoustically isolated from each other having demising walls detailed with two layers of gypsum board on either side of insulated metal stud wall cavity and resilient clips on one side to make an assembly with an STC rating of 56. The rooms have a "lid" of suspended gypsum board with acoustic tiles laminated on the gypsum board ceiling and turning down the exterior walls two feet. Room doors are poorly sealed or not acoustically sealed at all.

At some point, a renovation took place to expand the classroom and practice room areas. Plan reconfigurations resulted in the addition of two rooms on either side of the south lobby (labeled as room #221) resulting in a total of ten rooms where there were six originally. The alterations have single ply gypsum board partitions that extend just above the suspended ceiling and in general are poorly acoustically isolated from each other and from the adjacent corridors.

Office/Music Practice Rooms (south wing):

These multi-function rooms that are located in the south wing (211, 212, 213, 215, & 217) along the west wall do not appear to have been originally intended to be acoustically isolated because while the 6" thick masonry demising walls extend to the roof deck' the room doors all have return air grills to allow air to return through the corridor. The doors must be replaced with solid slabs with jamb, head, and sill seals added. The rooms could have return grills added in the ceilings with long glass lined duct boots extended through the corridor walls and to the return plenum near the toilet rooms.

"Smart Music" Classrooms (south wing):

Demising walls between these three large rooms in the south wing (214, 216, & 218) extend full height, but do not appear to be sealed to the underside of the roof deck. The classroom doors to these spaces have return air grills which will need to have new solid core wood doors, acoustic seals, sill drop seals, and ceiling return grills with duct boots extending through corridor demising walls to create effective sound isolation between the rooms for their music performance functions.

Estimate of Probable Cost :

As stated in the acoustical consultant's report, sound isolation is the greatest need identified by the survey. There are deficiencies that can be traced to the detailing of the building when it was originally constructed in 1965. Some of the deficiencies reported are the result of the change in use of rooms over the years as the music program has grown and the rooms have had to accommodate music performance functions. Other sound isolation conditions appear to be the result of renovations that have taken place which were made to a lower standard than needed for music performance.

Less of a priority is the identified need to upgrade the room acoustics of some spaces, but especially in the Band and Chorus spaces. These two rooms are the "heart" of the music facility and deserve upgrades to make them as good as they can be. However, the deficiencies identified in the acoustical consultant's report of room size, volume, and floor area per person based on the occupancy for performance functions should be resolved first.

Finally, beyond the reworking of return air louvers at room doors, there are minor adjustments that can be made to the mechanical systems to help the equipment run smoother, quieter, and possibly more efficiently.

The draft estimate of probable cost included with this report is a preliminary listing of the deficiencies identified for each type of space and a chance to assign some numbers to what it could cost to make the renovations needed. As the Planning and Construction department gathers input and suggestions from the staff and music program administrators, the scope of work can be adjusted along with the associated costs and available funding.

MHAworks Architects

William N. Gardner, AIA, NCARB
Project Architect

Chorus Room: Maximum room occupancy appears to exceed current industry standards for a room of this volume, floor area per person, and ceiling height.

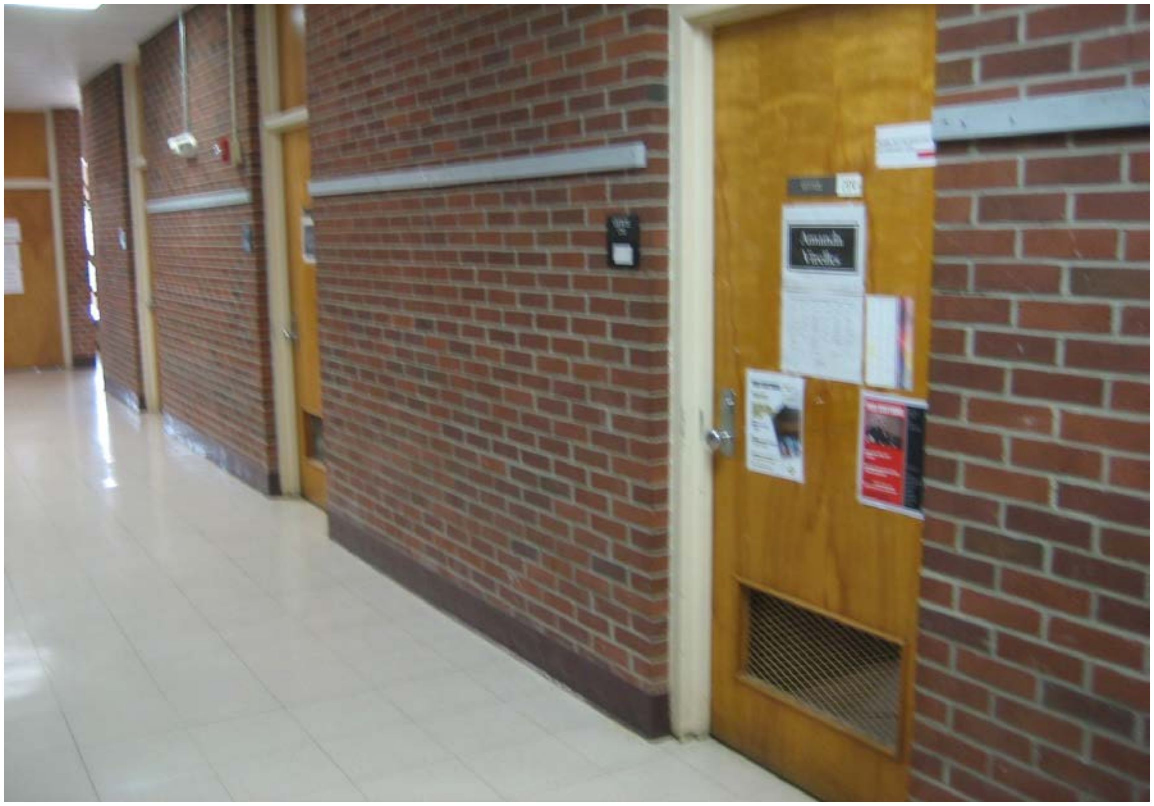
Band Room: Spatial volume, floor area, and ceiling heights are below minimum reguire-Mentss based on the maximum occupancy of the room.

Inspection above ceilings is performed to confirm that room demising walls are sealed above ceilings to create proper room sound isolation.

Corridor outside Chorus Room where original practice rooms concrete masonry walls join rooms renovated with gyp. board partitions creating ineffective sound isolation conditions.

Practice rooms of original 1965 design have masonry corridor walls & acoustic panels adhered to a suspended ceiling. Typical gyp. board wall assembly between rooms has a n STC rating of 56.

The recessed band room door is not original to the design and the walls above the suspended ceiling are incomplete creating poor sound isolation from the public corridor activities.



Sound isolation quality of heavy masonry corridor walls is defeated by return air grills in office doors. The south wing offices and “Smart “Classrooms as originally designed appear not to have been intended for acoustically isolated music performance functions as they are used currently.

Acoustic door seals are missing or old and poorly functioning. They need to be replaced at all rooms which are used for music performance functions. All doors need drop seals at the sills as well to correct the impact of corridor noise intrusion on the need for practice room privacy.

Stewart Acoustical Consultants

7330 Chapel Hill Road, Suite 201 sac@sacnc.com
Raleigh, NC 27607 919-858-0899

November 9th, 2017

Dr. Don N. Parker
Professor of Music/Percussion
Interim Chair
Fayetteville State University
Department of Performing and Fine Arts

Dr. Parker,

We were asked to evaluate the music department at Fayetteville State University and provide a summary of our findings in order to help improve the acoustical conditions of the various spaces.

In this report, we will first discuss the factors involved in providing good acoustics for these spaces including typical acoustics goals for designing such spaces. Second, we will go through each of the types of spaces and establish the current situation and how we could improve upon them to meet the necessary goals that we recommend.

Factors in Providing Good Acoustics – Setting Goals

Key factors in providing good acoustics include room acoustics, sound isolation, and building systems noise control. The primary concern in this effort is room acoustics and sound isolation. Room acoustics is how sound propagates within a space. Sound isolation is how well sound is kept from leaking to adjacent spaces and disturbing others, and vice versa. Building systems noise control is primarily concerned with controlling (HVAC) mechanical systems noise levels within the space. An appropriate background level and spectrum ensures a quality environment for musicians to practice their craft and hear the "silence" between the notes.

Room Acoustics

The basic goals of room acoustics are to provide adequate sound level control (loudness) and appropriate reverberation time (RT). Accomplishing both requires adequate room volume and the right quantity and type of sound absorptive materials. The amount of each required to achieve both goals depends on the number of musicians.

The more important of these two is sound level control (loudness). The sound arriving within the first 50-80 ms (milliseconds) is most critical as the ear adds those sounds together, and especially with impulsive sounds like snare drum and cymbals, this can mean substantial increases in perceived sound level if there is not enough space in the room to spread out the arrival of early reflections and/or sound absorption to moderate their strength. Loudness is one of the greatest factors impacting the hearing health of students and faculty. Duration and frequency of the exposure (noise dose), use of common sense hearing protective measures, and education of faculty and staff are also important. These other factors are not discussed further in this report.

RT is a way to indicate the rate of sound decay in a room, by measuring the number of seconds it takes for the sound to decay. The attached Sound Advice sheet describes how it is determined. RT is controlled by balancing room spatial volume and the quantity of absorptive finishes. RT does vary with frequency. Therefore, balance among frequencies is also important. We do not want a space to sound overly 'boomy' (bass reverberation) or 'dull' (lacking adequate high frequency reverberation) or 'bright' (too little high frequency reverberation). This balance is achieved with proper selection of sound absorptive materials including floor finishes. This basic quality is an important indicator of the liveliness and general response of the room to sound which must not be too strong and if feasible not too dead.

Finally, the blending of voices and instruments is critical to the success of a rehearsal space. Acoustical diffusion (placed on the ceiling and walls) promotes this by scattering sound across the group to allow musicians to hear each other and develop a blended group sound. In addition, balanced loudness of initial reflections off wall and ceiling surfaces is also important to promote blend. The height of the ceiling contributes to blend. Lower ceilings reduce blending of sounds across a group, while appropriate ceiling heights help blend sounds across a group. Arrangement of risers and seats can also significantly improve or hurt group blend.

The goals set in this report are as per the following publications, which are widely referenced by acoustical consultants while designing music education facilities.

1. Acoustical Design of Music Education Facilities: Edward McCue and Richard H. Talaske
2. Music Facilities: Building, Equipping, And Renovating: Harold P. Geerdes
3. A Planning Guide for School Music Facilities: Wenger Corporation

Goals and Guidelines

Spatial Guidelines - Specific guidelines to achieve acceptable and more desirably optimal conditions for room acoustics are as follows:

Room	Band	Chorus
Floor Area/person	Minimum 25 sq. ft.	Minimum 15 sq. ft.
	Preferably 30 or more.	Preferably 20 or more.
Volume/person	Minimum 400 cu. ft.	Minimum 300 cu. ft.
	Ideally 600 to 700.	Up to 400 desirable.
Ceiling Height	Minimum 16 ft.	Minimum 16 ft.
	Preferably 18-22 ft.	Up to 20 ft. desirable
	Up to 28 ft. if room is small	

If a band room ceiling needs to be more than 22 feet high, a cloud in a grid is usually suspended over the band at about 18 to 20 feet to provide some reflections. Note that in chorus rooms either the area or height needs to be more than the minimum to meet minimum volume requirements. Sometimes conditions do not allow these minimums to be provided. Compromises are then necessary.

Loudness Control - The above spatial requirements permit achieving all of the stated end goals of loudness, RT, and blend. When these requirements are not achieved, we must still provide adequate loudness control. Gradually, the quality of the space drifts towards low quality as control of loudness is maintained and other qualities suffer. Floor area minimums are generally essential especially in spaces without tiered seating to avoiding excessive loudness (for example, putting someone's head immediately in front of cymbals or a trumpet is never a good idea).

Diffusion (promote blend) and Absorption (loudness control) - These rooms should have a mixture of diffusing (or scattering) and absorbing elements on the walls and ceiling. The amount of sound absorption per student must be adequate to control the sound and is directly proportional to the number of students. Doubling the number of students requires twice the quantity of sound absorption. Instrumental spaces require substantially more absorption per musician than choral spaces. Since people and even hard surfaces absorb some sound, the difference between instrument and choral space sound absorption requirements means there may be little added absorption in a choral room of minimum volume while a similar minimally sized band room will have a significant amount of sound absorption. Rooms that are undersized require substantially more and higher quality diffusion to promote blend and greater care is required in the selection and placement of absorptive materials. Undersized rooms can be made to control loudness and provide some degree of blend, but are generally are never as good as what would be achieved with a properly sized room. While undersized rooms at the university level are not generally acceptable for new construction, in older buildings they can be kept in service with significant effort to provide blend and appropriate sound absorption.

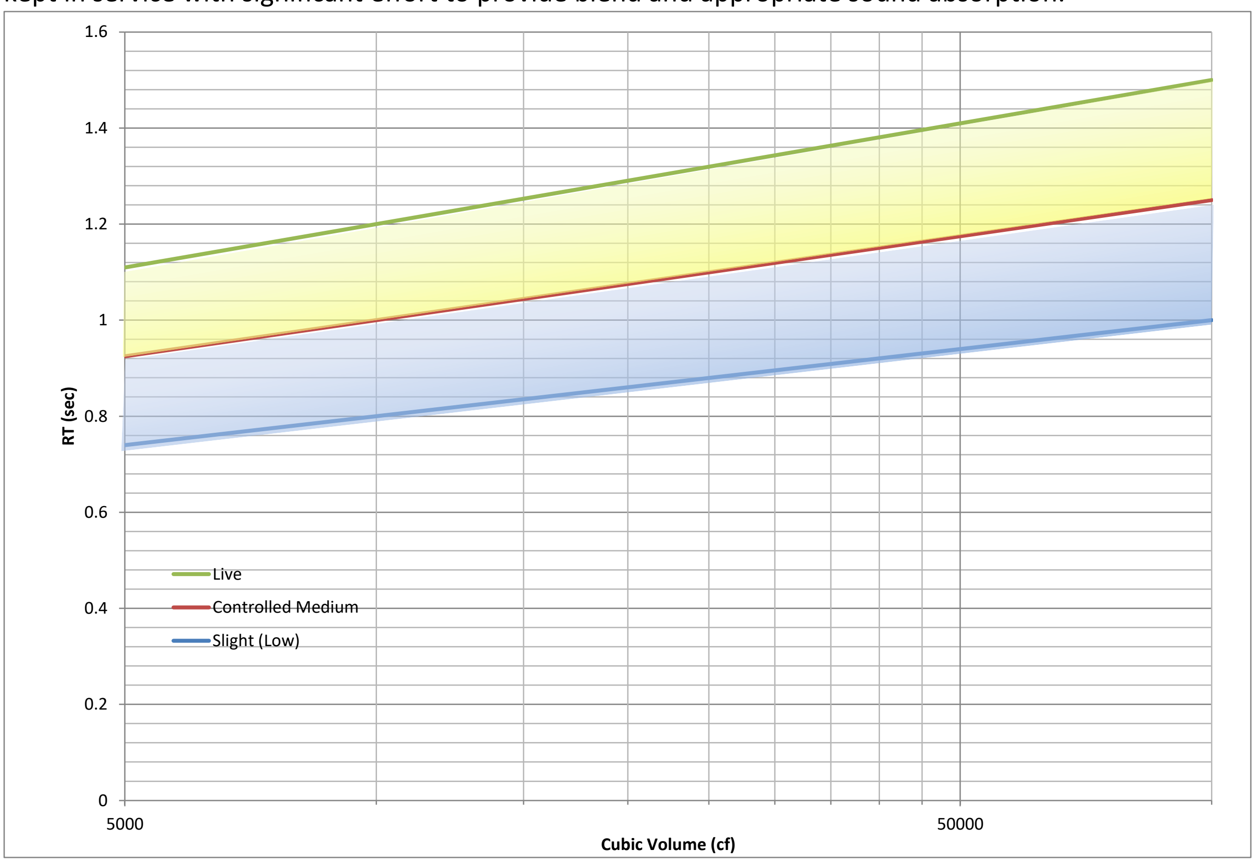


Figure 1: Recommended RT vs Volume

Reverberation Time - The opinions and desires of music directors vary regarding the liveliness (RT and to some degree loudness) of these practice spaces. If the space is primarily for teaching basics, it is more desirable that it be deader to allow individuals to be heard more clearly. If it is for practice by an accomplished group, it is usually preferable that the space be livelier to simulate a performance space. If the room is large enough, its acoustics can be modified by adding or removing absorptive panels to achieve the desired liveliness (RT). Generally, band rehearsal spaces have a slight (low) to approaching at most a medium (controlled) liveliness, and choral spaces have a medium (controlled) to approaching a (concert) “live” liveliness. The RT achieving this liveliness is a function of room volume. Larger volumes will have a slightly longer RT than smaller volumes to be judged similar in liveliness. Specific recommendations for RT are considered by space. Figure 1 illustrates RT at mid-frequencies by volume depending on how lively a space is needed. Generally, spaces below 5,000 cf. are evaluated based on cubic volume and sound absorption per person. Spaces that are undersized cannot achieve RT goals as priorities must be placed on targeted sound absorption and diffusion.

Sound Isolation

The goal of sound isolation is to reduce the sound level of the musicians from reaching adjacent sound sensitive spaces. Rooms produce different sound levels based on the size and type of group using the space. The sensitivity to intrusive sounds and background level present in the receiving space determine the level of sound blockage required from separating walls, floors, and ceilings. This of course goes both directions. Some room sources are not musicians or singers but mechanical spaces, bathrooms, elevator shafts, or external noise outside the building. Use of buffer zones and proper arrangement of sensitive spaces can minimize the use of more costly forms of construction and generally improves the sound isolation achievable. Music is bass heavy, and some instruments rest on the floor. Instruments and voices (other than some percussive instruments) are also tonal versus broadband in sound when striking/singing a note. This means that standard descriptors used in buildings like STC ratings are not adequate alone to describe the sound blockage and attention must be paid to the wall construction and actual blockage by frequency (in third octaves typically), along with specific resonances of the construction. Please read the attached primer on sound blockage. A combination of significant mass from masonry construction or multiple layers of gypsum in combination with some degree of airspace, batt insulation, and a second solid layer of construction of adequate but often lighter mass are required.

Goals - Commonly STC ratings from 50 to the mid-70’s are required between sensitive spaces in addition to adequate bass blockage of that construction. Our goals are listed in the subsequent tables from well researched papers and their field applications based on the books referenced above and are reported in the more important measure of NIC ratings, which is the actual overall noise reduction between two spaces in the field. The NASM published the following NIC ratings. They agree well with the papers we based our criteria on except for faculty studios. We also have criteria for band/choral rehearsal to practice room and for other adjacencies. These are shown in the results table. 5 points less can be considered acceptable in the field. Greater than 5 but less than 10 is clearly not acceptable but may not be judged poor. A deficiency of 10 or greater is clearly poor.

2. NIC Ratings Needed for Adjacent Music Building Spaces

Typical NIC ratings which are needed for adjacent music building spaces are recommended as follows:

a) Instrumental Rehearsal to Choral Rehearsal: 70.

b) Marching Band to Performance Stage: 95 (note: such a construction involves at least two systems with a rating of 70, separated by at least an 10-ft. corridor).

c) Percussion to Percussion: 70.

d) Faculty Studio to Faculty Studio: 60 to 65.

e) Practice Room to Practice Room: 56. *

Figure 2: NASM goals (with our modifier)

*Note: Original papers this criterion is based on clearly recommend NIC 56.

Mechanical Systems Noise Control

Goals - Noise levels are generally reported for mechanical equipment using the NC rating scale. See the attached primer on noise ratings for more information about the scale. Larger rehearsal spaces generally should be designed NC 25 with up to NC 30 in the field clearly acceptable. Practice rooms and faculty studios can be a little louder and help provide some masking. Recording spaces ideally should be as low as NC 15.

These recommended levels permit adequate dynamic range needed for rehearsal and recording, but also set the masking floor for other musical sounds bleeding into a space used to derive the sound isolation required. Experience suggests that exceedance of these recommended criteria by approximately five units will not result in unsatisfactory conditions for most performance or rehearsal categories. Our goals are derived from the same papers used for sound isolation that are the regularly used professional practice criteria.

NC rating HVAC noise Room Type	Recommended (Design Target)	Acceptable (Up to)	(Generally) Not Acceptable (Up To)	Poor (Anything Above)
Choir Room	25	30	35	>35
Band Room	25	30	35	>35
Practice Rooms	35	40	45	>45
Music Labs	35	40	45	>45
Music Faculty Office	30	35	40	>40
Music Classrooms	25	30	35	>35

These scales are not perfect, but they are a good starting point. One does not in reality suddenly go from acceptable to unacceptable by changing 1 point on the NC scale. However, a 5-point change is significant, and a 10-point change is roughly twice as loud.

Evaluation of Existing Spaces Against Goals and Guidelines

Room Acoustics

We inspected the room finishes to understand the acoustical properties of the ceilings, walls and floors. The dimensions of the rooms were also verified. This helped us understand if there was enough floor area, volume and ceiling height per person in the rooms and confirm if the ceiling heights were sufficient to provide good acoustics and loudness control in the various rooms. Based on what we found, we have graded the various spaces in the music suite using the following color scale:

(green)	Good
(yellow)	Acceptable
(orange)	Not Acceptable
(red)	Poor

These grades allow us to visually understand the problematic spaces better. Ceiling heights, floor area/person, volume/person, and absorption/person were all graded. Where there was not enough to meet these minimums for the maximum occupancies, the recommended maximum occupancy is reported.

Space Type	Room Numbers	Intended Type of Music	Max. No. of Performers	Typical No. of Performers	No. of Occupants (If different than Performers)	Ceiling	Floor Area/Per	Volume/Per	Absorption/Per (grade)	Recommended Max Allowed
Class Lab	204	Quiet lab for art and music	1	1	30	10	1000	10000		
SMART Classroom	214,216,218	Class/Instru/Voc	8	8	40	10	95	946		
Office/ Music CR.	211, 212, 213, 215,	Studio teaching one on one	2	2	1	10	88	875		
Director Office/ Music CR.	217	Studio teaching one on one	2	2	1	10	184	1835		
Office	224	Studio teaching one on one	3	1	1	10	33	327		
Office	226,227	Studio teaching one on one	3	1	1	10	88	883		
Office	233,234	Studio teaching one on one	3	1	1	10	43	433		
Office	241	Studio teaching one on one	3	1	1	10	50	500		
Practice Rooms	229, 235, 239, 237,232	Instrumental vocal and pno mix	2	1	1	10	35	350		
Practice Rooms	236, 238, 240, 242, 244, 246	Instrumental vocal and pno mix	2	1	1	10	38	375		
Practice Rooms	223	Instrumental vocal and pno mix	2	1	1	10	54	535		
Music Lab	248	Piano	15	15	15	10	44	445		
Chorus Room	230	Vocal mainly w/ piano some instrumental	116	5	116	15	14	207		80
Band Room	231	Instrumental	80	80		14	21	289		57
Office (Teaching Studio)	224	Instrument/Vocal	2	2	1	10	49	490		
Office (Teaching Studio)	226	Vocal	3	2	1	10	88	883		
Office (Teaching Studio)	227	Instrumental	3	2	1	10	87	867		
Office (Teaching Studio)	233	Instrumental	2	2	1	10	70	700		
Office (Teaching Studio)	234	Instrumental	2	2	1	10	65	650		
Office/Chamber ensemble rehearsal space	241	Instrumental/Vocal/ Combo	4	2	2	10	38	375		

Reverberation Time (RT) is another important criterion. We have shown for the maximum occupancy the estimated RT (mid-frequency average) in relation to these goals. We have only reported the music performance spaces with a cubic volume greater than 5000 cf. since we only use the reverberation time criteria for spaces with that volume. For rooms with volume lower than 5000 cf. we generally use the absorption values per person in the rooms.

The RT's fall well below the acceptable range because of the large number of students at maximum occupancy for the limited floor area and volume. The purple dot is only a slight RT, and well below the medium-live RT recommended for permitting blend. Our experience with properly sized spaces suggests there may be too much sound absorption in this space even if the occupancy is limited. If the maximum occupancy is reduced in the band room, some adjustment to the absorption may be feasible.

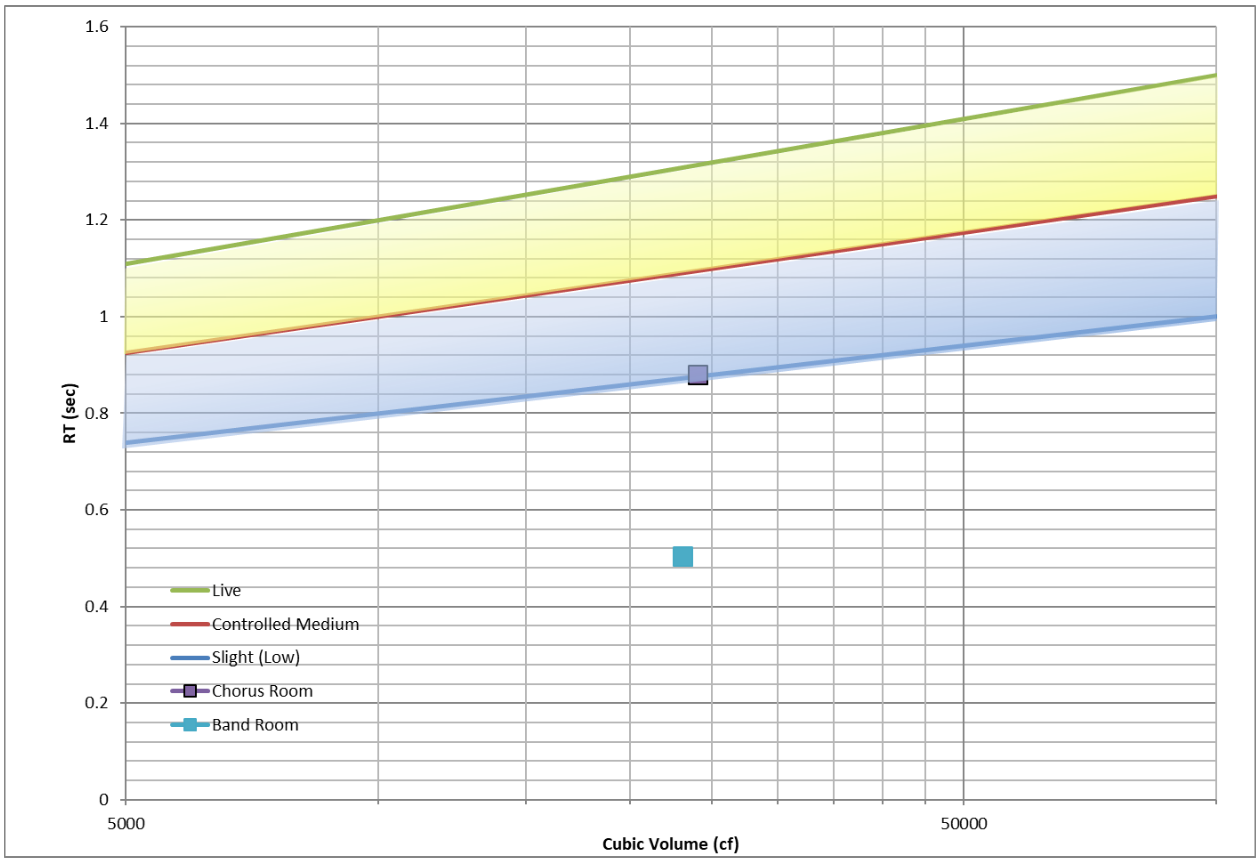


Figure 2: Measured RT vs Volume

Spaces not inspected

The class labs were not inspected and analyzed since they aren't exactly music performance spaces and hence not an immediate cause of concern.

Recommendations:

1. Band Room and Chorus Rooms – With the maximum occupancy condition, this space is below minimum floor area, ceiling height and spatial volume per person requirements. The sound absorption per person is sufficient. Perhaps, the program has grown significantly since it started and hence the facilities weren't designed to accommodate the current number of people. To solve the room acoustics issues the options are:
    a. The ceiling height is below recommended minimums, but if the regular occupancy is limited to below what is required to meet the other requirements, this can be tolerable. Otherwise, see item d, e, and f.
    b. Limit occupancy - Without any additional effort, the maximum occupancy would have to be reduced to the number that we have recommended in the table (57 for band and 80 for chorus room). Maximum occupancy means something that may occur once a week for a series of weeks, not once a year. One way to limit occupancy is by rehearsing part of the group at a time (with occasional combined sessions held elsewhere.) This is helpful in terms of acoustics as well as safety, especially in the band room where hearing loss is possible due to musicians too close to each other. Tiered seating can mitigate some of the concerns of proximity. Reducing occupancy in the choir room results in a livelier space and can help improve the audibility of the other members of the choir.
    c. Limit frequency of use for larger occupancy - If the maximum occupancy is very rare (a few times a year), then that can be tolerable, although students should understand they need to take steps to minimize sound exposure.
    d. If occupancy limitation is not a solution for FSU, attempting to achieve the guidelines requires we must have more floor area and may need more ceiling height if the increased area does not achieve minimum cubic volume per person. This means planning in the future for either using another facility on/off campus for those larger groups (performance hall, large gym, etc.), building a new facility, or exploring redoing this current facility. From what we could tell from the plans, it simply is not feasible to expand this space without closing off the hallway or reducing/relocating the choir space, digging deeper/raising the roof.
    e. If remaining in these spaces with current planned occupancy, we would recommend refinishing these spaces to optimize blend while controlling loudness. There was adequate quantity of diffusion in the ceiling and walls of the band room. However, if the ceiling was redone, a better pattern could be used with the same devices (or ideally, we would recommend a better type). With careful planning on location and type of sound absorption, we can reduce sound buildup to closer to that achieved with a properly sized room. When this is combined with the better-quality sound diffusion, the space can approach achieving the blend and loudness of a properly sized space.
    f. The general reverberation time is very low for both spaces. However, again this is due to the space being undersized for the stated maximum occupancy. If the occupancy is limited, we may need to see if too much absorption is present and seek to reduce the sound absorption. It is likely the chorus has too much sound absorption whether for recitals or for their rehearsal. The ceiling tile may need to be changed or mixed with a reflective tile. In general, since the spaces are undersized, it is not feasible to achieve the same RT that we would like to have to help promote blend. So, in its place, we have to provide very high-quality sound diffusion if we want to promote the quality of blend found in properly sized spaces. Nothing can be done to restore reverberation without significant cost (one such method would be using active acoustic systems like the active field control Yamaha AFC3 system – such systems can also replicate what the high-quality diffusion does).

2. Practice Rooms – The basic elements are there (cubic volume, floor area, sound absorption at mid-frequencies). However, additional low frequency sound absorption is needed for those spaces without bass traps. We can help determine that in the next phase.
3. In general, if new construction or significant renovation is undertaken – Obviously, if significant renovation is undertaken that requires redoing the finishes of any of the music department spaces, it would be highly recommended that full analysis and recommendations be employed to provide more optimal acoustics for all of these spaces. We focused on priorities to correct deficiencies, not optimizing the acoustics.

Sound Isolation

We performed sound isolation tests between the various adjacencies using high levels of pink noise at the source, to understand the isolation available for combinations of different room types.

The following table lists the recommended criteria for acoustical privacy between music spaces in terms of the noise isolation class (NIC) and the results from our tests based on a background level correction.

Description	From Room	To Room	NIC goal (final	NIC	Difference
1- NIC from 230 to 231	Choir Room	Band Room	70	57	13
2- NIC from 230 to 242	Choir Room	Practice Room	62	56	6
3- NIC from 230 to 240	Choir Room	Practice Room	62	53	9
4- NIC from 230 to 232	Choir Room	Practice Room	62	53	9
5- NIC from 230 to 248	Choir Room	Music Lab	62	55	7
6- NIC from 231 to 235	Band Room	Practice Room	63	49	14
7- NIC from 231 to 239	Band Room	Practice Room	63	54	9
8- NIC from 235 to 237	Practice Room	Practice Room	55	44	11
9- NIC from 235 to 239	Practice Room	Practice Room	55	50	5
10- NIC from 237 to 239	Practice Room	Practice Room	55	46	9
11- NIC from 217 to 215	Office	Office	56	40	16

Spaces not measured

1. We did not measure the NIC between the music lab and adjacent practice rooms. Requirements are same as practice room to practice room. Similar recommendations will apply.
2. NIC measurement between the offices and smart classrooms located with a hallway in between was skipped because of the obvious lack of isolation in the form of louvers in the doors. Recommendations to address the doors for faculty offices apply also to the classrooms.
3. We did not measure the NIC between practice rooms to adjacent offices as these offices did not have walls going to the deck.
4. Similarly, between offices that did not have walls going to deck we did not measure sound isolation for them.
5. The smart labs were skipped during our measurements because one wasn't a music space (used for screen printing) and the other was a computer lab used for listening to music rather than music performance.

Recommendations:

1. All music classrooms, faculty offices, practice rooms, rehearsal rooms must have door seals.
    a. Door bottom seals can be mitered into the door or possibly attached to the door (flush to the bottom).
    b. Perimeter seals where they exist are in bad shape and need replacement.
    c. Where perimeter seals were never used, they will need to be added.
2. The entry doors of both the band and choir rooms are recessed into the spaces with walls that stop just above the recessed area ceiling and do not extend to the deck. This should be taken care of. The construction of this vestibule like section is arbitrary as seen in the picture below, and the doors should be pushed out to the hall or existing door walls taken to the deck. The fundamental wall construction between the band room and the chorus does not seem to be the problem and isolation issues should be solved if the problems at the doors are solved.
3. Practice room general wall construction does not seem to be a problem. Since the walls do not go to the deck, further investigation is required beyond this study to see what additional improvement may be required for these walls. The gypsum ceiling is providing some benefit where it exists, but it is too difficult without detailed analysis to determine if it is adequate to make up for walls that do not quite go to deck. Right now, the limiting path clearly is the lack of door seals.
4. Faculty offices have louvers which definitely need to be removed and replaced with solid doors (1 ¾" solid core wood doors or similarly heavy metal doors) in order to prevent leakage into the passage and other adjoining spaces.
5. The walls between the multiple faculty offices and the multiple smart classrooms did not have apparent openings/large cracks but they should be sealed at the top and around penetrations as a precautionary measure (flexible non-hardening caulk/sealant). Any significant penetrations found will require more careful attention.
6. Any spaces that do not have walls going to deck and no gypsum lid such as faculty offices 233 and 227 will need substantial work to improve the walls to be acceptable. The gypsum walls for these spaces are also inadequate construction.
7. In general, masonry walls between faculty spaces (211 to 219) require more careful review. It was impossible in this survey to determine the real performance of the existing wall construction with the significant leakage. Additional furring may be required to achieve desired NIC ratings.

Figure 3: Area above ceiling outside choir room door (lifted acoustical ceiling tile just outside door)

Mechanical Systems Noise Control

The following table lists the HVAC levels on the NC rating scale for the various rooms and against the recommended NC levels for these rooms. We did not measure rooms that appeared adequately quiet.

Room	Recommended	NC	Difference
1- Choir Room (230)	25	32	-7
2- Band Room (231)	25	34	-9
3- Practice Room (242)	35	29	6
4- Practice Room (240)	35	28	7
5- Music Lab (248)	30	26	4
6- Faculty Office (217)	30	40	-10

Recommendations:

1. Subjectively, we found the music spaces to be relatively quiet and hence preference must be given to the room acoustics and sound isolation improvement measures.
2. The background noise in the faculty offices was unusually high in our measurements. We would like to further investigate the cause of this and see what can be recommended to reduce the noise.
3. At the time band/chorus renovations allow addressing HVAC noise, we recommend making improvements to provide some additional noise control. If desired, this could be investigated in the next phase to see what noise controls would be. It may be nothing more than add some flex duct or adding a few air devices to slow down airflow rates.

Conclusion:

The intention of this report is to summarize our findings for room acoustics, sound isolation and mechanical system noise levels from our site visit for the various music and non-music spaces against goals appropriate for an accredited university program. In terms of room acoustics, the band and chorus rooms certainly are below the minimum targets that we recommend for the stated maximum occupancy for several criteria. Several solutions are offered, some requiring no further work, and others substantial work. The rest of the places were found to be reasonable but some attention to bass absorption in practice rooms is recommended. Room acoustics in all of these spaces would benefit from optimization if a renovation was undertaken. Sound isolation is by far the greatest need as that addresses the issues raised by the accreditation report. Some items are readily identified and require minimal additional effort to specify such as door seals. Other concerns will require more careful evaluation (beyond the scope of this survey) to determine actual performance of the partition and ceilings and to derive feasible solutions. HVAC noise control is needed in the faculty spaces (211-219). Some improvement in the band and chorus rooms would be desirable but not as critical.

We look forward to answering any questions you may have. Let us know which items you would like to move forward with providing detailed recommendations, and we will prepare a proposed scope of work for your consideration.

Sincerely,

STEWART ACOUSTICAL CONSULTANTS

Joseph F. Bridger, Principal Consultant

MSME, member of NCAC, ASA, INCE. LEED AP

Siddharth A. Mahajan, MSME, Acoustical Analyst,

Member of INCE, ASA, AES

Attachments

Fayetteville State University

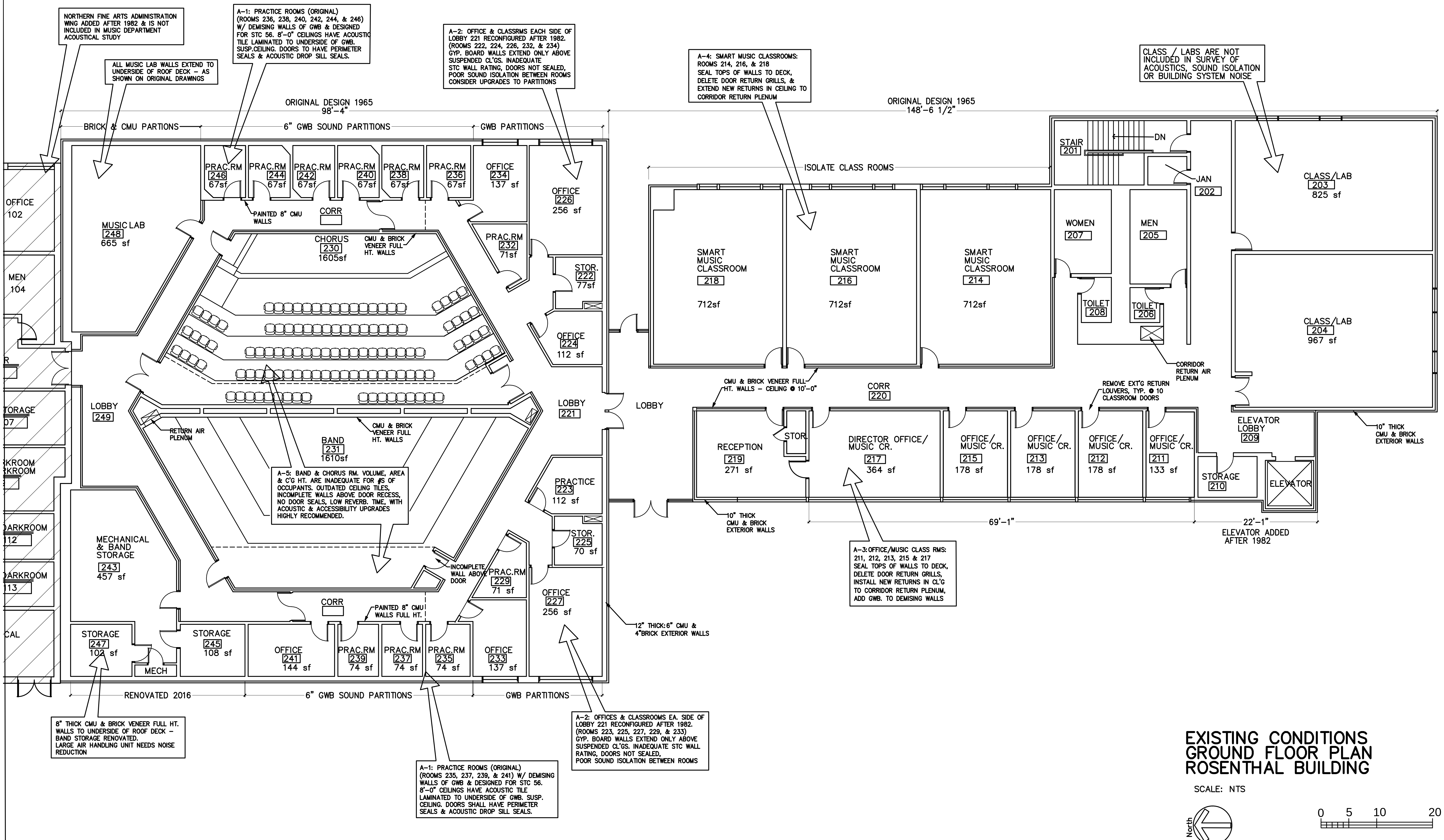
Rosenthal Building Acoustics and Sound Transference Study

11/09/17

Room Acoustics, & Sound Isolation Upgrades
Preliminary Budget Estimate

ITEM		Room Type/Function/Number	quantity	units	unit cost	total cost
A-1 Practice Rooms (236, 238, 240, 242, 244, 248, 235, 237, 239, 241 (as originally designed))						
Priority 1=Urgent (0-1yr), 2=Near Future (w/in 2yrs), 3=Could be Deferred (5-10 yrs)						
	A1.1	Install perimeter door frame seals & door drop seals at sills	10	EA.	750	6,750
	A1.2	Further study req'd to address above ceiling return air duct config.	0	LS	0	1,500
	A1.3	Further study req'd to address need for bass traps in these rooms	0	LS	0	1,500
	A1.4	Allowance to paint & replace finishes & room acoustic upgrades	0	LS	0	9,500
		subtotal				$19,250
A-2 Offices/Practice Rooms (222, 224, 226, 232, 234, 223, 225, 227, 229, 233) renovated spaces not part of original design						
Priority 1=Urgent (0-1yr), 2=Near Future (w/in 2yrs), 3=Could be Deferred (5-10 yrs)						
	A2.1	Install perimeter door frame seals & door drop seals at sills	10	EA.	550	5,500
	A2.2	Extend ext'g gyp. room demising walls to under side of roof deck	216	LF	35	7,560
	A2.3	Laminate additional layers of sound break gypsum board	4320	SF	2	8640
	A2.4	Further study required to confirm return duct routing in these spaces	0	0	0	1,500
	A2.5	Allowance to paint & replace finishes & room acoustic upgrades	0	LS	0	6,500
		subtotal				$29,700
A-3 Office/Music Classrooms (211, 212, 213, 215, 217) south wing						
Priority 1=Urgent (0-1yr), 2=Near Future (w/in 2yrs), 3=Could be Deferred (5-10 yrs)						
	A3.1	Install perimeter door frame seals & door drop seals at sills	5	EA.	550	2,750
	A3.2	Install new room doors (omit return grills)	5	EA.	1,500	7,500
	A3.3	Install new return ducts above ceiling to corridor plenum	5	EA.	1,250	6,480
	A3.4	Seal ext'g masonry room demising walls to under side of roof deck	163	LF	25	4,075
	A3.5	Allowance: paint & replace finishes & room acoustic upgrades	0	LS	0	8,000
		subtotal				$28,805
A-4 Smart Music Classrooms (214, 216, 218) south wing						
Priority 1=Urgent (0-1yr), 2=Near Future (w/in 2yrs), 3=Could be Deferred (5-10 yrs)						
	A4.1	Install perimeter door frame seals & door drop seals at sills	3	EA.	750	1,650
	A4.2	Install new room doors & hardware (to omit return grills)	3	EA.	1,500	4,500
	A4.3	Install new return ducts above ceiling to corridor plenum	3	EA.	1,250	4,950
	A4.4	Seal ext'g masonry room demising walls to under side of roof deck	63	LF	25	1,575
	A4.5	Allowance: paint & replace finishes & room acoustic upgrades	0	LS	0	6,500
						$19,175
A-5 Chorus and Band Rooms (230 & 231)						
Priority 1=Urgent (0-1yr), 2=Near Future (w/in 2yrs), 3=Could be Deferred (5-10 yrs)						
	A5.1	Install double door frame seals & door seal drop sills	2	EA.	1,550	3,100
	A5.2	Install room single entrace door frame seals & door sill drop seals	3	EA.	750	2,250
	A5.3	Rework perimeter walls above room entry doors (sound isolation)	5	EA.	1,200	6,000
	A5.4	Install new acoustic ceiling tiles in existing grid (room acoustics)	3,500	SF	3	8,750
	A5.5	Further study req'd to address mechanical noise control	0	LS	0	2,500
	A5.6	Allowance: new finishes, improve accessibility, & acoustics	0	LS	0	30,000
		subtotal				$52,600

Construction Cost	$149,530
Contractor's GC & OH @ 10__%	15,000
Contractor's Profit @ _10__%	15,000
Total Construction Cost	$179,530
Total A/E Design FEES	$16,158
Const. Contingency Reserve @ 15%	$26,929
Construction Budget	$222,617

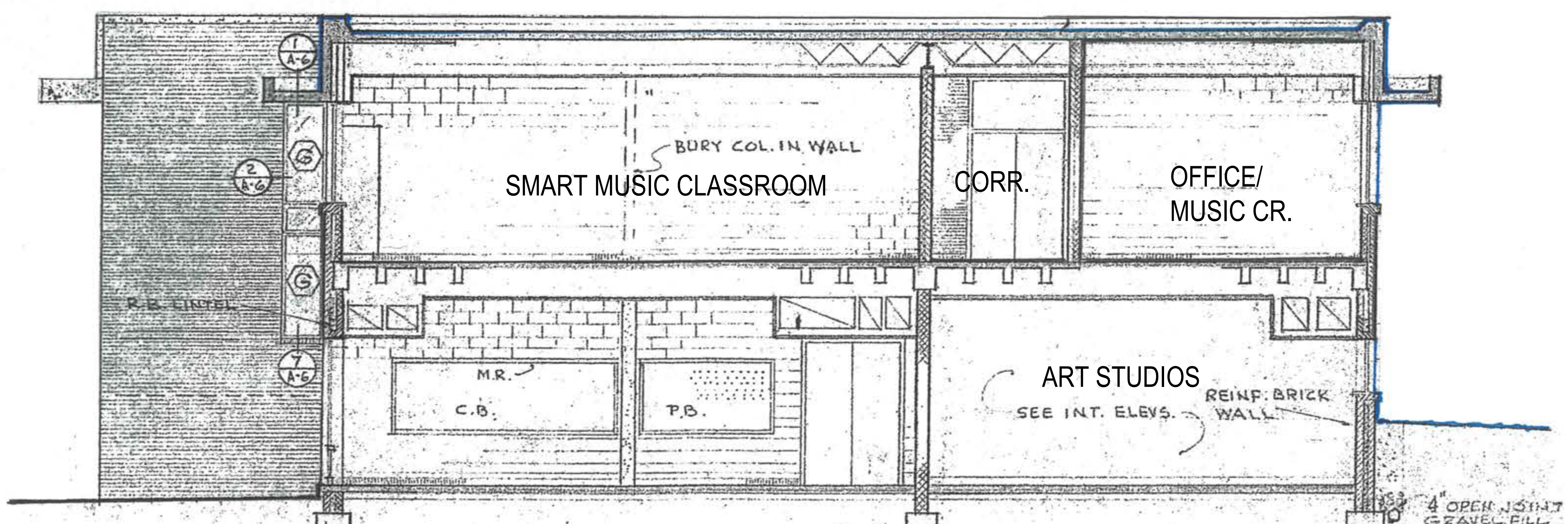


EXISTING CONDITIONS
GROUND FLOOR PLAN
ROSENTHAL BUILDING

SCALE: NTS

MHAworks # 17107 11/09/2017

CROSS SECTION "A-A" 1/8"= 1'-0"
(BAND & CHOIR ROOM WING)



CROSS SECTION "B-B" 1/8"= 1'-0"
(CLASSROOM WING)

ROSENTHAL BUILDING SECTIONS