



Glazing Strategies for Sound Control



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Learning Objectives

- Learn why a sound control strategy matters in project design
- Learn basic sound properties, how they are measured and principles for controlling unwanted noise
- Explore glazing solutions that provide sound control
- Learn why site-specific acoustical testing may be necessary

Sound vs. Noise

Sound is what we hear



Noise is unwanted sound



“Sound becomes noise when it either interferes with normal activities such as sleeping and conversation or disrupts or diminishes one’s quality of life.”

-EPA

Noise Pollution Defined

- Annoying or harmful noise in an environment
- Propagation of noise with harmful impact on the activity of human or animal life
- Regular exposure to elevated sound levels that may lead to adverse effects in humans or other living organisms

Noise Pollution is Harming Us



It is the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare.

-- Noise Control Act of 1972



A Sound
Control
Strategy
Matters

Health & Well Being

Rest, sleep, connect –
reduce stress and high
blood pressure

Workplace Productivity

Reduce distraction,
improve clarity

Comfort

Enjoy the space for
its intended purpose

U.S. Department of Housing and Urban Development

Controlling Noise in Single-Family & Multifamily Structures

Noise Notebook – Sound Reduction in Structures

- Elimination
- Absorption
- Sound Barriers
- Design



Acoustic Mediums



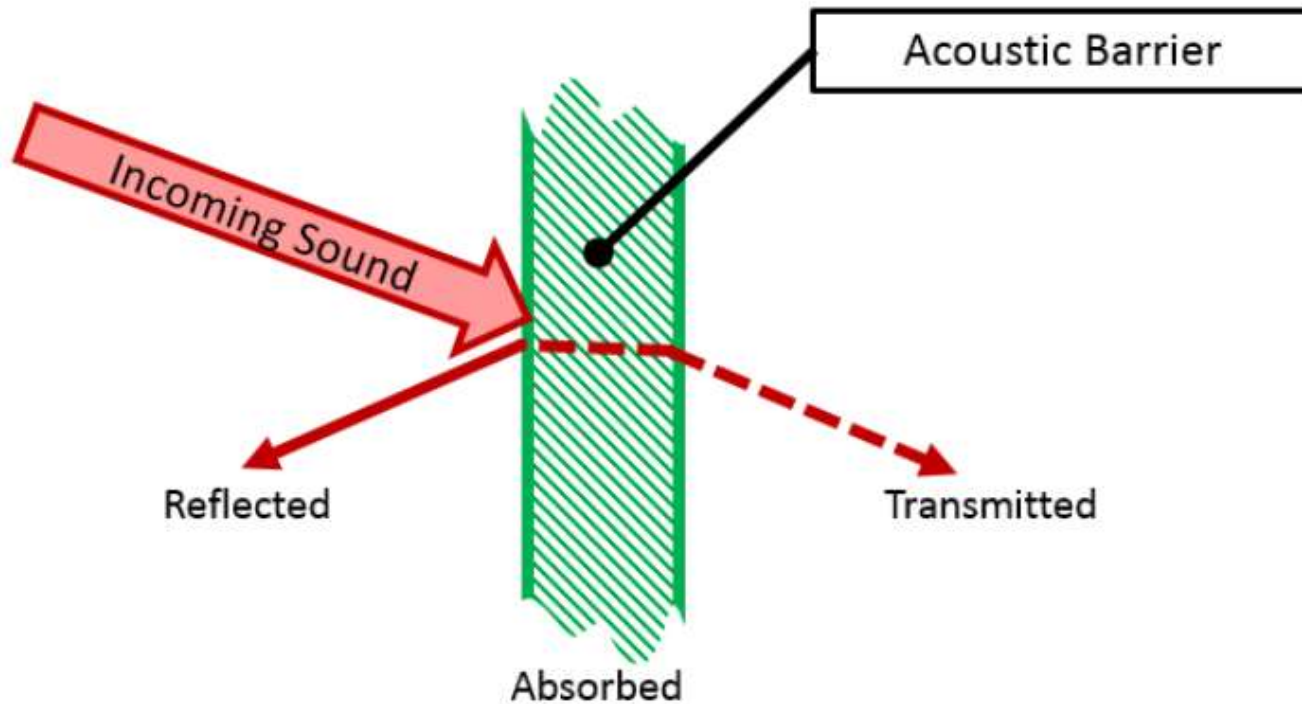
**Sound Travels
Through Air**

&



**Sounds Travels
Through Materials**

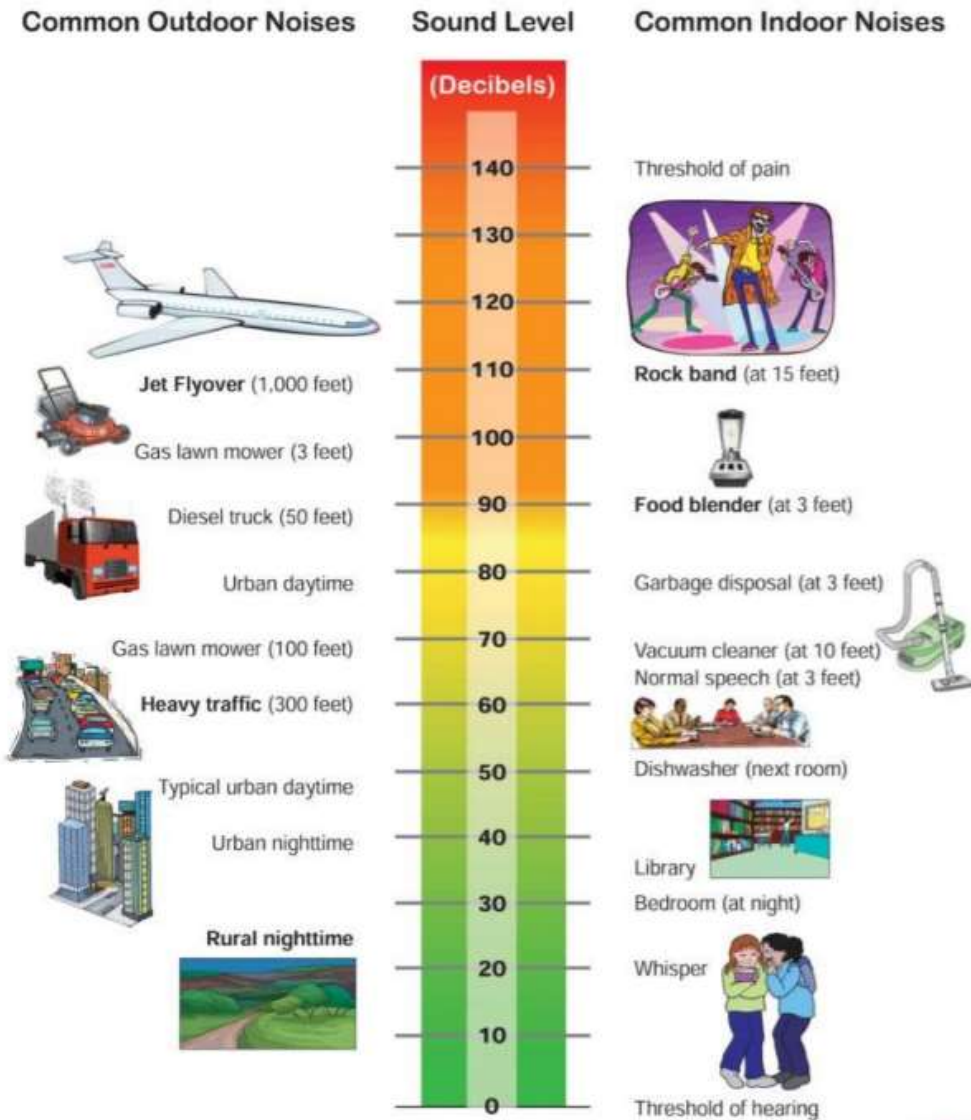
Sound Transmission Loss (TL)



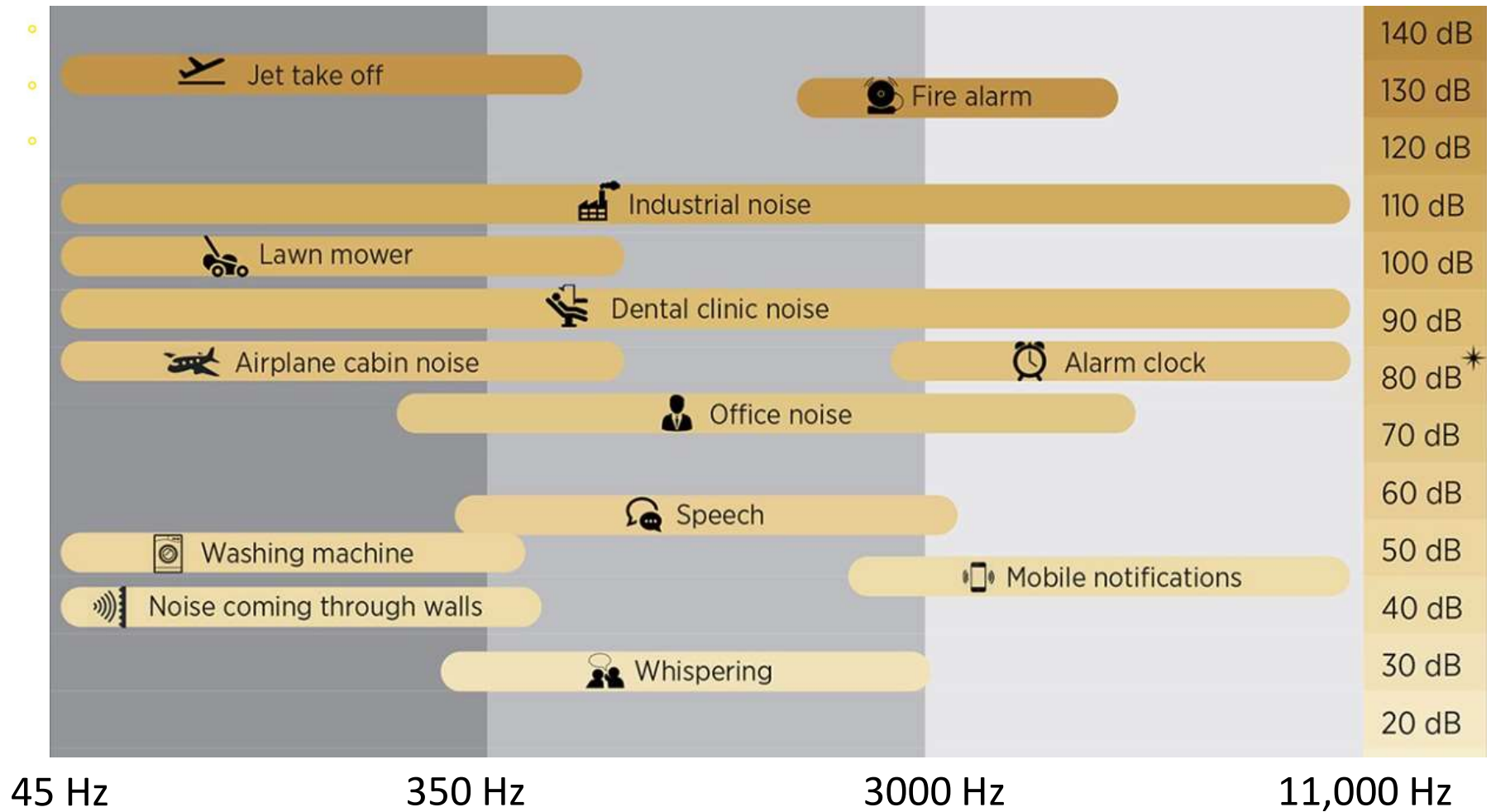
$$TL \text{ (dB)} = \text{Incoming Sound (dB)} - \text{Transmitted Sound (dB)}$$

Sound Pressure Levels

Change in Decibels	Change in Perceptable Loudness
1 dB	Imperceptable change
3 dB	Just barely distinguishable
5 dB	25% Change in Loudness
10 dB	50% Change in Loudness
15 dB	63% Change in Loudness
20 dB	75% Change in Loudness



Frequency (Hz)



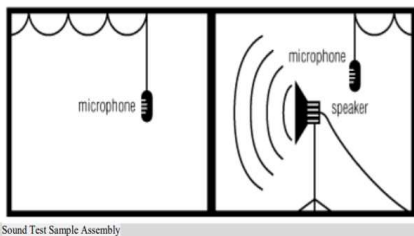


Sound Transmission Class (STC)

- Sound Transmission Class is a rating of how well a building partition attenuates airborne sound.
- Originally developed for interior partitions, ceilings and floors, STC is now used to rate exterior walls, windows and doors.

Measuring Sound Transmission to Determine STC

- Continuous random noise
- Frequency range of 125 to 4,000 Hz
- Readings at every sixteen 1/3-octave frequency-band intervals

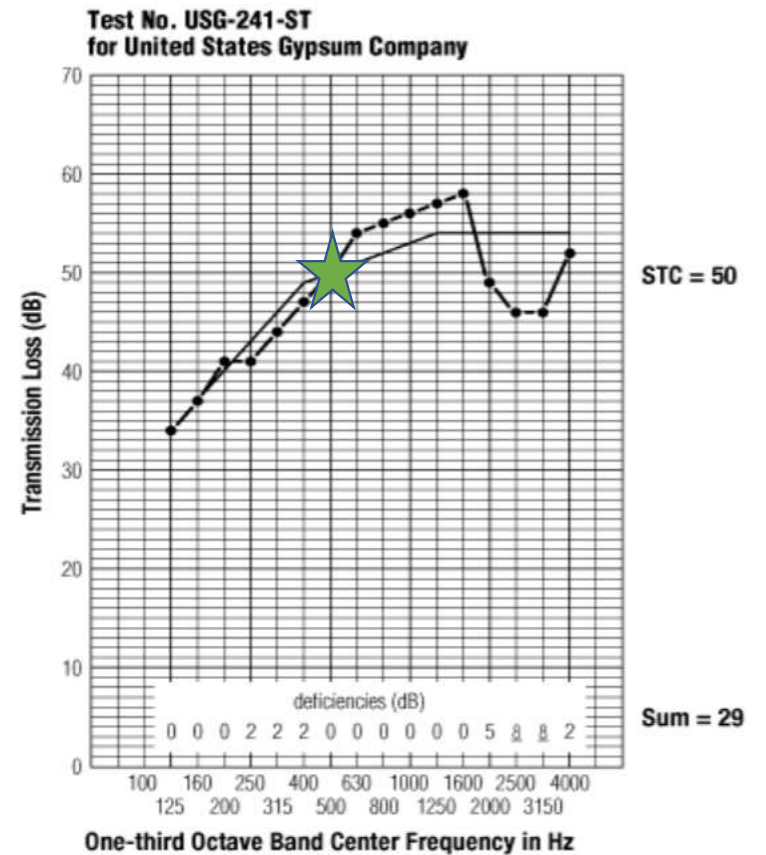


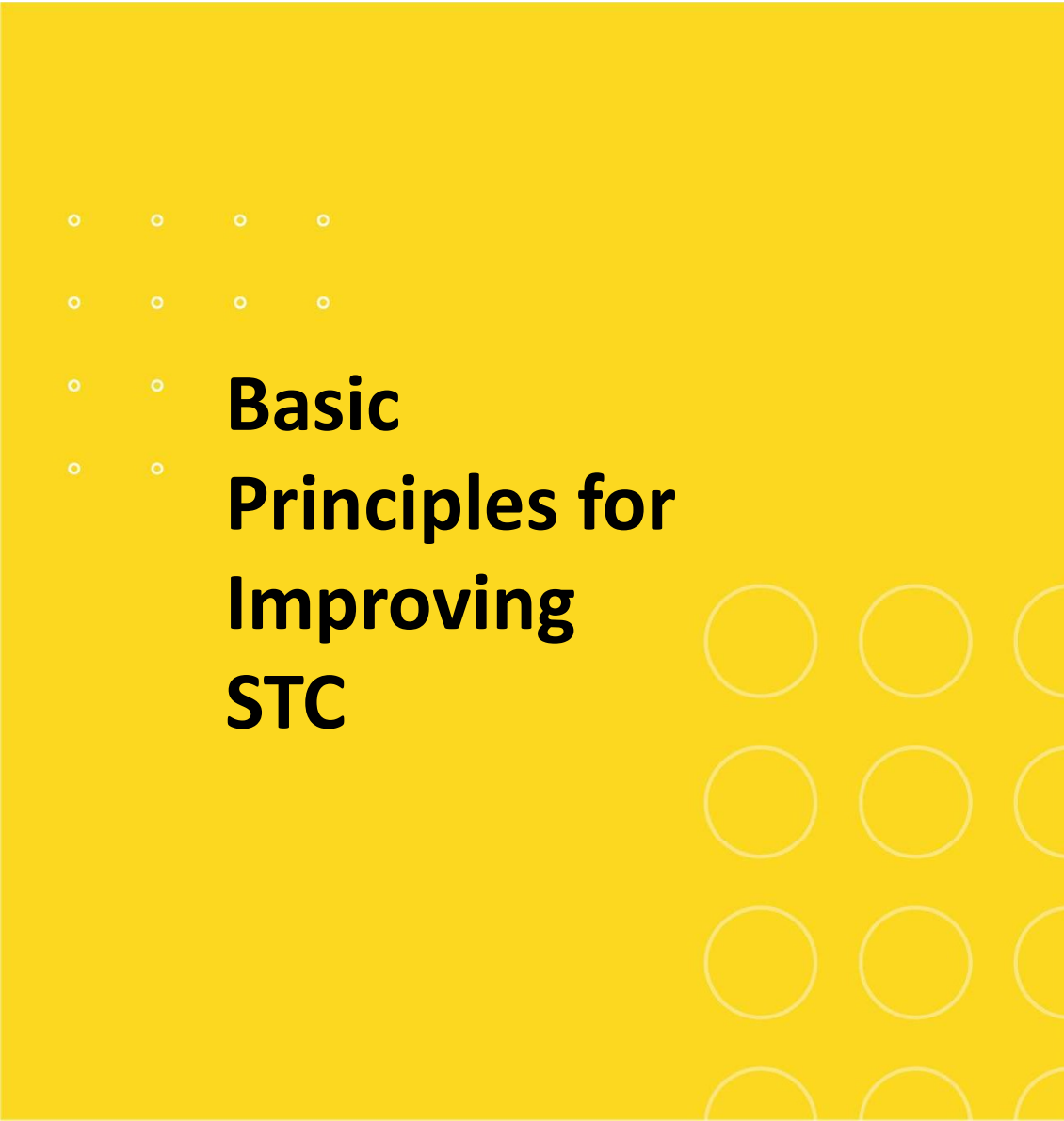
Sound Transmission Class (STC)

- Transmission loss results in decibels are plotted
- Compared to standard reference contour
- Reference contour adjusted to prescribed testing parameters
- STC taken at 500 Hz intersection



Determination of Sound Transmission Class





Basic
Principles for
Improving
STC

Mass

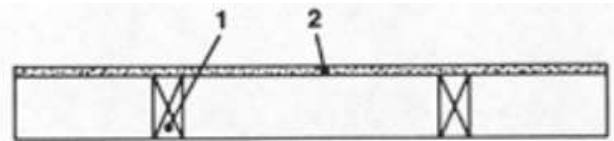
- Density of material

Thickness

- Overall thickness of the material
- Variations in thickness of the composite

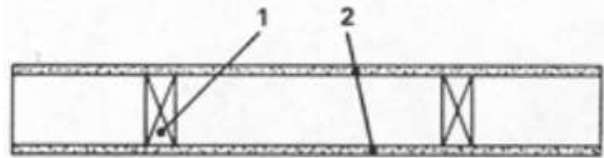
Air Leaks

- Leaks can negate thoughtful material selections



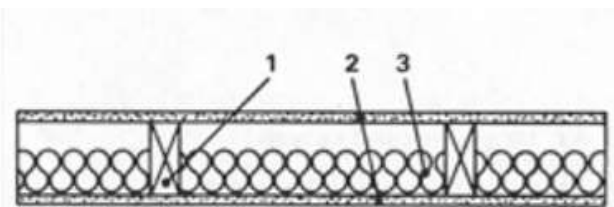
1. 2x4" studs, 16" o.c.
2. 5/8" gypsum board screwed to studs.

STC = 28



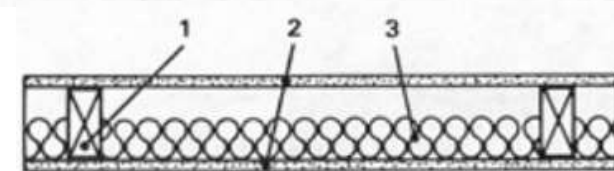
1. 2x4" studs, 16" o.c.
2. 1/2" gypsum board screwed to studs.

STC = 34



1. 2x4" studs, 16" o.c.
2. 1/2" gypsum board screwed to studs.
3. 2" thick sound attenuation blanket.

STC = 37



1. 2x4" studs, 24" o.c.
2. 1/2" gypsum board screwed to studs.
3. 2" thick sound attenuation blanket.

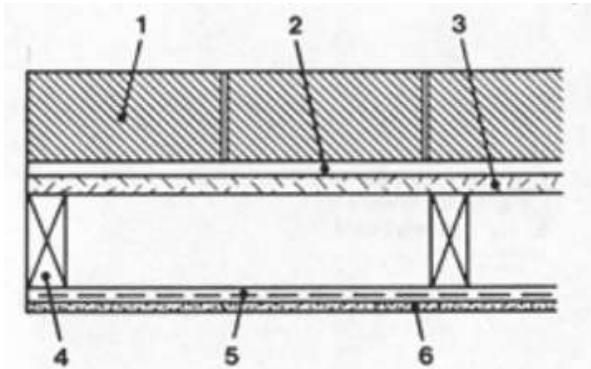
STC = 40

Interior Wall Construction Example



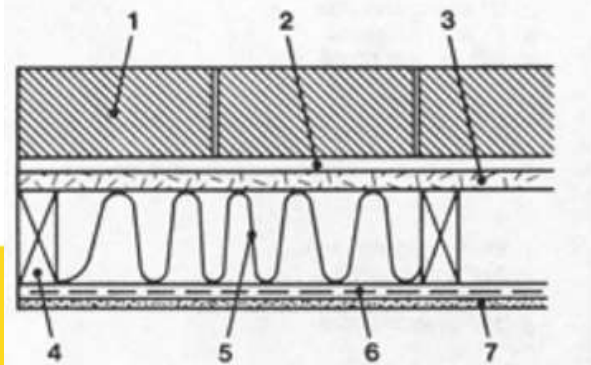
1. 4" face brick, mortared together.

STC = 45



1. Face brick.
2. 1/2" air space, with metal ties.
3. 3/4" insulation board sheathing.
4. 2x4" studs 16"o.c.
5. Resilient channel.
6. 1/2" gypsum board.

STC = 54



1. Face brick.
2. 1/2" air space, with metal ties.
3. 3/4" insulation board sheathing.
4. 2x4" studs 16"o.c.
5. Fiberglass building insulation (3 1/2").
6. Resilient channel.
7. 1/2" gypsum board.

STC = 56

Exterior Wall Construction Example

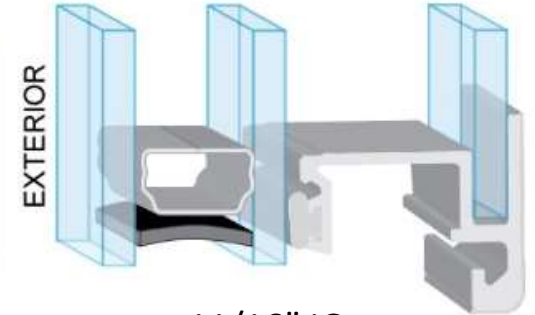
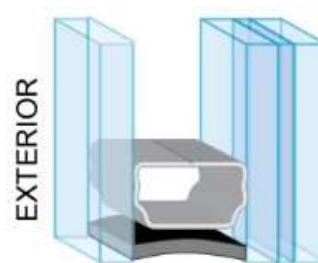
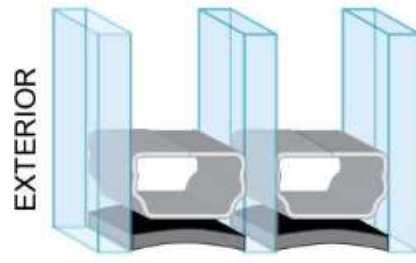
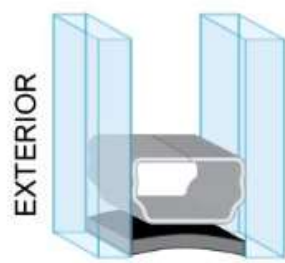
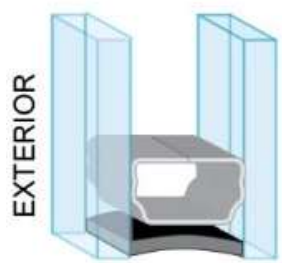


You can design a wall to protect like a tank....

.... but windows and doors must be part of the acoustic solution

Total Wall Considerations

Common Glazing Solutions



11/16" Overall IG
3mm Exterior
3mm Interior

11/16" Overall IG
3mm Exterior
5mm Interior

1-1/4" Overall IG
3mm Exterior
3mm Center
3mm Interior

1" Overall IG
5mm Exterior
10mm Laminated Interior

11/16" IG
3mm Exterior
3mm Interior
+ 3mm Interior Panel

STC = 26

STC = 30

STC = 27

STC = 36

STC = 33

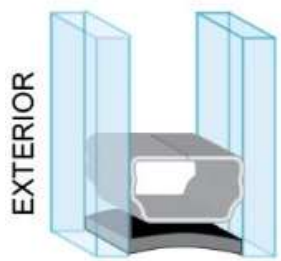
STC Ratings based on 48" x 60" Fixed Window

Outdoor-Indoor Transition Class (OITC)

- Better measure for exterior glazing assemblies
- Frequency low drops from 120 Hz to 80 Hz (aircraft/rail/truck traffic)
- Reference contour is weighted more to lower frequencies



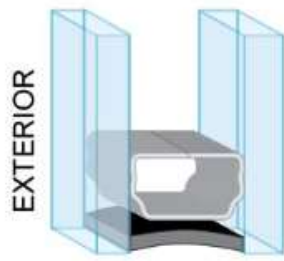
Common Glazing Solutions



11/16" Overall IG
3mm Exterior
3mm Interior

STC = 26

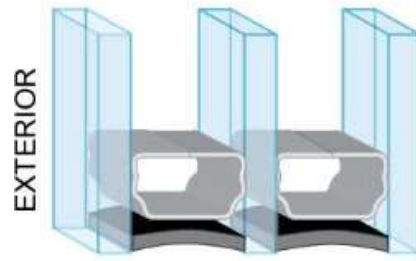
OITC = 22



11/16" Overall IG
3mm Exterior
5mm Interior

STC = 30

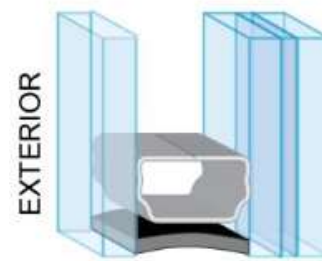
OITC = 25



1-1/4" Overall IG
3mm Exterior
3mm Center
3mm Interior

STC = 27

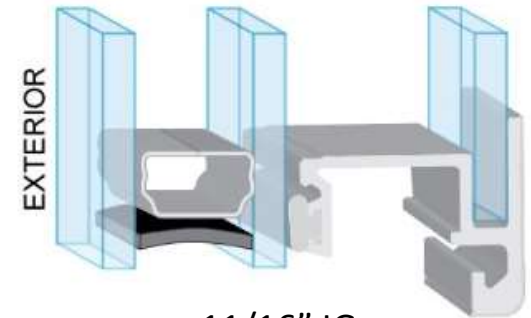
OITC = 22



1" Overall IG
5mm Exterior
10mm Laminated Interior

STC = 36

OITC = 30



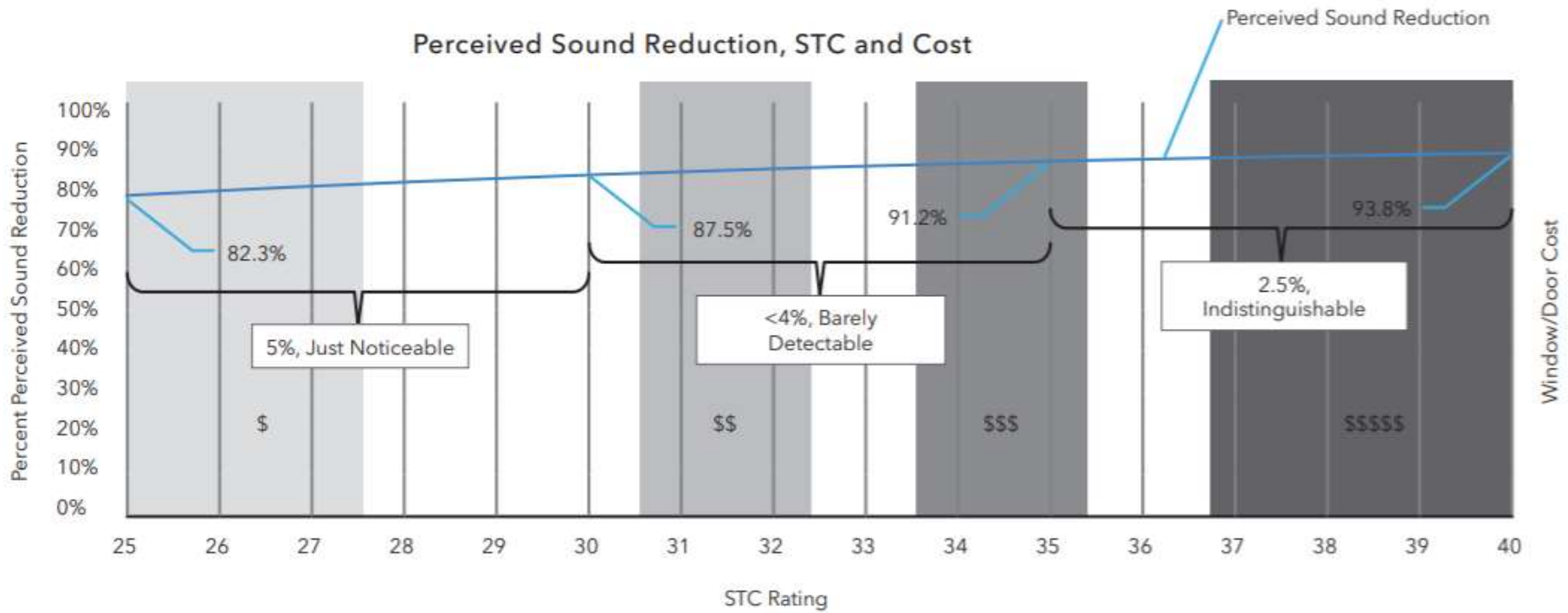
11/16" IG
3mm Exterior
3mm Interior
+ 3mm Interior Panel

STC = 33

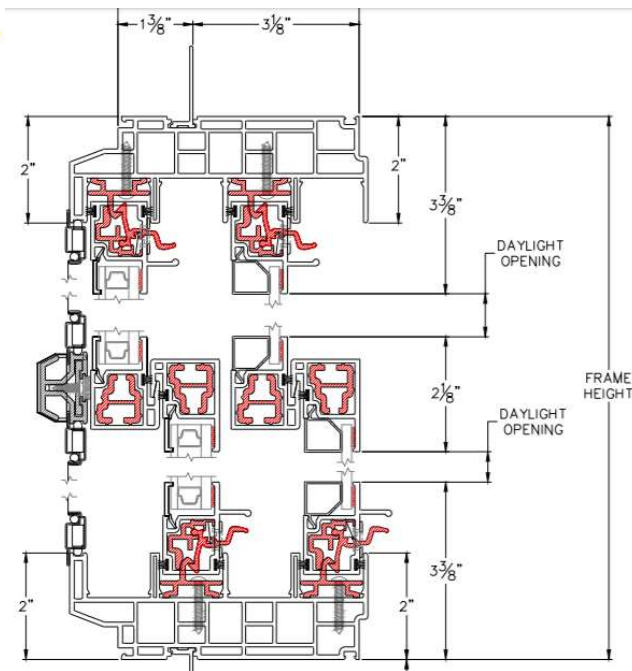
OITC = 27

STC Ratings based on 48" x 60" Fixed Window

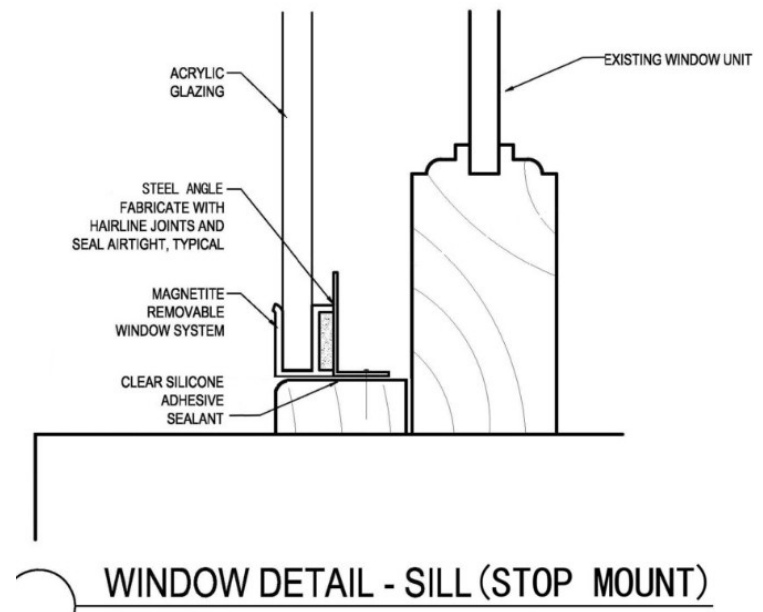
Perceived Sound Reduction vs. Cost



Performance Sacrifice

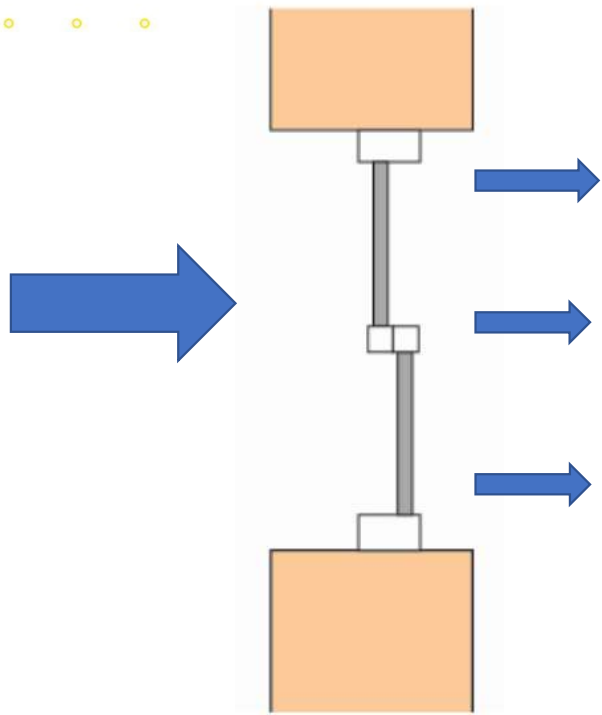


Double-Hung w/double sash

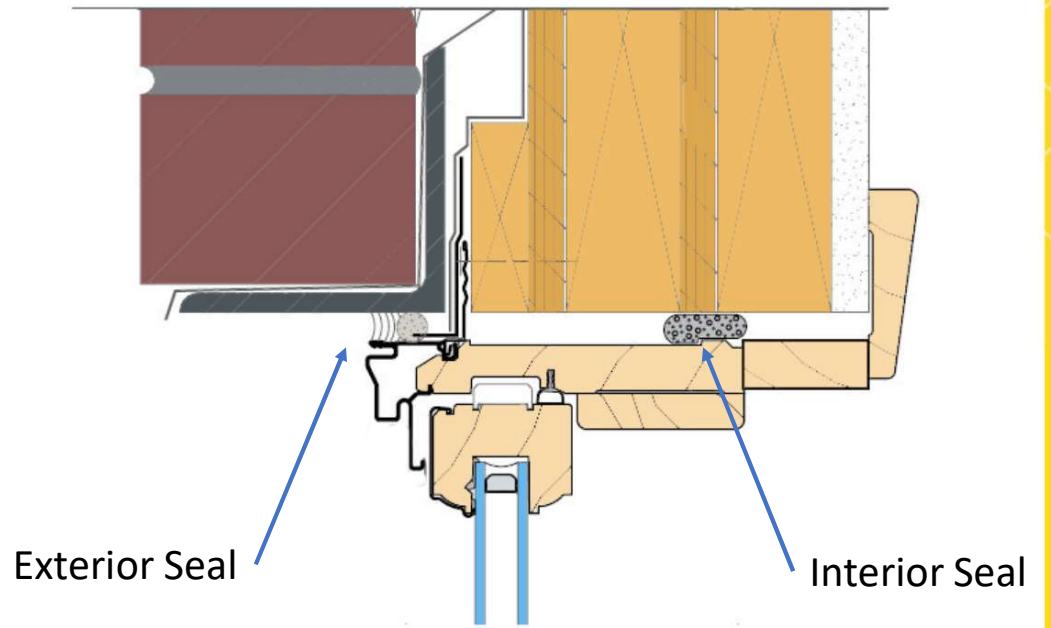


Acrylic Storm Panel

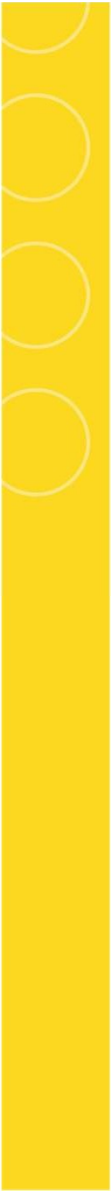
Air Leaks



Wall Section



Head Detail





Specifying STC and OITC

- AIA MasterSpec - select from options or insert project specific requirement

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

E. Sound Transmission Class (STC): Rated for not less than [26] [30] <Insert rating> STC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.

F. Outside-Inside Transmission Class (OITC): Rated for not less than [22] [26] [30] <Insert rating> OITC when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E1332.



Sound Control Guidelines

8.3.3.1 Exterior Sound. Wall and roof-ceiling assemblies that are part of the building envelope shall have a composite outdoor-indoor transmission class (OITC) rating of 40 or greater or a composite sound transmission class (STC) rating of 50 or greater, and fenestration that is part of the building envelope shall have an **OITC or STC rating of 30** or greater for any of the following conditions:

- a) Buildings within 1000 ft (300 m) of expressways.
- b) Buildings within 5 mi (8 km) of airports serving more than 10,000 commercial jets per year.
- c) Where yearly average day-night average sound levels at the property line exceed 65 dB.



USGBC Standard for
the Design of High -
Performance Green
Buildings

Evaluate design components based on project specifics

- Residential occupancy
- Proximity to high traffic routes
- Special function interiors
- Cost vs. benefit
- Energy performance



Sound Study

2.2 WINDOW PERFORMANCE REQUIREMENTS

F. Sound Transmission Class (STC): Rated for not less than 30 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

G. Outside-Inside Transmission Class (OITC): Rated for not less than 26 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.



WINDOW STC / OITC / RATING EXHIBIT

Case Study

- Project specification: 31 OITC
- Product A = 31 OITC **Rejected**
- Product B = 30 OITC **Accepted**



1/3 Oct. Band, Hz	L ₁ (dB)	L ₂ (dB)	Bkgd (dB)	A _v /m ² Sabins	TL (dB)	Def (dB)	95% Conf.	Notes
80	95.8	63.4	41.5	4.6	26	-	2.4	
100	100.4	68.0	45.4	4.9	25	-	1.7	
125	102.2	72.4	42.9	4.3	23	0	2.0	
160	97.4	65.8	36.6	4.1	25	0	1.7	
200	94.5	62.1	34.7	4.3	26	0	0.8	
250	99.1	63.6	37.5	4.4	29	0	0.9	
315	100.0	62.8	40.5	4.2	31	0	0.6	
400	100.2	62.7	37.0	4.3	31	3	0.6	
500	102.9	61.0	35.4	4.9	34	1	0.6	
630	102.1	59.8	33.7	5.2	35	1	0.4	
800	99.8	58.8	30.6	5.5	33	4	0.4	
1000	97.3	55.5	26.2	5.8	34	4	0.3	
1250	95.8	56.1	26.7	6.3	31	8	0.3	
1600	96.6	53.9	21.1	6.8	34	5	0.3	
2000	96.1	45.4	20.6	7.8	41	0	0.3	
2500	94.0	40.8	20.1	8.5	43	0	0.3	
3150	89.6	37.6	20.0	10.2	41	0	0.3	
4000	86.8	36.7	20.8	12.6	39	0	0.4	
5000	87.9	34.5	21.6	14.7	41	-	0.2	

STC Rating: 35

TL = Transmission Loss (dB)
Def = Deficiencies (below STC contour)

Note #1: Noise Level was less than 10dB above ambient.
Note #2: Confidence Level Exceeded

Deficiency: 26

OITC Rating: 31

F (Hz)	TLs	95% CI	def
80	24	2.2	-
100	27	1.3	-
125	24	1.9	0
160	27	1.6	0
200	25	0.8	0
250	25	0.7	3
315	24	0.6	7
400	27	0.4	7
500	30	0.3	5
630	33	0.2	3
800	35	0.2	2
1000	37	0.2	1
1250	39	0.2	0
1500	41	0.2	0
2000	40	0.2	0
2500	39	0.1	0
3150	39	0.2	0
4000	40	0.4	0

Temp (°C) R.H. (%) ATM (mbar)

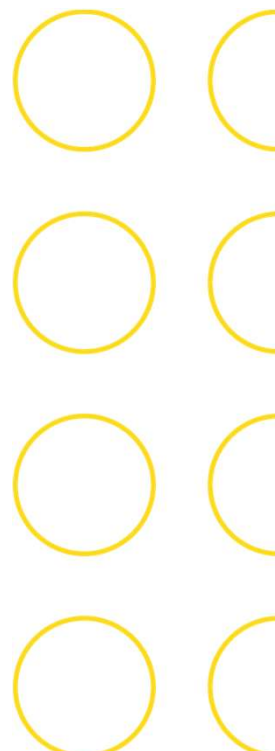
21.6 50 1000

Noise source: schoolyard
Kids playing frequency: 1250 Hz
Sound consultant study:
35 dB TL at 1250 Hz

TL at 1250 Hz:

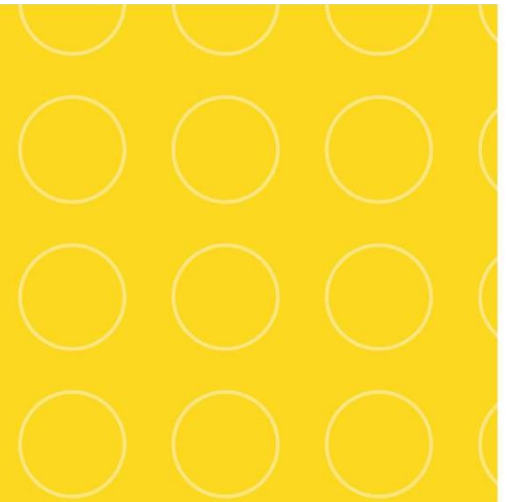
Product A: 31 dB

Product B: 39 dB



- ◦ ◦ ◦
- ◦ ◦ ◦
- ◦
- ◦ ◦ ◦
- ◦ ◦ ◦

Summary





THANK YOU!



This concludes the American Institute of Architects
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