Acoustic performance

EQ10 | Possible point

Glossary

Intent

To provide classrooms that facilitate better teacher-to-student and student-to-student communications through effective acoustical design.

To provide building occupants with an indoor healing environment free of intrusive or disruptive levels of sound.

Provide classrooms that are quiet and in which teachers can speak to the class without straining their voices and students can effectively communicate with each other and the teacher.

Provide classrooms that facilitate better teacher-to-student and student-to-student communications.

To provide classrooms that facilitate teacher-to-student and student-to-student communication through effective acoustic design.

To provide workspaces and classrooms that promote occupants' well-being, productivity, and communications through effective acoustic design.

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To provide workspaces and classrooms that promote occupants' well-being, productivity, and communications through effective acoustic design.

To provide classrooms that facilitate better teacher-to-student and student-to-student communications through effective acoustical design.

Requirements

Sound transmission

Design classrooms and other core learning spaces to meet the Sound Transmission Class (STC) requirements of ANSI Standard S12.60-2002, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools, except windows, which must meet an STC rating of at least 35. Projects outside the U.S. may use a local equivalent to ANSI Standard S12.60-2002.

AND

Background noise

Reduce background noise level[1] to 40 dBA or less from heating, ventilating and air conditioning (HVAC) systems in classrooms and other core learning spaces.

Design the facility to meet or exceed the sound and vibration criteria outlined in the 2010 FGI Guidelines for Design and Construction of Health Care Facilities (aka 2010 FGI Guidelines) and the reference document on which it is based, Sound and Vibration Design Guidelines for Health Care Facilities (aka 2010 SV Guidelines).

Option 1 (1 point)

Sound isolation

Design sound isolation to achieve speech privacy, acoustical comfort and minimal annoyance from noise-producing sources. Consider sound levels at both the source nd receiver locations, the background sound at the receiver locations, and the occupant's acoustical privacy and acoustical comfort needs. Speech privacy is defined as "Techniques… to render speech unintelligible to casual listeners" by ANSI T1.523-2001,Telecom Glossary 2007.

Design the facility to meet the criteria outlined in the sections of the 2010 FGI Guidelines Table 1.2-3: Design Criteria for Minimum Sound Isolation Performance between Enclosed Rooms and Table 1.2-4 Speech Privacy for Enclosed Room and Open-Plan Spaces (2010 FGI Guidelines and 2010 SV Guidelines).

Calculate or measure sound isolation and speech privacy descriptors achieved for representative adjacencies as necessary to confirm compliance with criteria as identified in Sections 1.2-6.1.5 and 1.2-6.1.6 (including associated sections of the Appendix) of the 2010 FGI Guidelines and the reference standard on which it is based: the SV Guidelines.

Room noise

Consider background sound levels generated by all building mechanical-electricalplumbing systems, air distribution systems and other facility noise sources under the purview of the project building design-construction team.

Design the facility to meet the 2010 FGI Guidelines Table 1.2-2 Minimum-Maximum Design Criteria for Noise in representative interior rooms and spaces.

Calculate or measure sound levels in representative rooms and spaces of each type as necessary to confirm compliance with criteria in the above referenced table using a sound level meter that conforms to ANSI S1.4 for type 1 (precision) or type 2 (general purpose) sound measurement instrumentation. For spaces not listed in Table 1.2-2, refer to the ASHRAE 2007 Handbook, Chapter 47, Sound and Vibration Control, Table 42.

Option 2 (2 points)

Achieve Option 1

AND

Acoustical finishes

Specify materials, products systems installation details, and other design features to meet the 2010 FGI Guidelines Table 1.2-1 Design Room Sound Absorption Coefficients (including associated sections of the Appendix) and its reference the 2010 SV Guidelines.

Calculate or measure the room average sound absorption coefficients for representative unoccupied rooms of each type in the building, as necessary, to confirm conformance with requirements for this credit.

Site exterior noise

Minimize the impact of site exterior noise on building facility occupants produced by all exterior noise sources—road traffic, aircraft flyovers, railroads, on-site heliports, emergency power generators during maintenance testing, outdoor facility MEP and building services equipment. Also minimize impacts on the surrounding community produced by all facility MEP equipment and activities as required to meet the lower of the local applicable codes or Table 1.2-1 of the 2010 FGI Guidelines and the supporting Table 1.3-1 of the 2010 SV Guidelines.

Comply with the appropriate sections of the 2010 FGI Guidelines for each category:

- Heliports – A1.3-3.6.2.2
- Generators – 2.1-8.3.3.1
- Mechanical Equipment – 2.1-8.2.1.1
- Building Services – A2.2-5.3

Measure and analyze data to determine the Exterior Noise Classification (A, B, C, or D) of the facility site. See Table A1.2a: Categorization of Health Care Facility Sites by Exterior Ambient Sound in the 2010 FGI Guidelines and Table 1.3-1 in its reference standard, the 2010 SV Guidelines.

Design the building envelope composite STC rating based on the 2010 FGI Guidelines for the Categorization of Health Care Facility Sites by Exterior Ambient Sound and analyze contract documents to show conformance with requirements for this credit.

For Exterior Site Exposure Categories B, C or D calculate or measure the sound isolation performance of representative elements of the exterior building envelope to determine the composite sound transmission class (STCc) rating for representative façade sections as necessary. Measurements shall generally conform to the current edition of ASTM E966 Standard Guide for Field Measurements of Airborne Sound Insulation of Building Façades and Façade Elements.

Design classrooms and other core learning spaces to meet the Reverberation Time (RT) requirements of ANSI Standard S12.60-2002, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools. Also design classrooms and other core learning spaces to meet the Sound Transmission Class (STC) requirements, excepting windows which must meet an STC rating of at least 35.

AND EITHER

Option 1

Using the methodology described annexes B through D in Standard S12.60-2002, achieve a maximum background noise level in classrooms and other primary learning spaces of 45 dBA.

Option 2

Design classrooms and other core learning spaces using the methodology listed in the 2003 HVAC Applications ASHRAE Handbook, Chapter 47 on Sound and Vibration Control, and achieve an RC (N) Mark II level of 37.

Design classrooms and other core learning spaces to meet the Reverberation Time (RT) requirements of ANSI Standard S12.60-2002, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools. Also design classrooms and other core learning spaces to meet the Sound Transmission Class (STC) requirements, excepting windows, which must meet an STC rating of at least 35.

AND

Option 1

Using the methodology described in Standard S12.60-2002, achieve a maximum unoccupied background noise level in classrooms and other primary learning spaces of:
40 dBA (1 Point)
35 dBA (2 Points)

Option 2

Design classrooms and other core learning spaces using the methodology listed in the 2003 HVAC Applications ASHRAE Handbook, Chapter 47 on Sound and Vibration Control, and achieve an RC (N) Mark II level of:
32 (1 Point)
27 (2 Points)

HVAC background noise

Achieve a maximum background noise level of 40 dBA from heating, ventilating, and air-

conditioning (HVAC) systems in classrooms and other core learning spaces. Follow the recommended methodologies and best practices for mechanical system noise control in ANSI Standard S12.60–2010, Part 1, Annex A.1; the 2011 HVAC Applications ASHRAE Handbook, Chapter 48, Noise and Vibration Control (with errata); AHRI Standard 885–2008; or a local equivalent for projects outside the U.S.

Exterior noise

For high-noise sites (peak-hour Leq above 60 dBA during school hours), implement acoustic treatment and other measures to minimize noise intrusion from exterior sources and control sound transmission between classrooms and other core learning spaces. Projects at least one-half mile (800 meters) from any significant noise source (e.g., aircraft overflights, highways, trains, industry) are exempt.

Reverberation time

Adhere to the following reverberation time requirements.

Classrooms and core learning spaces < 20,000 cubic feet (566 cubic ceters)

Design classrooms and other core learning spaces to include sufficient sound-absorptive finishes for compliance with the reverberation time requirements specified in ANSI Standard S12.60–2010, Part 1, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools, or a local equivalent for projects outside the U.S.

Option 1

For each room, confirm that the total surface area of acoustic wall panels, ceiling finishes, and other sound-absorbent finishes equals or exceeds the total ceiling area of the room (excluding lights, diffusers, and grilles). Materials must have an NRC of 0.70 or higher to be included in the calculation.

OR

Option 2

Confirm through calculations described in ANSI Standard S12.60-2010 that rooms are designed to meet reverberation time requirements as specified in that standard.

Classrooms and core learning spaces ≥ 20,000 cubic feet (566 cubic meters)

Meet the recommended reverberation times for classrooms and core learning spaces described in the NRC-CNRC Construction Technology Update No. 51, Acoustical Design of Rooms for Speech (2002), or a local equivalent for projects outside the U.S.

Exceptions

Exceptions to the requirements because of a limited scope of work or to observe historic preservation requirements will be considered.

HVAC Background noise

Achieve a background noise level of 35 dBA or less from heating, ventilating, and air-conditioning (HVAC) systems in classrooms and other core learning spaces. Follow the recommended methodologies and best practices for mechanical system noise control in ANSI Standard S12.60–2010, Part 1, Annex B; the 2011 HVAC Applications ASHRAE Handbook, Chapter 48, Sound and Vibration Control, with errata; AHRI Standard 885–2008; or a local equivalent.

Sound Transmission

Design classrooms and other core learning spaces to meet the sound transmission class (STC) requirements of ANSI S12.60–2010 Part 1, or a local equivalent. Exterior windows must have an STC rating of at least 35, unless outdoor and indoor noise levels can be verified to justify a lower rating.

For all occupied spaces, meet the following requirements, as applicable, for HVAC background noise, sound isolation, reverberation time, and sound reinforcement and masking.

HVAC Background Noise

Achieve maximum background noise levels from heating, ventilating, and air conditioning (HVAC) systems per 2011 ASHRAE Handbook, HVAC Applications, Chapter 48, Table 1; AHRI Standard 885-2008, Table 15; or a local equivalent. Calculate or measure sound levels.

For measurements, use a sound level meter that conforms to ANSI S1.4 for type 1 (precision) or type 2 (general purpose) sound measurement instrumentation, or a local equivalent.

Comply with design criteria for HVAC noise levels resulting from the sound transmission paths listed in ASHRAE 2011 Applications Handbook, Table 6; or a local equivalent.

Sound Isolation

Meet the composite sound transmission class (STCC) ratings listed in Table 1, or local building code, whichever is more stringent.

Table 1. Maximum composite sound transmission class ratings for adjacent spaces

Adjacency combinations		STC_C
Residence (within a multifamily residence), hotel or motel room	Residence, hotel or motel room	55
Residence, hotel or motel room	Common hallway, stairway	50
Residence, hotel or motel room	Retail	60
Retail	Retail	50
Standard office	Standard office	45
Executive office	Executive office	50
Conference room	Conference room	50

Office, conference room	Hallway, stairway	50
Mechanical equipment room	Occupied area	60

Reverberation Time

Meet the reverberation time requirements in Table 3 (adapted from Table 9.1 in the Performance Measurement Protocols for Commercial Buildings[1]).

Table 3. Reverberation time requirements

Room type	Application	T60 (sec), at 500 Hz, 1000 Hz, and 2000 Hz
Apartment and condominium	—	< 0.6
Hotel/motel	Individual room or suite	< 0.6
	Meeting or banquet room	< 0.8
Office building	Executive or private office	< 0.6
	Conference room	< 0.6
	Teleconference room	< 0.6
	Open-plan office without sound masking	< 0.8
	Open-plan office with sound masking	0.8
Courtroom	Unamplified speech	< 0.7
	Amplified speech	< 1.0
Performing arts space	Drama theaters, concert and recital halls	Varies by application
Laboratories	Testing or research with minimal speech communication	< 1.0
	Extensive phone use and speech communication	< 0.6
Church, mosque, synagogue	General assembly with critical music program	Varies by application
Library		< 1.0
Indoor stadium, gymnasium	Gymnasium and natatorium	< 2.0
	Large-capacity space with speech amplification	< 1.5
Classroom	—	< 0.6

Sound Reinforcement and Masking Systems

Sound Reinforcement
For all large conference rooms and auditoriums seating more than 50 persons, evaluate whether sound reinforcement and AV playback capabilities are needed.

If needed, the sound reinforcement systems must meet the following criteria:

- Achieve a speech transmission index (STI) of at least 0.60 or common intelligibility scale (CIS) rating of at least 0.77 at representative points within the area of coverage to provide acceptable intelligibility.
- Have a minimum sound level of 70 dBA and must
- Maintain sound-level coverage within +/–3 dB at the 2000 Hz octave band throughout the space.

Masking Systems
For projects that use masking systems, the design levels must not exceed 48 dBA. Ensure that loudspeaker coverage provides uniformity of +/–2 dBA and that speech spectra are effectively masked.

[1] Adapted from ASHRAE (2007d), ASA (2008), ANSI (2002), and CEN (2007)

Design the facility to meet or exceed the sound and vibration criteria outlined below, which are adapted from the 2010 FGI Guidelines for Design and Construction of Health Care Facilities ("2010 FGI Guidelines") and the reference document on which it is based, Sound and Vibration Design Guidelines for Health Care Facilities ("2010 SV Guidelines").

Option 1. Speech Privacy, Sound Isolation, and Background Noise (1 point)
Speech Privacy and Sound Isolation

Design sound isolation to achieve speech privacy, acoustical comfort, and minimal annoyance from noise-producing sources. Consider sound levels at both source and receiver locations, the background sound at receiver locations, and the occupants' acoustical privacy and acoustical comfort needs. Speech privacy is defined as "techniques ... to render speech unintelligible to casual listeners" (ANSI T1.523-2001, Telecom Glossary 2007).
Design the facility to meet the criteria outlined in the sections of Table 1.2-3, Design Criteria for Minimum Sound Isolation Performance between Enclosed Rooms, and Table 1.2-4 Speech Privacy for Enclosed Room and Open-Plan Spaces (in the 2010 FGI Guidelines and 2010 SV Guidelines).
Calculate or measure sound isolation and speech privacy descriptors achieved for representative adjacencies as necessary to confirm compliance with the criteria in the 2010 FGI Guidelines, Sections1.2-6.1.5 and 1.2-6.1.6, and the 2010 SV Guidelines (including the appendix).

Background Noise

Consider background noise levels generated by all building mechanical-electrical-plumbing systems, air distribution systems and other facility noise sources under the purview of the project building design-construction team.

Design the facility to meet the 2010 FGI Guidelines, Table 1.2-2 Minimum-Maximum Design Criteria for Noise in representative interior rooms and spaces.

Calculate or measure sound levels in representative rooms and spaces of each type to confirm compliance with criteria in the above-referenced table using a sound level meter that conforms to ANSI S1.4 for type 1 (precision) or type 2 (general purpose) sound measurement instrumentation. For spaces not listed in Table 1.2-2, refer to ASHRAE 2011 Handbook, Chapter 48, Sound and Vibration Control, Table 1.

Option 2. Acoustical Finishes and Site Exterior Noise (1 point)

Meet the requirements for acoustical finishes and site exterior noise.

Acoustical Finishes

Specify materials, products systems installation details, and other design features to meet the 2010 FGI Guidelines, Table 1.2-1, Design Room Sound Absorption Coefficients (including associated sections of the appendix) and the 2010 SV Guidelines.
Calculate or measure the average sound absorption coefficients for representative unoccupied rooms of each type in the building to confirm conformance with the requirements.

Site Exterior Noise
Minimize the effect on building occupants of site exterior noise produced by road traffic, aircraft flyovers, railroads, on-site heliports, emergency power generators during maintenance testing, outdoor facility MEP and building services equipment, etc. Also minimize effects on the surrounding community from all facility MEP equipment and activities as required to meet (1) local applicable codes or (2) Table 1.2-1 of the 2010 FGI Guidelines, Table 1.2-1, and the 2010 SV Guidelines, Table 1.3-1, whichever is more stringent.
Comply with the 2010 FGI Guidelines for the following noise sources:

- heliports, A1.3-3.6.2.2;
- generators, 2.1-8.3.3.1;
- mechanical equipment, 2.1-8.2.1.1;
- building services, A2.2-5.3

Measure and analyze data to determine the exterior noise classification (A, B, C, or D) of the facility site. See the 2010 FGI Guidelines, Categorization of Health Care Facility Sites by Exterior Ambient Sound, Table A1.2a, and the 2010 SV Guidelines, Table 1.3-1.
Design the building envelope composite STC rating based on the 2010 FGI Guidelines, Categorization of Health Care Facility Sites by Exterior Ambient Sound, and show conformance with requirements.
For exterior site exposure categories B, C, or D, calculate or measure the sound isolation performance of representative elements of the exterior building envelope to determine the composite sound transmission class (STCc) rating for representative façade sections. Measurements should generally conform to ASTM E966, Standard Guide for Field Measurements of Airborne Sound Insulation of Building Façades and Façade Elements, current edition.

For all occupied spaces, meet the following requirements, as applicable, for HVAC background noise, sound isolation, reverberation time, and sound reinforcement and masking.

HVAC Background Noise

Achieve maximum background noise levels from heating, ventilating, and air conditioning (HVAC) systems per 2011 ASHRAE Handbook, HVAC Applications, Chapter 48, Table 1; AHRI Standard 885-2008, Table 15; or a local equivalent. Calculate or measure sound levels.

For measurements, use a sound level meter that conforms to ANSI S1.4 for type 1 (precision) or type 2 (general purpose) sound measurement instrumentation, or a local equivalent.

Comply with design criteria for HVAC noise levels resulting from the sound transmission paths listed in ASHRAE 2011 Applications Handbook, Table 6; or a local equivalent.

Sound Isolation

Meet the composite sound transmission class (STCC) ratings listed in Table 1, or local building code, whichever is more stringent.

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Adjacency combinations		STC_C
Residence (within a multifamily residence), hotel or motel room	Residence, hotel or motel room	55
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Laboratories	Testing or research with minimal speech communication	< 1.0
	Extensive phone use and speech communication	< 0.6
Church, mosque, synagogue	General assembly with critical music program	Varies by application
Library		< 1.0
Indoor stadium, gymnasium	Gymnasium and natatorium	< 2.0
	Large-capacity space with speech amplification	< 1.5
Classroom	—	< 0.6

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For all large conference rooms and auditoriums seating more than 50 persons, evaluate whether sound reinforcement and AV playback capabilities are needed.

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- Have a minimum sound level of 70 dBA and must
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Masking Systems
For projects that use masking systems, the design levels must not exceed 48 dBA. Ensure that loudspeaker coverage provides uniformity of +/–2 dBA and that speech spectra are effectively masked.

[1] Adapted from ASHRAE (2007d), ASA (2008), ANSI (2002), and CEN (2007)

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Design classrooms and other core learning spaces to meet the Sound Transmission Class (STC) requirements of ANSI Standard S12.60-2002, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools, except windows, which must meet an STC rating of at least 35. Projects outside the U.S. may use a local equivalent to ANSI Standard S12.60-2002.

AND

Background noise

Reduce background noise level[1] to 40 dBA or less from heating, ventilating and air conditioning (HVAC) systems in classrooms and other core learning spaces.