Drywall Contractor Online Training

Basics of Acoustics

Sound Transmission Training Module

CertainTeed
SAINT-GOBAIN
Gypsum

Benefits of Sound Control

- Unwanted sounds can adversely affect building occupants
- Noise can originate from adjacent areas in a building, as well as from the exterior
- Noise can negatively impact people's hearing ability, diminish productivity, and obstruct learning
- Noise can affect occupant comfort and safety

Knowledge of the physics of sound is helpful in understanding how to control it

Acoustic Comfort Drivers

- Commercial
  - IgCC – International Green Construction Code - Acoustics Sect 807
  - LEED for Schools and Healthcare – specific acoustic requirements
  - ANSI S12.60-2002 Acoustical Performance Criteria Requirements and Guidelines for Schools
  - HIPAA - *Health Insurance Portability and Accountability Act*
  - Hotel / Motel design is getting more sophisticated and specific on room acoustics

Acoustic Comfort Drivers

- Residential
  - Separation walls in multi-family building codes
    - Noise typically #1 or #2 issue for construction lawsuits in multi-family
  - Media Rooms or Home Theaters are one of the top requested home “upgrades” in a recent NAHB survey
  - Trend to locate laundry room near bedrooms for convenience
  - Light-weight board trend creates a latent opportunity in promoting enhanced acoustic performance
  - Builders are trying to identify and leverage additional upgrade options where improved acoustics provide a benefit:
    - Home offices
    - Multi-generation suites

Science of Sound

Science of Sound

- Acoustics is the science of sound including its production, transmission and effects
- Sound is what we hear when pressure variations in the air vibrate our eardrums
- Sound waves can travel through any media (air, water, wood, steel, etc.)
- Unwanted sound is classified as noise
- To minimize unwanted sounds learn how to use acoustical products and systems – but first understand the science of sound

Sound Paths

- Airborne sound – radiates from a source directly into the air.

  Examples:

  - Passing traffic
  - Music
  - Voices in the next room

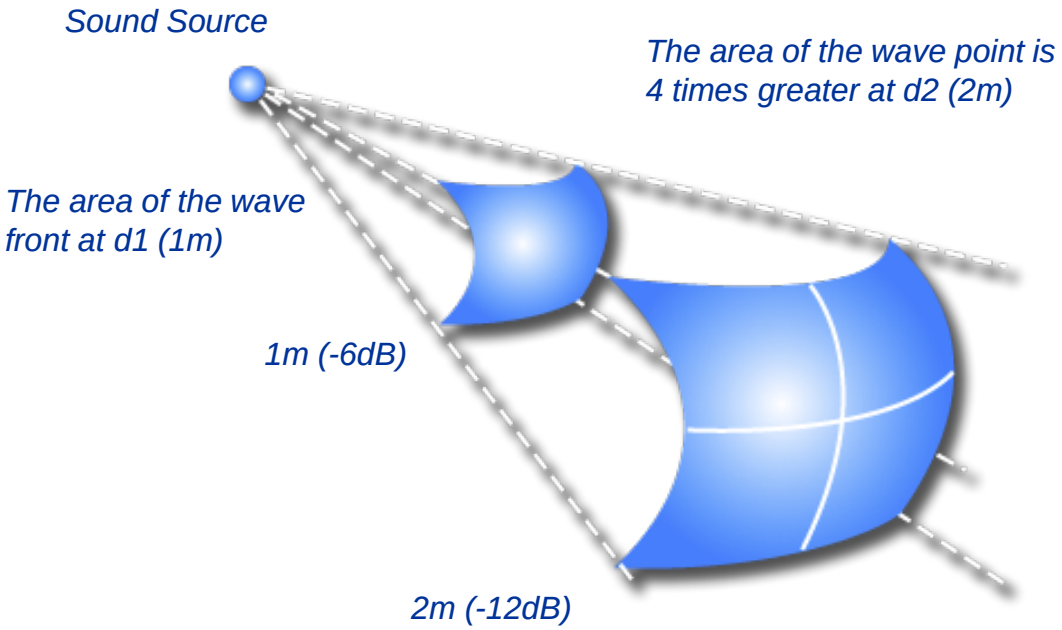
- Structure borne sound – travels through solid building materials.

  Examples:

  - Footsteps from the floor above
  - A knock at the door

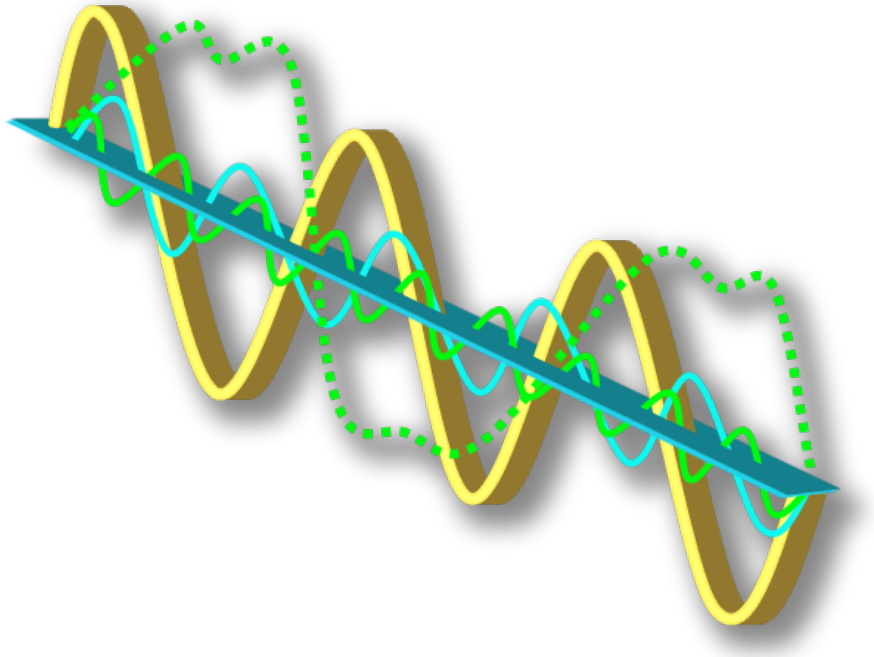
Sound Wave Propagation

- Sound waves spread in three dimensions, as expanding spheres of pressure waves
- Sound waves radiate directly around the source, decreasing in amplitude the further they get from the source



Frequency (Pitch)

- Frequency is the number of cycles per second made by a sound wave
- Frequency is expressed in Hertz (Hz)
- The sound we hear is usually radiated in all directions from a sound source
- Human hearing range is 16 Hz to 20,000 Hz



Typical Sound Pressure Levels

- Whisper 20 dB
- Avg. Conversation 50 dB
- Noisy Office 80 dB
- Subway Train 100 dB
- Thunder 115 dB
- Pain Threshold 120 dB

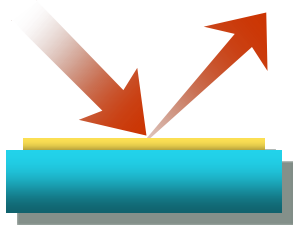
What do we hear?

Perception of dB change…

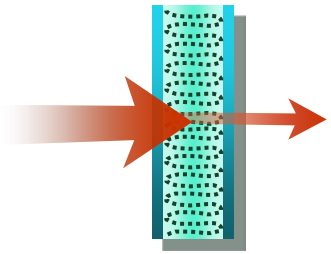
Change in sound level	*Perception of loudness*
+/- 1 dB	*Can not be heard (Not perceivable)*
+/- 3 dB	*Can just be heard (Just perceptible)*
+/- 5 dB	*Noticeable difference*
+/- 10 dB	*Twice (or half) as loud*
+/- 15 dB	*Large change*
+/- 20 dB	*Huge change, four times (or ¼) as loud*

Four ASTM Test Methods for Acoustical Performance

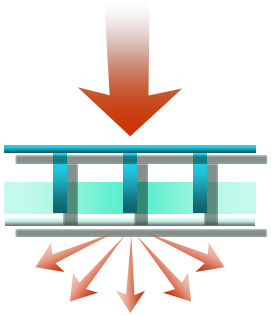
Building materials and systems are tested for:



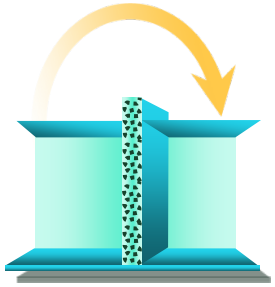
Sound Absorption



Airborne Sound Transmission



Impact Sound Transmission



Airborne Sound Transmission through Suspended Ceilings

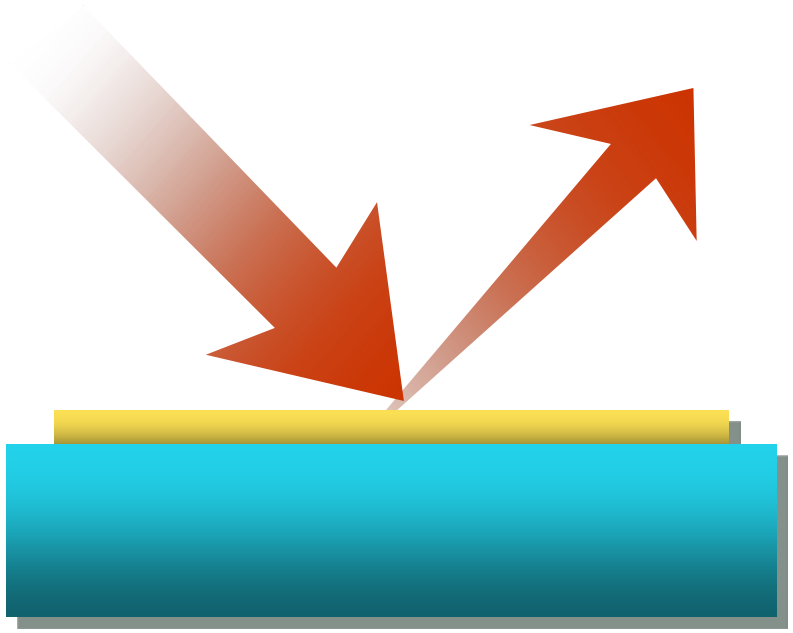
Sound Absorption

- Sound absorption is the ability of a material to absorb rather than reflect sound waves

Sound Absorption

Specification: NRC or SAA

Sound control within rooms



Airborne Sound Transmission

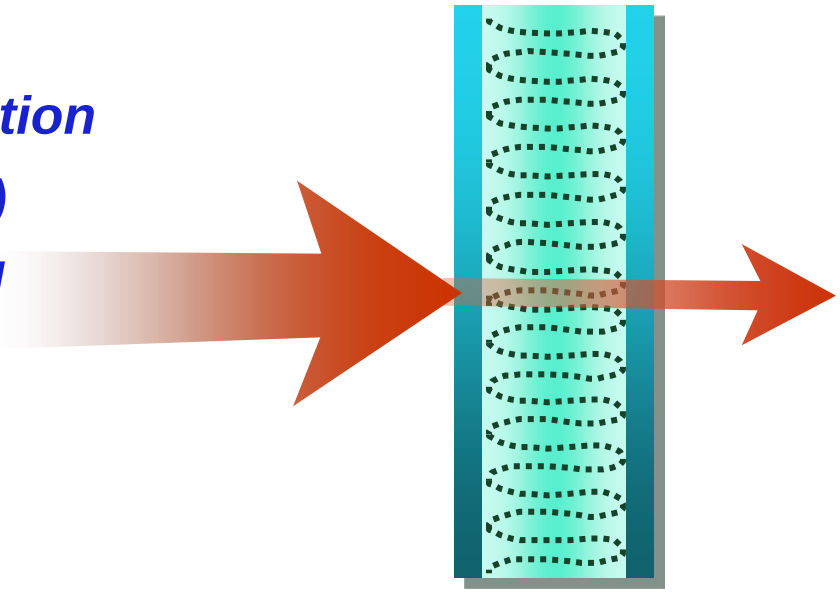
Sound Transmission

- Sound transmission loss is the decrease in sound energy expressed in decibels of airborne sound as it passes through a building construction

Sound Transmission Classification

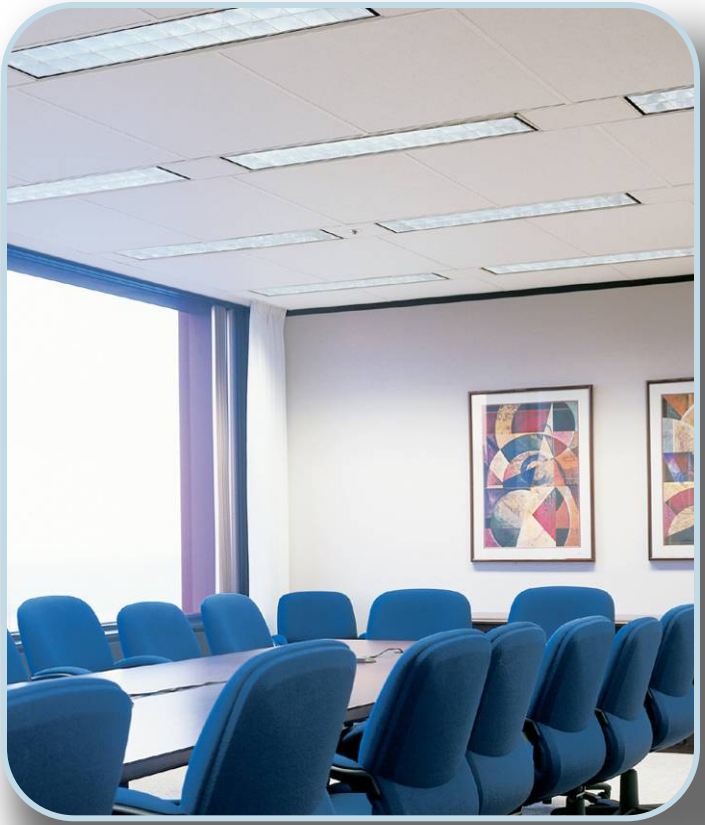
Specification: FSTC (Field STC)

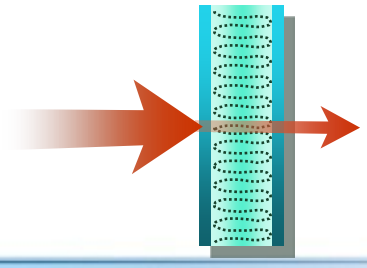
Control of room-to-room sound transmission



Airborne Sound Transmission Measurements (ASTM E90)

- Sound Transmission Class (STC)
- A single number rating for evaluating the efficiency of systems
- The higher the STC rating, the better
- A rule of thumb is that a 10 point increase in the STC value will decrease the perceived noise by one half



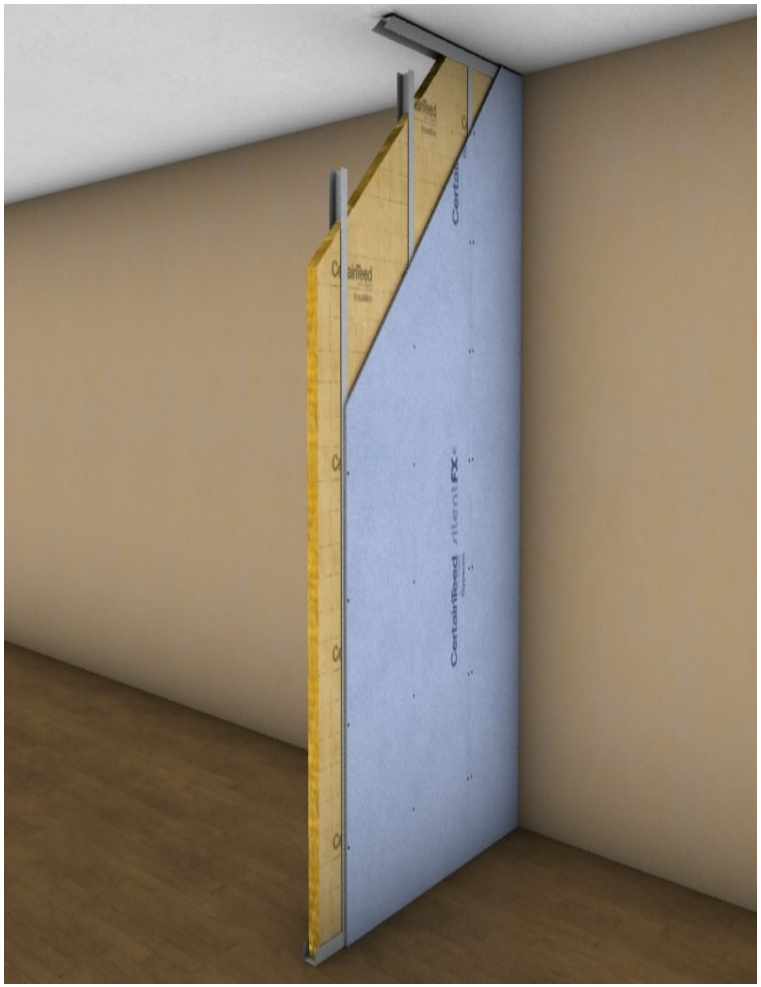


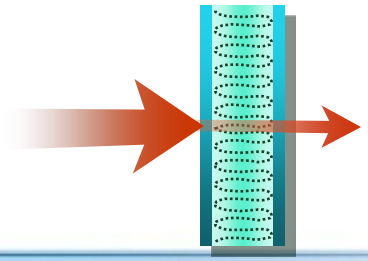
Controlling Sound through Building Assemblies

- Steel stud partition walls
- Wood stud partition walls
- Wood joist floor-ceiling assemblies
- Metal buildings
- Concrete floors

Steel Stud Partition Walls

- Steel studs are acoustically resilient
- Air sealing improves sound control
- Significant increase in acoustical performance by adding CertainTeed Thermal & Acoustical fiberglass cavity insulation.
- Similar increase by using SilentFX instead of standard drywall.

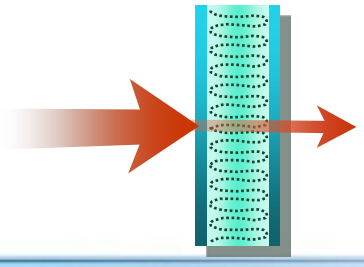


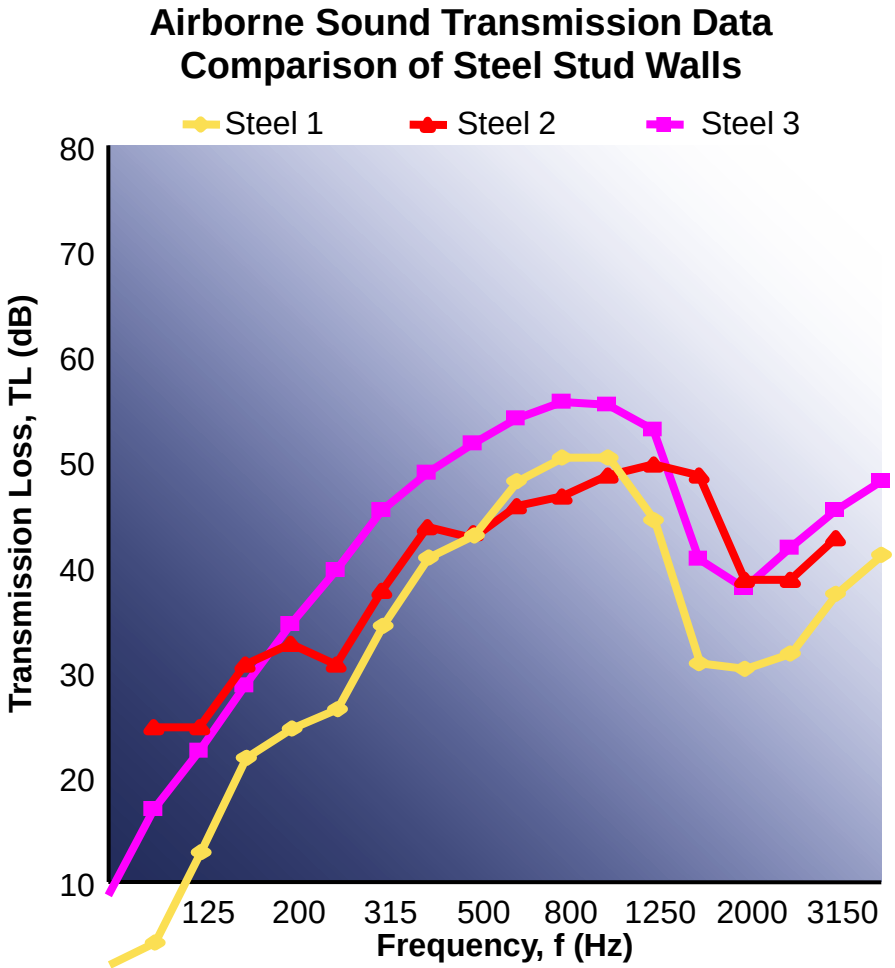


CertainTeed
SAINT-GOBAIN

Steel Stud Partition Walls

- Steel 1 – STC 38
  Standard construction
- Steel 2 – STC 50
  Double layer of standard drywall, no cavity insulation, air sealed
- Steel 3 – STC 57 or greater
  5/8” SilentFX with 3-1/2" [90 mm] CertainTeed Thermal & Acoustical Fiber Glass Insulation

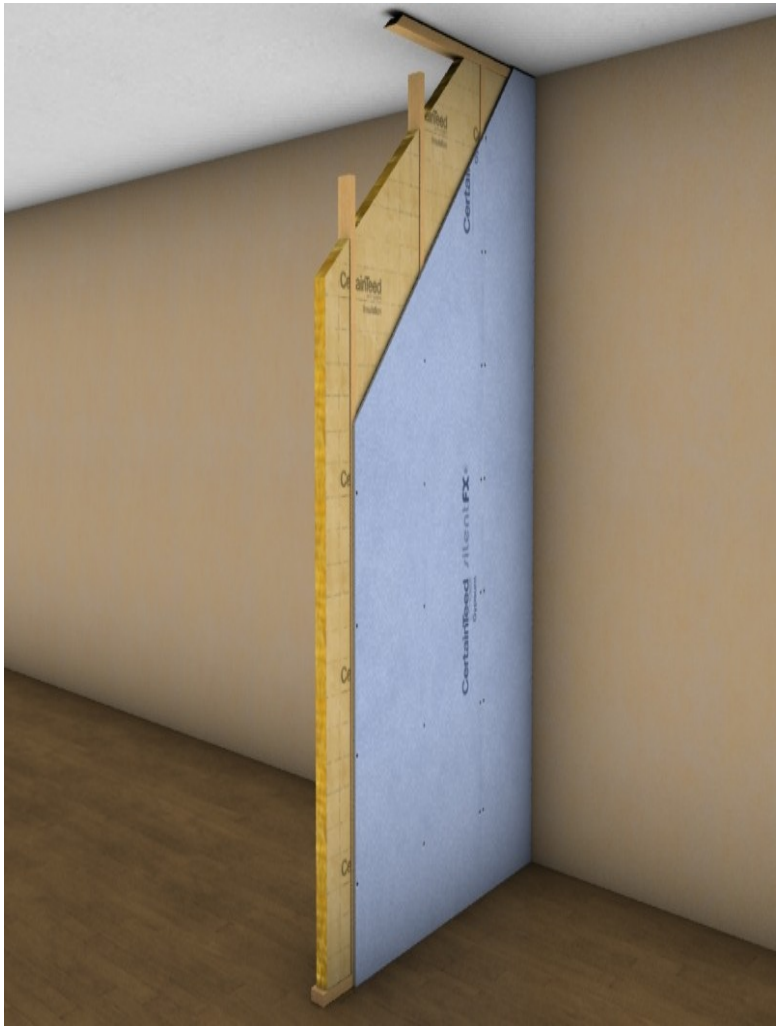


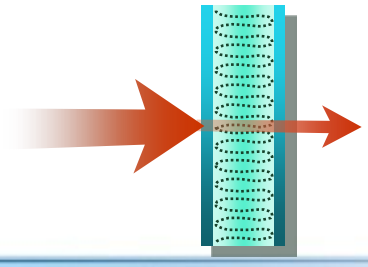


CertainTeed
SAINT-GOBAIN

Wood Stud Partition Walls

- Wood studs are acoustically stiff
- Air sealing improves sound control
- Adding CertainTeed Thermal & Acoustical fiberglass cavity insulation increases STC 2-3 points
- Increase in acoustical performance by mounting SilentFX to resilient channel.

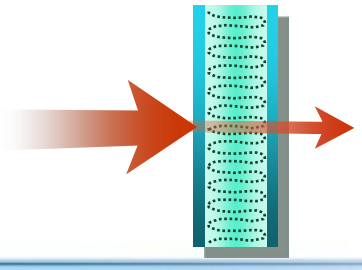


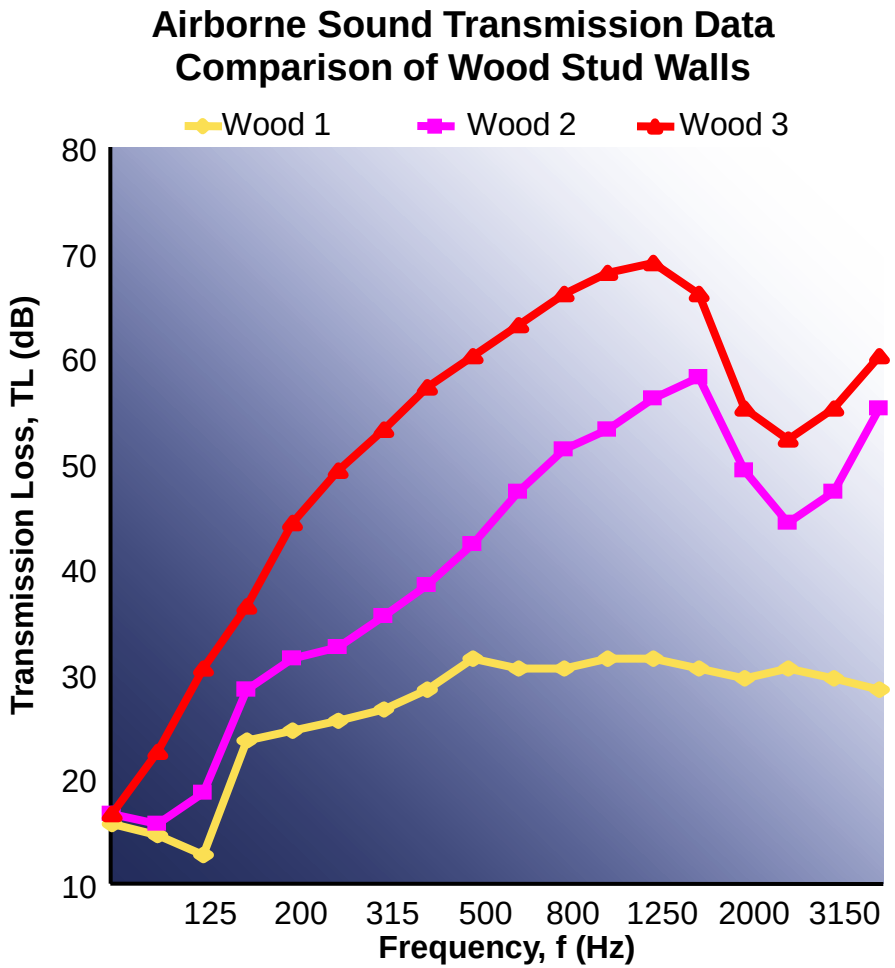


CertainTeed
SAINT-GOBAIN

Wood Stud Partition Walls

- Wood 1 – STC 29
  Standard construction
- Wood 2 – STC 46
  Standard 5/8” construction adding cavity insulation and air seal
- Wood 3 – STC 56 or greater (system dependent) adding CertainTeed Thermal & Acoustical fiberglass insulation, mounting SilentFX to resilient channel and air seal





CertainTeed
SAINT-GOBAIN

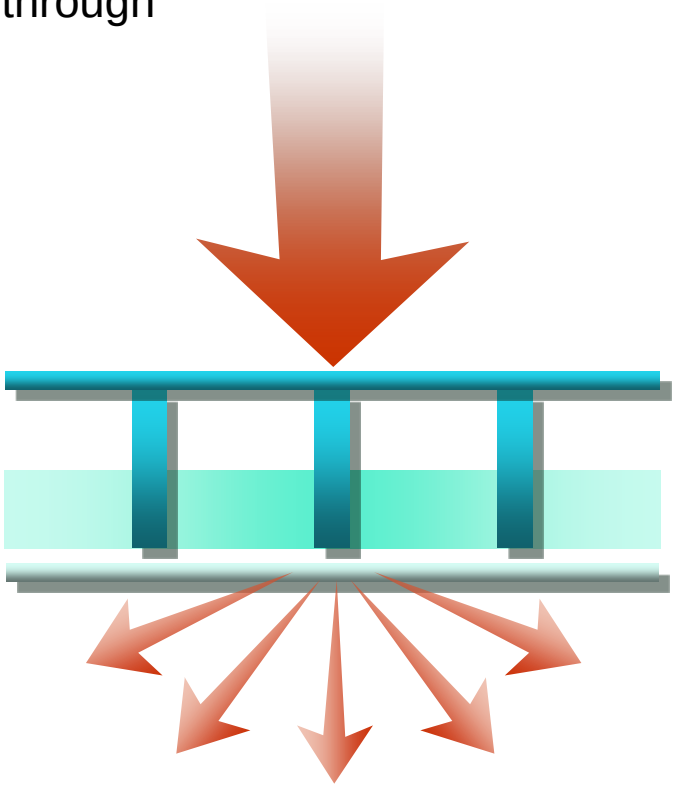
Impact Sound Transmission

- Impact sound transmission loss is expressed in decibels of airborne sound. This decrease in sound energy is measured after it passes through a floor-ceiling assembly.

Impact Insulation Class

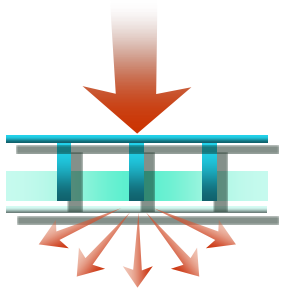
Specification: FIIC (Field)

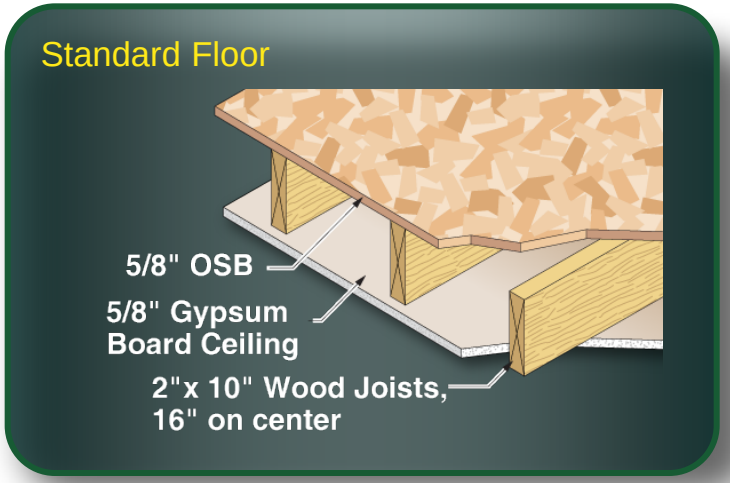
Control of floor-to-ceiling impact sound transmission.

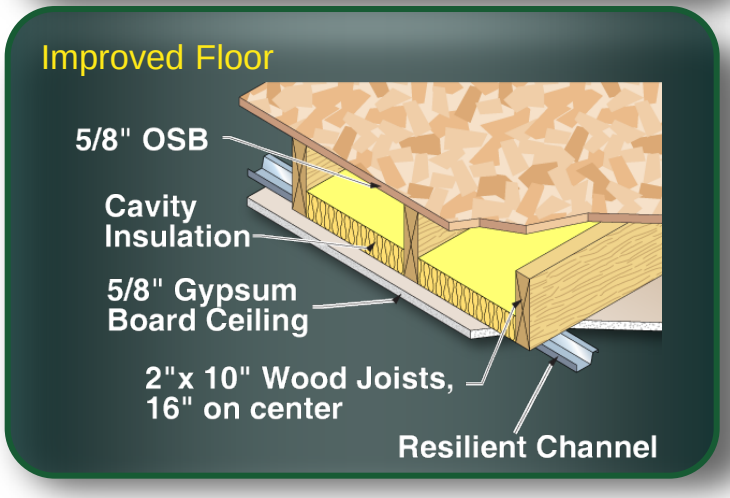


Wood Joist Floor-Ceiling System

- Wood joists are acoustically stiff
- Air sealing improves sound control
- Adding cavity insulation only increases IIC 1-2 points due to the strong structural tie between the finishing materials and the frame







Designing Environments for Sound Control

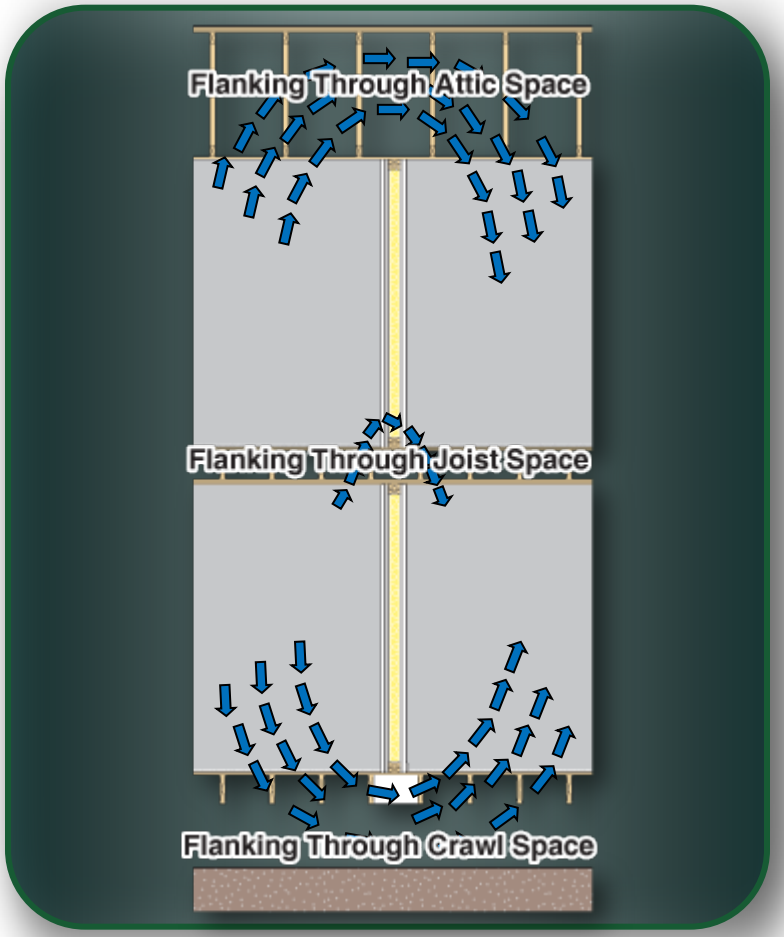
CertainTeed
SAINT-GOBAIN

Controlling Sound Flanking

- The following recommendations are based on ASTM E497 “Standard Practice for Installing Sound-Isolating Lightweight Partitions”
- Increase the acoustical performance of sound control building assemblies by:
  - Controlling air leakage
  - Isolating structure borne sound paths
  - Compartmentalizing spaces

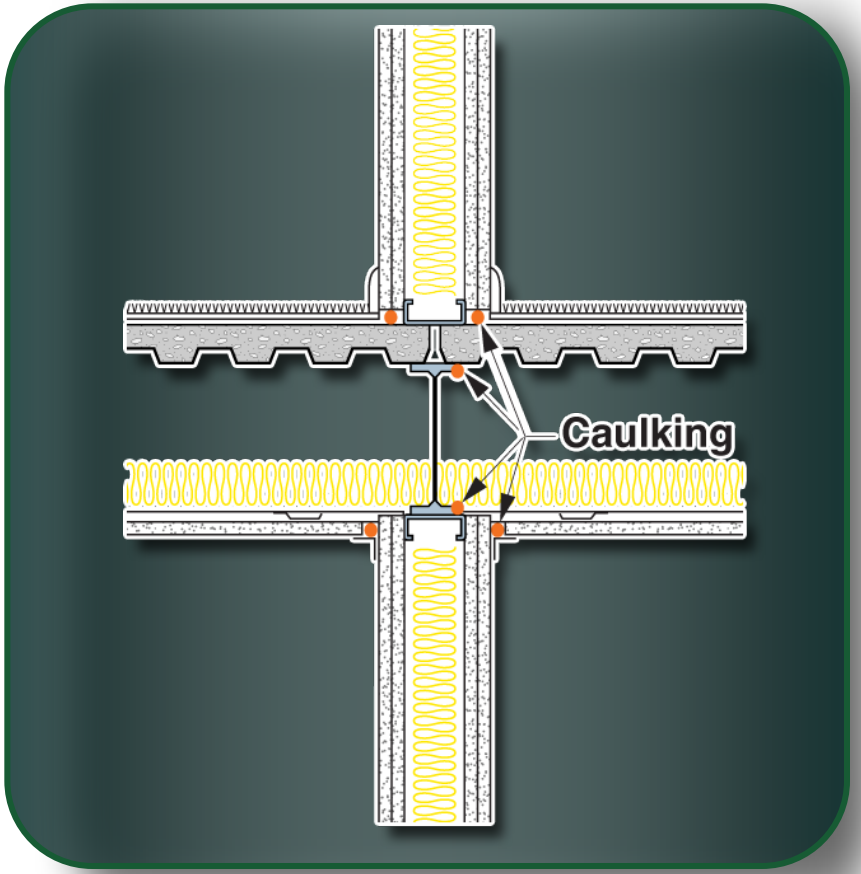
Sound Flanking Paths

- Sound energy “leaks” through paths of least resistance
- Sound is transmitted around acoustical partitions
- Blocking above, between and under partitions ensures maximum sound control



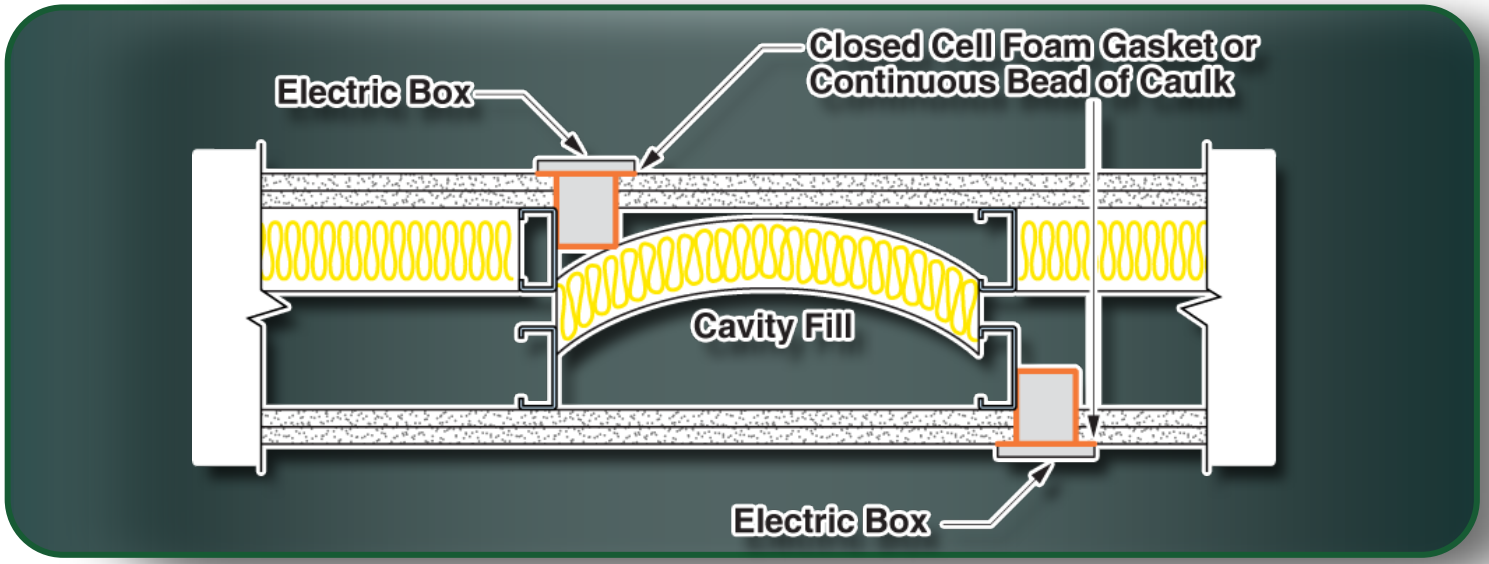
Air Sealing is Important

- Air seal barrier with acoustical sealant to increase the sound blocking benefit



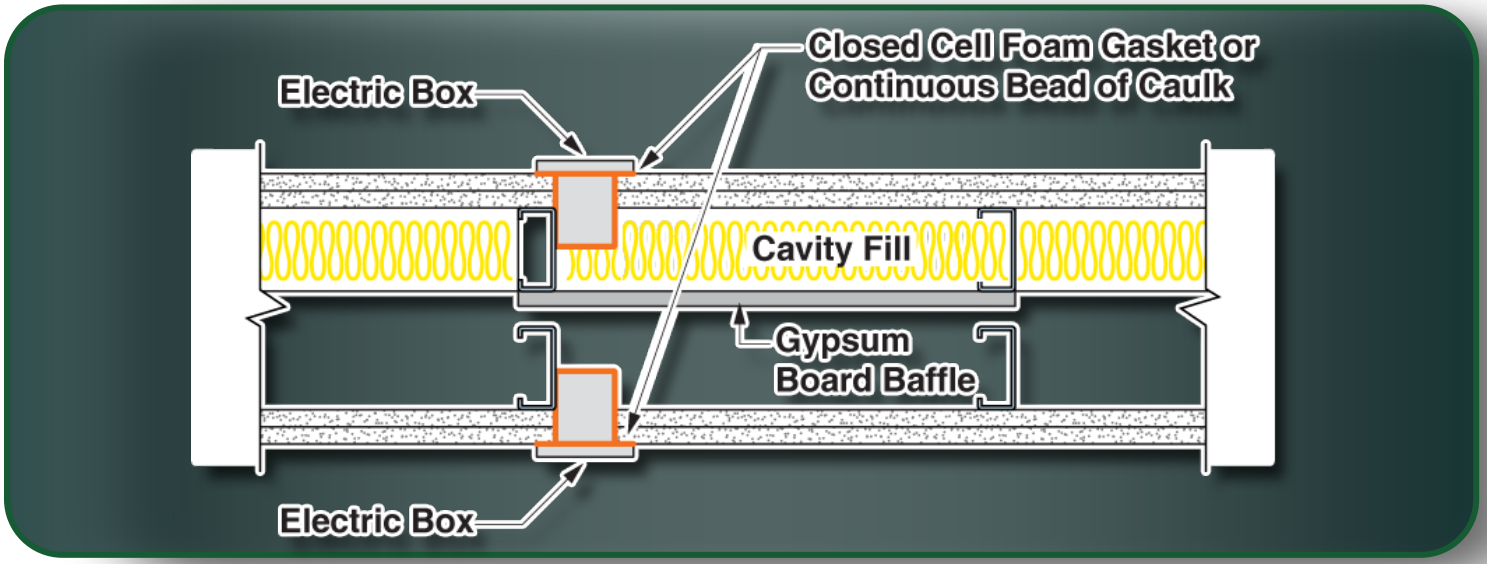
Electrical Outlet Treatments

- Air seal electrical outlets
- Stagger outlet locations to reduce direct sound paths



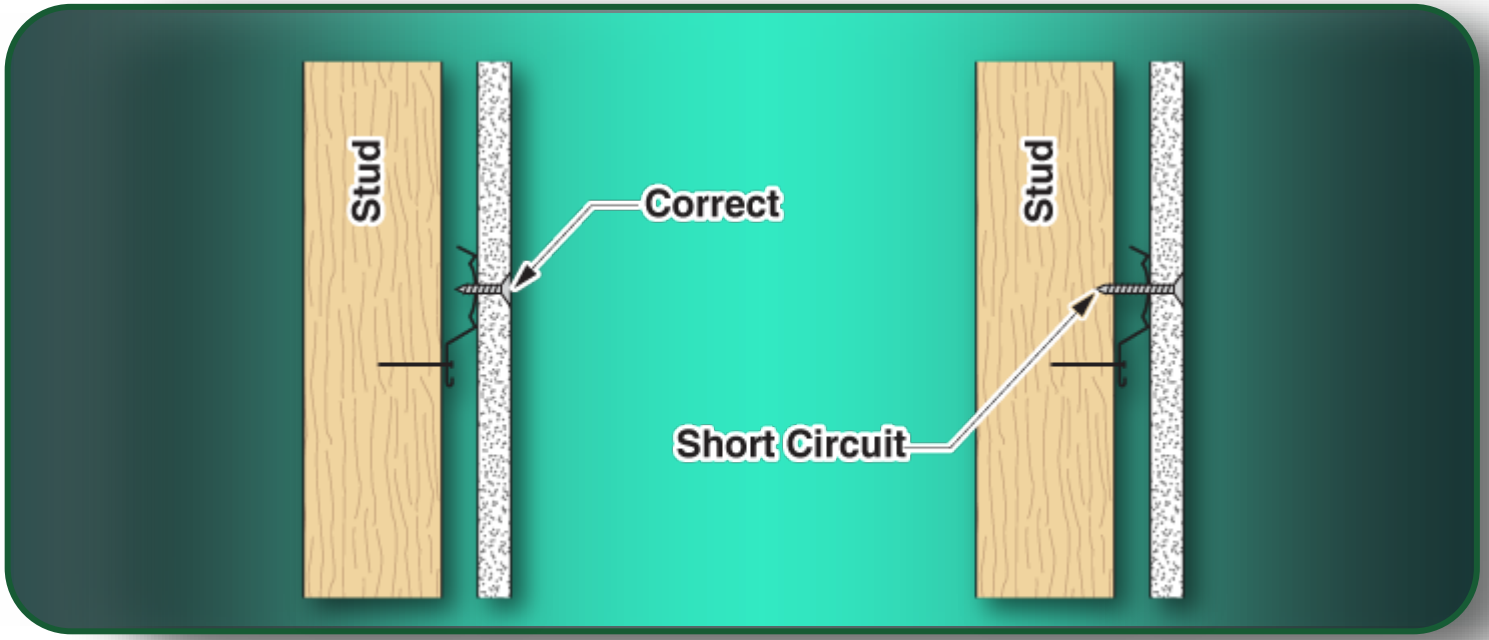
Electrical Outlet Treatments

- If outlets are not staggered, block direct paths between outlets with sound barrier



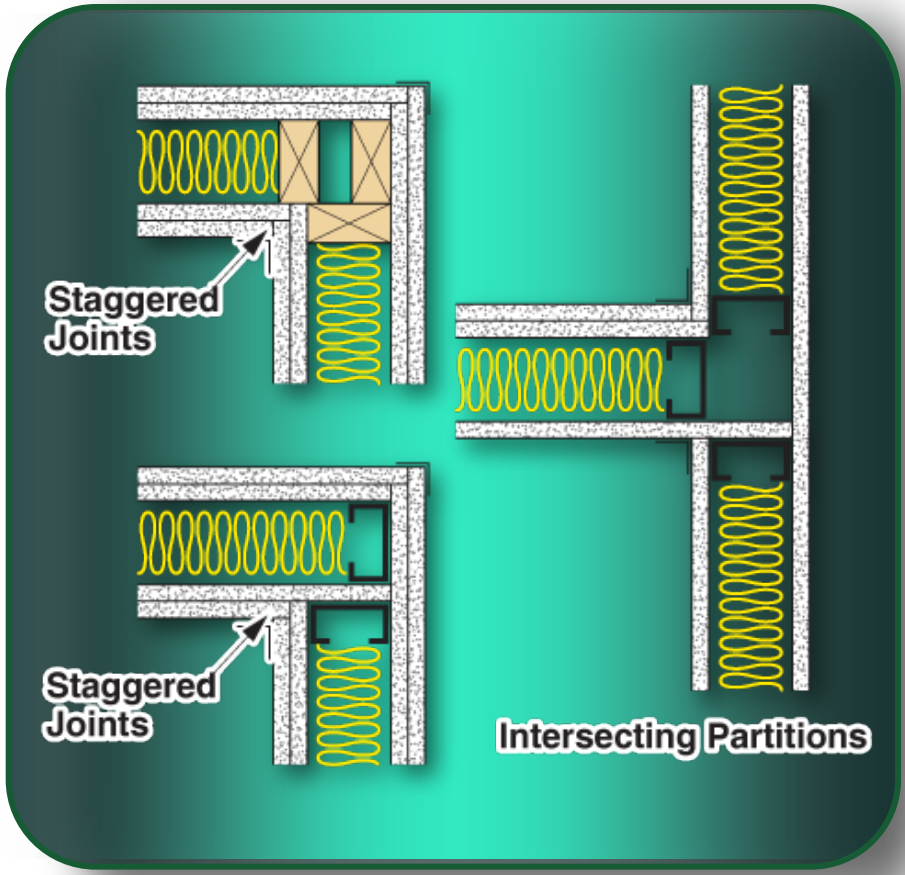
Potential Negative Impact of Fasteners

- Ensure that drywall fasteners do not short circuit resilient channel sound isolation



Wall/Corner & Floor/Ceiling Intersections

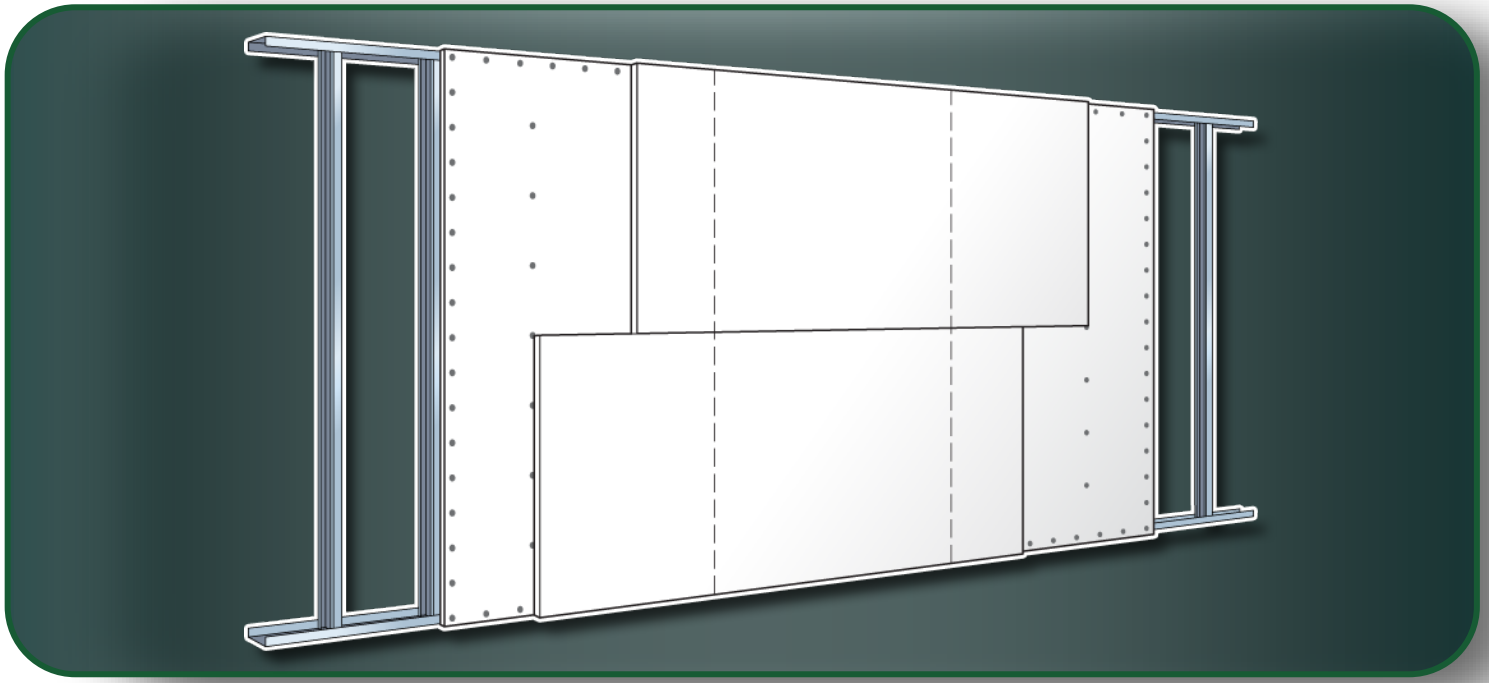
- Minimize direct contact between adjacent studs to reduce sound transmission
- Stagger drywall joints to minimize sound paths



CertainTeed
SAINT-GOBAIN

Gypsum Board Attachment

- Stagger gypsum board seams to reduce sound transmission



Additional References

Sound Control For Commercial And Residential Buildings

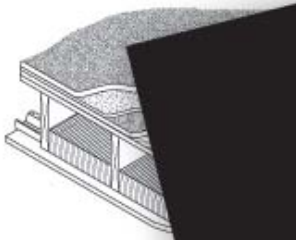
NAIMA

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION

www.naima.org

Typical Floor/Ceiling Assemblies

STC-53 IIC-73 (Figure 25)



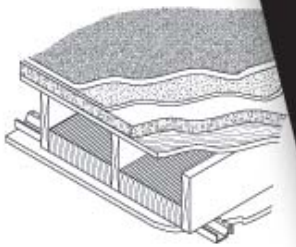
Wood Floor

Carpet and pad, ⅜" particle bo
2x10 joists 16" o.c., one thickn
insulation, resilient channel, ½"

Fire Rating – 1 hr.

Variation	Construction	IIC
25A	*No resilient channel* *No insulation*	60
25B	*½" plywood floor* ⅜" plywood subfloor	72
25C	*Vinyl floor* *Instead of carpet and pad*	49

STC-58 IIC-74



Concrete Floor

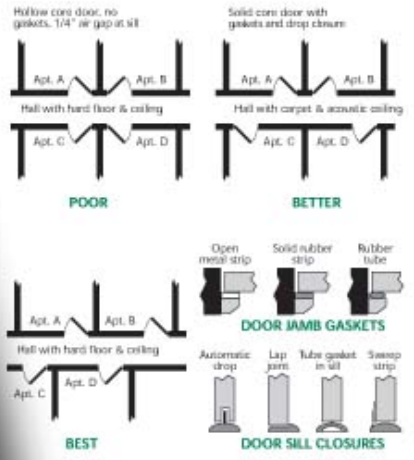
Carpet and pad, 1⅝" lightweight concrete floor, ¾"
wood subfloor, 2x10 joists 16" o.c., one thickness
fiber glass batt insulation, resilient channel, ½" Type
sum board.

Fire Rating – 1 hr. est.

Variation	Construction	IIC	STC	Fire Rat
26A	*No resilient channel* *No insulation*	59	47	NR
26B	*2x8 joists,* *1¾" lightweight concrete floor*	74	53	NR
26C	*2x8 joists,* *Vinyl floor* *Instead of carpet and pad*	47	50	NR

* *Single* – one wall finish each side *Unbalanced* – one wall finish one s
Partitions with STC ratings within 1-2 points of the listed criteria are acceptable given th
of 1-2 dB on identical configurations are not unusual. (Subjectively, the human ear wo

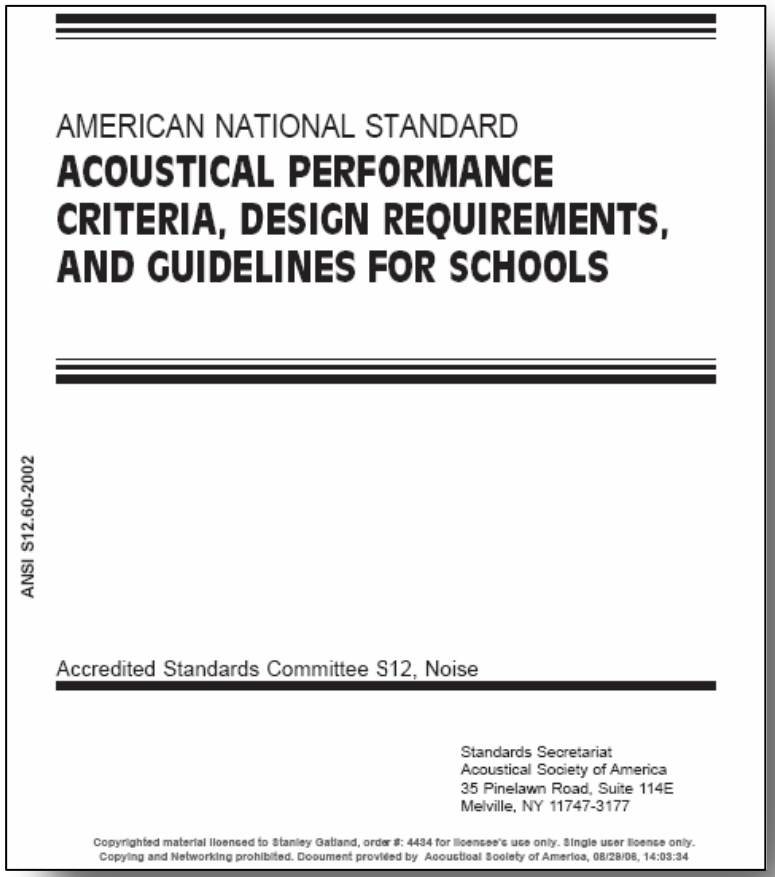
Methods



Acoustical Performance Required for Schools

– **ANSI S12.60-2002**

- Equipment noise control
  - HVAC systems
  - Electrical systems
  - Plumbing systems
  - Instructional equipment
- Minimum background noise limit of 35 dB
- Controlling reverberation with sound-absorbing materials
- Noise isolation
  - Between interior spaces
  - Open-plan classrooms
  - Outdoor-to-indoor
  - Impact sound
  - Vibrating machinery


AMERICAN NATIONAL STANDARD

ACOUSTICAL PERFORMANCE CRITERIA, DESIGN REQUIREMENTS, AND GUIDELINES FOR SCHOOLS

ANSI S12.60-2002

Accredited Standards Committee S12, Noise

Standards Secretariat
Acoustical Society of America
35 Pinelawn Road, Suite 114E
Melville, NY 11747-3177

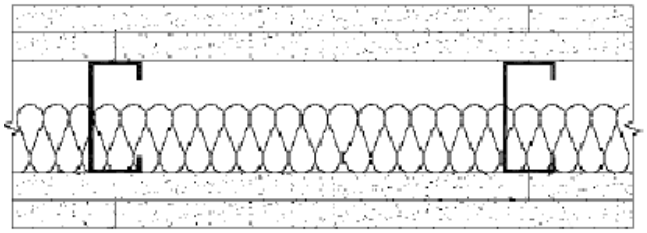
CertainTeed
SAINT-GOBAIN

What is SilentFX?

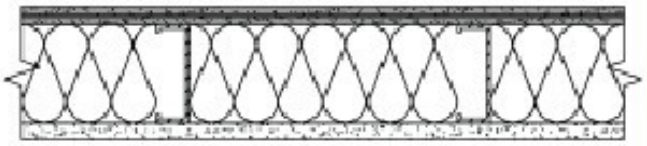
- A noise-reducing gypsum board specifically designed for systems requiring high STC ratings
- Features viscoelastic applied between two specially formulated gypsum boards with a dense gypsum core
- Enclosed in 100% recycled moisture and mold paper
- Fire (Type X only) and abuse resistant
- Available in 1/2” regular & 5/8” Type X

Why use SilentFX vs traditional methods?

- More reliable than clips and channels
  - Board cannot be short circuited during or after installation
  - More consistent lab to field STC results
- Improves performance across all frequency ranges
  - Addresses high and low frequency noises that double layer gypsum board cannot
- Square foot savings
  - Achieves high STC ratings with less material allowing for thinner wall systems



Without SilentFX: STC 55
Wall thickness: 6.125”



With 1 layer of SilentFX: STC 57
Wall thickness: 4.875”

Tools Available

- SilentFX Microsite – www.certainteed.com/silentfx
- “dB Station” iPad or Android application

Knowledge Test

1. All of the following are drivers of the acoustic building marketplace except:

A. Laundry room being placed near bedroom for convenience

B. Building codes such as IgCC or LEED

C. Smaller closets mean less clothes to help block sound from one room to another.

D. Unwanted sound (noise) can affect occupant comfort and safety.

Knowledge Test

2. Sound waves are capable of travelling though:

A. Air

B. Water

C. Wood

D. All of the above

Knowledge Test

3. Sound waves travel:

A. In a three dimensional form, expanding as it travels

B. In a more lineal fashion, as directed from source to receiver

C. Science has not yet readily determined how sound travels as of yet.

Knowledge Test

4. A knock on the door is an example of what type of sound:

A. Airborne sound

B. Structure borne sound

C. Radiant borne sound

Knowledge Test

5. The number of cycles per second made by a sound wave is called:

A. Hertz

B. Pitch

C. Frequency

Knowledge Test

6. The range of human hearing is generally considered to be between:

A. 16 Hz to 20,000 Hz

B. 160,000 Hz to 2,000,000 Hz

C. 1.6 Hz to 2,000 Hz

D. -16 Hz to – 20,000 Hz

Knowledge Test

7. The unit in which sound is measured is called:

A. Trebles

B. Decibels

C. Audibles

D. Foibles

Knowledge Test

8. True or false: 3 decibels is all that is needed for a human to detect a change in sound volume.

A. True

B. False

Knowledge Test

9. The pain threshold for humans, measured in decibels, is considered to be:

A. 50 db

B. 75 db

C. 100 db

D. 120 db

Knowledge Test

10. Which of the following is not one of the 4 ASTM methods to test acoustical performance:

A. Sound Absorption

B. Airborne sound transmission

C. Impact sound transmission

D. Airborne sound transmorgrification

Knowledge Test

11. The difference between STC and FSTC is:

A. One is conducted in a laboratory and the other in an actual finished construction setting in the field.

B. Nothing, they are just two different agencies testing the same thing and compete against each other.

C. The ‘F’ stands for French and is the European standard whereas the other is the United States standard.

Knowledge Test

12. Which of the following systems would you expect to have the highest STC rating?

A. Steel studs, no insulation, 5/8” Silent FX board

B. Wood studs, insulation, 5/8” Silent FX board

C. Steel studs, insulation, 5/8” Silent FX board

D. Steel studs, insulation, 5/8” Type X board

Knowledge Test

13. True or false: If you hang the board properly, using a noise proofing compound to seal the air will not increase sound control.

A. True

B. False

Knowledge Test

14. Impact sound transmission tests noise that is generated from:

A. Wall systems

B. Floor to ceiling systems

C. Outside noise into a building

D. Bass sounds from a large speaker system

Knowledge Test

15. True or false: Compartmentalizing spaces is an effective technique in controlling sound flanking.

A. True

B. False

Knowledge Test

16. Controlling sound flanking is important due to the fact:

A. It isn’t, sound ‘moves’ in the direction outwardly from the direction it is emitted and does not flank.

B. Sound leaks through the path of least resistance.

C. It isn’t, science has yet to fully determine the way in which sound moves.

Knowledge Test

17. True or false: Sometimes small details such as the placement of electrical outlets are important in sound mitigation.

A. True

B. False

Knowledge Test

18. True or false: Resilient channel design system may lose effectiveness if fasteners are driven improperly.

A. True

B. False

Knowledge Test

19. Which of the following is not a helpful tip in wall/corner or floor/ceiling intersections:

A. Minimize direct contact between adjacent studs to reduce sound transmission.

B. Stagger drywall joints to minimize sound paths.

C. Alternate walls between vertically hung and horizontally hung panels.

Knowledge Test

20. Using an acoustic panel as opposed to standard drywall can be advantageous for which of the following reasons:

A. Decreased wall thicknesses as one 5/8” Silent FX panel may replace two standard 5/8” panels in tested systems.

B. Boards are likely to be more reliable than clips and channels.

C. Silent FX addresses high and low frequency noises that double layer gypsum board cannot.

D. All of the above.