Summary of ANSI S12.60-2002

"Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools"

This summary is not meant to take the place of the full standard. The complete standard is available online from the Acoustical Society of America. The text in italics is supplemental information provided by Technological Design Studios and is not a part of the actual standard.

Background Noise Levels

Background noise is comprised of noise from building systems, exterior sound transmission, and sound transmission from adjacent spaces. Excessive background noise can seriously degrade the ability to communicate.

For core learning spaces with internal volumes of 20,000 cubic feet or less, one-hour steady-state background noise levels should not exceed **35 dBA**.

For core learning spaces with internal volumes of 20,000 cubic feet or more, one-hour steady-state background noise levels should not exceed **40 dBA**.

If the noisiest one-hour period during which learning activities take place is dominated by transportation noise, the maximum noise limits are increased by 5 dB.

Controlling the background noise levels within a space involves careful consideration of several building systems. Noise from HVAC, electrical fixtures, light fixtures, and plumbing systems should all be considered in the noise control design. According to this standard, it is the architect or designers responsibility to specify systems and installation methods in order to meet the background noise levels required in the standard. The implementation of the noise control design is the responsibility of the contractor.

The standard goes on to list several minimum specifications for HVAC systems including selection of grilles and diffusers, airflow velocities, and duct lining. Light fixtures with low-noise ballasts are recommended in learning spaces. Several suggestions are outlined to limit noise from the plumbing system including, locate restrooms away from classrooms, do not run piping above learning spaces, use cast iron waste water pipes when possible, and resiliently isolate all water piping from the structure. An important issue that is mentioned in the standard is planning. One of the best ways to reduce problems with background noise is to isolate quite areas, such as classrooms, from noisier areas, such as mechanical equipment rooms.

Exterior sound transmission can also contribute to background noise. In order to limit this concern, issues to consider in the design of a new school include, site location, existing exterior noise levels at the site, and prediction of future noise levels.

The background noise levels specified in this standard are very stringent. In order to meet the specified levels, a designer will need to consider background noise while in the design phase. Locate noisy areas away from quieter areas. You will also need to work closely with the mechanical engineer to specify an adequate HVAC system. A Noise Criteria of approximately 25-35 will be required. Also discuss sound control options with the plumbing and electrical engineers.

Reverberation Time

Although some reverberation within a space can aide in speech distribution, longer reverberation times will cause a build-up of noise and degrade speech intelligibility.

The maximum reverberation time for core learning spaces with internal volumes of greater than 10,000 cubic feet should not exceed **0.6 seconds**.

For core learning spaces with internal volumes of more than 10,000 but less than 20,000 cubic feet the maximum reverberation time is **0.7 seconds**.

Reverberation time for spaces with more than 20,000 cubic feet of internal volume is not specified, however, guidelines are given in Annex C of the standard.

The reverberation time within an existing space can be tested with special equipment. Calculations can be done in order to determine what the reverberation time will be in a proposed new space. An explanation of the formulas and how they work can be found in Annex C of the standard.

Variables that affect the reverberation time include the volume of the space and the amount of sound absorption within the room. In order to determine the amount of sound absorption, a material's absorption coefficient multiplied by the surface area for that material must be calculated. Once the amount of absorption for each material has been calculated, the sum of these will give the total amount of sound absorption within the room. Laboratory-certified sound absorption coefficients should be available from the manufacturer of the material.

It is the designer or architect's responsibility to ensure that a space meets the required reverberation times by providing the appropriate amount of absorptive materials.

In order to achieve the required reverberation time, acoustical treatments will be necessary on either the walls or the ceiling, or most likely both. There are several options of acoustical treatments available. If reverberation time is considered in the design phase, the acoustical treatments can be a part of the design rather than an unwanted addition.

Sound Transmission Class

The amount of airborne sound blocked from transmitting through a partition is measured in a Sound Transmission Class (STC) rating. A higher STC rating will Sound transmission through walls will add to the background noise level in the space, degrading the ability to hear and understand speech.

Single or composite walls, floor-ceiling and roof-ceiling assemblies should provide specific sound transmission class (STC) ratings when separating a core learning space from an adjacent space:

- **STC-45** if the adjacent space is a corridor, staircase, office or conference room,
- **STC-50** if the adjacent space is another core learning space, speech clinic, health care room or outdoors,
- **STC-53** if the adjacent space is a restroom,
- **STC-60** if the adjacent space is a music room, mechanical equipment room, cafeteria, gymnasium or indoor swimming pool.
- Classroom doors should be rated as **STC-30** or more, and music room doors as **STC-40** or more. Entry doors across a corridor should be staggered to minimize noise transmission.
- STC ratings ranging from **45-60** are outlined for assemblies separating ancillary spaces from adjacent spaces.
- (Note: Open-plan classroom designs will not meet the requirements of this standard.)

Achieving a specific STC rating depends highly on the materials and the installation methods used. Wall and ceiling assemblies can be specified and detailed to meet a required STC rating. This is the architect or designer's responsibility. However, specifying an STC level is not all that will be required. It is important to note that sound transmission can be strongly affected by sound leakage through penetrations, joints, and over or around the structure.

The number and location of penetrations through the wall, as well as the number and location of electrical outlets should be considered in the design. In order to meet a specified STC, installation methods become crucial. Placement and installation instructions for the electrical system are given within Annex B in order to limit sound transfer between rooms. For single stud walls, electrical boxes should not be located within the same stud space. For staggered or Dual stud walls, boxes should be separated by at least 24". If back-to-back electrical boxes cannot be avoided, they should be enclosed in full gypsum board enclosures that do not contact the framing of the other row of studs. Additionally, all joints and air gaps should be sealed air tight with caulking or acoustical sealant.

As mentioned previously, background noise is a major concern in learning facilities. STC ratings will help to limit the background noise levels within a space (depending on the effect of sound transmission on the background noise level). It may be necessary to increase a required STC rating in order to meet a specified background noise level requirement.

Sound transmission problems can be avoided or lessened by good site selection and good space planning.

Typical, single stud construction will not meet the required STC ratings. The walls will most likely require staggered or dual stud construction and/or multiple layers of drywall. (There are also specialty products that can help ensure compliance.) It is also important to note that acoustical ceiling tiles will not prevent sound transmission over the wall. Walls surrounding core learning spaces should extend to the deck of the building structure in order to adequately control sound transmission.

Carefully consider the placement of electrical outlets. Do not place them back-to-back. Again it will be important to work with your electrical engineer in order to specify installation instructions that will limit sound transmission. Specify on your drawings for contractors to seal all joints and penetrations with an acoustical sealant.

Most importantly, do not locate mechanical equipment rooms, restrooms, music rooms, gymnasiums, cafeterias, or any other noisy space adjacent to a classroom or core learning space.

Impact Insulation Class

Impact Insulation Class (IIC) is a rating for the ability of a floor-ceiling assembly to block impact/structure borne noise from transmitting to the space below. A floor-ceiling assembly with a low IIC rating will potentially cause distracting noise in the room below, leading to possible annoyance and problems with communication.

- IIC ratings for floor-ceiling assemblies above core learning spaces should be at least **IIC-45** and preferably **IIC-50** (measured without carpeting on the floor).
- In new construction, gymnasia, dance studios or other high floor impact activities shall not be located above core learning spaces.
- In existing facilities **IIC-65-70** (depending on the volume of the space below) is recommended if gymnasia, dance studios or other high floor impact activities are located above core learning spaces.

IIC is a major concern for multi-story educational facilities. The floor-ceiling system should be specified and constructed in order to meet the specified IIC rating. Installing carpet on the floor above will help reduce impact sounds. It may be necessary to isolate the finished floor from the structural floor or to isolate the ceiling from the floor above. For any vibrating machinery located on the floor above or on the roof structure, rubber pads or spring

systems should be installed. As with all requirements in the standard, it is the architect or designers responsibility to make the necessary steps in specification and design, but careful construction and installation will be necessary to ensure compliance.

This is not only a concern for multi-story schools. Adjacent rooms can also transmit vibration based noise. In many cases, installing carpet on the floor above will dramatically improve the IIC rating. In order to achieve the specified levels, a separate airtight ceiling assembly could be required. Ideally, this would be completely isolated from the floor structure above. The classroom below may still need an acoustically absorptive ceiling treatment in order to meet the required reverberation time. Working with your mechanical engineer, be sure to specify appropriate vibration dampening measures for mechanical equipment.

Verify Conformance

Annex E of the standard goes on to outline architectural practices and procedures to verify conformance with the standard. Steps include, design to conform, monitor activities during construction, check for conformance before completion of construction is accepted.

Testing is not required by the standard but should be done in order to verify conformance. An acoustical consultant can test background noise levels, reverberation time, STC and IIC using special testing equipment. The standard itself gives conformance tolerances in each area

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