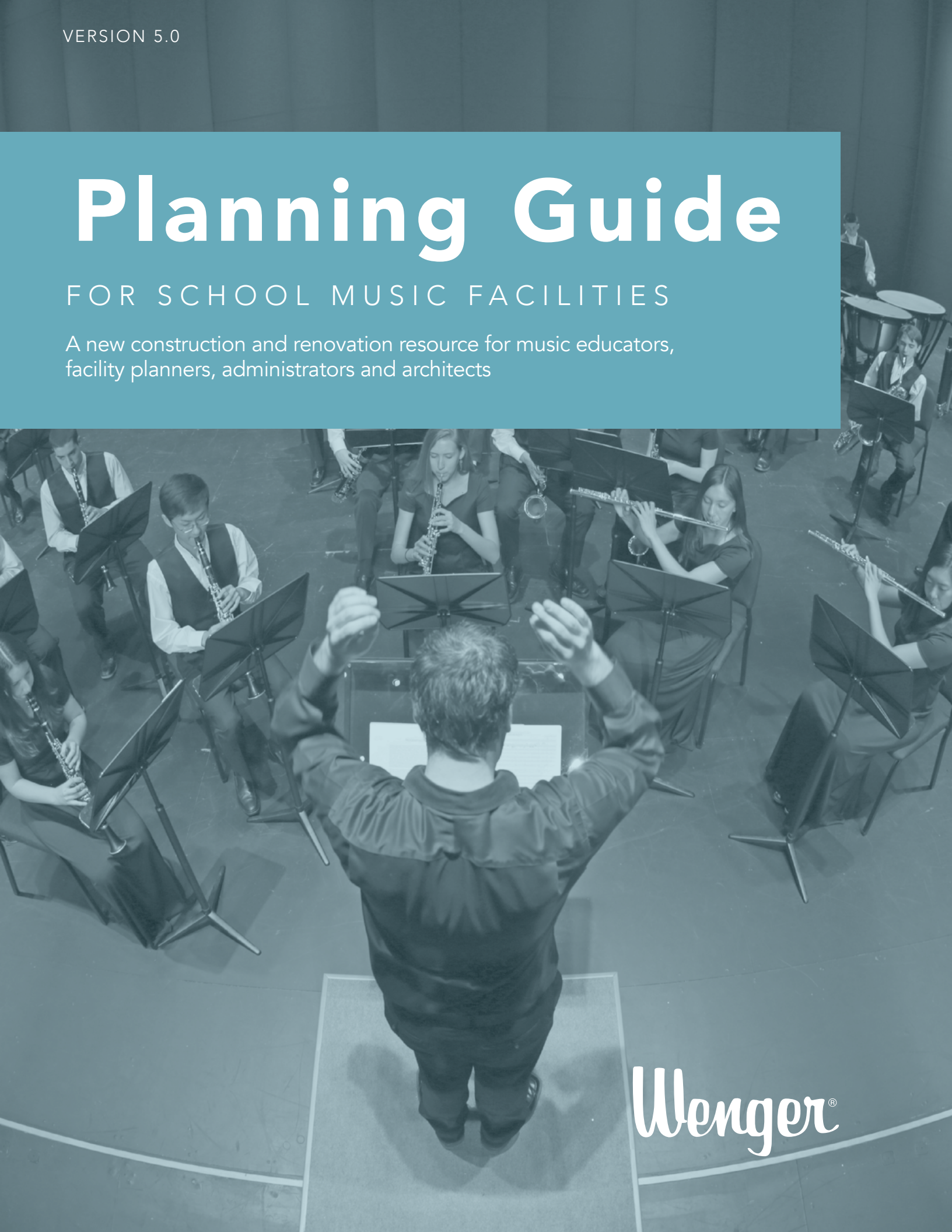
VERSION 5.0

Planning Guide

FOR SCHOOL MUSIC FACILITIES

A new construction and renovation resource for music educators, facility planners, administrators and architects



Wenger®

Introduction

This planning guide is designed to help you — music educators, administrators, facility planners, architects and consultants — focus on the fundamental requirements of the music suite. Though it is written from the perspective of the music educator, your entire planning team can use this information to create a music suite that is both effective and exciting.

The following guidelines are the culmination of over 75 years of Wenger Corporation experience. By visiting with thousands of music educators, we understand what it takes to make a music suite successful and what seemingly insignificant design elements can jeopardize its effectiveness.

Use our expertise. If you have questions, a Wenger Corporation representative is always just a phone call or email away.

Wenger Corporation works with the American Institute of Architects Continuing Education System as a registered AIA/CES provider.

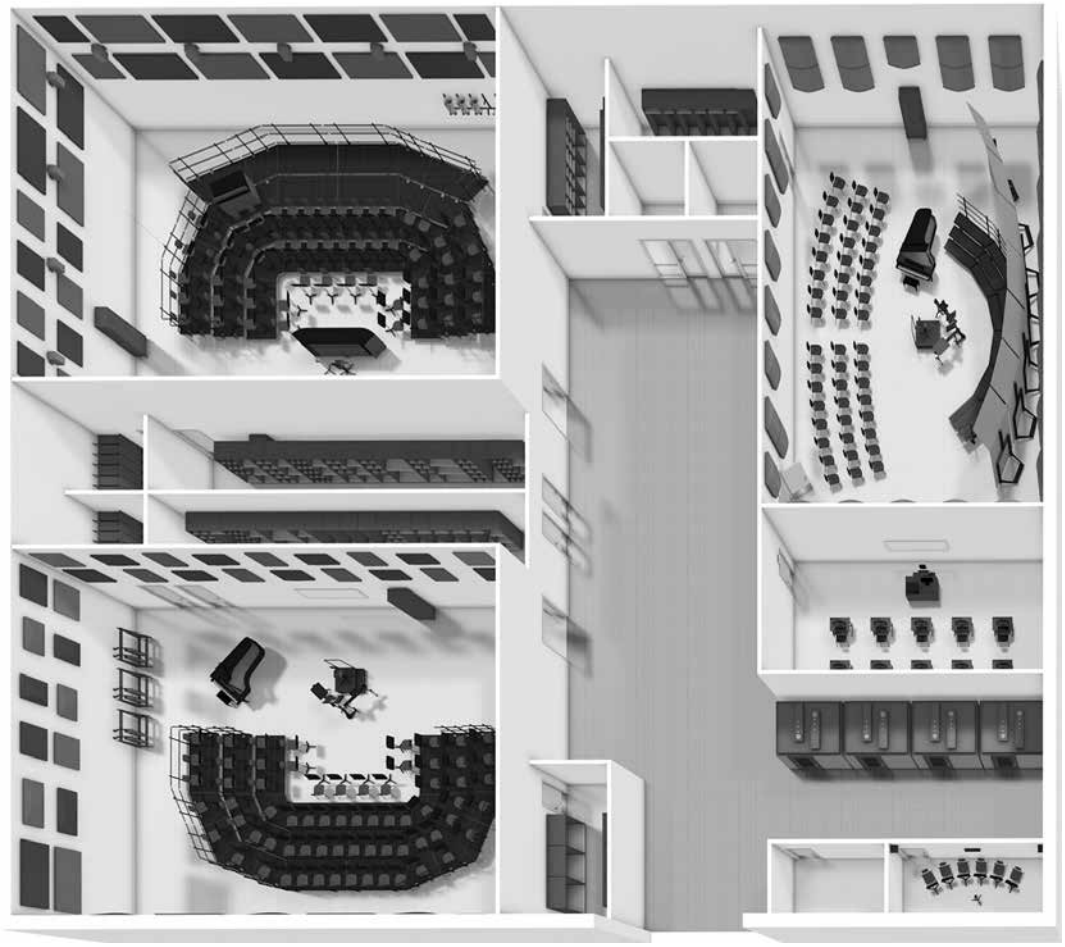
Using This Guide

This guide provides brief explanations of the critical factors affecting the music suite. By applying this information to your needs and using the worksheets included, you'll be able to communicate music area fundamentals to architects and administration more quickly and clearly. You'll get the most out of this guide if you use it in the following fashion:

- Read the guide thoroughly.
- Use the information to establish the fundamental needs of your music facility.
- Apply these fundamentals to your specific project.
- Use the Planning Guide worksheets as the basic programming documents you'll share with architects.
- Most importantly, start now. The most critical decisions are often made years before construction begins. And, as the project progresses, changes become difficult and cost-prohibitive. Spending time now can save money and avoid problems later.

Table of Contents

The Music Suite



The Music Suite:
All rooms or areas designed and used for music education.

Considerations

Definition
All rooms or areas designed and used for music education constitute the music suite.

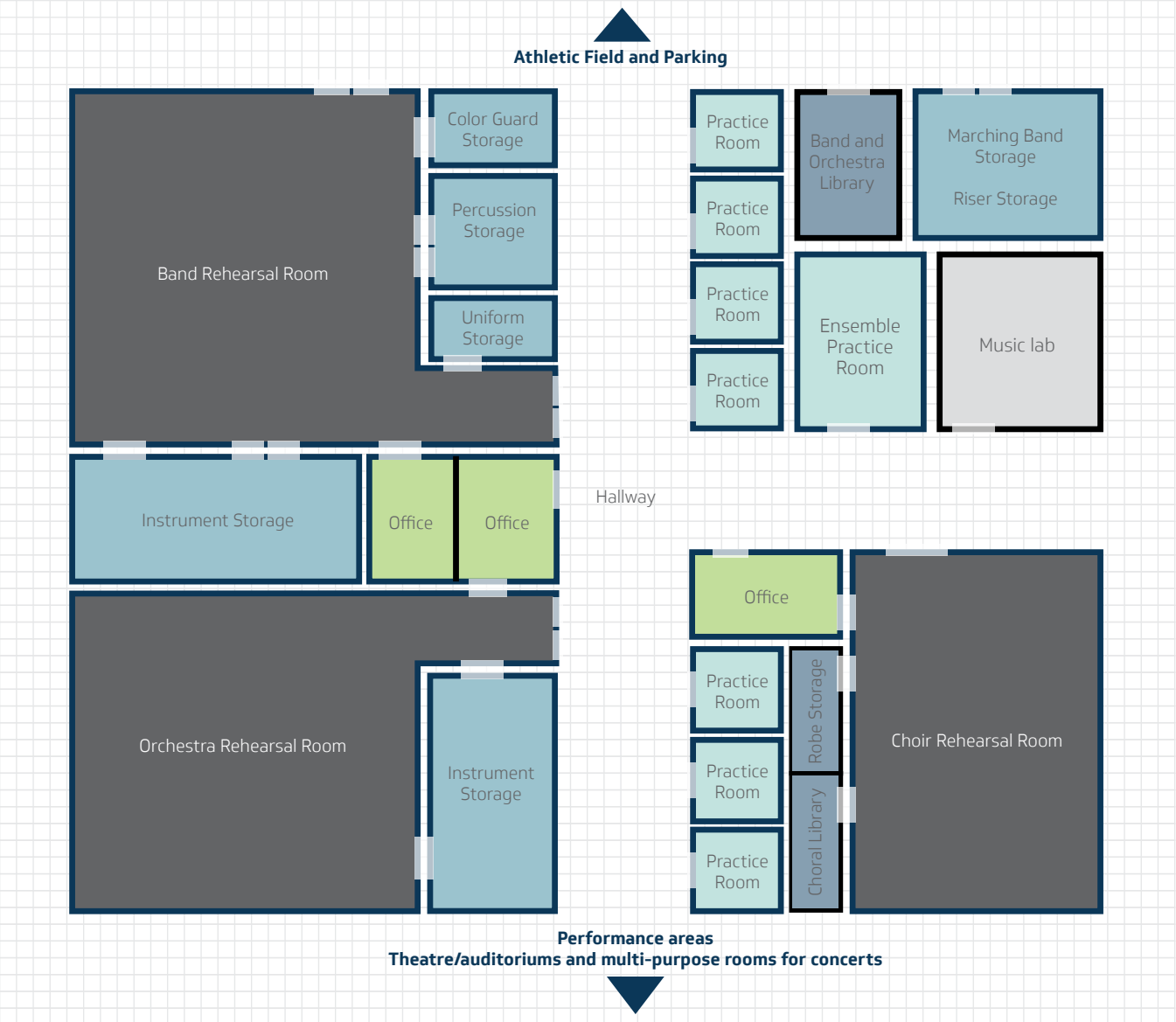
First Priority
Learning within the music suite is accomplished by critical listening; the success of the design is measured by how well teachers and students can hear within this special environment. Every aspect of the rehearsal and practice areas must be designed to promote clear hearing. As a result, the acoustical considerations of music areas are the first priority.

Space Requirements
Because of the sheer number of music students and the physical nature of music education, music activities require more room, greater flexibility and more fresh air than other classrooms.

Real Costs
Sound isolation, quieter mechanical systems, additional room volume and other specialized needs make music suite construction costs per square-foot typically double that of other school areas. This guide will show why cutting corners in the music suite will cut the effectiveness of your music education program. You often only have one chance to do it right. Careful, informed decisions will maximize the value of your long-term investment.

The Music Suite Layout

The music suite is a complex environment with many different areas and unique dynamics. This planning guide was created to help you understand these dynamics and needs so that your music suite design ensures effective education — and no surprises down the road.



Practice Rooms for small group and individual practice

Music Lab for electronic music instruction or music production/ recording studio

Rehearsal Rooms for band, orchestra and choral ensembles

Storage Rooms for instruments, uniforms, robes, garments, marching band equipment, choral risers, audio equipment, pianos and more

Music Libraries for sheet music storage

Offices and Studios for music directors

The Construction Process

Get Involved

Proper planning and continued involvement are essential to creating the music suite you want. Use this information to get involved early so you can put, and keep, the project on the right track.

Construction Phases

The following phases are the basic steps in a new construction or renovation project.

Phase 1

Pre-Planning

Establish Team & Objectives

- Define project goals.
- Form planning committee with administrators, district officials, music educators and end users (include teacher representatives from non-typical environments such as the fine arts, athletics).
- Research by contacting manufacturers, attending trade shows and visiting other music suites.
- Explore funding options, including federal/state arts grants.

Phase 2

Programming

Develop Detailed Vision

- Gather input for creating a "big picture" plan. Keep in mind you won't get what you don't ask for.
- Define the music suite's goals and anticipate future needs.
- Present ideas from this guide to architect/consultant.
- Explain needs, space requirements and unique factors.
- Communicate research/usage requirements to the design team.
- Compile an equipment list including fixtures and furniture.

Phase 3

Schematic Design

Create Initial Concepts

- The architect diagrams the music suite and allocates square footage to fit the budget.
- Fine tune the diagram with the planning committee.
- Agree on the final schematic; future changes are difficult and costly.

Phase 4

Design Development

Design Development

- The architect creates blueprints with exact dimensions.
- Confirm dimensions of the music suite, performance area and support spaces.
- Review electrical/lighting, audio/visual, rigging and other mechanical systems.
- Review and scrutinize all details, even minor elements as bidding and construction are firmly based on this plan.

"The Planning Guide is an excellent resource. As an architect, you're always looking for ways to convey information clearly to the owner, and to also have that information substantiated to some degree. And while we have extensive experience in this area, it's very helpful to reference the Planning Guide."

Richard T. Connell, AIA, Principal
The S / L / A / M Collaborative, Glastonbury, CT

Phase 5

Construction Documents

Complete Plans for Bidding

- Design team details everything for bidding and construction.
- Finalize general contractor selection and all cost estimates.

Phase 6

Bidding

Initiate Selection Process

- Issue invitations to bid (ITBs) to general contractors, as well as electricians, carpenters and other subcontractors.
- Review bids and award contracts.

Phase 7

Construction

Oversee Building Activity

- Last opportunity to make sure that the music suite is being built according to specifications.
- Visit site often and discuss concerns with general contractor, consultants and administration.
- Be part of the solution for problems encountered.

Phase 8

Equipment Purchasing & Installation

Ensure Timely Procurement

- Equipment, fixtures and furniture such as such as storage cabinets, acoustical treatments and pre-engineered practice rooms are specified, bid and contracts are awarded to subcontractors.
- Approved subcontractors procure materials, manufacture equipment and install as scheduled.
- Order products like storage cabinets, staging/risers, music chairs, stands and portable acoustical shells.

Phase 9

School Opening!

Congratulations!

Suite Essentials

The following five critical factors will determine the effectiveness of your facility.
Every decision involving your music suite must put all five of these factors at the top of your priority list.
Along with these brief descriptions, you'll find all five factors covered in detail in this guide.

CRITICAL FACTOR 1

Acoustics

How well your facility promotes critical listening is directly proportional to how effective it will be.

CRITICAL FACTOR 2

Floor Plan

The layout of your music suite determines whether it is effective, ineffective or even unusable.

CRITICAL FACTOR 3

Technology

Planning for current and future technology needs will help you maximize your music suite investment.

CRITICAL FACTOR 4

Storage

Storage not only affects equipment but also acoustics, traffic flow and security.

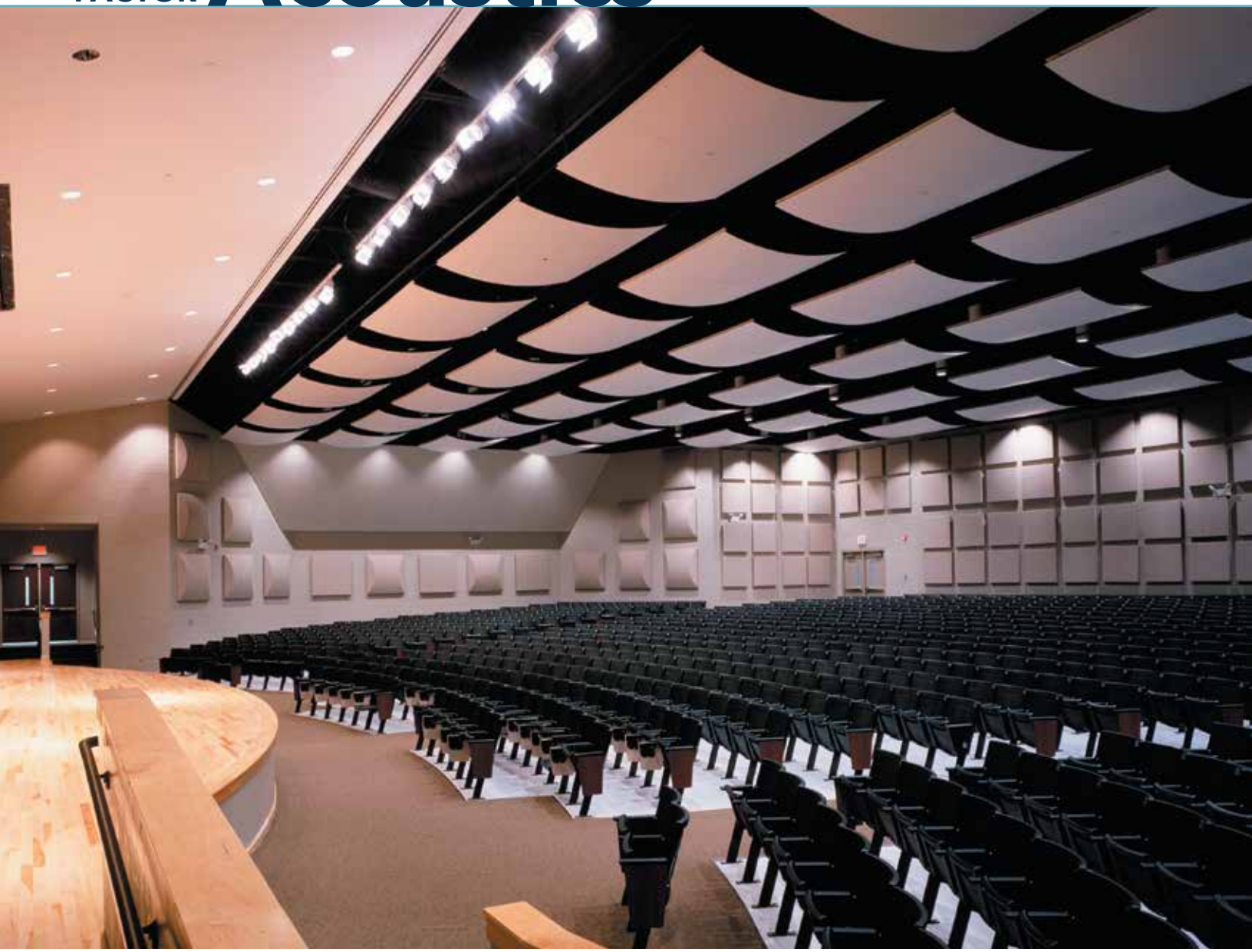
CRITICAL FACTOR 5

Equipment

Choosing proper equipment is the final step toward guaranteeing a successful music suite.

> "Wenger's Planning Guide is a common trusted source for planning; I've used it for nearly 30 years. We refer to the layout examples, standards and details, mostly during the early design phases. Our clients usually have a copy too; it validates what we tell them. The Guide is simple, clean, informational – and a little artsy."
>
> **Dean S. Beeninga**, AIA, LEED AP REFP, President
> ATSR, Minneapolis, MN

CRITICAL FACTOR Acoustics



The study of music is dependent upon the ability to hear and learn differences in intonation, dynamics, articulation and balance. This skill, called critical listening, can be developed only in a learning environment with proper acoustics.

To guarantee that acoustics promote critical listening and effective music education, your facility's design must pay close attention to the following elements:

- Cubic volume and room shape.
- Sound isolation between rooms.
- Acoustical treatments to walls, ceilings and furnishings.
- Properly designed mechanical systems.

The following section will help you understand how you can effectively enhance acoustics and reduce the noise and interference that jeopardize quality music education.

Improper acoustics, particularly excessive loudness, is a workplace-safety issue impacted by OSHA regulations. Hearing damage is a real risk with serious long-term consequences. The acoustical complexity of the music suite makes the input of an experienced acoustical consultant extremely valuable.

Considerations

The cubic volume of your rehearsal room and shape of its walls have a profound effect on the quality of its acoustics. To ensure excellent sound, start by following these basic principles:

Cubic Volume

- Never underestimate the value of cubic volume; it is **the single most important place** to put your music suite dollars. Without adequate cubic volume, the music suite cannot be successful.
- Cubic volume is equal to floor area multiplied by ceiling height. Reducing this space can make your room unresponsive, excessively loud, and may also be impossible to completely correct.
- Low ceilings are a common cause of poor music room acoustics. Correct ceiling height is the essential component of cubic volume.
- Use portable risers instead of poured concrete tiers. Concrete tiers dramatically reduce room volume and increase loudness. The space beneath portable risers, if left open, will not reduce cubic volume.

Wall Shape

- Untreated parallel walls cause flutter echo. This annoying ringing or buzzing sound can be corrected with acoustical treatments that diffuse and absorb sound.
- When carefully used, non-parallel and splayed walls can reduce the amount of acoustical treatments that would otherwise be required to control loudness and flutter echoes without eliminating significant room volume.
- Avoid visual acoustics. These are designs — such as curved walls and domes — that look attractive and appear to have good acoustical properties but in reality are often disastrous to the acoustic environment.
- Square or cube-shaped rooms with parallel walls create additive wavelengths, called "standing waves," that over-emphasize certain frequencies, making them abnormally loud. Creating a rectangular room by varying one dimension 30% or more is a typical solution; or use a 3:2 dimension ratio.

TIP:

Don't overlook your cubic volume when planning your space – it's foundational to good acoustics.

Small Rehearsal Rooms
Primary reflections return in under 30 milliseconds, making the room excessively loud, unresponsive, and potentially causing hearing damage.

Large Rehearsal Rooms
Primary reflections are slightly delayed and envelop the musician. Loudness is dissipated.

"I've been involved in secondary school music projects for nearly 30 years. I've used the Planning Guide during meetings with fine arts directors and band teachers. It helps them ask the right questions to ensure their critical information gets communicated."

Stephen Hafer, AIA, NCARB, LEED AP Principal
Huckabee Architects, Fort Worth, TX

Cubic Volume

Excellent acoustics demand adequate cubic room volume, resulting from higher ceilings and ample floor space. When cubic volume is inadequate, the first sound reflections return to the musicians' ears so quickly that they do not hear their sound in the room. When adequate cubic volume is achieved, however, sound takes longer to reflect off more distant walls and surfaces, surrounding the musicians with sound and providing a sense of presence or envelopment. Musicians can hear better, creating an environment in which real learning can be achieved by listening. This is the minimum goal of spaces designed for music learning, both instrumental and choral.

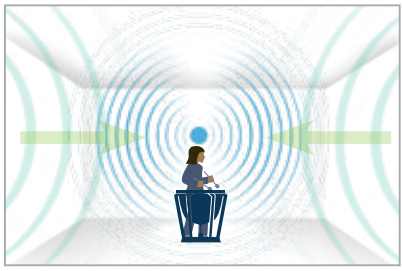
All too often, rehearsal rooms are designed so small that musicians simply cannot hear the full range of musical sound. Remember, musicianship is learned by critical listening. Rooms that are too small also result in dangerously high sound-pressure levels. There simply isn't enough space to dissipate and absorb the loudness musical ensembles generate. **Rehearsing in an excessively loud room is extremely stressful for both students and teachers and can cause permanent hearing loss over time.** Concert bands, marching bands, orchestras and jazz bands generate especially high sound-pressure levels – up to 64 times louder than the range of human speech – and special care should be taken to control loudness in areas where these groups rehearse and perform. In the chart below, the highest ceiling height number is optimal.

Cubic Volume Requirements				
Room	Class size	Ceiling Height	Typical Floor Space	Resulting Cubic Volume Per Musician
Choral Rehearsal	60-80 students	16-20 feet (4877-6096 mm)	1,800 ft^2 (167 m^2)	350-500 ft^3 (9.9-14.2 m^3)
Band/Orchestra Rehearsal	60-75 students	18-22 feet (5486-6706 mm)	2,500 ft^2 (232 m^2)	550-700 ft^3 (15.6-19.8 m^3)

Source: *Architectural Acoustics*, M. David Egan.

Wall & Ceiling Shape

Wall and ceiling shapes play a crucial role in acoustics because they determine how sound will be reflected and diffused within the environment.



Untreated Parallel Walls = Flutter Echo
Untreated parallel surfaces cause undesirable flutter echoes and standing waves. You can dramatically enhance acoustics by adding sound-absorbing and sound-diffusing panels on opposing surfaces.

Curved Walls or Dome Ceilings = Hot Spots
Concave ceilings and domes are representative of visual acoustics — eye-pleasing designs that are usually disastrous to the ear. For instance, sound is reflected by concave planes and domes, creating hot spots of concentrated sound.

Square Rooms = Standing Waves
Avoid cubed rooms or square rooms – they create standing waves. Remember that wavelengths have a physical length to them – if the wavelength matches the size of the room, that frequency will be louder than all others.

Considerations

Good sound isolation effectively blocks the transmission of sound from one room to another. It is one of the surest and most cost-effective ways to maximize your music suite investment. Conversely, inadequate sound isolation can greatly impede music learning. Start by following these basic principles:

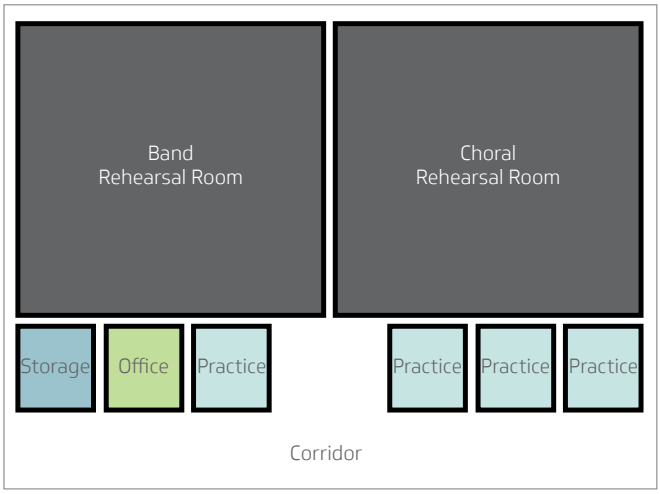
- Use full-height, sound-isolating walls, with an airtight seal to the building structure at both the floor and permanent roof deck. Sound isolation is easily compromised. Even a 1" (25 mm) hole in a 4' x 8' (1219 x 2438 mm) wall section can reduce sound isolation by up to 80%!

  Source: *Architectural Acoustics*, M. David Egan.
- Buffer zones, such as corridors and storage rooms, are better sound isolators than single walls.
- Practice rooms should be quiet and are not effective buffers; put them as far away from major rehearsal rooms as possible.
- If individual practice rooms must be near rehearsal rooms, separate them with sound-isolating walls and buffer zones.
- Modular practice rooms offer better sound isolation than most built-in rooms and also provide greater flexibility. Costs are comparable, sound isolation is guaranteed, and they can be moved or resized as needs evolve.
- Specify doors and windows that have an acoustical rating equal to the wall construction.
- Keep doors and windows to a minimum to reduce sound leakage.

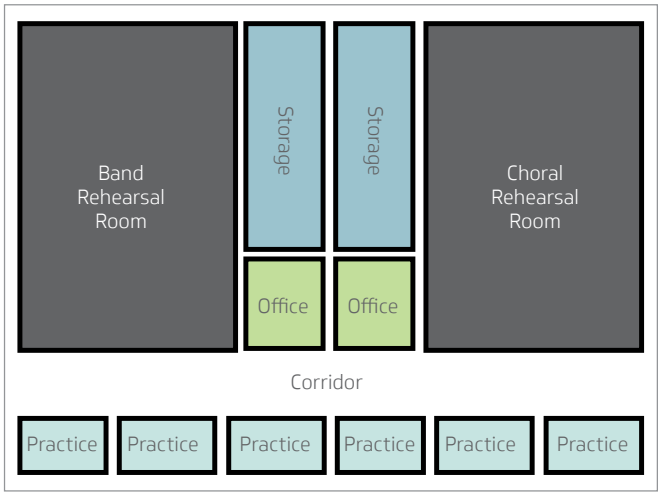
TIP:

Sound isolation is easily compromised. Even a 1" hole in a 4' x 8' wall section can reduce sound isolation by up to 80%!

Room Adjacencies



Incorrect Room Adjacencies
Rehearsal and practice spaces placed adjacent to one another make sound isolation impossible without complex and costly construction.



Correct Room Adjacencies
Used as buffer zones, non-playing areas — such as storage, offices and corridors — are a far superior means of isolating sound.

"Wenger's Planning Guide was an extremely valuable resource throughout the process – from design through construction. It answered a lot of my questions, including about cubic volume and sound isolation. During construction, the Guide helped me be the on-site music room expert."

Anthony H. Bailey, Director of Bands
Hart High School, Santa Clarita, CA

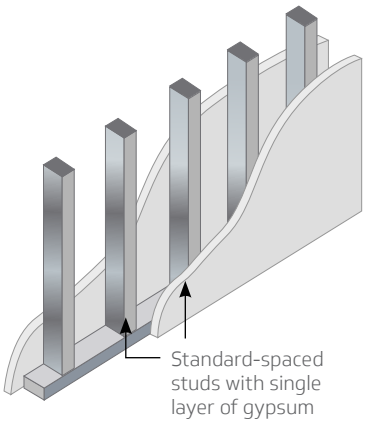
Wall Construction

Improper wall construction is a common source of sound leakage. Make certain that best practices for sound isolation and sealed construction are noted in the design.

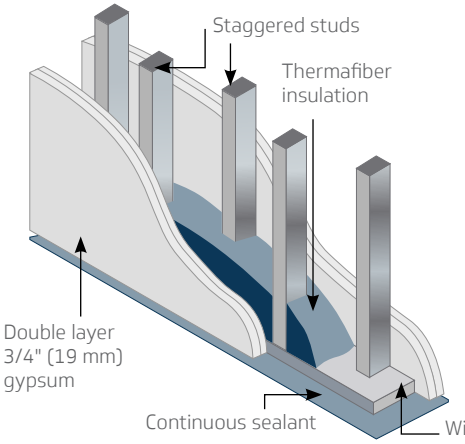
- Check wall seams at permanent roof deck, floor, electrical outlets and ventilation ducts.
- Spaces that allow air to move from room to room also allow sound to move from room to room.
- **Note: An entire sound-isolated wall can be rendered ineffective by something as seemingly insignificant as a room-to-room electrical box, or a gap as small as one-square-inch.**

Stud Wall

Normal Construction

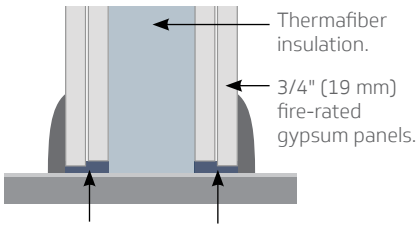


Proper Sound-Isolating Construction



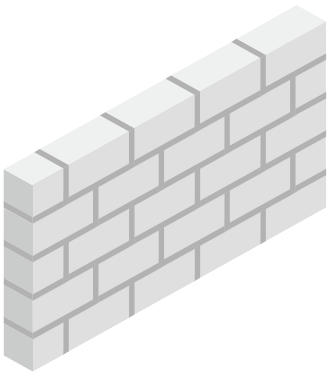
Wall Seam Construction

Composite structure, including studs, insulation and surrounding air space, enhances sound isolation.

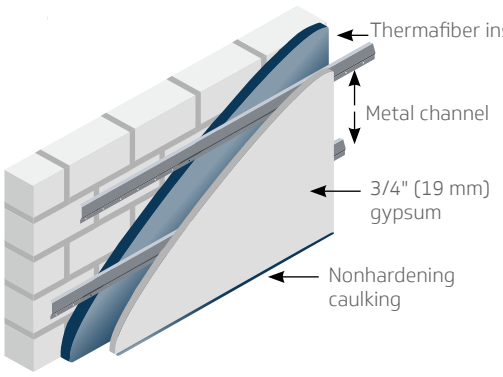


Masonry Wall

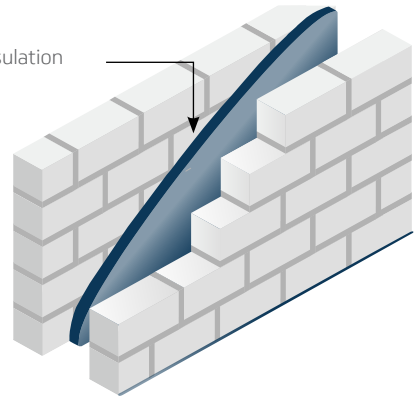
Single Layer (Good)



Single Layer (Better) (with resiliency supported skin)

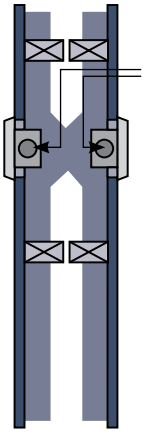


Double Layer (Best)

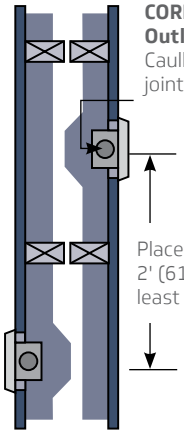


- For concrete block construction, fill blocks with insulated substrate – not sand.

Wall Construction

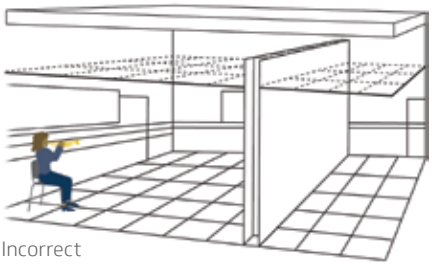


INCORRECT
Outlet Placement
Receptacle boxes placed in direct line from room to room create a direct flow of sound.

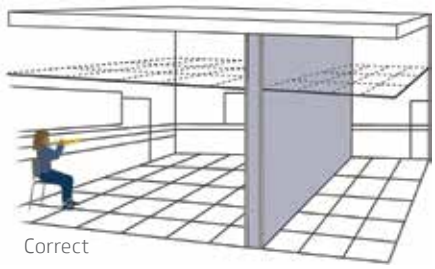


CORRECT
Outlet Placement
Caulk outlet box openings and perimeter joints to prevent sound leakage.

Place receptacle boxes at least 2' (610 mm) apart to guarantee at least one stud between outlets.



Incorrect

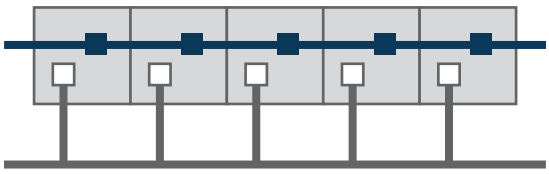


Correct

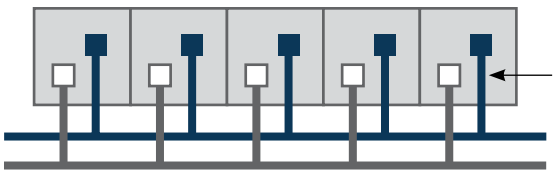
Wall Height
Building walls all the way to the permanent roof deck and sealing properly at the floor and ceiling will help prevent sound transfer from room to room.
Note: Any wall penetrations (ductwork, electrical conduit, alarms, trusses, etc.) must be sealed with a non-porous sealant.

Ventilation/HVAC

Ventilation/HVAC systems are notorious for transferring sound between rooms, especially between practice and rehearsal rooms. The most effective solution is routing acoustically lined takeoff branches into each room from the supply source placed outside the rooms. See page 22 for additional information on mechanical systems.



INCORRECT Ventilation
Direct ventilation supply ducts channel mechanical noise and carry sound directly from room to room.



CORRECT Ventilation
Individual takeoff branches feed each room from the supply duct positioned outside the rooms.

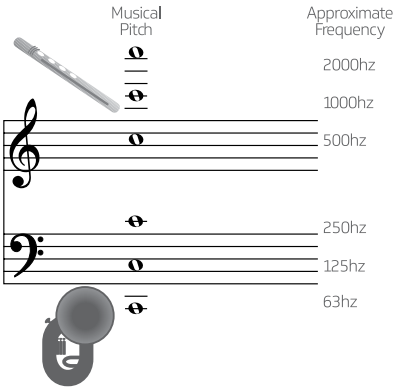
Dynamics of Sound Generation

- **Sound travels through the air at about 1' per millisecond, or 1130 ft/sec,** until it strikes an obstacle that reflects, absorbs or transmits it.
- **Frequency**, the "pitch" we hear, is the cycles per second of a sound measured in Hertz (Hz). For example, the tuning "A" pitch generates sound waves at 440 Hz.
- **Sound waves** can be measured by physical length from crest to crest – the wavelength. Some sound wavelengths generated in a music suite are very large. For example, "C" below "middle C" generates a wavelength of about eight feet.
- **Low sound frequencies have longer wavelengths than high frequencies**. These longer wavelengths are also unaffected by small obstacles. When planning a music rehearsal room, the size of reflectors and type of absorption should be tailored to the room's sound wavelengths. Altering big, energetic sound waves requires equally large treatments.

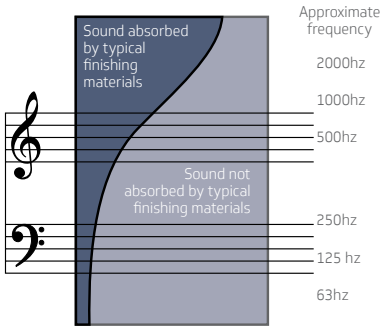
Frequency Range

The frequency range of sound in the music suite is very different than the frequencies produced in other areas of the school, and must be treated accordingly.

- Common finishing materials — such as carpet, drapes, and upholstery — absorb higher frequencies but not lower frequencies.
- In rooms that only utilize high-frequency absorption, flutes, violins, sopranos and other high-frequency sounds, including the high overtones of most instruments, can be lost; intonation, articulation and timing can be blurred; and critical listening becomes impossible.
- Similarly, the remaining low frequencies become overpowering, and acoustics within the environment will lack clarity and become loud and boomy.



The sound frequencies produced by different instruments react differently when they come into contact with different surfaces. Flutes and violins, for example, produce high-frequency sounds which are easily absorbed by a wide variety of common materials. Tubas and drums, on the other hand, produce low-frequency sounds that are more difficult to absorb; they also produce easily absorbed overtones in higher-frequency ranges that are critical to good intonation.



The dark shaded area represents sound energy absorbed by typical finishing materials such as carpets and drapes. The lighter shaded area represents sound that is not so easily absorbed, resulting in spaces that can be loud and boomy. Due to the complexity of musical sound, and the need to both absorb and diffuse specific frequencies, it is critical that treatments be specifically designed to cover this broad range of sound.

Frequency Range (Cont.)

Unique Requirements of the Music Suite

- Standard classrooms are designed for speech intelligibility, which falls into a smaller range of sound level (decibels, or dB) and frequency than music classrooms (see diagram).
- Instrumental music spans a much broader range of sound level and frequency: up to 140 dB in some cases, comparable to a jet engine up close. Instrumental music can be up to 64 times louder than speech.
- As noted on page 11, teachers and students can suffer hearing damage from excessive noise exposure. Safety guidelines from NIOSH (National Institute for Occupational Safety and Health) consider both dB levels and exposure time. If you have concerns about noise exposure, contact your district safety officer.

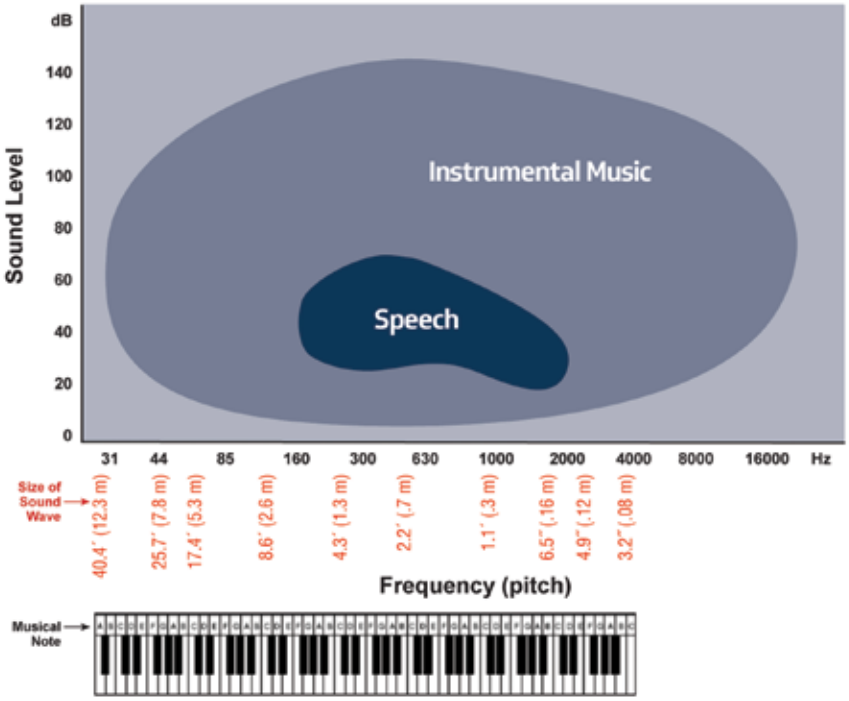


Diagram credit: *The Audio System Designer Technical Reference*, published by Klark Teknik.

Reverberation Time

- **Reverberation time** is the amount of time it takes for a sound to "fade away" or decay until it can no longer be heard. It is the result of many sound reflections mixing in a closed space.
- The length of reverberation time depends on the size, surface finishes and objects within a room.
- Reverberation plays a crucial role in the quality of music – creating fullness, space and envelopment. However, too much reverberation can lead to excessive loudness and a lack of clarity, or "muddiness".

Reverberation Times	
Room	Reverberation time
Choral Rehearsal	0.8 - 1.3 seconds
Band/Orchestra Rehearsal	0.8 - 1.0 seconds
Performance Area	1.25 - 2.25 seconds

Every room is different, but ideal reverberation times would fall within these guidelines.

Absorption & Diffusion

The ideal music suite has the proper combination of absorption and diffusion to control excessive loudness and scatter sound throughout the environment, providing a sense of "ensemble."

Absorption

Sound absorption can generally be defined as the reduction of sound energy that occurs when sound comes into contact with various surfaces and materials. When sound strikes a hard, dense surface — such as a gymnasium floor — there is nominal absorption. When sound comes into contact with thick, fibrous materials — such as a theater's curtained walls and acoustical panels — a great deal of sound energy can be absorbed and less sound is reflected back toward its origin.

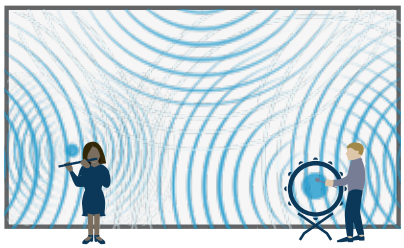
Diffusion

Sound diffusion can generally be defined as the scattering and redirection of sound caused by acoustically reflective surfaces. Diffusion of musical sound is necessary so it can be clearly heard from all points in a facility. The extravagant ornamentation, columns and plasterwork in historic theaters, for example, provides many angled, acoustically reflective surfaces which result in excellent diffusion.

- Different music environments require varying degrees of absorption and diffusion depending upon shape, volume, ensemble size and instrumentation.
- The right balance of absorption and diffusion is also necessary to create proper reverberation times, giving instructors the opportunity to more accurately evaluate student performance and progress.
- An environment treated only with absorber panels will only reduce loudness. Diffusive surfaces are necessary to scatter sound and improve communication from one part of the room to another.

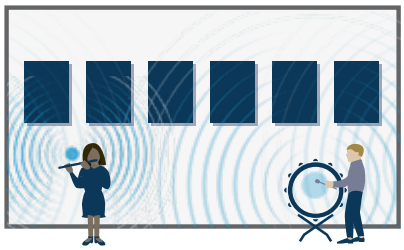
NOTE:

Music environments must be individually treated, depending upon their shape, volume, ensemble size and instrumentation.



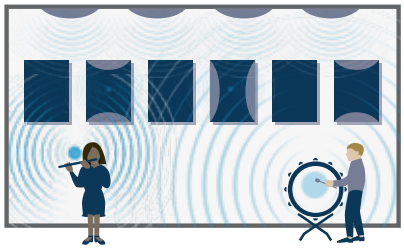
Untreated Room

- Parallel walls create flutter echo.
- Carpet, drapes and upholstery absorb higher frequencies only.
- Remaining lower frequencies become overpowering, reverberant and indistinct.
- Loudness is excessive and nearly impossible to control.



Treated with Absorber Panels Only

- Panels absorb high and low frequencies, reducing flutter echo and boomy sound.
- Loudness is also reduced, but overall acoustics are unbalanced.
- Lack of diffuser panels severely limits sound reflection, which adversely affects communication within the ensemble.



Treated with Diffuser and Absorber Panels

- The ideal combination of absorber and diffuser panels creates an acoustically balanced environment.
- Flutter echo, excess reverberation and boomy sounds are minimized.
- Loudness is controlled and balanced over the full audible range.
- Performers hear themselves and others.
- Instructors hear balance with accuracy.

Considerations

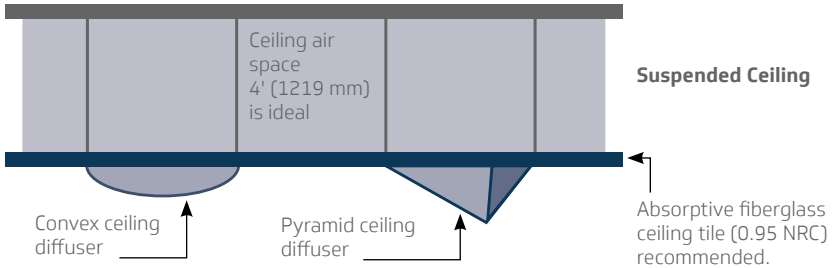
Every surface in the music environment has a direct effect on how sound and acoustics work within the space. This can significantly impact critical listening: the ability to hear and learn differences in intonation, dynamics, articulation and balance. The following treatments affect the interior acoustics of the room.

TIP:

Every surface in the music rehearsal space impacts the acoustics.

Ceiling Finishes

- The ceiling is the largest unencumbered square footage area available for acoustical treatment.
- Suspended ceiling treatments create air space needed to absorb low-frequency sounds.
- Suspended absorptive fiberglass tiles provide the broad-range frequency absorption required for the typical band room and are twice as effective as typical mineral board ceilings; plus, diffuser panels can be hung from the suspended ceiling grid to help scatter sound.
- Be sure to specify absorptive fiberglass ceiling tiles with 0.95 NRC rating; they are often identical in appearance to mineral board ceilings.
- Note: Ceiling height should always be measured from floor to suspended ceiling.



Floor Finishes

- Carpeting absorbs high-frequency sounds. If carpet must be used, select thin industrial carpet that is nearly acoustically transparent.
- Excessive use of even thin carpet will reduce acoustic support of high-frequency sounds.
- Most musicians prefer wood or other hard-finish floors for several reasons:
  - Bare floors are easier to clean.
  - Most performance areas are hard surfaces.
  - Emptied spit valves from brass instruments can make carpet stale and musty.

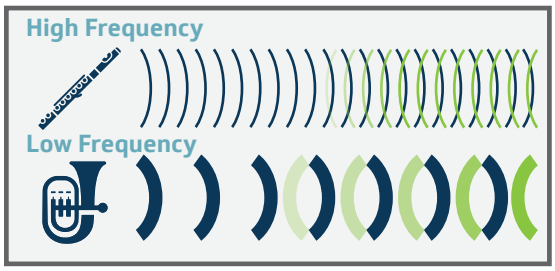
Wall Finishes

- Walls must be treated with a combination of sound-absorbing and sound-scattering surfaces.
- Absorber panels placed in the corners of the room and on the wall behind the percussion and lower brass sections will reduce loudness.
- Diffuser panels placed around the room in a variety of shapes, sizes and orientations improve sound scattering.
- Acoustical draperies, banners and dynamic (tunable) panels provide variable sound absorption for flexible room acoustics.

Absorber Panel | Convex Diffuser Panel | Pyramid Diffuser Panel | Tunable Wall Panel | Curtains, Banners or Drapes

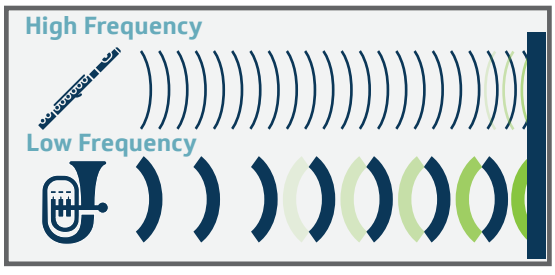
- The thicker the fiberglass treatment, the lower the frequency it can absorb. A minimum 3" (76 mm) thick fiberglass panel is good for effective, wide-range absorption of musical frequencies.
- All finishing materials must be evaluated for their effect on the variety of frequencies produced within the music environment.

For absorption of sound, material thickness is important!



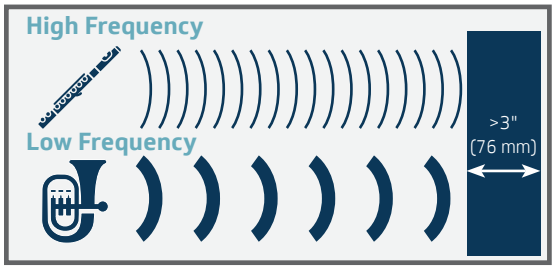
Bare Wall

- A wall with no treatment will reflect all frequencies of sound easily, making for a very loud room.



Wall with Thin Absorber

- A wall with thin panels has a similar effect as carpeting – only high frequencies are absorbed. Low-frequency sounds are unaffected, leading to a bass-heavy or muddy room.



Wall with Thick Absorber

- For a more balanced room, use high-quality acoustic panels with absorptive materials that are at least 3" (76 mm) thick.

Flexible Acoustic Finishes

There are several types of acoustical treatments that, although permanently mounted, offer a degree of flexibility beyond traditional acoustic panels. By altering the absorptive and reflective characteristics of a space, they give teachers the ability to adjust loudness and reverberance of natural sound and configure the room's acoustics to suit preferences and comfort needs.

Motorized Acoustical Banners

Banners are available in variety of fabrics – such as heavy velour and wool serge – with each providing certain absorptive characteristics. Other banner variables include width, length, space between the multiple fabric layers, and distance from the wall. Push-button control and preset options provide fast, simple operation.

Tunable Wall Panels

These panels alternate between providing absorption or diffusion by manually adjusting an internal diaphragm, allowing the teacher to "tune" the rehearsal room for various groups and needs. For example, a jazz ensemble might desire more sound absorption than a concert band which uses the same rehearsal space.

Drapes

Like banners, drapes are available in a variety of heavy, dense fabrics. They are usually hung on tracks along the back and side walls of the rehearsal room. As with banners, the cavity size between the drape and the wall impacts acoustic performance, as does the fabric thickness and total square footage of fabric deployed.

Furnishings

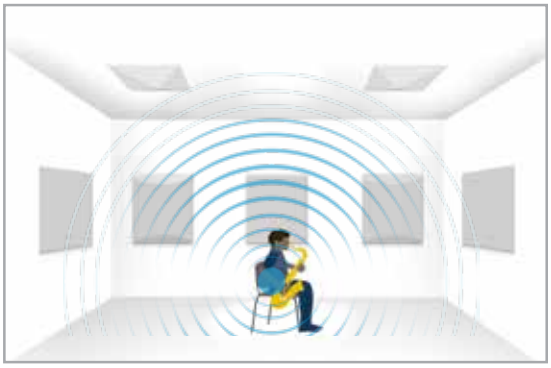
- Instrument storage cabinets with solid doors reduce cubic volume and occupy wall space better served by acoustical treatments. They should be kept outside of rehearsal rooms, if possible.
- Cabinets that must remain in rehearsal rooms should use grille doors because they do not reduce the room's cubic volume. Special acoustic storage cabinets with grille doors are available with built-in absorption in the back of the cabinet.
- If the instruments must be stored inside the music rehearsal room, consider using special acoustic cabinets which provide absorption and diffusion.
- Be cautious of furnishings that may resonate when exposed to high sound levels (things that may buzz, rattle or ring). These can be distracting to the group, especially during music passages that have dramatic changes in loudness.
- Portable storage racks for string and large brass instruments provide added flexibility and do not adversely affect the room acoustics.

Considerations

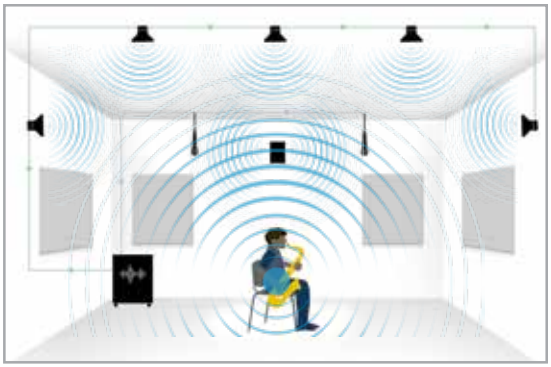
Acoustic Enhancement Systems – also commonly referred to as Active or Virtual Acoustic Systems – use microphones, distributed loudspeakers and digital signal processing to vary the acoustics of an environment. This technology can be installed into any space within the music suite including practice rooms, teaching offices, rehearsal rooms, and even performance venues. It equally supports all ensemble types and sizes within the same physical space – from choir and string orchestra to concert and marching band.

Unlike sound reinforcement systems which amplify sound, acoustic enhancement does not amplify the sound source. Instead, sound reflections and reverberation are added through a distributed speaker system to enhance the room acoustics. It is important that the natural acoustics of the space – the loudness, reverberation time and background noise – are first controlled using sound absorption and isolation.

Active Acoustic Technology transforms the acoustics of rehearsal rooms into various performance spaces through digital signal processing.



Traditional Acoustic Treatments
Absorber and diffuser panels applied to walls and ceilings balance the way sound is absorbed and distributed within the environment.



Active Acoustics (Virtual Acoustics)
Using a base of traditional acoustic treatments, active acoustics uses speakers, microphones and digital signal processing to simulate acoustic environments for practice and performance.

Benefits of Acoustic Enhancement

- A wide range of acoustic environments helps musicians develop critical listening skills and adjust to a variety of venues.
- Custom presets simulate onstage acoustics, preparing ensembles for performances in a specific concert venue.
- Enables cross-communication for better ensemble (balance and blend), allowing musicians to hear themselves and each other.
- Enhanced reflections and reverberation can accelerate the development of tone, timbre, dynamic range and articulation.
- Overcomes limited ceiling height by providing a supportive yet hearing-safe environment in rehearsal spaces with inadequate room volume.
- Integrated recording capability and immersive playback provide immediate feedback, improve sectional work and create high quality audition recordings.
- Included wall and ceiling treatment provides the optimal environment to communicate instruction and maintain student focus.
- Integrates with other classroom technologies to create an exciting and fun learning environment which helps students rehearse more efficiently and inspires practice.

Considerations

Hissing. Humming. Blowing. Vibration. These typical mechanical sounds are so commonplace we are rarely disturbed by them. Except in the music suite, where they can inhibit learning by totally masking the music that students and teachers are trying to make. Avoiding such disturbances is a key reason the input of an acoustical consultant is invaluable.

Vibration

- Mechanical equipment causes vibration and should not be directly connected to any structure within the music suite. It's imperative that your HVAC contractor provide low-vibration alternatives.
- Place equipment such as drinking fountains or in-floor geothermal pumps outside of rehearsal rooms so their noise won't cause a distraction.

Air Exchange

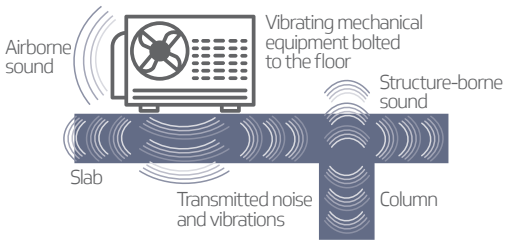
- Air exchange units should never be located directly above ensemble or rehearsal rooms.
- The music suite is a physically active environment, requiring an air exchange rate that is double that of other classrooms.
- Use larger ducts and vents with larger grilles to reduce the whooshing sounds caused by increased air volume and velocity.
- Ventilation systems, notorious for transferring sound between rooms, can be quieted by routing acoustically dampened and isolated takeoff branches into each room.
- Computer and electronic equipment labs also require additional air flow to cool the increased heat generated by the equipment.

Lighting

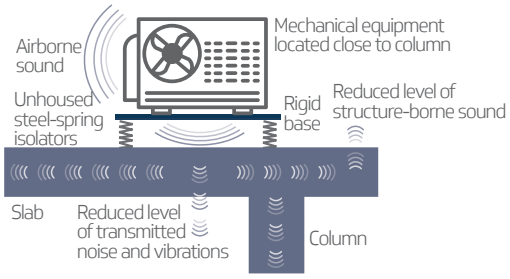
- The music suite has a lighting requirement of 70 to 100 foot-candles. This is necessary to help musicians read music scores.
- In situations where a gymnasium is renovated into a band room, the lighting will likely need to be evaluated and replaced.
- Although less common today, certain older fluorescent lighting generates a slightly flat B-flat pitch, creating a constant sense of discordance that can make it impossible for students to tune to concert A or concert B-flat. Ensure any fluorescent lights use electronic quiet-rated ballasts, or place ballasts outside the room.

TIP:

Common background noises that can be overlooked in other rooms can be very disruptive in music rooms.



INCORRECT
Mechanical equipment bolted to the floor transmits vibration directly to the structure. This construction method is unacceptable in the music suite.



CORRECT
Mechanical system vibration can be reduced by mounting the equipment on steel spring isolators.

> "We found the Wenger Planning Guide tremendously helpful from start to finish. This includes the rule-of-thumb guidelines on room size and volume, information about buffer zones and room adjacencies, and storage cabinet advice."
>
> **Mark J. Hulme**, AIA, LEED AP, BD + C
> Marx Okubo, Pasadena, CA

CRITICAL FACTOR Floor Plan

What is true in other areas of the school is not necessarily so in the music suite. The music suite requires more square footage, per student, than any other area of your school, and your floor plan must reflect that.

Space is only one concern. An effective music suite design must successfully integrate the following elements:

- Floor space
- Traffic flow
- Access to related areas
- Teacher monitoring
- Flexibility for multiple activities and future needs

The following section will make it clear how much space you need, why you need it, and how you can put all of the above elements into a single, effective floor plan.

NOTE:

The music suite requires more square footage, per student, than any other area of your school.

Considerations

Wenger Corporation square footage recommendations are based on successful facilities and the physical requirements of music education. We can assure you that reducing these figures will have an adverse impact on your suite. Consider the following:

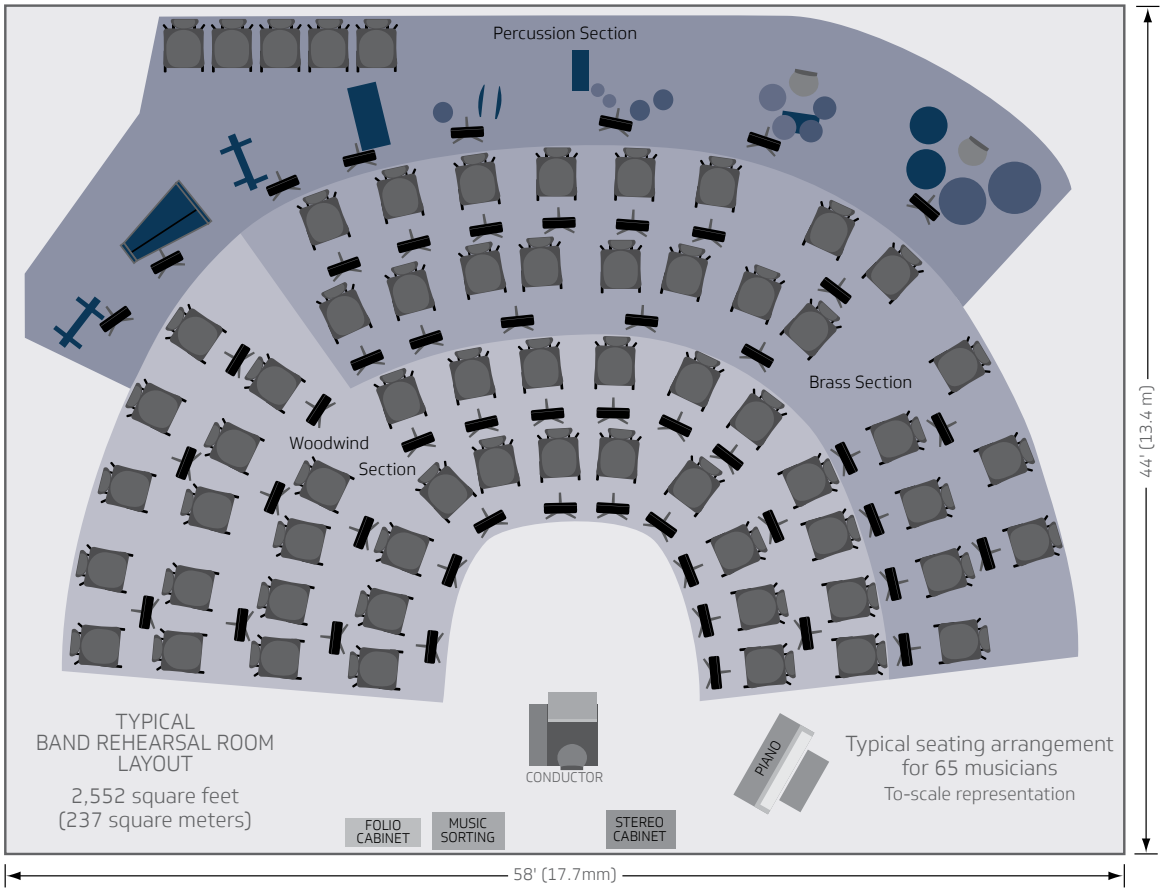
- Adequate room size is necessary to achieve effective, safe acoustics.
- Music education is a physical activity; vocalists and instrumentalists need room to move.
- Instrumentalists need even more floor space than vocalists to accommodate instruments and music stands.
- Student traffic is more concentrated and hurried in the music suite, as students must quickly move from storage to rehearsal areas, and back again, during a single class period.
- Pianos, podiums, risers and other equipment require permanent space in the rehearsal room.
- Other items — such as sheet music, garments and instruments — also require additional storage.
- Plan for the program you expect in 3 to 5 years, including program growth, curriculum changes, scheduling changes, computers and technology, expansion, etc.

An effective floor plan provides adequate space for vocalists and instrumentalists, who need room to rehearse. The space also accommodates equipment, storage, and busy student traffic, as well as the necessary cubic volume for proper, safe acoustics.

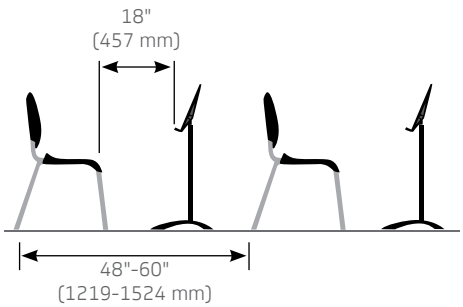
Rehearsal Rooms

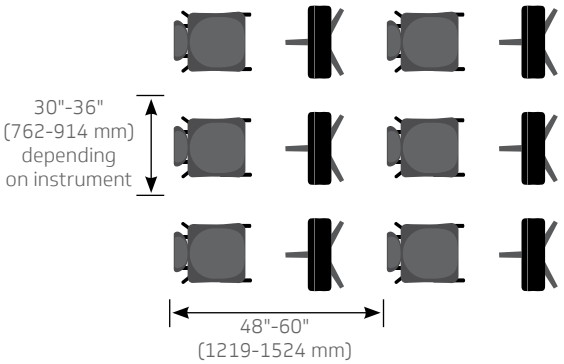
When designing rehearsal rooms, remember that music is a physical activity. Instrumentalists need space for their instrument and the elbow room to play it. Choir members need space for vocal exercises and choreography. The space must also accommodate equipment and traffic flow.

For these reasons, and to meet acoustic requirements, we recommend the following guidelines. You should start with a minimum of 1,800 ft² (167 m²) for choral and 2,500 ft² (232 m²) for band even if the ensembles are small. Otherwise, use the "per vocalist" number if your group is larger than 60-75 instrumentalists or 60-80 vocalists.



Typical Chair and Stand Spacing for Band Rehearsal Rooms

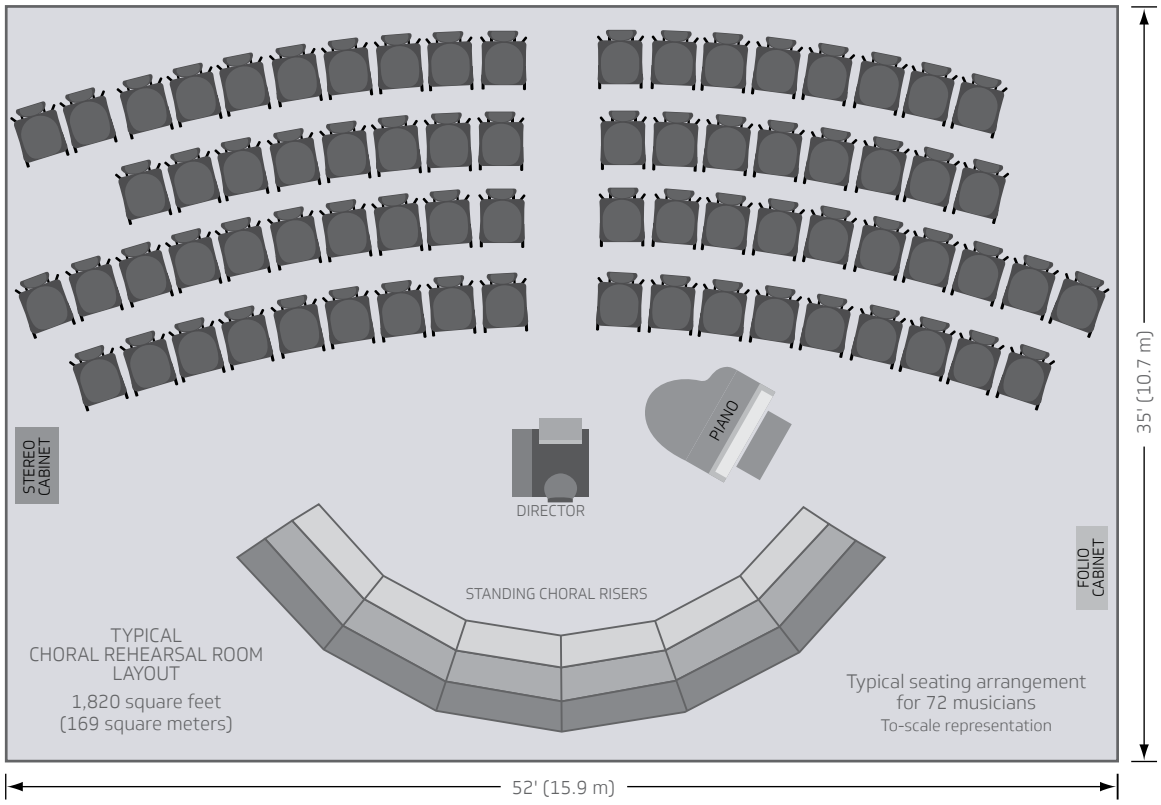




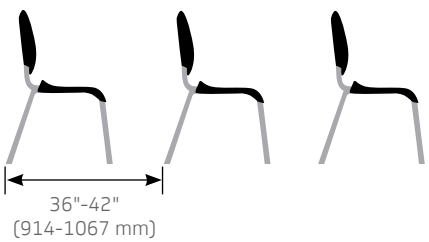
Rehearsal Rooms (continued)

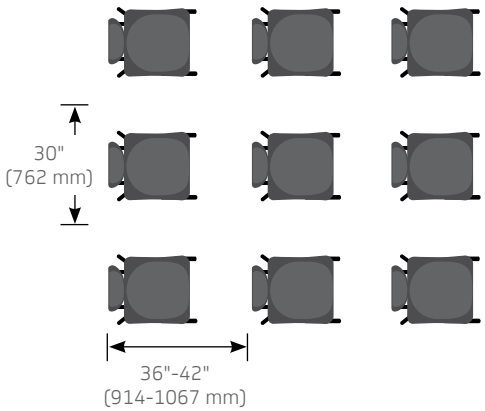
Rehearsal Room Guidelines		
Room	Recommended Floor Area	Formula
Band/Orchestra Rehearsal	2,500 ft² (232 m²) minimum for 60-75 students	30-35 ft² (2.8-3.2 m²) per instrumentalist*
Choral Rehearsal Room	1,800 ft² (167 m²) minimum for 60-80 students	20-25 ft² (1.9-2.3 m²) per vocalist*

*The total per-musician square-footage requirement is not equal to the footprint of a musician within the room. Instead, it is a means for calculating total additional rehearsal room size for larger groups and it takes into consideration additional space requirements such as aisles, storage, etc.



Typical Chair Spacing for Choral Rehearsal Rooms





Practice Rooms

Quality pre-engineered practice rooms are superior to most permanent rooms because they guarantee sound isolation and can be moved or altered as needs change. Achieving an equivalent level of sound isolation with built-in rooms usually requires construction that is more expensive than pre-engineered rooms. A properly designed music suite will have a mix of different-sized practice rooms to accommodate a wide range of department activities. Plan for multiple connectivity options (phone lines, Cat 6 cables, Wi-Fi, etc.).

Practice Room Guidelines			
Room	Purpose	Maximum Capacity	Floor Space
Small Practice	Individual practice	1 student	35-40 ft² (3.2-3.7 m²)
Keyboard	Private lessons, keyboard practice	2 students	55-60 ft² (5.1-5.6 m²)
Small Group	Small group practice and rehearsal	4 students	75-80 ft² (7.0-7.4 m²)
Medium Group	Medium group practice and rehearsal	6 students	95-100 ft² (8.8-9.3 m²)
Ensemble Practice	Group rehearsals and lessons, sectionals	15 students	350-450 ft² (32.5-41.8 m²)*
*Additional ceiling height should be planned for larger practice rooms.			

Storage Rooms

The music suite requires more storage space than any other part of the school because of its wide assortment of equipment, instruments and garments. See pages 38-43 for additional storage information.

Storage Room Guidelines	
Room	Floor Space
Instruments	600-800 ft² (55.7-74.3 m²)*
Choral Robes	2.5 ft² (0.23 m²) per garment or 150-200 ft² (13.9-18.5 m²)* (2"-4" [0.05-0.101 m] per hanging robe)
Band Uniforms	3 ft² (0.28 m²) per garment or 300-400 ft² (27.8-37.2 m²)* (4"-5" [0.101-0.127 m] per hanging garment)
*Square footage requirements given are for a 60-80 member program.	

Music Lab

Music labs have high square-footage requirements to accommodate MIDI and computer workstations. They also require a surge-protected power source, multiple electrical outlets, and indirect lighting to eliminate screen glare. Plan for multiple connectivity options (phone lines, Cat 6 cables, Wi-Fi, etc.).

Music Lab Guidelines		
Requirements	Workstations	Floor Space
Secured space, for classes and independent study, requiring many electrical outlets with surge protection	11-21 workstations	500-750 ft² (46.4-69.7 m²) minimum (35-45 ft2 [3.3-4.2 m²] per workstation)

Additional Rooms

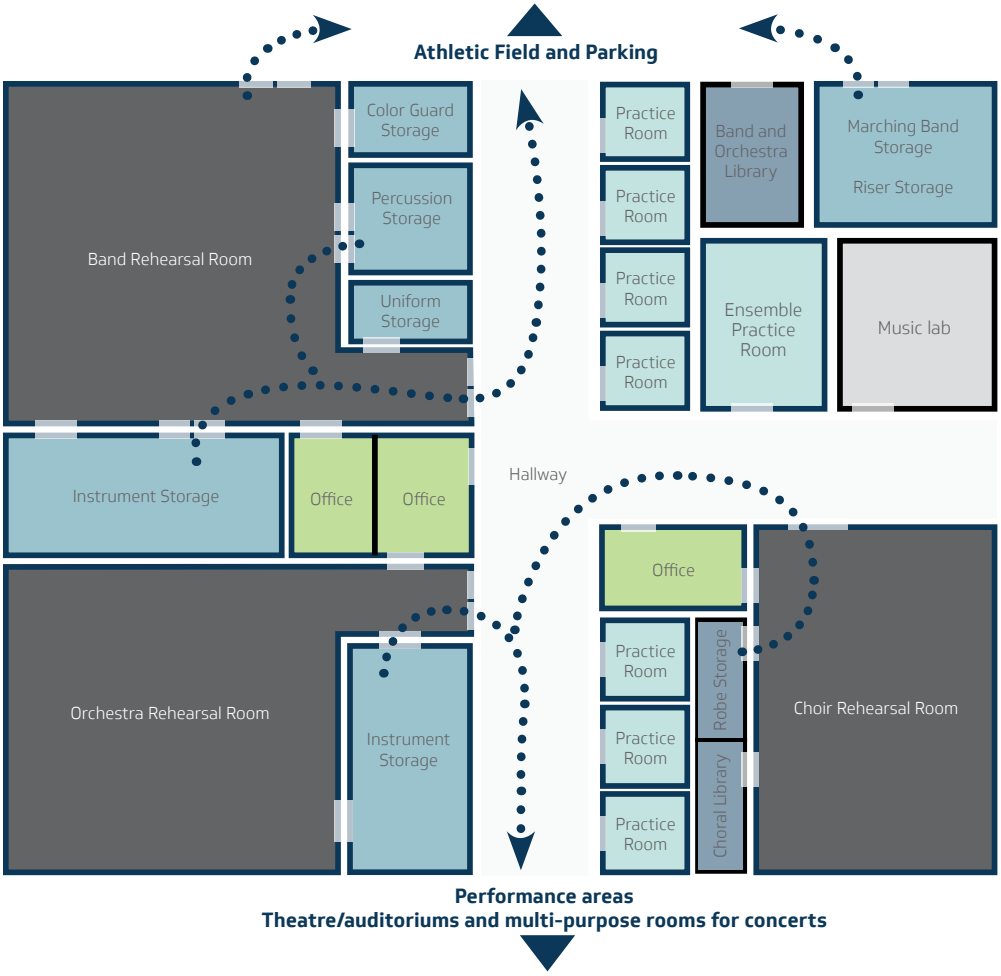
The most successful floor plans place a variety of application-specific rooms in strategic locations. Your plan, at the very least, must provide adequate floor space for each room.

Additional Room Guidelines			
Room	Purpose	Accommodates	Recommended Floor Area
Offices	Administrative needs, private lessons, equipment, piano	1 teacher	100-200 ft² (9.3-18.5 m²)
Music library	Sheet music storage	Music for 150 students	150-200 ft² (13.9-18.5 m²)
Instrument repair	Minor repair requiring sink, 8' (2438 mm) counter, storage for parts and tools	1-3 people	50-75 ft² (4.6-7.0 m²)
Commons area	A gathering place to promote the department with conversation areas, awards, displays, etc.	Large groups and activities	500-700 ft² (46.4-65.0 m²)

Considerations

The music suite is a center of activity, and your floor plan must promote easy movement in and out at all times.

- Large numbers of students enter and exit together within minutes; good traffic flow must provide natural routes and adequate space for these groups.
- The start of class can be frenzied, as students find their music, get their instruments from storage, and take their seats for rehearsal — all in a short window of time.
- The end of class is just as hectic, as students rush to put away instruments and music, gather their books, and move to their next class.
- Small groups often move from large rehearsal areas to smaller practice rooms in the same period.
- Many individuals use the suite throughout the day for private lessons and study.
- Equipment and instruments are frequently moved from one part of the suite to another.
- Many activities are happening simultaneously in the music suite, and traffic flow should be planned not to disturb any activity or area.
- Traffic flow solutions should include separate entry and exit doors to reduce congestion, a design that moves traffic flow away from rehearsal areas to reduce distractions. Designing doorways, hallways, corners and ramps so they can facilitate the movement of large equipment.



Good traffic flow must provide natural routes for large groups so they can get what they need from storage and take their places as quickly and quietly as possible.

Considerations

An effective floor plan positions related areas adjacent to one another within the music suite, and also positions the music suite itself in a strategic position within the school.

- The suite should be located near ramps, rather than stairways, to facilitate movement of large equipment and instruments, such as timpani and pianos.
- Doorways should be wide and unobstructed. Hallways and corners should be wide enough to accommodate grand pianos.
- The music suite is often busy with activities after hours and on weekends. Students and instructors must have access to the suite at these times without opening the entire school. Bathrooms and performance areas must also be nearby and accessible.
- The music suite should be located away from the general student traffic flow to reduce noise and help prevent vandalism and disruption.

TIP:

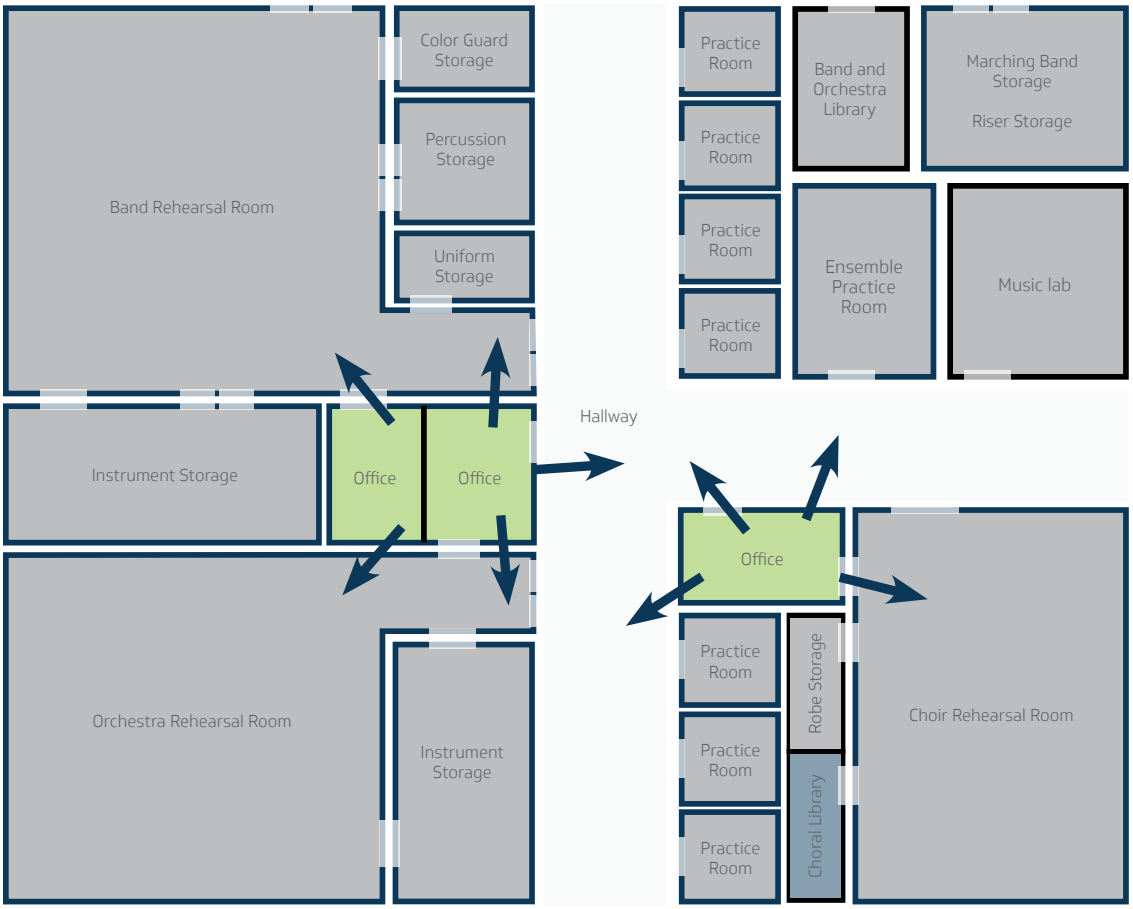
An effective floor plan positions related areas adjacent to one another within the music suite.

The most efficient music suites are located near the athletic field for marching band rehearsals, near the auditorium for performances, and near a parking lot for buses.

Considerations

Music department faculty frequently supervise many students and several activities at one time. They need to see as much of the suite as possible at all times to optimize monitoring, control and safety

- Ideally, all areas of the music suite should be visible from suite offices.
- Offices should be centrally located, with large windows for clear sight lines.
- Offices should also have a clear view of entrances and exits.
- Practice rooms with glass doors enable better monitoring.



To improve monitoring, music suite offices should have a clear view of the entire suite at all times, including practice rooms and storage areas.

Considerations

Flexibility for multiple activities

Along with daily routines, an effective floor plan must also accommodate marching drills, choreography practice for musicals, dance line rehearsals, even community events. Flexibility within the suite is crucial.

- Rehearsal rooms should reconfigure easily for various uses.
- Use portable seated risers, instead of built-in tiered seating, for increased flexibility and greater available cubic volume in the room.
- Flat, open floors are more flexible, allowing the space to be used for a variety of activities.
- Portable equipment also frees you to make better use of space.

Flexibility for future needs

Start by estimating future enrollment, and recognize that technology will have an effect on your suite. Plan for today's technology needs while anticipating tomorrow's.

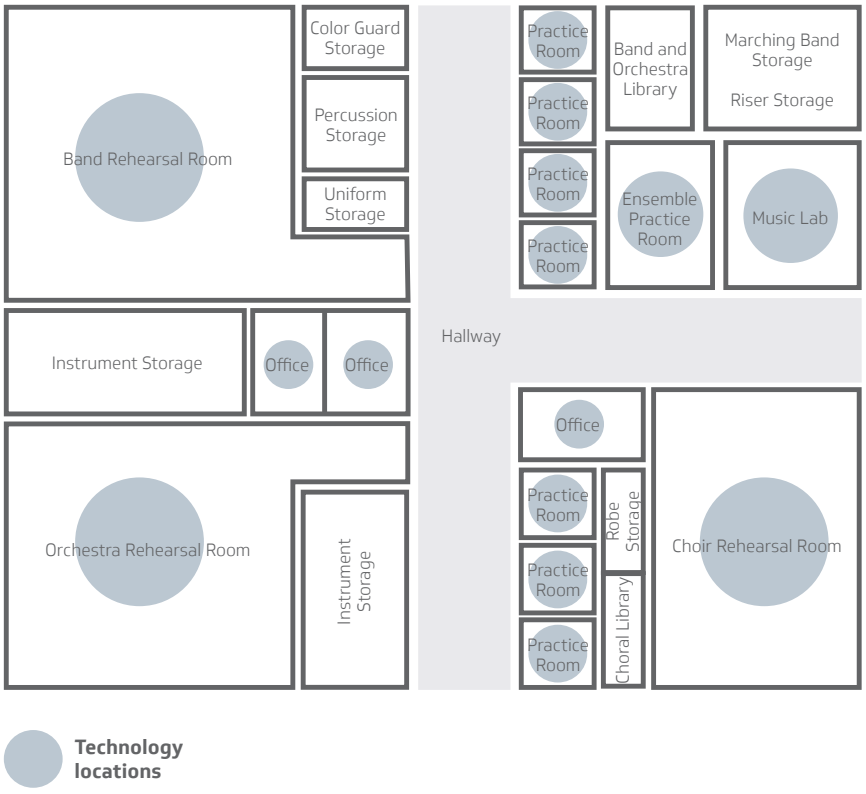
CRITICAL FACTOR Technology

Technology has the potential to greatly enhance the educational experience within the music suite – for both students and teachers. Proper planning effectively accommodates today's tech needs while providing flexibility for the future.

The most successful music suites consider these aspects of technology:

- Audio Visual Systems (AV)
- Record/Playback Capability
- Internet Connectivity/Remote Learning Support
- Wiring & "Future-Proofing"
- Active Acoustics Systems
- Benefits of Consultant Input
- Technology Questions for Programming Phase

The following section will help you understand some of the unique requirements of technology and how to maximize the value of this significant investment. This complex subject could warrant its own Planning Guide; this is only an overview.



Audio Visual Systems

Considerations

As with traditional classrooms, most rehearsal rooms incorporate some type of video projection system including built-in stereo playback for computers and other devices. Ideally, the teacher is able to control the system via touch-screen or other interface, usually provided and programmed by the AV integrator.

- Because a rehearsal room is significantly larger than a traditional classroom, the display technology should scale up appropriately in brightness, screen size, etc.
- Determining proper equipment size and location within the space can be complicated. An AV integrator can assist, also minimizing sight-line conflicts with ceiling-mounted speakers, mics, etc. Involving an integrator early in the process can significantly reduce total project costs, and maximize system performance by limiting changes later in the project life-cycle.
- To improve screen visibility and contrast, a separate switched row of overhead lights in front of the room is helpful.
- To facilitate critical listening, ensure all equipment, including in AV racks, are extremely quiet and without noisy fans. If necessary, place the rack in a well-ventilated closet or remote location.

Record/Playback

Considerations

Along with recording the entire ensemble, such as for an audition or contest submission, the teacher may also use a recording for group evaluation. This enables students to hear where changes/corrections are needed, and aligns with the artistic process of *Responding* outlined in the National Music Standards. The ability to listen to this same recording in a practice room aids individual or ensemble work. Those smaller spaces also benefit from their own record/playback capabilities for self-critique, completing assessments, and audition recordings.

- Consider if recordings will be made directly to a laptop, specific device in the AV system, or both, because requirements vary. Plan for future flexibility. An active acoustic system should provide integrated record/playback functionality.
- For connectivity planning, consider the music suite a dynamic space where a "performance" recording could happen almost anywhere.
- In the rehearsal room, the orientation of the teacher and ensemble impacts microphone and speaker locations. The AV integrator will specify proper sizes and positions to provide optimal coverage patterns for both.
- Instructional amplification and music recording require very different types of microphones.

> "Earlier in my teaching career at another district, we saved several hundred thousand dollars on our new construction because of the Wenger Planning Guide. Our district leader said that no one was to undertake any new construction projects without reading the Planning Guide first."
>
> **Andrew Fowler**, Band Director
> Childress High School, Childress, TX

Internet Connectivity / Remote Learning Support

Considerations

To support both in-person and remote learning, internet connectivity within the entire music suite – including rehearsal rooms, practice rooms and offices – is an important requirement.

- The Wi-Fi coverage plan should account for potential signal degradation, either by providing strong emitters throughout the entire music suite and/or access points inside each room.
- To facilitate Wi-Fi connectivity into practice rooms, windowed doors are superior to metal doors, which can block signals.
- The metal construction of modular practice rooms may inhibit Wi-Fi signals and require additional access points; steel degrades or blocks signals.

Wiring & "Future-Proofing"

Considerations

Just as you would not buy plumbing for a new building after the fact, you should plan for the music suite's required infrastructure from the earliest stages.

- Think about your power and connectivity needs for all instructional technology throughout the rehearsal room to provide convenient operation and control at the podium while minimizing tripping hazards.
- While network infrastructure is ideally installed during construction, teachers expect the ability to plug in their own devices like phones, tuners, metronomes and computers. Provide the necessary interfaces and power at the podium, or a nearby wall plate.
- Install extra conduit in the walls, floor and ceiling to facilitate future changes and wiring needs. These empty channels offer long-term flexibility when inevitable changes or upgrades are needed.
- Bluetooth and other wireless technologies are effective ways to reduce cables and increase flexibility. Receiver range, connection security and signal-to-noise ratio are all important considerations.

TIP:

You should plan for the music suite's required infrastructure from the earliest stages.

Acoustic Enhancement Systems

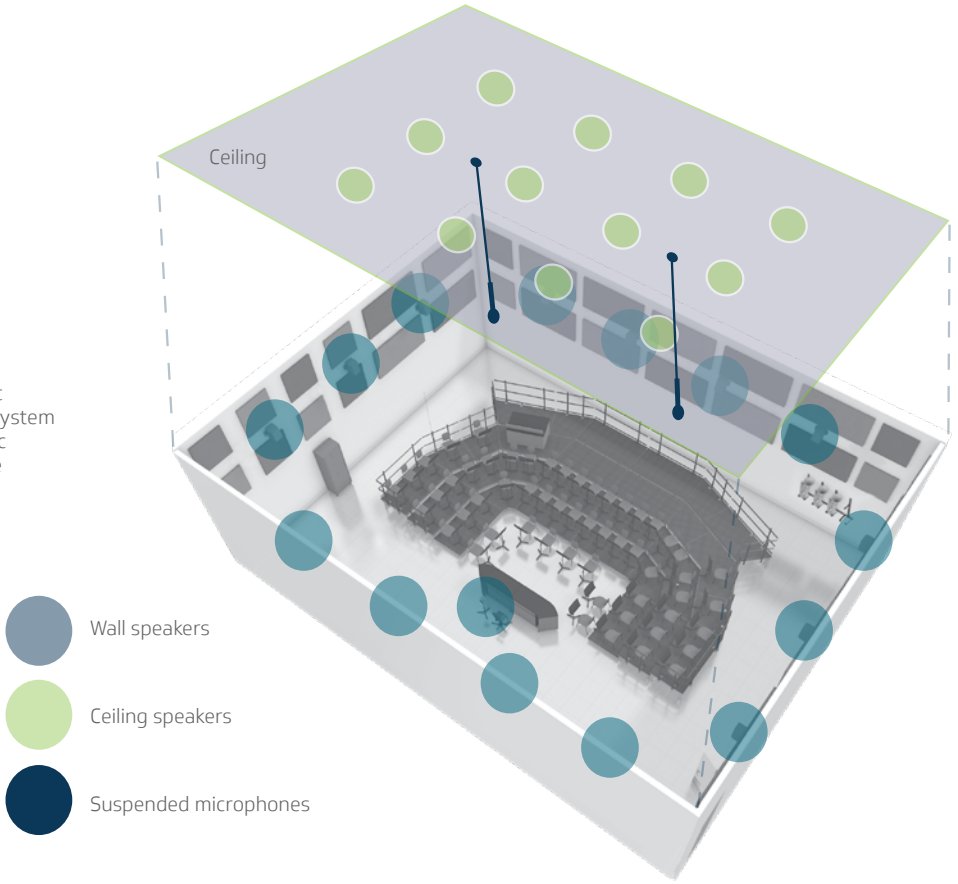
Acoustic enhancement provides an alternative to more traditional acoustic treatments while offering several key advantages (see Page 21). This technology can be installed into any space within the music suite including practice rooms, teaching offices, rehearsal rooms and even performance venues.

TIP:

A simulated performance environment can provide realistic preparation for students.

Considerations

- Natural room acoustics including loudness, reverberation and background noise level must be controlled prior to installing an acoustic enhancement system. This is best accomplished using acoustic ceiling tiles and sound-absorbing wall panels.
- System provider handles the design layout including the proper selection and positioning of all microphones and loudspeakers.
- Control panel should be accessible from teaching location to efficiently prompt acoustic preset changes and to control record and playback.
- Installation should always be completed by the system provider or a certified AV integrator.
- In-wall conduit and wall boxes should be coordinated with project electrician to manage system cables (low-voltage audio signal).
- Integration is possible with other AV systems and classroom technologies.
- Following the complete installation, commissioning or "tuning" of these systems is required by the system provider before they can be used.



Typical acoustic enhancement system layout for music rehearsal space

Benefits of Consultant Involvement

Technology in the music suite is increasingly complicated and dynamic; that complexity is only increasing. Mistakes can be costly, requiring additional expenditures and negatively impacting educational outcomes. To ensure the maximum benefit and longevity of your school's technology investment, your architect can partner with an outside technology consultant with relevant experience.

Technology Questions For Programming Phase

Early on in the project, during the Programming Phase, here are some questions that consultants should ask the building owner to help properly design the space:

Users

- Who are users of the technology? Will it always be the same group of people, or will outsiders be coming in and expected to know how to use the technology?
- What kind of training is provided? (Manual, video, other training material?)
- What are security expectations? Will technology in music suite ever be unattended while students are around?

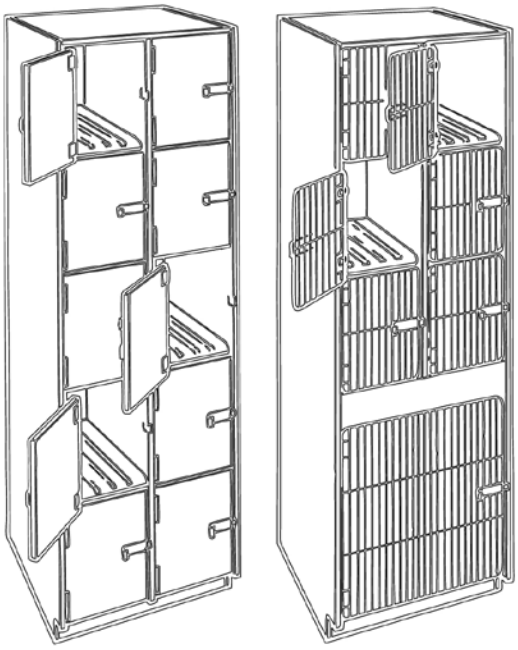
Integration

- Will equipment ever need to be moved or relocated?
- What's the prevailing operating system in the district...Mac OS, Windows or Chrome?
- How will the technology interact with the building control systems (HVAC, lighting, fire alarm/suppression, etc.)?

Equipment

- How long will the technology be expected to perform? 5 years? 15 years?
- Is there an upgrade cycle? Is there a maintenance or support contract? Is there a budget for recurring maintenance? How will it be supported and who will train new users?
- What about the warranty?

CRITICAL FACTOR Storage



Storage needs in the music suite are great and varied, and your floor plan must provide adequate storage for instruments, robes, uniforms and music. Because most music equipment is fragile, expensive and prone to theft and vandalism, storage spaces must be durable and secured. **You'll want to make these vital elements your main concern throughout the process:**

- Types of storage
- Traffic flow
- Security

The following section will help you create a floor plan with the best storage layout for your music suite.

TIP:

Music equipment is expensive and fragile, so take care in planning for how it is stored and protected.

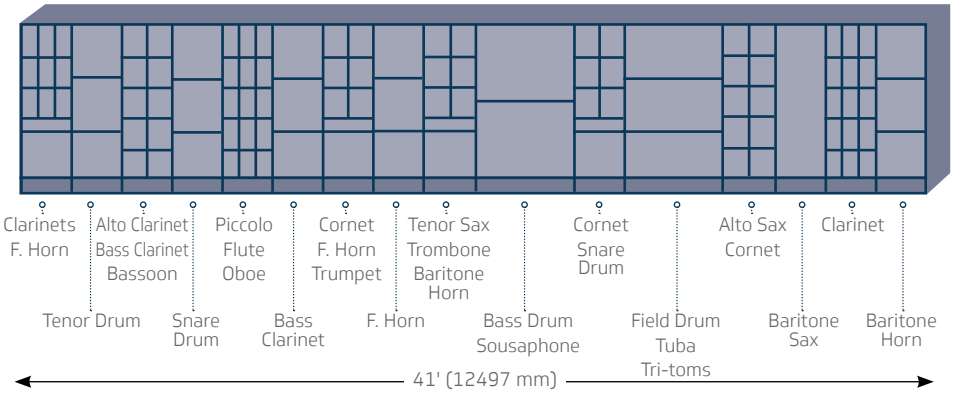
Considerations

Underestimating storage needs is a very common problem. Make sure you plan for enough space and that the storage equipment you choose is durable and secure.

Instrument Storage

- Music instrument storage should also be large enough to store the student's books, jacket, etc.
- Storage areas should maintain consistent, year-round temperature and relative humidity levels to help prevent damage to instruments, such as cracking, loosening of glue joints, and corrosion.
- Temperature should remain constant between 65˚ and 72˚ F (18˚ and 22˚ C), and relative humidity should stay between 35% and 50%.

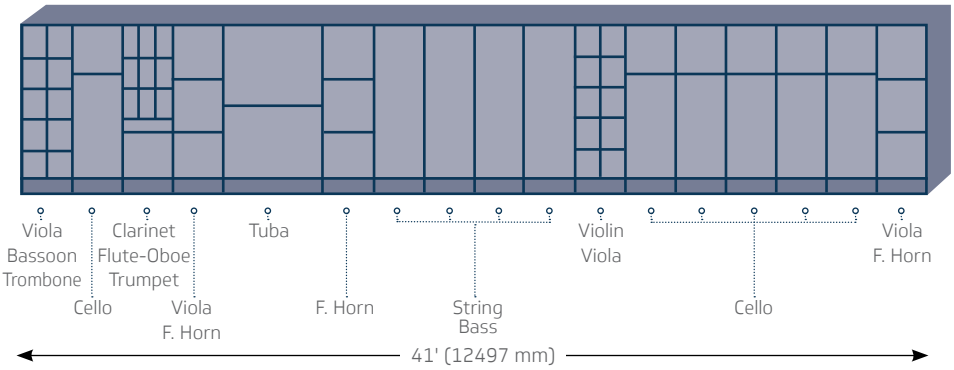
Typical set of cabinets for 100 Band Instruments



Average Distribution of Band Instruments

Instrument	Percent
Piccolo	1%
Oboe	3%
Flute	12%
Clarinet	24%
Alto Clarinet	3%
Bass Clarinet	3%
Bassoon	4%
Alto Sax	5%
Tenor Sax	1%
Baritone Sax	1%
Cornet/Trumpet	14%
French Horn	6%
Baritone Horn	4%
Trombone	6%
Tuba	4%
Snare Drum	6%
Tenor Drum	2%
Base Drum	1%
	100%

Typical set of cabinets for 50 Orchestra Instruments



Average Distribution of Orchestra Instruments

Instrument	Percent
Violin	25%
Viola	19%
Cello	14%
Double Bass	8%
Flute	3%
Clarinet	3%
Trumpet	6%
Trombone	4%
Tuba	1%
French Horn	11%
Oboe	3%
Bassoon	3%
	100%

Instrument Storage Guidelines		
Type of Storage	Accommodates	Floor Space
Instrument	150-200 instruments	4 ft^2 (0.37 m^2) per instrument or 600-800 ft^2 (55.7-74.3 m^2)
*Square footage requirements given are for a 60-80 member program.		

Garment Storage

Secure, ventilated storage will prevent mildew and protect robes, uniforms and other garments.

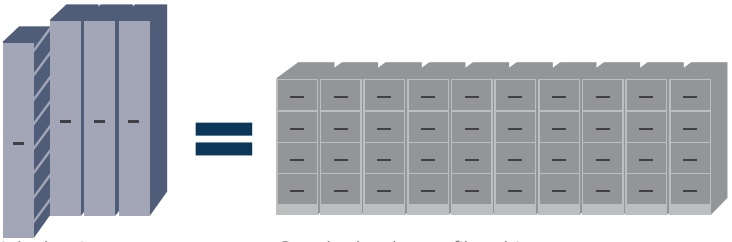
Garment Storage Guidelines		
Type of Storage	Accommodates	Floor Space
Choral robes	100 robes	2.5 ft² (0.23 m²) per garment or 150-200 ft² (13.9-18.6 m²)* (2"-4" [0.05-0.101 m] per hanging robe)
Band uniforms	100 uniforms	3 ft² (0.28 m²) per garment or 300-400 ft² (27.9-37.2 m²)* (4"-5" [0.101-0.127 m] per hanging uniform)
*Square footage requirements given are for a 60-80 member program.		

Music Library

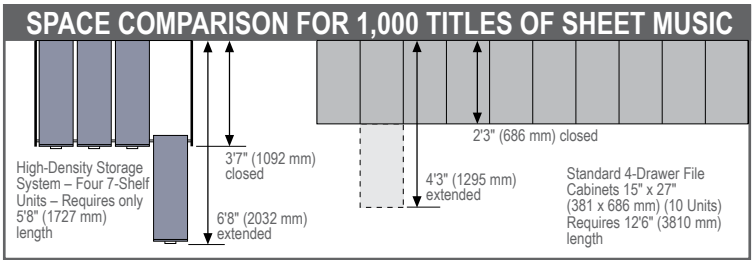
Few people outside of music departments realize how much space it takes to store sheet music. Music libraries need to be convenient, so music can be located quickly, easily and quietly.

- Place sheet music storage in or near the music director's office to control access and security.
- Place storage systems in the corner of the room to maximize space utilization.
- Pull-out, high-density music storage units work best on tile, wood or other hard-finished surfaces.
- Plan for an adjacent area where you can quickly and easily sort, collect and distribute music.

Sheet Music Storage Guidelines		
Number of Titles	High Density Storage Systems Floor Area Required	Standard File Cabinets Floor Area Required
500	35 ft² (3.3 m²)	65 ft² (6.0 m²)
1,000	70 ft² (6.5 m²)	130 ft² (12.1 m²)
2,000	140 ft² (13.0 m²)	260 ft² (24.2 m²)
3,000	210 ft² (19.5 m²)	390 ft² (36.2 m²)



High-density storage | Standard 4-drawer file cabinets



High-density storage lets you store the same number of titles in less than half the space of typical storage solutions.

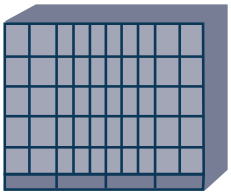
Other Storage Needs

- Plan space in your main rehearsal rooms for portable storage of music folios, small percussion instruments and stereo/recording equipment.
- Portable storage units allow you to easily move instruments and equipment between music areas.

"The Planning Guide was extremely helpful, including the floor plan guidelines and square footage calculations. Following its recommendations made all the difference – we now have enough space for instruments and uniforms."

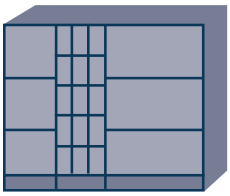
Travis Erikson
Choral Director/District Music Coordinator
DeKalb High School, DeKalb, IL

Types of Storage (continued)



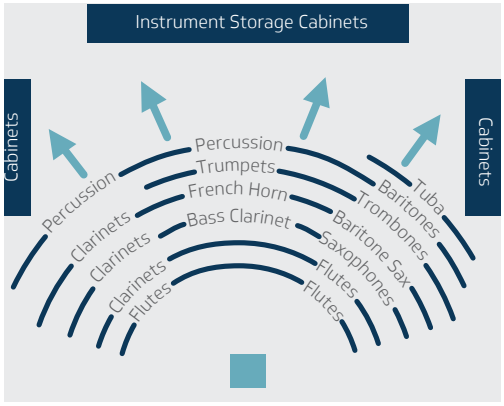
Incorrect Cabinet Layout

Multi-compartment cabinets placed together or near a room entrance will create congestion.



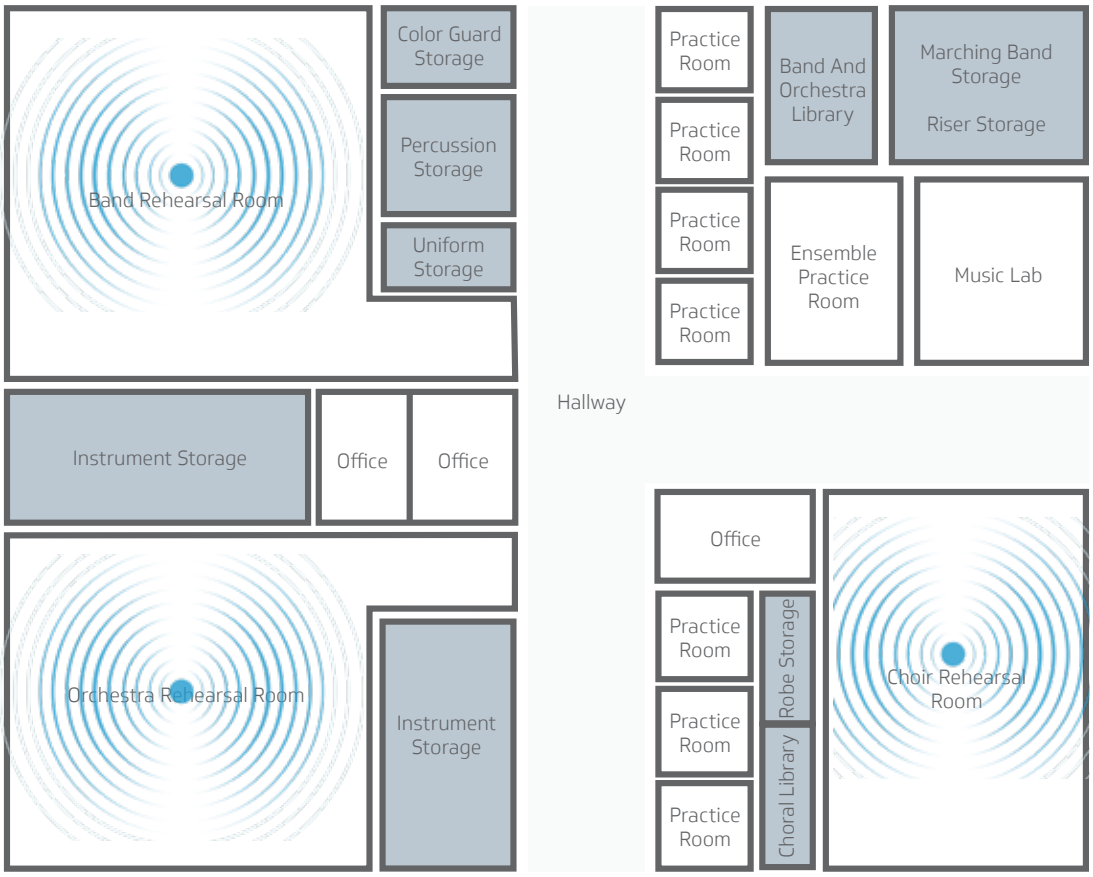
Correct Cabinet Layout

You'll reduce congestion and facilitate traffic flow by putting cabinets with many compartments next to cabinets with only a few. This will spread out students as they retrieve or replace their instruments.



- If instruments must be stored in the band or rehearsal room, place the cabinets near appropriate instrument sections.
- Acoustically treated instrument storage cabinets are recommended for use in this space.

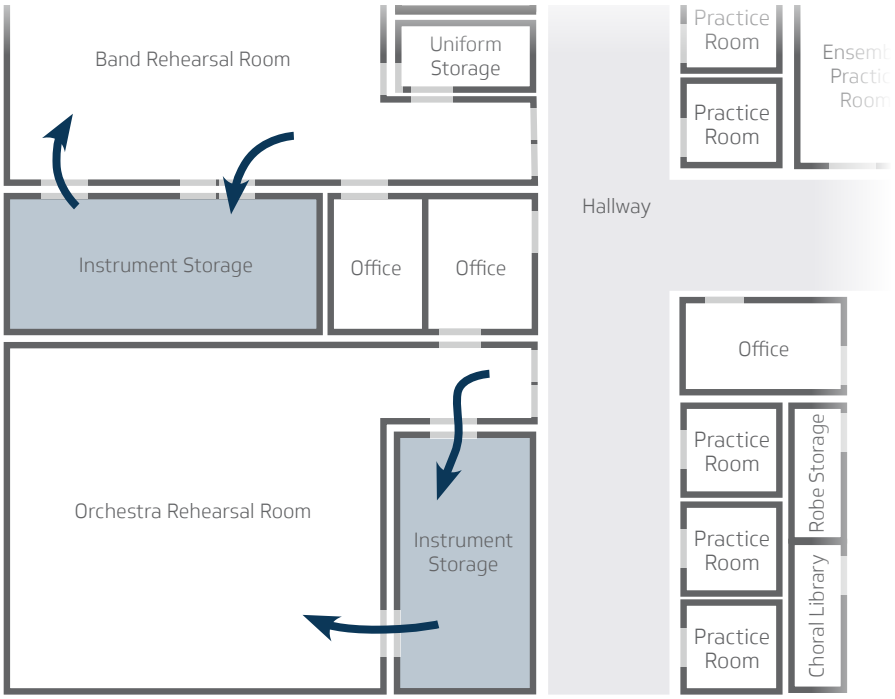
Storage areas provide excellent sound isolation when used as buffer zones between rehearsal rooms.



Considerations

Music suite storage areas are prone to congestion. Without a floor plan that promotes smooth traffic, valuable class time can be wasted.

- Instruments should be stored in a separate area outside the rehearsal room so students can retrieve instruments without disturbing rehearsals.
- Instrument storage and robe/uniform storage rooms provide excellent sound isolation when used as buffer zones between rehearsal rooms.
- If instruments must be stored in the band or rehearsal room, place the cabinets near appropriate instrument sections to minimize congestion and confusion.
- Instrument cabinets in the rehearsal room should also use grille doors to help diffuse sound and eliminate flutter echo. Grille doors, instead of wood doors, should be used as they do not reduce cubic volume.
- Grille doors also allow visual inspection and increase ventilation.
- Cabinets should always be arranged to reduce congestion in any given area.
- Doors at each end of the instrument storage room promote excellent traffic flow and reduce congestion at the beginning and end of class.
- Allow a 3' (914 mm) minimum between cabinets and opposing walls, and 6' (1829 mm) between rows of facing cabinets to reduce the likelihood of instrument damage.
- Avoid placing double door cabinets next to one another to prevent doors from swinging into each other. This will also ensure students don't have to wait for another cabinet's doors to close to gain sufficient access to their own cabinet.



Doors at each end of instrument storage rooms promote excellent traffic flow and help minimize congestion at the beginning and end of class.

Considerations

Expensive equipment and instruments are stored throughout the music suite, making security a top priority for any successful facility.

- For maximum security, plan for separate, lockable rooms with lockable cabinets inside.
- Motion detectors help prevent unauthorized entry and vandalism or theft of instruments, computers and other equipment.
- Position storage rooms where they can be visually inspected from music suite offices.
- The music suite should be secured from the rest of the school for maximum security during after-hours and weekend activities.

Equipment	Amount Invested
Musical Instruments	$500,000
Choral Robes	$25,000
Band Uniforms	$60,000
Sheet Music	$100,000
Music Stands	$7,000
Music Chairs	$10,000
Choral Risers	$15,000
Stereo Equipment/Speakers	$7,000
Acoustical Shells	$20,000
Computers	$45,000
Electronic Keyboards	$20,000
Total	$809,000*
*Based on a typical music program	

The music suite stores some of the school's most costly investments, making high security a top priority.

CRITICAL FACTOR Equipment

The final step in planning your music suite is choosing equipment specially designed for your music activities. Although furniture and equipment are normally not included in the general building contract, your advanced planning will make sure you have a budget large enough to purchase the equipment you need.

The following section provides basic worksheets that will help you equip the music suite with everything required for quality music education.

TIP:

Plan ahead with your budgeting to make sure you can purchase the equipment you need.

Quality Equipment

Considerations

Choose quality equipment for your music suite to ensure a successful, functional, durable music environment. When selecting equipment, consider the following:

- Music suite equipment should be considered a long-term investment that guarantees priceless returns — successful music students.
- Sturdy, functional, well-designed equipment is not only your best long-term value, but it also helps teachers and students get the most out of their daily efforts in the music suite.
- Chairs designed specifically for music posture help students produce better tone and thus become better musicians.
- Chairs should be stackable for easy storage; chair carts make it easy to transport chairs between performance and rehearsal areas.
- Music stands should be wobble-free and designed to withstand heavy use and abuse; stand carts also make it easy to move stands between performance and rehearsal areas.
- Conductor's equipment should match the conductor's style and facilitate good teaching.
- Portable risers allow greater adaptability to changes in your music program and, unlike poured concrete risers, they don't reduce cubic volume or adversely affect acoustics.
- Flexibility is the key to selecting equipment. Choose products that adapt easily to changes in the music environment and also facilitate changes to meet future needs.

Quality Equipment (continued)

See page 48 for complete worksheet.

Equipment Planning Worksheet	Band Rehearsal Room	Choral Rehearsal Room	Orchestra Rehearsal Room	Ensemble Room	Practice Rooms	Electronic Music Lab	Office	Performance Area	Instrument Storage Rooms	Music Library	Garment Storage Rooms	Total	Budget
Largest class size	75	75	60	20	-	20	-	-	-	-	-	-	
School-owned instruments	50	-	25	-	-	-	-	-	-	-	-	75	
Music posture chairs	75	75	60	20	17	20	2	-	-	-	-	269	
Chair storage carts	4	-	4	1	-	-	-	-	-	-	-	9	
Music posture chair with tablet arm	-	30	-	-	-	-	-	-	-	-	-	30	
Music stands	65	-	50	20	17	-	2	-	-	-	-	154	
Music stand storage carts	3	-	3	1	-	-	-	-	-	-	-	7	
Portable seated risers	1 set	1 set	1 set	-	-	-	-	-	-	-	-	3 sets	
Portable standing choral risers, 6-unit set	-	1 set	-	-	-	-	-	1 set	-	-	-	2 sets	
Conductor's chair, music stand, podium	1 set	1 set	1 set	1 set	-	-	-	-	-	-	-	4 sets	
Piano/keyboard	1	1	1	1	1		-	-	-	-	-	5	
Portable music folio cabinet, per room	3	3	2	-	-	-	-	-	-	-	-	8	
Stereo equipment component	1 set	1 set	1 set	-	-	1 set	-	-	-	-	-	4 sets	
Cabinet for stereo equipment	1	1	1	-	-	1	-	-	-	-	-	4	
Portable acoustical shell, 12-unit set	-	-	-	-	-	-	-	1 set	-	-	-	1 set	
Computers	1	1	1	-	-	20	1	-	-		-	24	
Electronic keyboards	1	1	1	-	-	20	1	-	-	-	-	24	
Workstation for computers/keyboard	1	1	1	-	-	20	1	-	-	-	-	24	
Teacher's desk, per teacher	-	-	-	-	-	-	1	-	-	-	-	1	
Teacher's file cabinets, per teacher	-	-	-	-	-	-	2	-	-	-	-	2	
Instrument storage	-	-	-	-	-	-	-	-	15 cab.	-	-	15	
Sheet music storage	-	-	-	-	-	-	-	-	-	6 units	-	6	
Robes and uniforms	-	-	-	-	-	-	-	-	-	-	10 cab.	10	
Other													

Glossary

Absorption
Absorption is the reduction of reflected sound energy that occurs when sound comes into contact with various surfaces and materials. When sound comes into contact with thick, fibrous materials such as drapery, a great deal of sound energy can be absorbed and less sound is reflected back toward its origin.

Active Acoustic Systems
Active Acoustics uses electro-acoustic elements – speakers, microphones and digital signal processing – along with appropriate sound absorption, to vary the acoustics of an environment.

Acoustic Surface Treatments
Acoustic products and finishes which are installed onto the ceiling, walls and floor surfaces to balance the way sound is absorbed and distributed within the environment.

Diffusion
Diffusion is the scattering and redirection of sound that occurs when sound strikes an acoustically reflective surface. Diffusion is necessary so that sound can be clearly heard from all points in a facility. The extravagant ornamentation in historic theaters, for example, provides many angled, acoustically reflective surfaces which result in excellent diffusion.

Echoes
Echoes are produced when different surfaces reflect sound to a listener long after the direct sound from the original source has already been heard. Trombonists onstage often produce echoes off the back wall of an auditorium. While both absorbers and diffusers can be used to control echoes, diffusers are generally preferred.

Flutter
Flutter occurs when a sound source is situated between parallel, sound-reflecting surfaces. A rim shot played on a snare drum inside an untreated rectangular classroom will produce the prolonged, buzzing sound of flutter. Diffusers are generally the best cure for flutter.

Frequency
Frequency is the physical description of musical pitch. A thick carpet absorbs a portion of the high-frequency sounds of a piccolo but has little effect on the low-frequency energy of a tuba.

Loudness
Excessive loudness occurs when an ensemble plays in a room that is too small or acoustically untreated. Absorber panels can help control excessive loudness.

Masking
Masking occurs when a noise conflicts with a musical sound similar or higher in pitch. Building mechanical system noise can easily mask the sound of basses and cellos in an orchestra rehearsal hall.

Noise Criteria (NC)
A single number rating to quantify the level of background noise. The lower the NC, the quieter the space.

Presence
Presence is achieved within a room when the primary reflections of sound from room surfaces, such as walls and ceilings, arrive back at the musician's ears within 30 to 80 milliseconds (thousandths of a second). This delay cannot be achieved without significant room size — the distance from the musician to the walls and ceiling — or Active Acoustics.

Reflection
Sound reflection off a hard, flat surface can be compared to the reflection of light off a mirror. Vocalists often stand back from the edge of a stage so that their sound can be reflected off the platform into the audience.

Resonance
Resonance is the emphasis of a particular frequency. This may occur when there is vibration of materials or furnishings that are exposed to high sound levels. The sympathetic vibration may create a sound on its own.

Reverberation
Reverberation is the buildup of reflected sound in an enclosure that affects the character and quality of music. The sound of a band in a fieldhouse is reverberant because it is reflected many times before it dies away. The same music played outdoors does not reverberate because there are no walls or ceiling to contain it. Absorbers are required to control excessive reverberation.

Sound Transmission
Sound transmission can occur through materials as light as air or as dense as concrete and steel. The sound of bouncing balls in a gymnasium is transmitted into an adjacent choir room primarily through the building structure while the majority of the sound of a choir heard in an adjoining corridor is transmitted through the gaps around the rehearsal room door.

Visual Acoustics
Visual Acoustics are designs within the music suite that feature visually attractive elements that have an adverse affect on quality acoustics. Curved walls and domed ceilings, for instance, create hot spots where sound concentrates and sound quality suffers. The domes and concave walls, though pleasing to the eye, are terrible to the ear.

Instrument Worksheet

Estimate quantity and type of instrument inventory.

Instrument Planning Worksheet			
Quantity	Instrument	Quantity	Instrument
	Piccolo		Percussion/Bell Kit
	Flute		Marching Trios
	Oboe		Marching Quads
	English Horn		Marching Quints
	E-flat Clarinet		Sousaphone
	B-flat Clarinet		Marching Mellophone
	2 Pc. Alto Clarinet		Marching Baritone
	1 Pc. Alto Clarinet		Marching Trombone
	2 Pc. Bass Clarinet		Marching French Horn
	1 Pc. Bass Clarinet		Violin
	Contralto Clarinet		Viola
	Contrabass Clarinet		Cello
	Bassoon		String Bass
	Contrabassoon		Acoustic Guitar
	Soprano Saxophone		Electric Guitar
	Alto Saxophone		Bass Guitar
	Tenor Saxophone		Spanish Guitar
	Baritone Saxophone		Guitarron
	Bass Saxophone		Vihuela
	Cornet	Mallet Percussion (Select only if you wish to store in cabinets)	
	Trumpet		Concert Bass Drum – 16" x 36" (406 x 914 mm)
	Flugelhorn		Concert Bass Drum – 18" x 40" (457 x 1016 mm)
	French Horn		Timpani
	Trombone		Orchestra Bells
	Bass Trombone		Chimes
	Baritone Horn		Marimba – under 58" (1473 mm)
	Mellophone		Vibes – under 58" (1473 mm)
	Euphonium		Xylophone – under 58" (1473 mm)
	Tuba	Additional Items:	
	Tuba (upright bell)		Uniforms
	Recording Bass		Robes
	Snare Drum – 6-1/2" x 14" (165 x 355 mm)		Hats
	Snare Drum – 8" x 14" (203 x 355 mm)		Flags
	Marching Snare Drum – 12" x 15" (305 x 381 mm)		Rifles
	Field Drum – 15" x 18" (381 x 457 mm)		Inches of Music Titles
	Bass Drum – 14" x 22" (355 x 559 mm)	Other	
	Bass Drum – 14" x 24" (355 x 610 mm)		
	Bass Drum – 14" x 28" (355 x 711 mm)		
	Bass Drum – 16" x 30" (406 x 762 mm)		
	Bass Drum – 16" x 32" (406 x 813 mm)		

Programming Worksheet

Use this programming worksheet to determine the square footage you'll need for a successful music suite. Be sure to follow the Rule of Thumb Guidelines located on the inside back cover.

Programming Planning Worksheet		
Major Instruction Area	Related Adjacent Spaces	Estimated Square footage
Band Rehearsal Room	Practice Rooms #_____	
	Band Office	
	Instrument Repair	
	Instrument Storage Room	
	Band Music Library	
	Ensemble Room	
	Marching Equipment Storage	
	Uniform Storage	
	Other	
Choral Rehearsal Room	Practice Rooms #_____	
	Choral Office	
	Choral Music Library	
	Ensemble Room	
	Choir Robe Storage	
	Other	
Orchestra Rehearsal Room	Practice Rooms #_____	
	Orchestra Office	
	Instrument Storage Room	
	Orchestra Music Library	
	Ensemble Room	
	Uniform Storage	
	Other	
Electronic Music Lab		
Commons/Main Entry Way		

Equipment Worksheet

Use this equipment worksheet to determine the types and amount of equipment you'll need for your entire music suite. Use the sample worksheet on page 44 as your guide.

Equipment Planning Worksheet	Band Rehearsal Room	Choral Rehearsal Room	Orchestra Rehearsal Room	Ensemble Room	Practice Rooms	Electronic Music Lab	Office	Performance Area	Instrument Storage Rooms	Music Library	Garment Storage Rooms	Total	Budget
Largest class size													
School-owned instruments													
Music posture chairs													
Chair storage carts													
Music posture chair with tablet arm													
Music stands													
Music stand storage carts													
Portable seated risers													
Portable standing choral risers, 6-unit set													
Conductor's chair, music stand, podium													
Piano/keyboard													
Portable music folio cabinet, per room													
Stereo equipment component													
Cabinet for stereo equipment													
Portable acoustical shell, 12-unit set													
Computers													
Electronic keyboards													
Workstation for computers/keyboard													
Teacher's desk, per teacher													
Teacher's file cabinets, per teacher													
Instrument storage													
Sheet music storage													
Robes and uniforms													
Other													

Bibliography

- Acoustical Design of Music Educational Facilities, E. McCue and R.H., Talasee, Editors. Published by the Acoustical Society of America, through the American Institute of Physics, New York, NY, 1990
- Acoustics for Performance, Rehearsal and Practice Facilities, National Association of Schools of Music, 2000
- Architectural Acoustics, M. David Egan, J. Ross Publishing, Plantation, FL, 2007
- Music Facilities: Building, Equipping, and Renovating, Harold P. Geerdes, MENC, 1987
- Planning New or Renovated Music Facilities, by Michael R. Howard, Charles R. Boner, Mark A. Holden, Ewart A. Wetherill. Presented at the National Association of Schools of Music workshop, Dallas, November, 1996
- The School Music Program: Description and Standards, 2nd Ed., Music Educators National Conference, MENC, 2005
- Theater Checklist, from the American Theater Planning Board, Wesleyan University Press, Middletown, CT, 2018
- Theater Design, by George C. Izenour, McGraw Hill, 1997

Resources

The following resources are excellent places to find names, numbers and addresses of acoustic and theatre professionals.

- NCAC, National Council of Acoustical Consultants, 3502 Woodview Terrace, Suite 300, Indianapolis, IN 46268, (317) 328-0642, www.ncac.com
- ASTC, American Society of Theatre Consultants, P.O. Box 22, La Luz, NM 88337, 1-855-800-2782 www.theatreconsultants.org

Other Wenger Corporation Publications

The following are additional resources made available by your Wenger Corporation representative or found at www.wengercorp.com.

- Planning Guide For Elementary Music Programs
- Planning Guide For School Music Facilities
- Acoustics Primer For Music Spaces
- Acoustical Problems and Solutions for Music Rehearsal and Practice Areas
- Rigging Planning For Performance Spaces
- Planning Guide For Performance Spaces
- Planning Guide For Athletic Facilities

Acoustic Questions for Programming Phase

Because proper acoustics are critical in the music suite, here are some key questions music educators should ask about the rehearsal and practice rooms early in the construction process. (For more details, please refer to pages 9-22.)

- What is the rehearsal room ceiling height and cubic volume?
- How are walls sealed at roof deck?
- Are sound-isolating walls specified?
- What are the hidden wall penetrations and how are they sealed?
- Are the doors and windows sound-rated?
- Are any mechanical systems connected to music suite structure? If so, how is their sound isolated?
- How often is fresh air exchanged?

The Case for Space

Considerations

Wenger Corporation square footage recommendations are based on successful music facilities. And though they may seem high to the inexperienced, they represent over 75 years of determining what works and what doesn't in music suites all around the world. Reducing these figures in any way will have an adverse affect on your suite's success. Consider the following:

- Proper acoustics require specific amounts of space, measured in cubic volume.
- Music education is a physical activity that requires more space than other curriculum — vocalists and instrumentalists need room to move and perform.
- Instructors need room to demonstrate, observe and also perform.
- Instrumentalists need more space than vocalists to accommodate their instruments and music stands.
- Student traffic is more concentrated and hurried in the music suite and the floor plan must provide adequate space to eliminate congestion and ensure excellent traffic flow.
- A vast amount of valuable equipment requires secure storage.
- You must plan space to meet expansion needs.
- Wenger Corporation square footage recommendations account for all the elements that make the music suite a unique space with very specific — proven — space requirements.
- Rooms designed for choral music must have a minimum of 1,800 ft^2 (167.2 m^2) and 28,800 ft^3 (815.5 m^3) of volume, regardless of group size. Band rooms must be a minimum of 2,500 ft^2 (232.3 m^2) and 45,000 ft^3 (1274.3 m^3) of volume, also regardless of group size. Groups larger than 60 students should use the Rule of Thumb guidelines to determine adequate square footage.

Rule of Thumb Guidelines

Use the following Rule of Thumb Guidelines to determine square footage and volume for your music suite. These numbers are based on Wenger Corporation's over 75 years of experience with successful music suites around the world; reducing them will severely jeopardize the effectiveness of your facility. We've also included rehearsal room guidelines for small, medium and large class sizes for your convenience.

Rehearsal Rooms					
Room	Class size	Floor Area Total	Floor Area Per Musician	Ceiling Height	Resulting Cubic Volume
Choral Rehearsal	60-80 students	1,800 ft^2 (167.2 m^2)	20-25 ft^2* (1.9-2.3 m^2)	16-20 ft (4.9-6.1 m)	28,800-36,000 ft^3 (815.5-1019.4 m^3)
Band/Orchestra Rehearsal	60-80 students	2,500 ft^2 (232.3 m^2)	30-35 ft^2* (2.8-3.3 m^2)	18-24 ft (5.5-7.3 m)	45,000-60,000 ft^3 (1274.3-1699.0 m^3)
*The total per-musician square-footage requirement is not equal to the footprint of a musician within the room. Instead, it is a means for calculating total additional rehearsal room size for larger groups and it takes into consideration additional space requirements such as aisles, storage, etc.					

Sound-Isolating Practice Rooms		
Room	Accommodates	Floor Space
Small Practice	1 student	35-40 ft^2 (3.2-3.7 m^2)
Keyboard	2 students	55-60 ft^2 (5.1-5.6 m^2)
Small Group	4 students	75-80 ft^2 (7.0-7.4 m^2)
Medium Group	6 students	95-100 ft^2 (8.8-9.3 m^2)
Ensemble Practice	15 students	350-450 ft^2 (32.5-41.8 m^2)*
*Additional ceiling height should be planned for larger practice rooms.		

Music Lab		
Type of Space	Workstations	Floor Space
Electronic Keyboard Lab	11-21 workstations	500-750 ft^2 (46.5-69.7 m^2)

Additional Rooms		
Room	Accommodates	Recommended Floor Area
Offices	1 teacher	100-200 ft^2 (9.3-18.5 m^2)
Music library	Music for 150 students	150-200 ft^2 (13.9-18.5 m^2)
Instrument repair	1-3 people	50-75 ft^2 (4.6-7.0 m^2)
Commons area	Large groups and activities	500-700 ft^2 (46.4-65.0 m^2)

"The Planning Guide is a good reference. Its rule-of-thumb guidelines about square footage and ceiling height are useful tools with customers; we also incorporate this information into our own materials. Depending on the project, sometimes the design team has no experience with acoustics."

Harold Merck
Merck & Hill Consultants, Inc., Atlanta, GA

Storage Areas		
Type of Storage	Accommodates	Floor Space
Instrument	150-200 instruments	4 ft^2 (0.37 m^2) per instrument or 600-800 ft^2 (55.7-74.3 m^2)
Choral robes	100 robes	2.5 ft^2 (0.23 m^2) per garment or 150-200 ft^2 (13.9-18.6 m^2)* (2"-4" [0.05-0.101 m] per hanging robe)
Band uniforms	100 uniforms	3 ft^2 (0.28 m^2) per garment or 300-400 ft^2 (27.9-37.2 m^2)* (4"-5" [0.101-0.127 m] per hanging uniform)
*Square footage requirements for a 60-80 member program.		

Sheet Music Storage		
Number of Titles	High Density Storage Systems Floor Area Required	Standard File Cabinets Floor Area Required
500	35 ft^2 (3.3 m^2)	65 ft^2 (6.0 m^2)
1,000	70 ft^2 (6.5 m^2)	130 ft^2 (12.1 m^2)
2,000	140 ft^2 (13.0 m^2)	260 ft^2 (24.2 m^2)
3,000	210 ft^2 (19.5 m^2)	390 ft^2 (36.2 m^2)

Notes

"I find Wenger's Planning Guide very helpful when working with school personnel. The Guide's schematic and programmatic sections describe 'best practices' for music facilities, including information about optimal floor plans, spatial layouts and room adjacencies. Wenger has taken a very functional approach that can be expanded to a specific facility's needs."

David Minnigan, Sr. Design Architect/ Principal
Earl Swensson Associates, Inc., Nashville, TN

Wenger®
CORPORATION

Minnesota Location Wenger Phone 800.4WENGER (493-6437) Wenger Worldwide +1.507.455.4100 | Parts & Service 800.887.7145 | wengercorp.com
GearBoss Phone 800.493.6437 | gearboss.com
555 Park Drive, PO Box 448 | Owatonna | MN 55060

New York Location JR Clancy Phone 800.836.1885 JR Clancy Worldwide +1.315.451.3440 | jrclancy.com | 7041 Interstate Island Road | Syracuse | NY 13209

Brands of Wenger Corporation

Wenger® JRCLANCY GEARBOSS®

Follow us on Social Media

Music Education *Performing Arts* *Athletics*