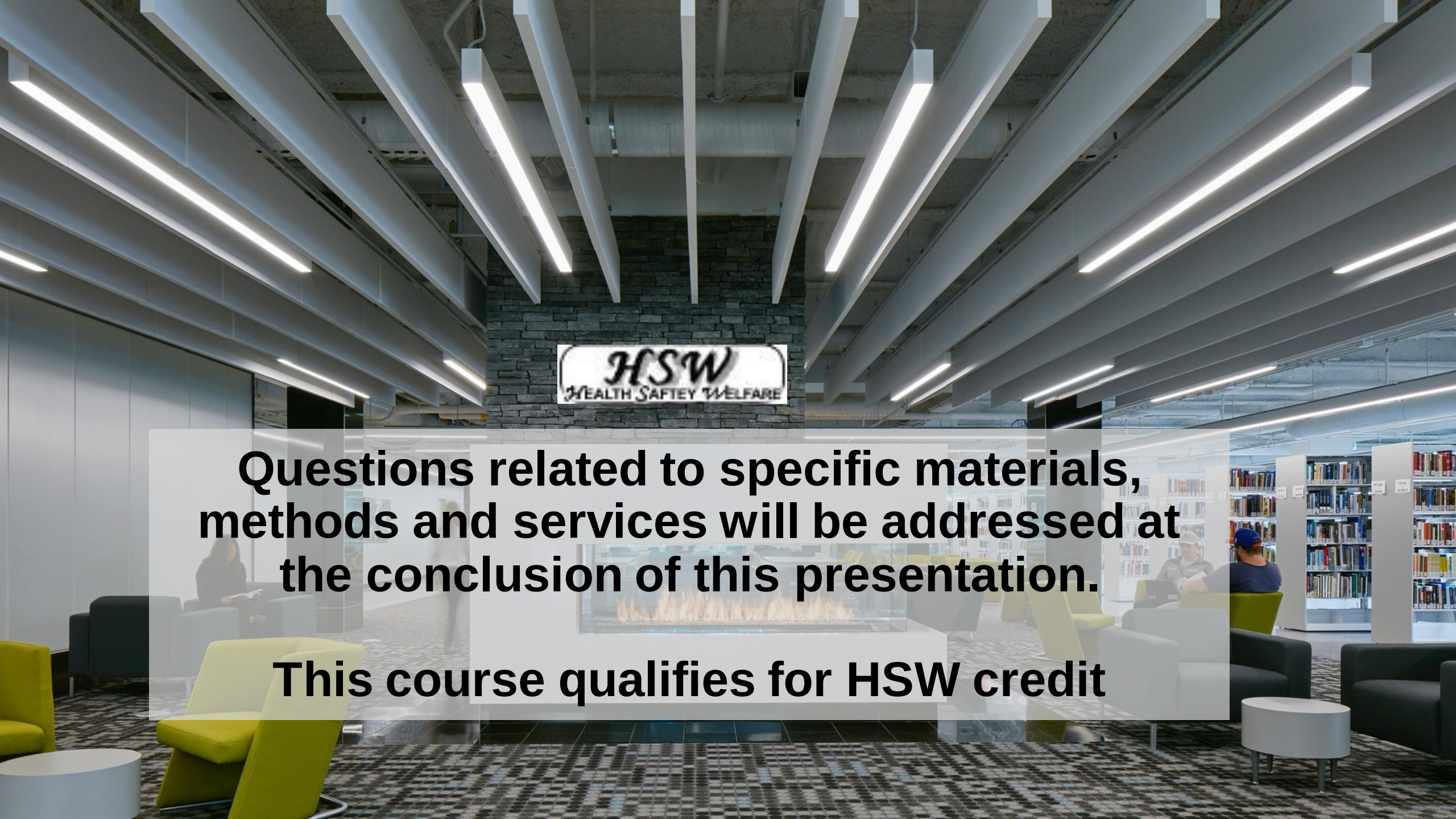
Acoustical Ceilings: for the Eye, the Ear and the Mind

(CTL12-3)

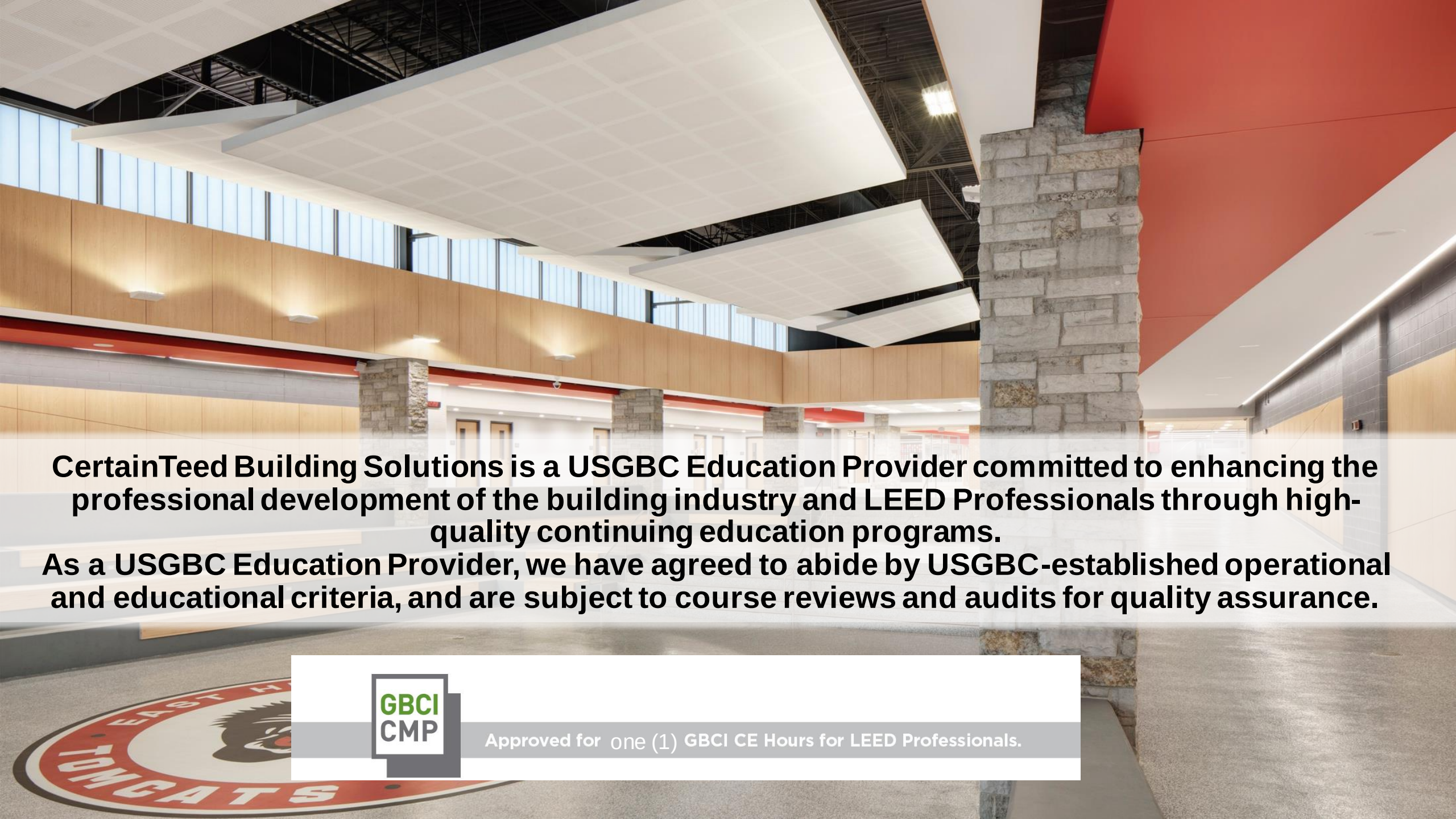
CertainTeed is a Registered Provider with the American Institute of Architects Continuing Education System. Credit earned upon completion of this program will be reported to CES records for all AIA members. Certificates of Completion for non-AIA members are available upon request.

This program is registered with AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing or dealing in any material product.



Questions related to specific materials, methods and services will be addressed at the conclusion of this presentation.

This course qualifies for HSW credit



CertainTeed Building Solutions is a USGBC Education Provider committed to enhancing the professional development of the building industry and LEED Professionals through high-quality continuing education programs.

As a USGBC Education Provider, we have agreed to abide by USGBC-established operational and educational criteria, and are subject to course reviews and audits for quality assurance.

GBCI CMP

Approved for one (1) GBCI CE Hours for LEED Professionals.

Copyright

Learning Objectives

After completing this course, you will have learned:

- **The Basis of Classification**
- **Noise Reduction Coefficient (NRC)**
- **Frequency and Hertz**
- **Assessing the Acoustic Performance of a Product**
- **Ceiling Attenuation Class (CAC)**
- **Light Reflectance (LR)**
- **Environmental Certifications**
- **The Power of Enhanced Acoustic Environments**

Basis of Classification / Type

Per ASTM E 1264-14

“Standard Classification for Acoustical Ceiling Products”

- **Type I – XX**
  - 15- different types

Basis of Classification / Type

Per ASTM E 1264-14

“Standard Classification for Acoustical Ceiling Products”

- **TYPE III**
  Mineral base with painted finish
- **TYPE IV**
  Mineral base with membrane-faced overlay
- **TYPE XII**
  Glass fiber base with membrane-faced overlay

QUICK QUIZ

These 3 types of ceiling tiles make up what % of Market share in North America

Per ASTM E 1264-14

“Standard Classification for Acoustical Ceiling Products”

- **TYPE III**
  Mineral base with painted finish
- **TYPE IV**
  Mineral base with membrane-faced overlay
- **TYPE XII**
  Glass fiber base with membrane-faced overlay

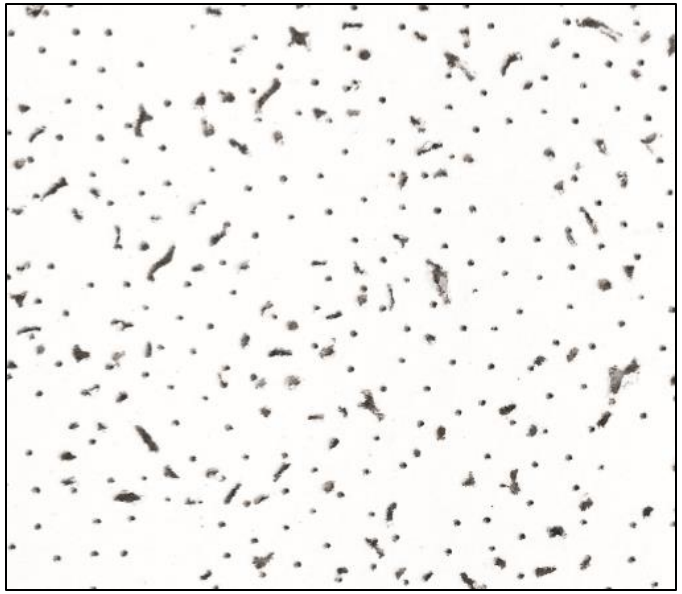
Over 90% of all ceilings in North America

Basis of Classification / Type

Per ASTM E 1264-14

“Standard Classification for Acoustical Ceiling Products”

- **TYPE III**
  Mineral base with painted finish

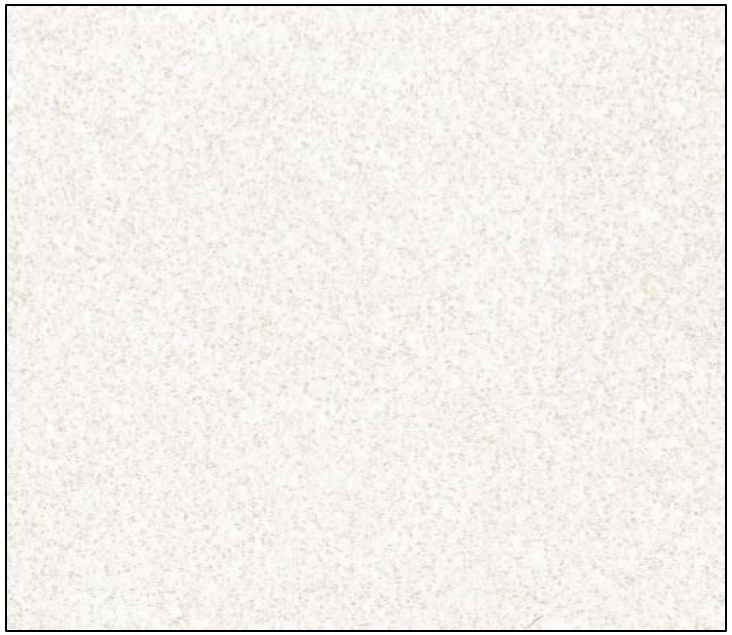


Basis of Classification / Type

Per ASTM E 1264-14

“Standard Classification for Acoustical Ceiling Products”

- **TYPE IV**
  Mineral base with membrane-faced overlay

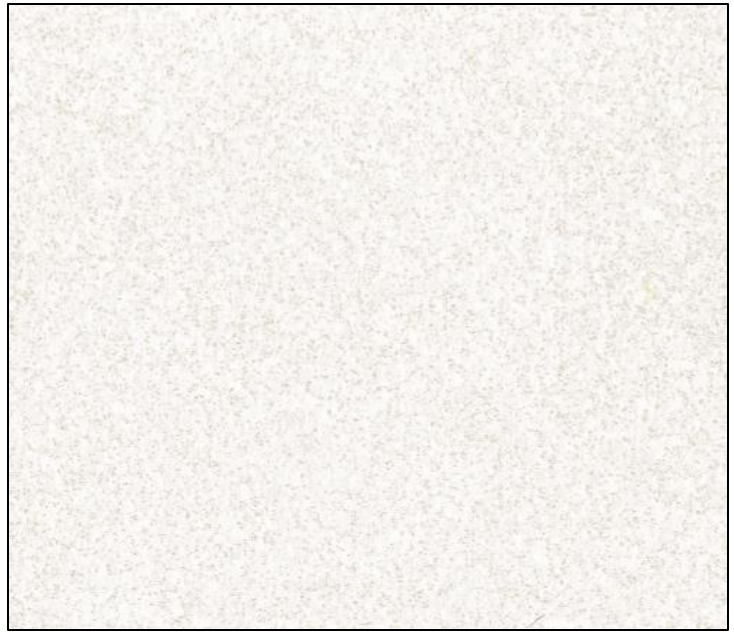


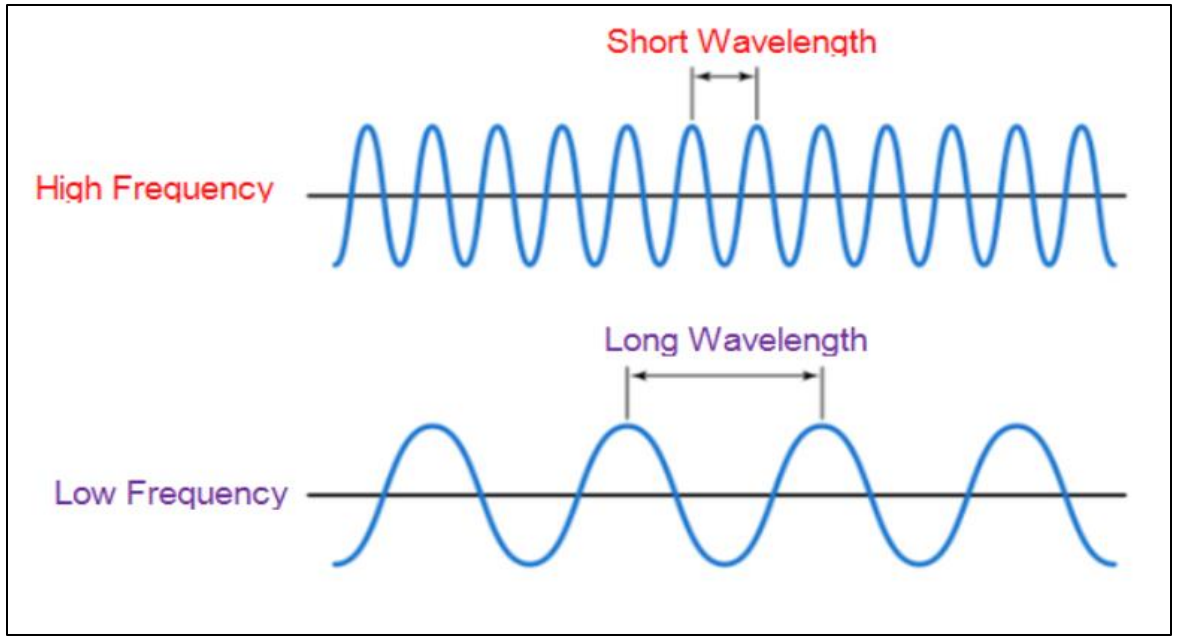
Basis of Classification / Type

Per ASTM E 1264-14

“Standard Classification for Acoustical Ceiling Products”

- **TYPE XII**
  Glass fiber base with membrane-faced overlay

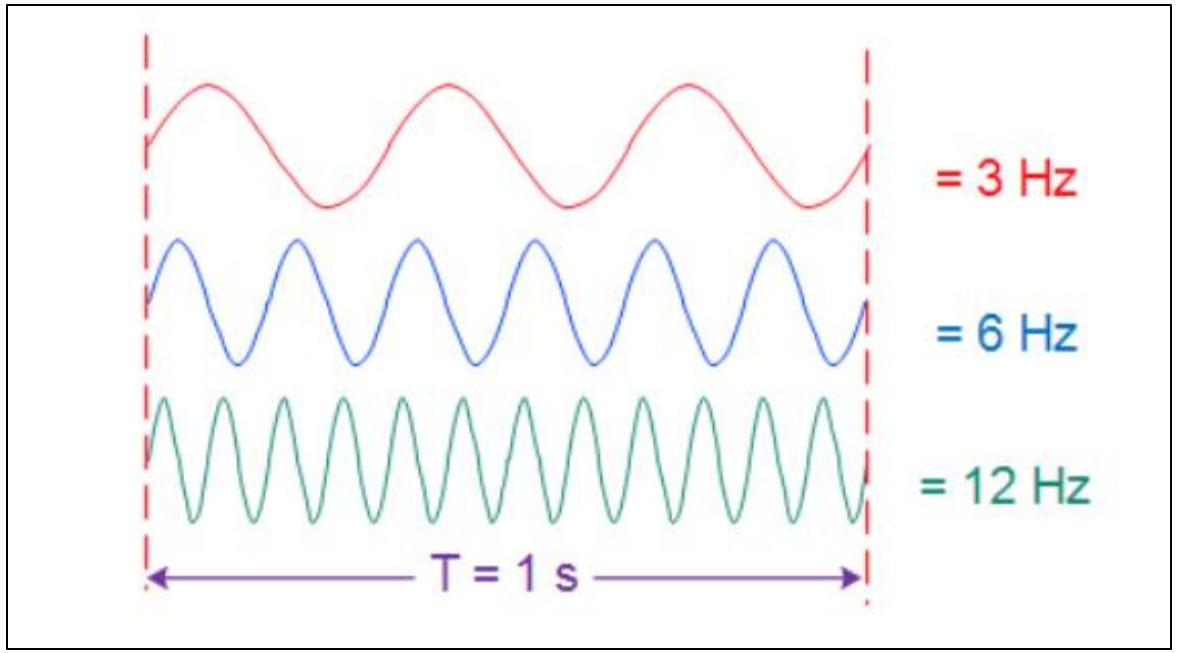


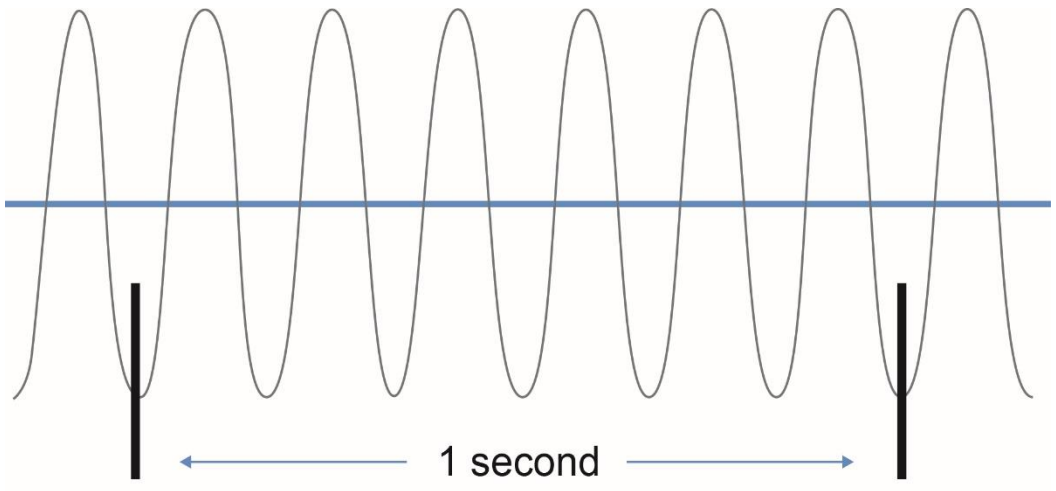


Frequency?

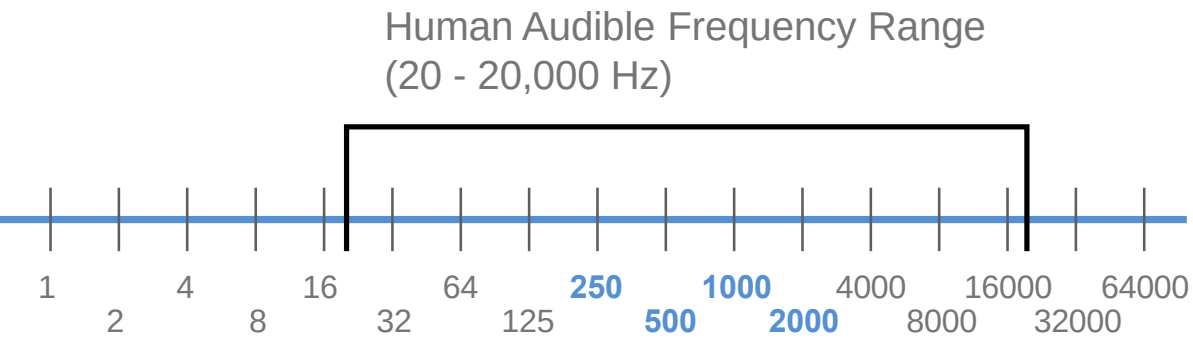
Sound waves move at a certain speed past a fixed point.

$$\frac{\text{Number of cycles}}{\text{Second}} = \text{Hertz (Hz)}$$

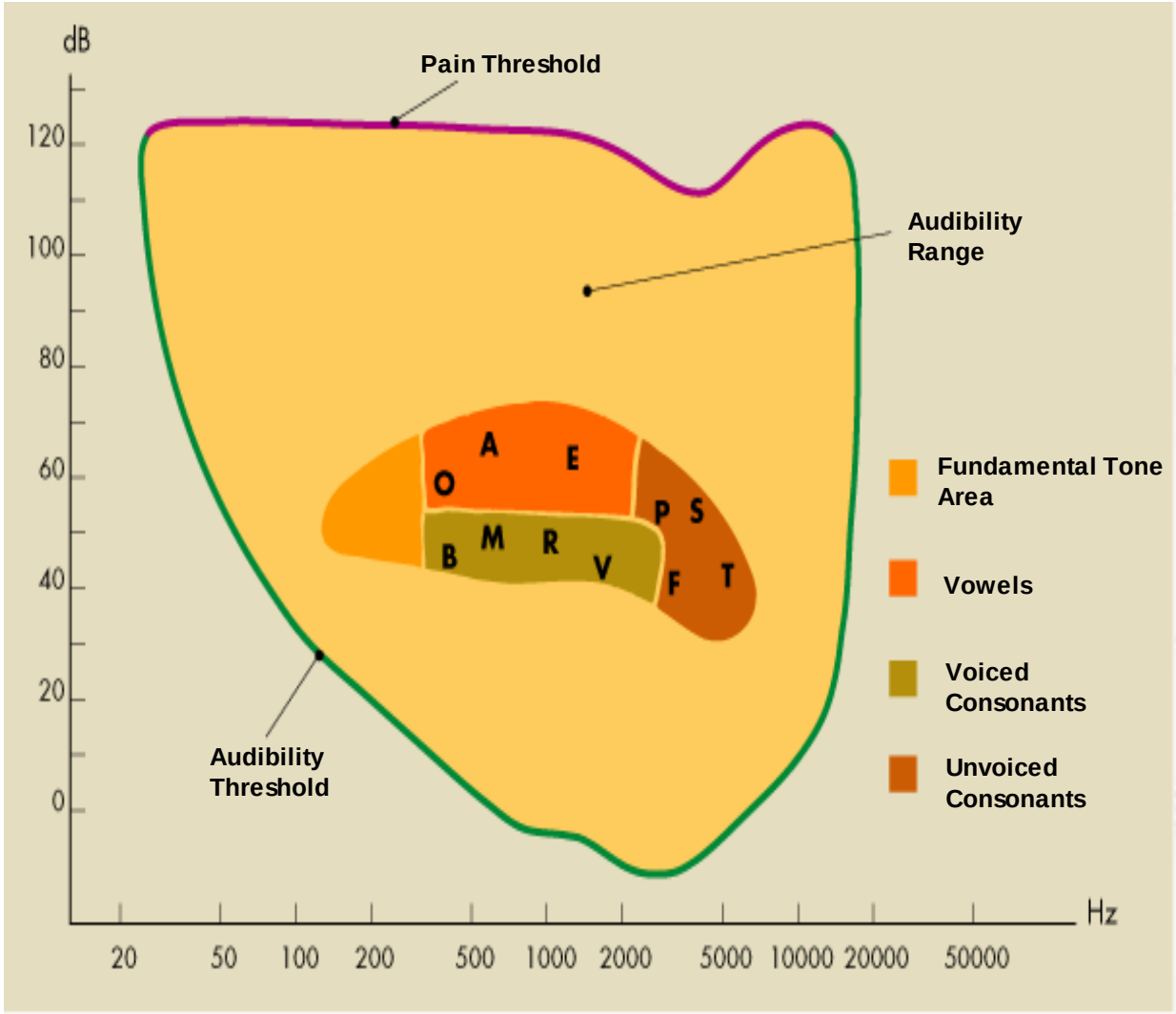




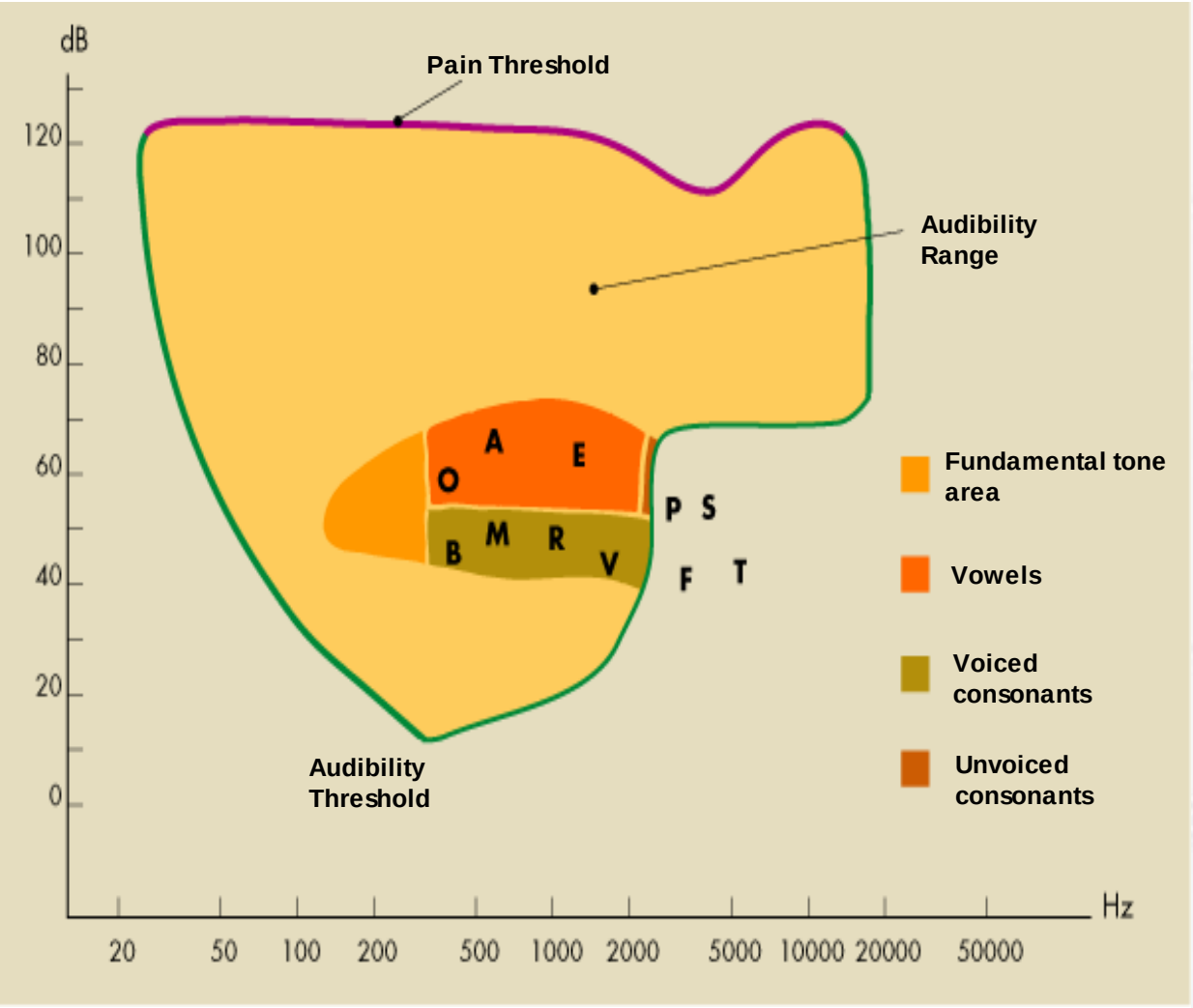
Frequency
(what can you hear?)



Frequency
(what can you hear?)
Normal Hearing Threshold



Frequency
(what can you hear?)
Hearing Impaired Threshold



Frequency
(who are the hearing impaired?)

Too significant to ignore

- Noise induced hearing impairment
  - 12.5% of general population
- Inherited permanent hearing loss or congenital loss
  - 17% of general population
- Cold/allergy sufferers can see a temporary reduction of between 25-49 decibels depending on severity

Frequency
(What is NRC?)

ASTM C423-17
Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

A single number rating, the average of only four (4) sound absorption coefficients at 250 Hz, 500 Hz, 1000 Hz & 2000 Hz (rounded off to the nearest 0.05)

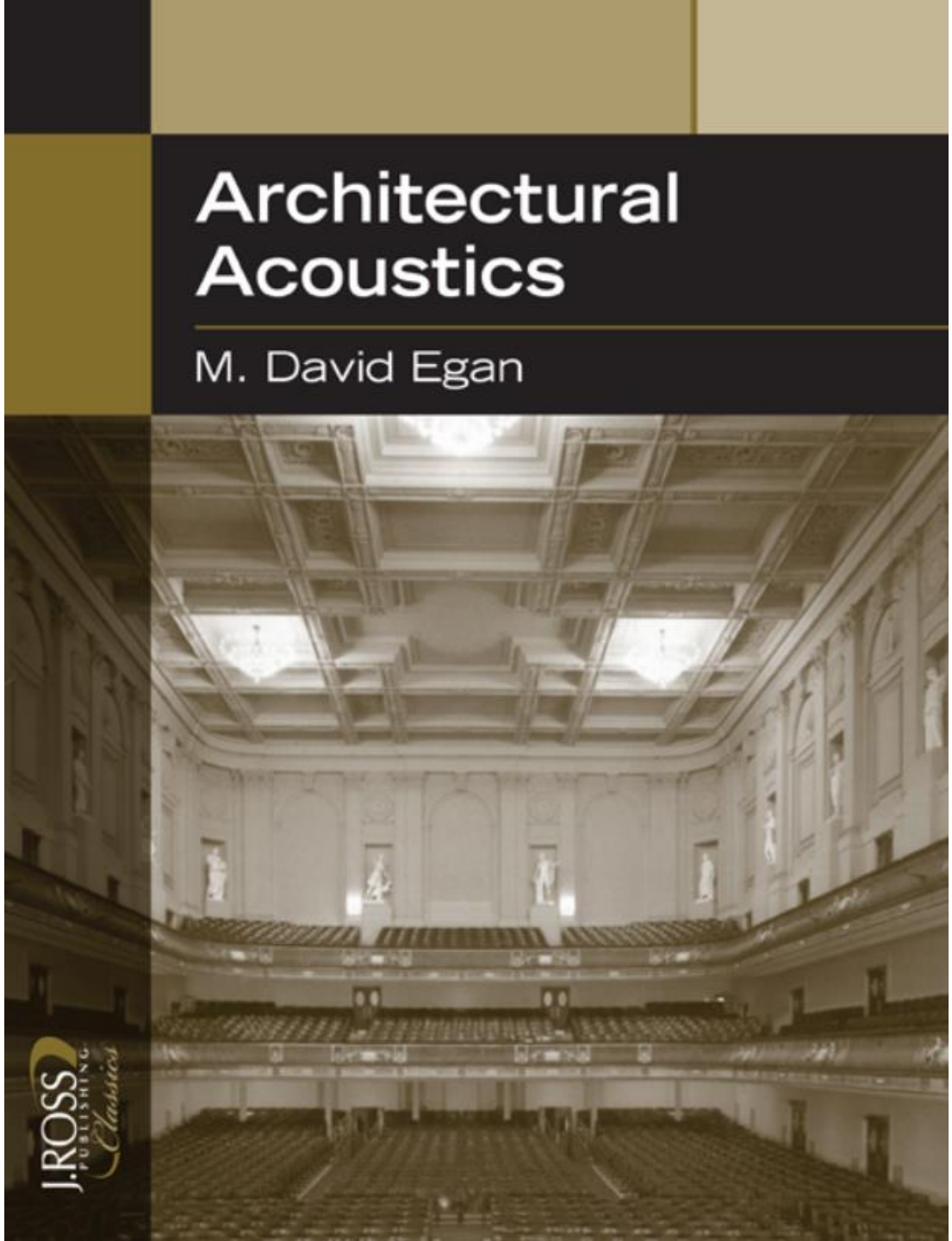
$$\text{NRC} = \frac{a\ 250 + a\ 500 + a\ 1000 + a\ 2000}{4}$$

NRC is good?

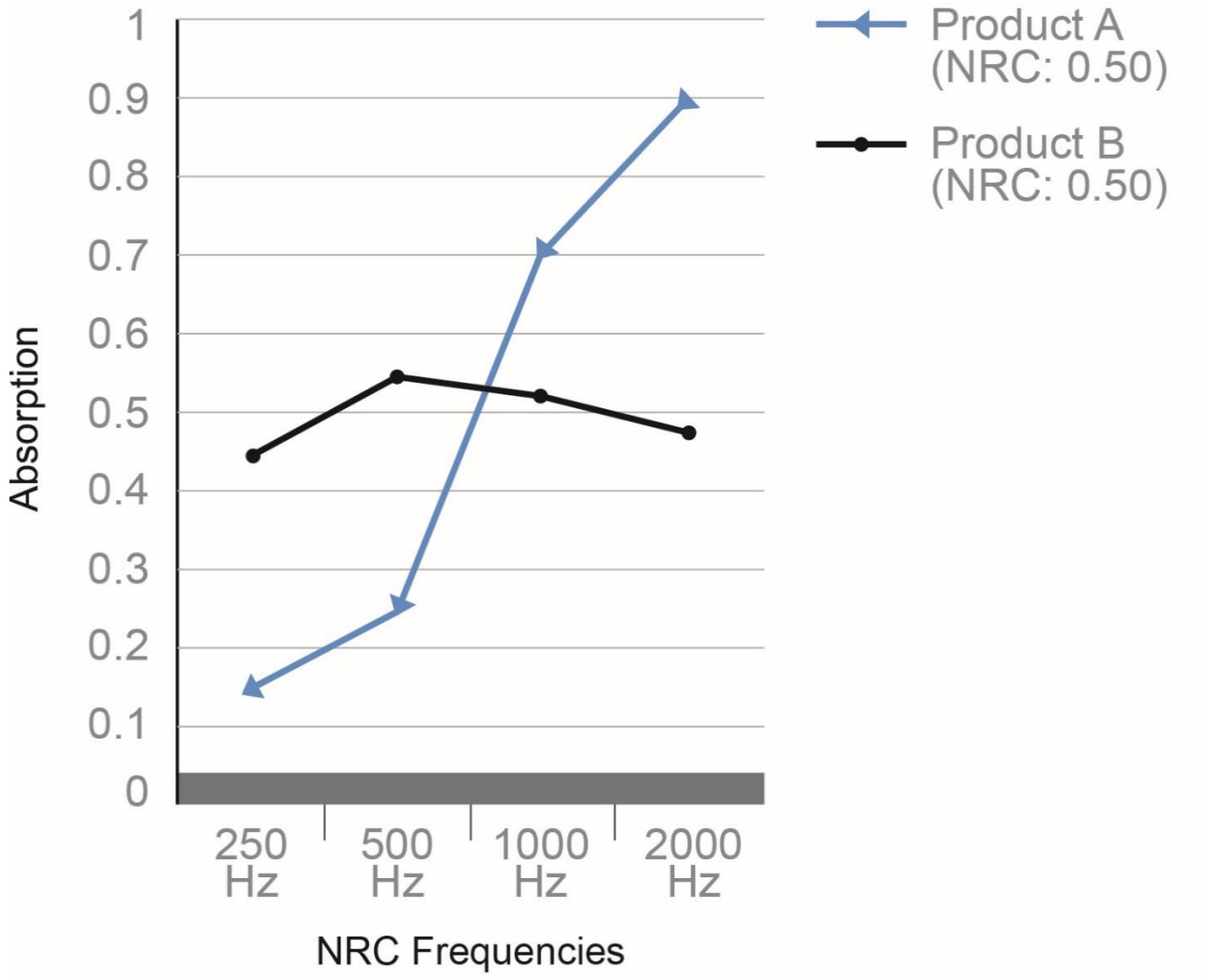
"Be careful when selecting a product based on NRC alone. Because NRC is an average over a **limited frequency range**, two materials may have identical NRCs…

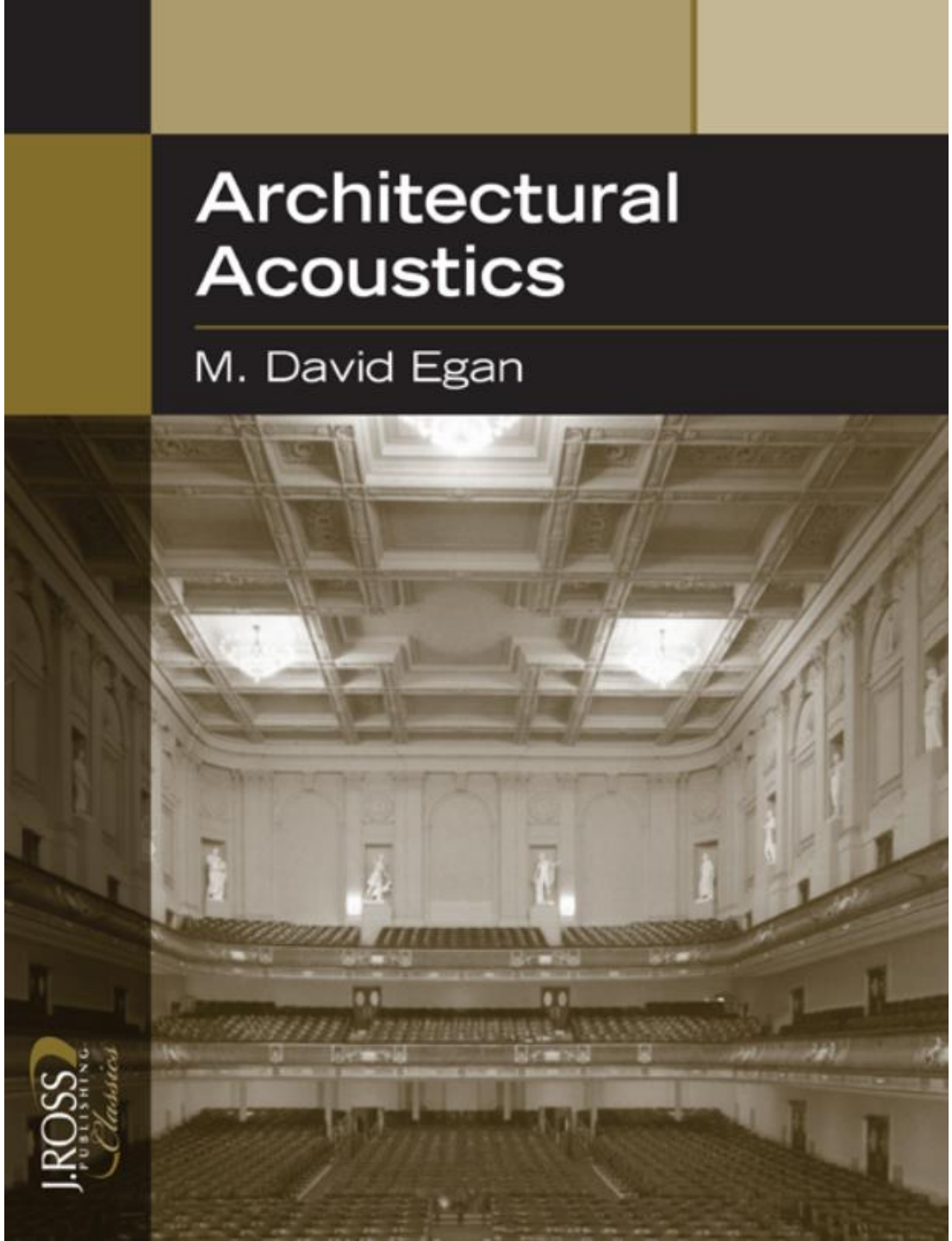
…but very different absorption characteristics."

M. David Egan Architectural Acoustics



NRC is good?


Absorption
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
250 Hz
500 Hz
1000 Hz
2000 Hz
NRC Frequencies
Product A (NRC: 0.50)
Product B (NRC: 0.50)

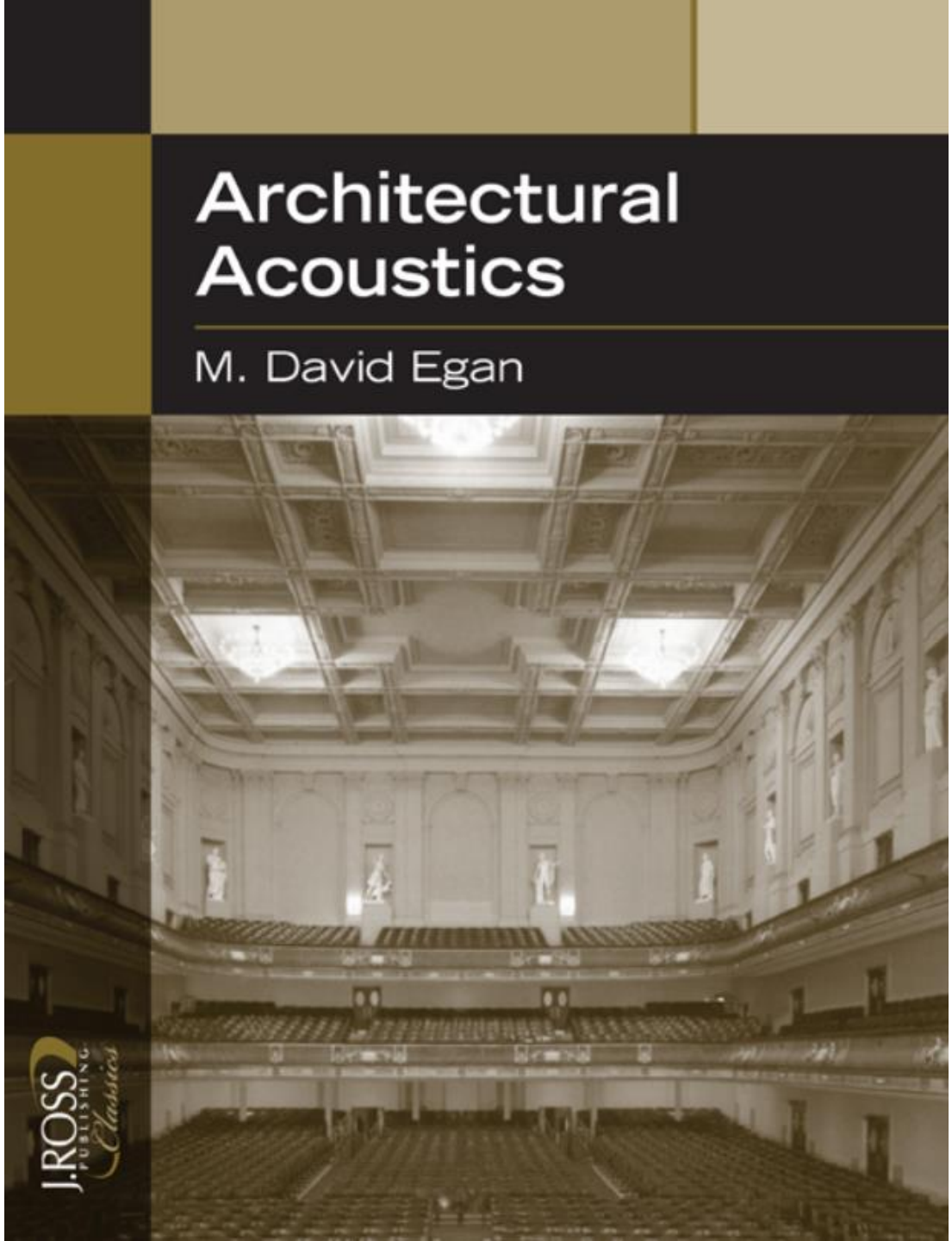

Architectural Acoustics
M. David Egan
J.ROSS PUBLISHING

NRC is good?

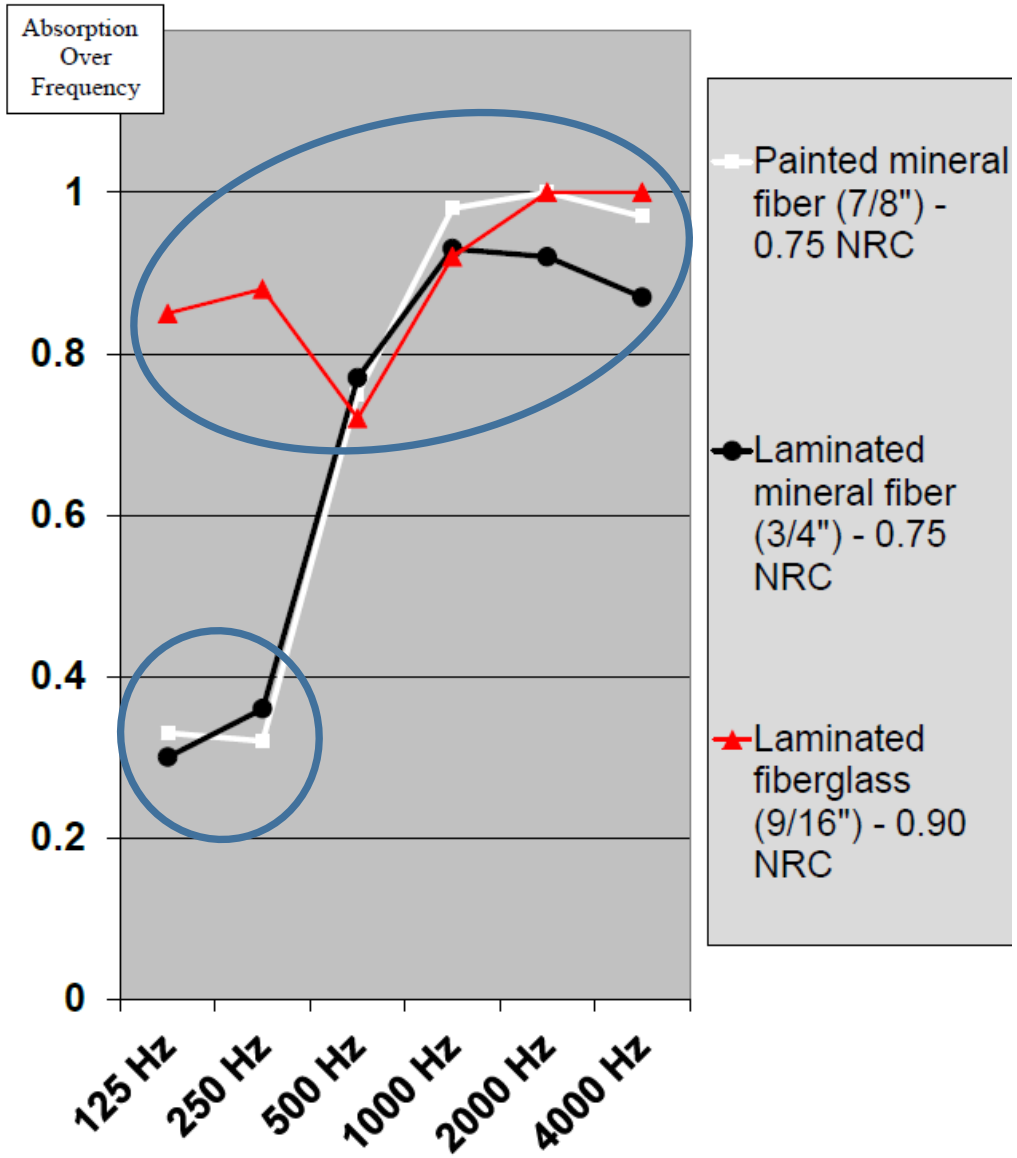
"In addition, because NRC does not include absorption coefficients at 125 Hz and 4000 Hz…

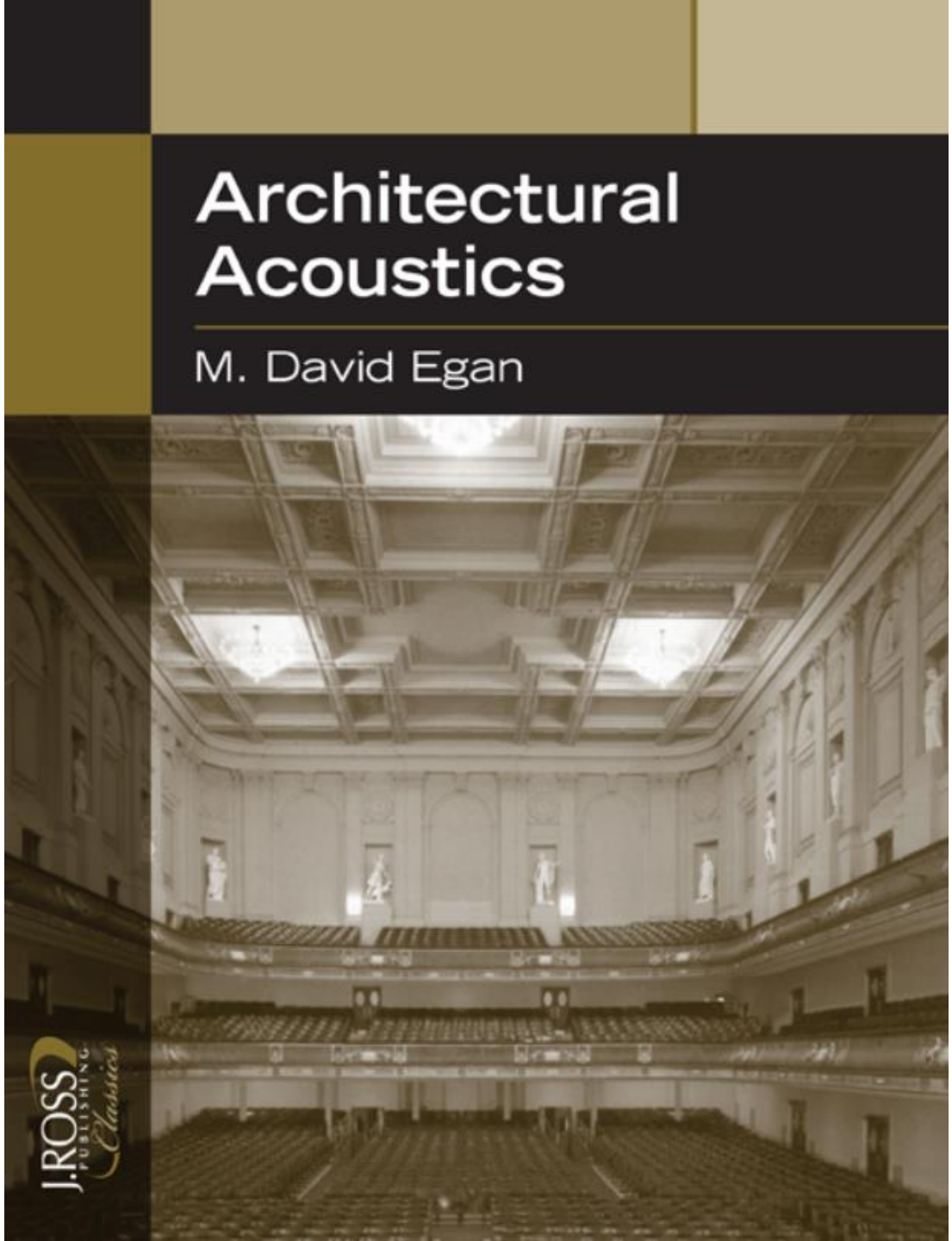
…**it should not be used to evaluate materials for rooms where speech perception is important.**"

M. David Egan Architectural Acoustics



NRC is good?


Absorption Over Frequency
1
0.8
0.6
0.4
0.2
0
125 Hz
250 Hz
500 Hz
1000 Hz
2000 Hz
4000 Hz
Painted mineral fiber (7/8") - 0.75 NRC
Laminated mineral fiber (3/4") - 0.75 NRC
Laminated fiberglass (9/16") - 0.90 NRC


Architectural Acoustics
M. David Egan
J.ROSS PUBLISHING

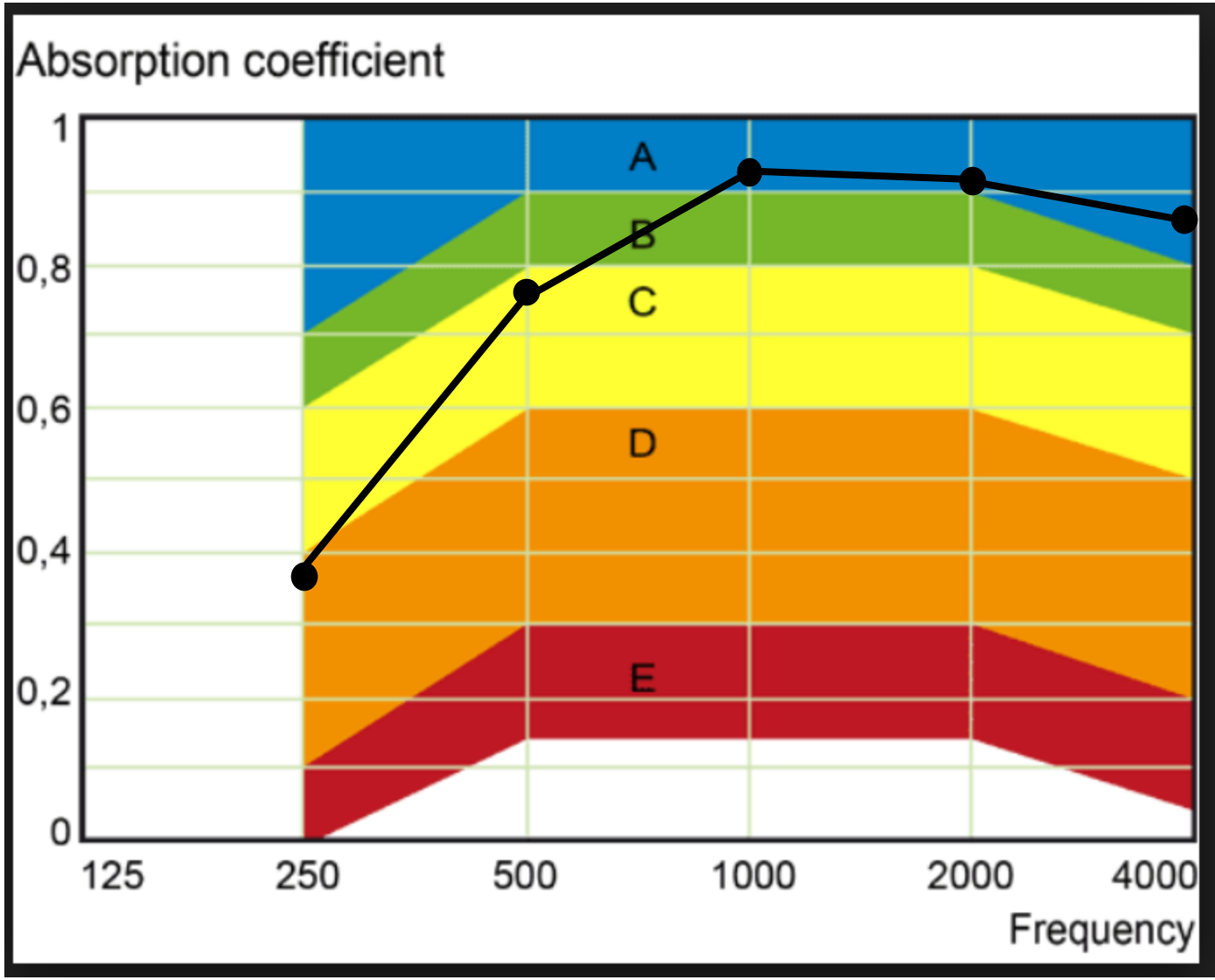
Classification of Sound Absorbers

ISO 11654: 1997

“Acoustics – Sound absorbers for use in buildings – Rating of sound absorption”

3/4” Laminated Mineral fiber (0.75 NRC)

- Most are Class C or Class D
- Note the skewed nature of the performance curve



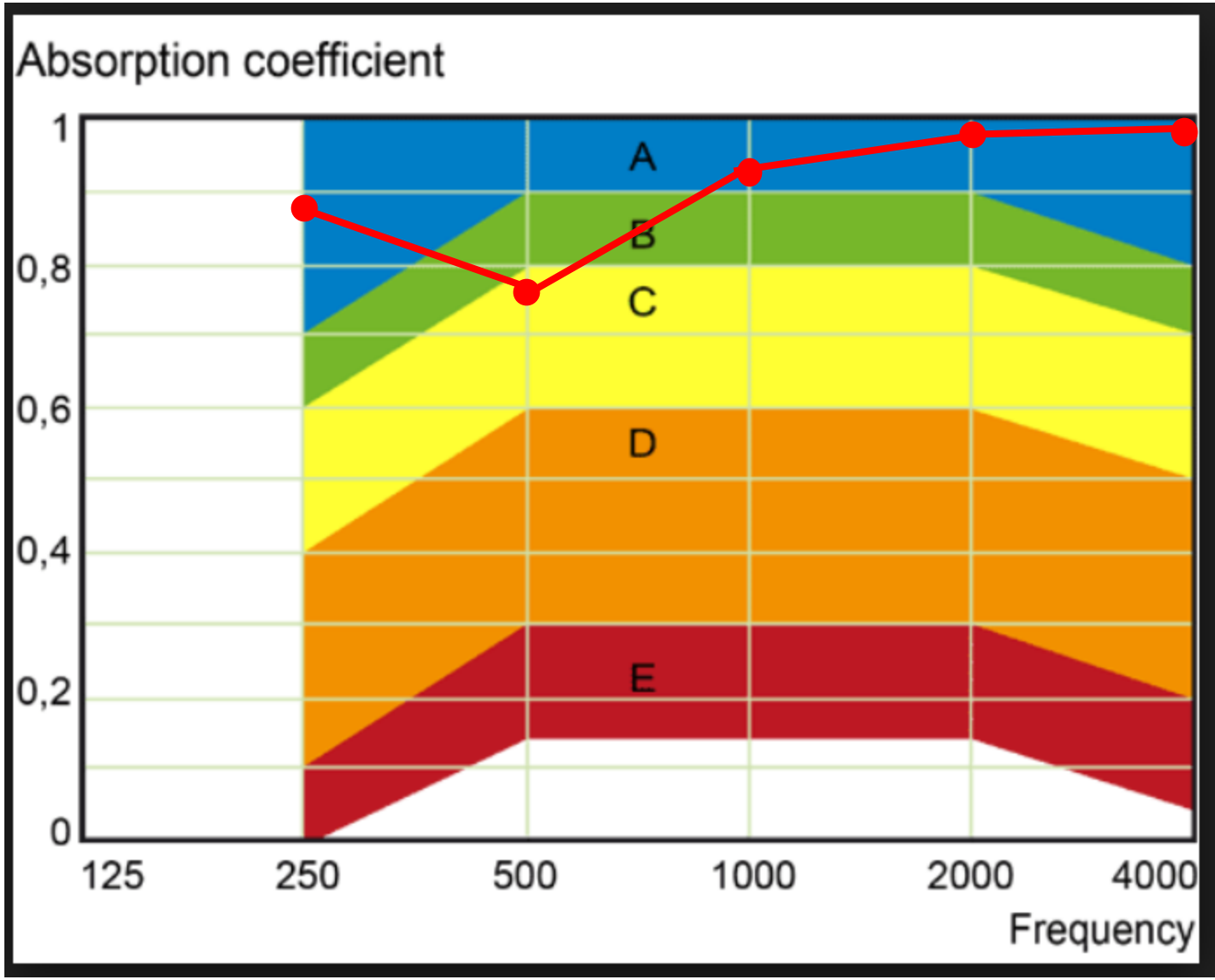
Classification of Sound Absorbers

ISO 11654: 1997

“Acoustics – Sound absorbers for use in buildings – Rating of sound absorption”

9/16” Laminated Fiberglass (0.90 NRC)

- Most are Class A or Class B
- Note the flat nature of the performance curve



QUICK QUIZ

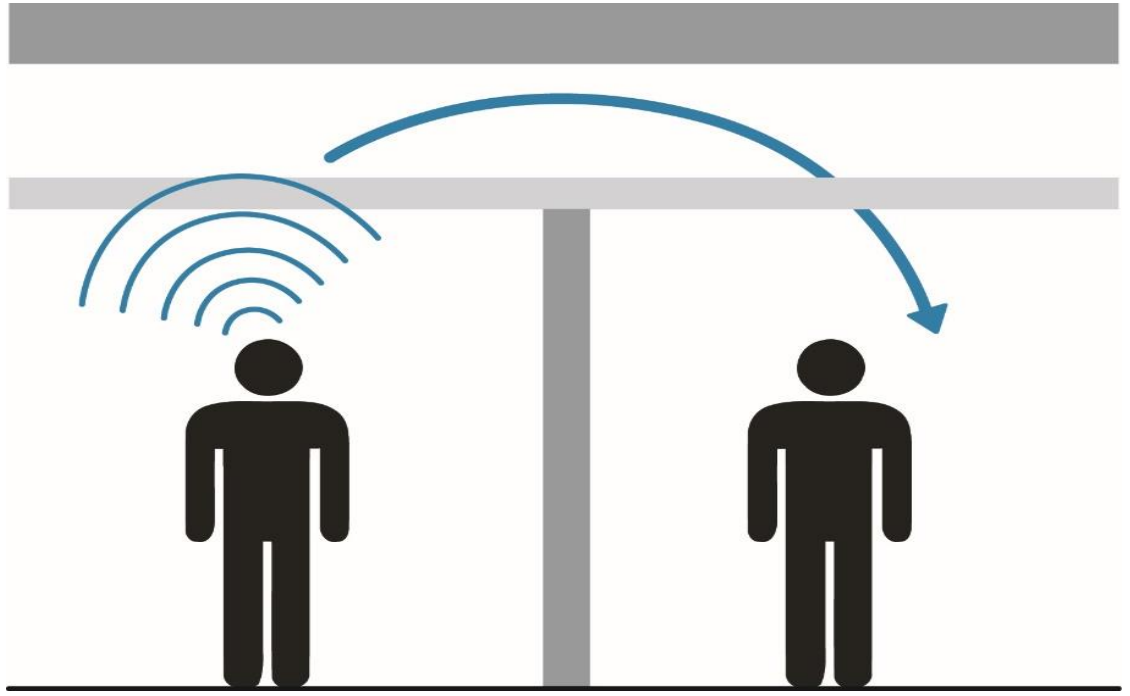
Which Type of Ceiling Tile is best when walls do not go to the deck?

A. TYPE III
Mineral Fiber with painted finish

B. TYPE IV
Mineral Fiber with membrane-faced overlay

C. TYPE XII
Fiberglass with membrane-faced overlay

D. Both A and B



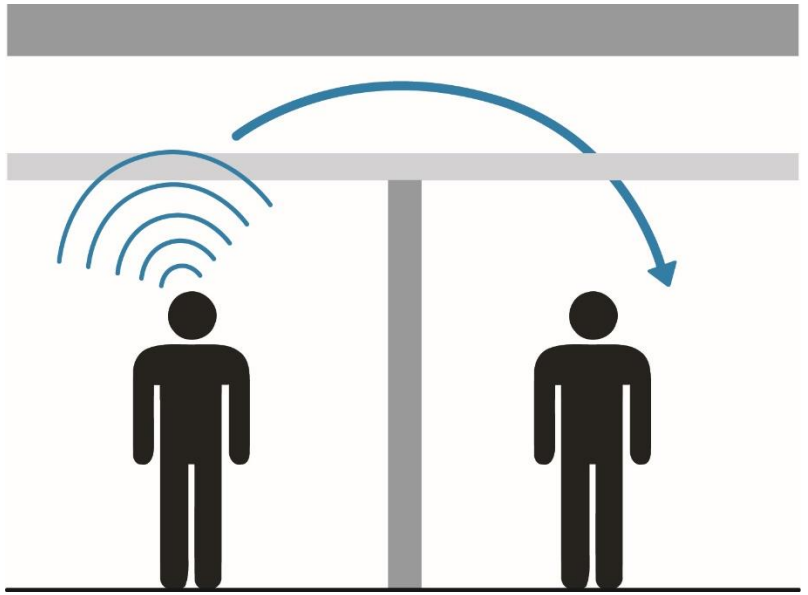
CAC

(specific acoustic concept applied to a specific application)

(Ceiling Attenuation Class)

- ASTM E1414

  “Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum”



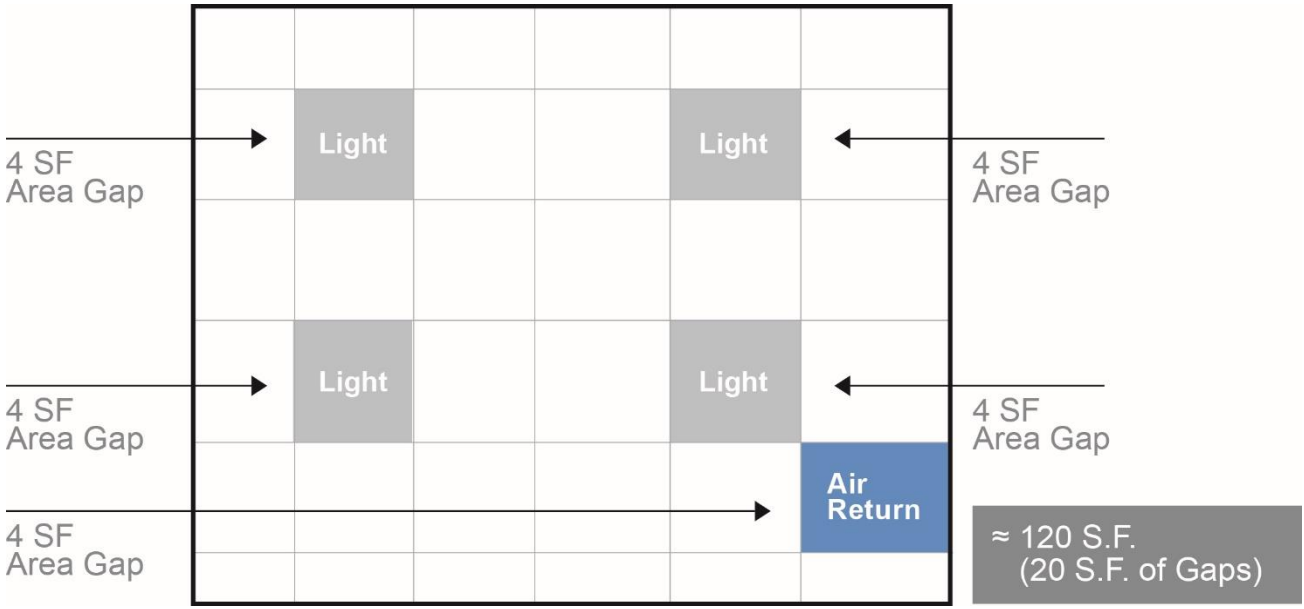
CAC

(specific acoustic concept applied to a specific application)

(Ceiling Attenuation Class)

- ASTM E1414

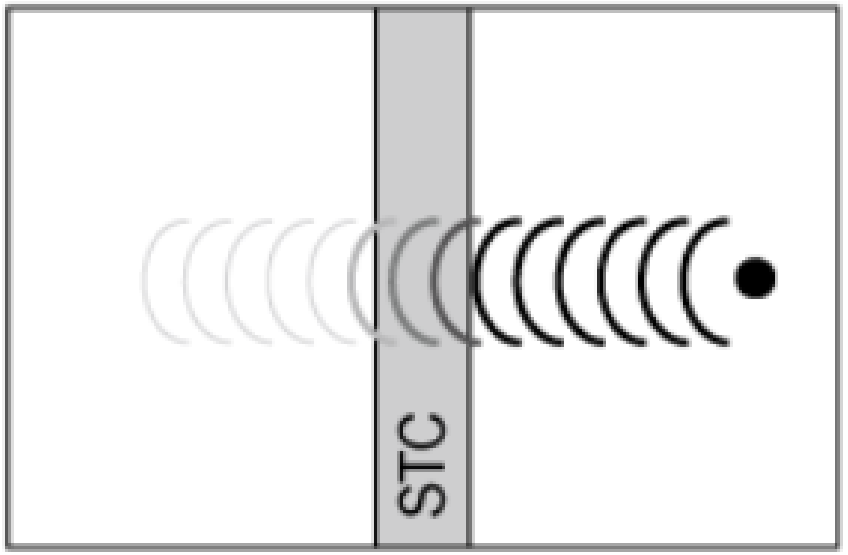
  "Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum"



STC
(specific acoustic concept)

- ASTM E90

  “Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements”



Light Reflectance
(How valuable?)

ASTM E1477

“Standard test method for luminous reflectance factor of acoustical materials by use of integrating sphere reflectometer”

- Technically, “How much light is being reflected off of the ceiling?”

Light Reflectance
(How valuable?)

ASTM E1477

“Standard test method for luminous reflectance factor of acoustical materials by use of integrating sphere reflectometer”

- If the ceiling is populated with lay-in lighting, how much is the assembly affected by an LR of 0.82 v 0.92?

Light Reflectance
(How valuable?)

ASTM E1477

“Standard test method for luminous reflectance factor of acoustical materials by use of integrating sphere reflectometer”

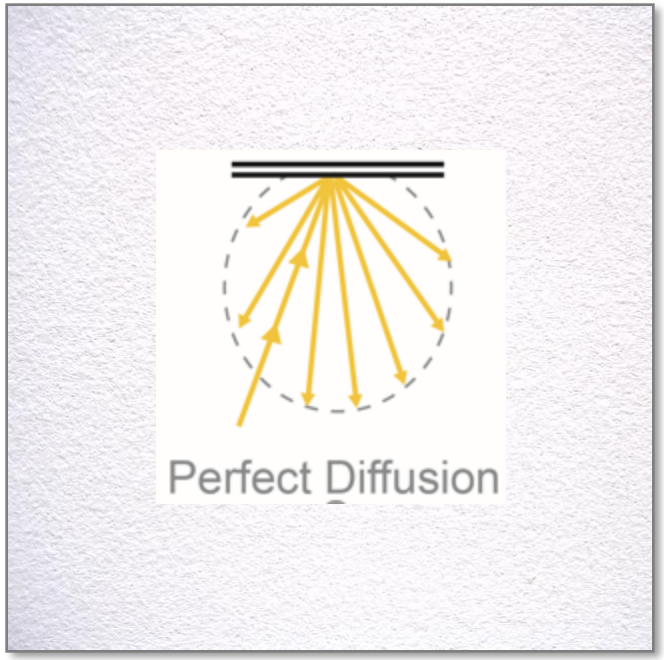
- If the ceiling is populated with indirect lighting, how much is the assembly affected by an LR of 0.82 v 0.92?

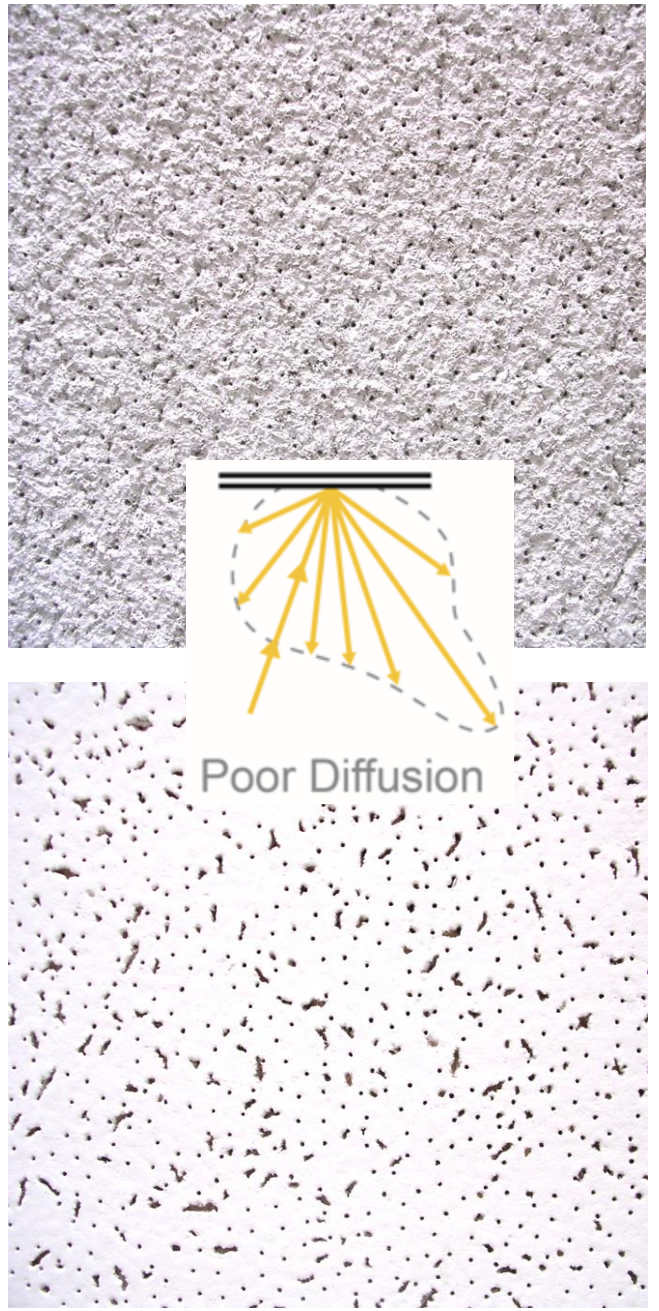
Light Reflectance
(How valuable?)

ASTM E1477

“Standard test method for luminous reflectance factor of acoustical materials by use of integrating sphere reflectometer”

- If the ceiling is populated with indirect lighting, how much is the assembly affected by poor light diffusion?





ENVIRONMENTAL Considerations

Product = assumed peace of mind

- Product selection carries a measure of liability
- Designers should expect that product manufacturers have conducted evaluations and testing.
- Furthermore, that the testing results are available for examination
- Finally, designers should be able to have comfort with regard to the way that the product is manufactured… from an environmental perspective

Environmental Labels

- The ISO 14020 series
  - (14020, 14021, 14024, 14025)

    - Is designed to assist businesses with measuring and communicating their efforts to minimize environmental impacts

Environmental Labels

According to the ISO 14024

- "Environmental Labels And Declarations - Type I Environmental Labeling - Principles And Procedures"

TYPE I – Verified, Single Attribute

- Employs a third-party certification process to verify product compliance with a pre-selected set of criteria

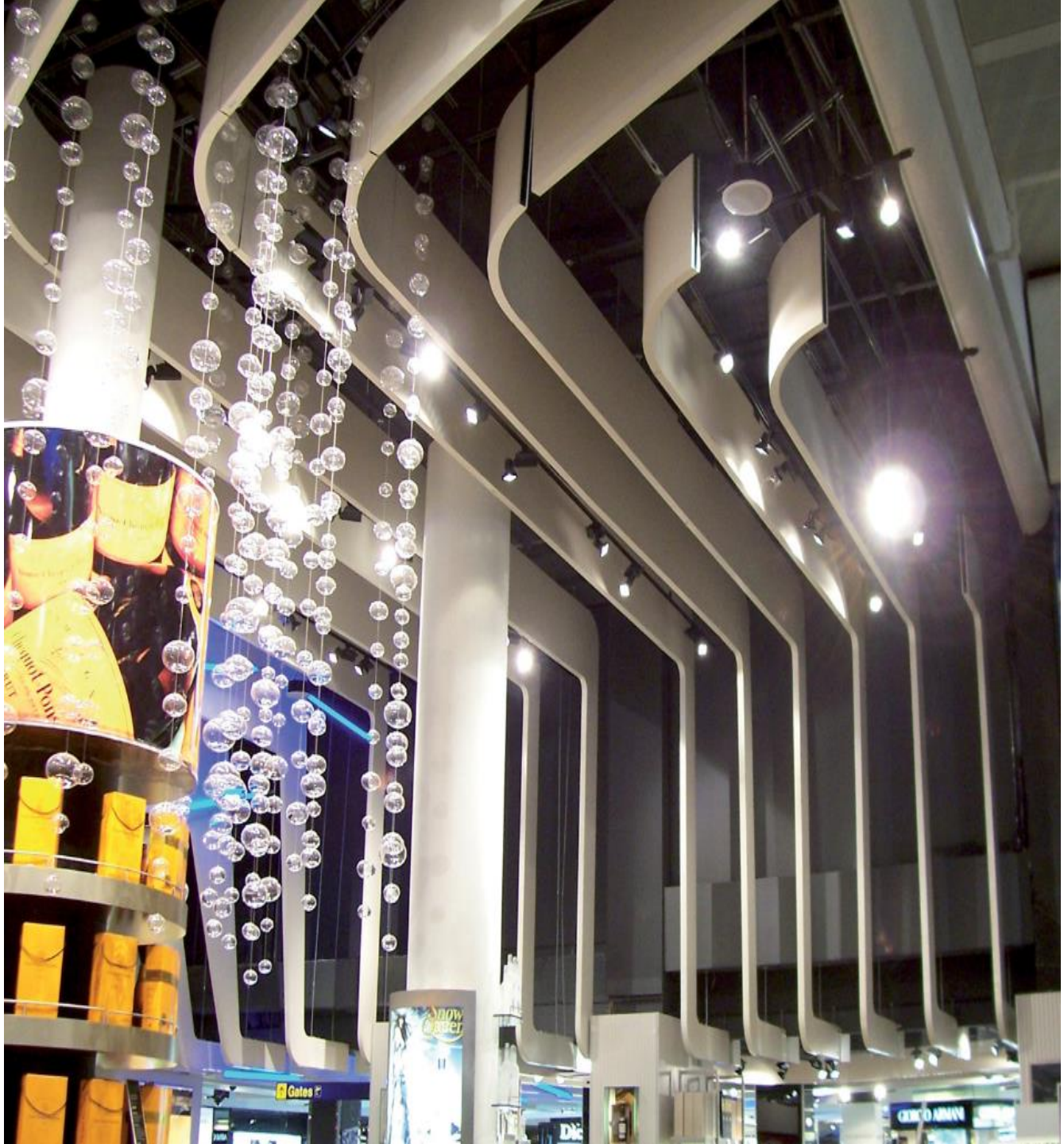
Environmental Labels

According to the ISO 14021

- *“Environmental Labels and Declarations - Self-declared Environmental Claims - Type II Environmental Labeling”*

TYPE II – NOT Verified, Self-Declared

- This is a label that is only put on products that satisfy the criteria set by each manufacturer group



Environmental Labels (EPDs)

According to the ISO 14025

- “Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures”

TYPE III – Verified, Environmental Declarations (EPDs)

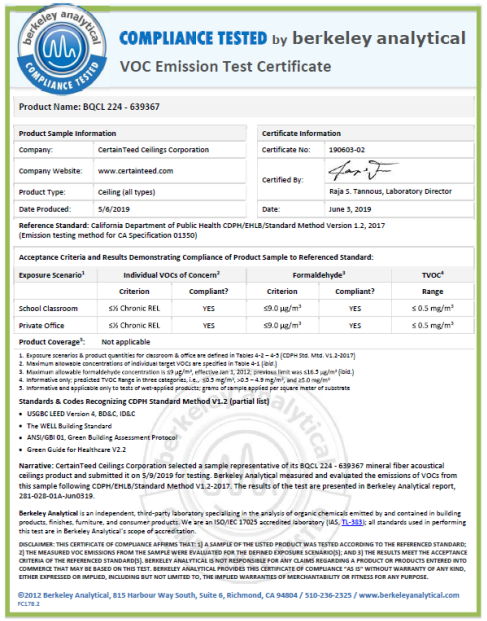
- Specifies a format for reporting quantifiable life cycle data

MR CREDIT: BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION—ENVIRONMENTAL PRODUCT DECLARATIONS

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION

VOC Certificates of Compliance

- Certifies that the tested ceiling product is in compliance with California Department of Public Health Standard Method CDPH v1.2 2017
  - Effectively assures that the ceiling panel emits almost ZERO formaldehyde



COMPLIANCE TESTED by berkeley analytical

VOC Emission Test Certificate

Product Name: BQCL 224 - 639367

Product Sample Information		Certificate Information	
Company:	CertainTeed Ceilings Corporation	Certificate No:	190603-02
Company Website:	www.certainteed.com	Certified By:	Raja S. Tannous, Laboratory Director
Product Type:	Ceiling (all types)		
Date Produced:	5/6/2019	Date:	June 3, 2019

Reference Standard: California Department of Public Health CDPH/EHLB/Standard Method Version 1.2, 2017 (Emission testing method for CA Specification 01350)

Acceptance Criteria and Results Demonstrating Compliance of Product Sample to Referenced Standard:

Exposure Scenario[1]	Individual VOCs of Concern[2]		Formaldehyde[3]		TVOC[4]
	Criterion	Compliant?	Criterion	Compliant?	Range
School Classroom	≤⅓ Chronic REL	YES	≤9.0 µg/m³	YES	≤ 0.5 mg/m³
Private Office	≤⅓ Chronic REL	YES	≤9.0 µg/m³	YES	≤ 0.5 mg/m³

Product Coverage[5]: Not applicable

1. Exposure scenarios & product quantities for classroom & office are defined in Tables 4-2 – 4-5 (CDPH Std. Mtd. V1.2-2017)
2. Maximum allowable concentrations of individual target VOCs are specified in Table 4-1 (ibid.)
3. Maximum allowable formaldehyde concentration is ≤9 µg/m³, effective Jan 1, 2012; previous limit was ≤16.5 µg/m³ (ibid.)
4. Informative only: predicted TVOC Range in three categories; i.e., ≤0.5 mg/m³, >0.5 – ≤ 1.9 mg/m³, and ≥5.0 mg/m³
5. Informative and applicable only to tests of wet-applied products: grams of sample applied per square meter of substrate

Standards & Codes Recognizing CDPH Standard Method V1.2 (partial list)

- USGBC LEED Version 4, BD&C, ID&C
- The WELL Building Standard
- ANSI/GBI 01, Green Building Assessment Protocol
- Green Guide for Healthcare V2.2

Narrative: CertainTeed Ceilings Corporation selected a sample representative of its BQCL 224 - 639367 mineral fiber acoustical ceilings product and submitted it on 5/9/2019 for testing. Berkeley Analytical measured and evaluated the emissions of VOCs from this sample following CDPH/EHLB/Standard Method V1.2-2017. The results of the test are presented in Berkeley Analytical report, 281-028-01A-Jun0519.

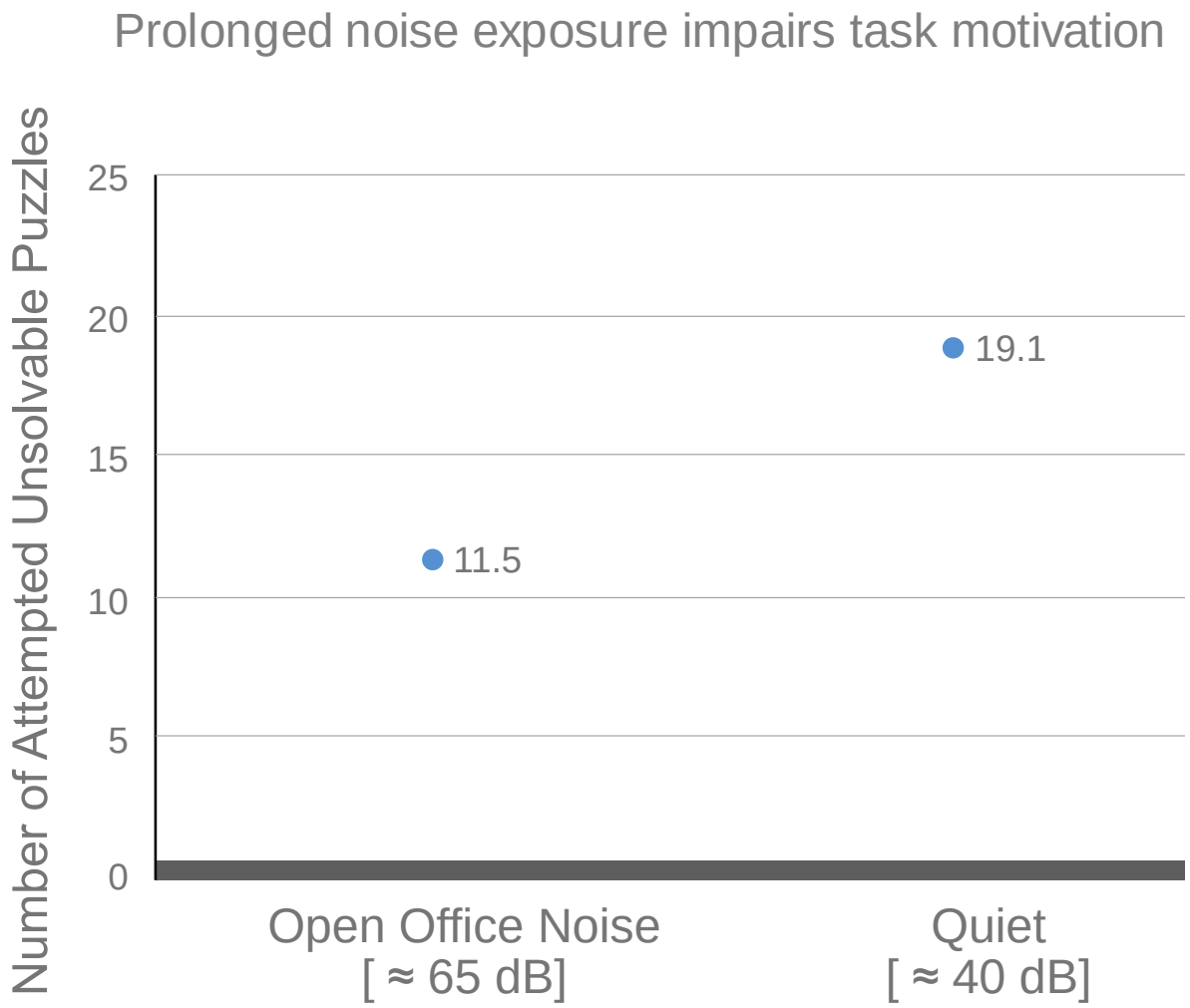
Berkeley Analytical is an independent, third-party laboratory specializing in the analysis of organic chemicals emitted by and contained in building products, finishes, furniture, and consumer products. We are an ISO/IEC 17025 accredited laboratory (A5, TL-583); all standards used in performing this test are in Berkeley Analytical's scope of accreditation.

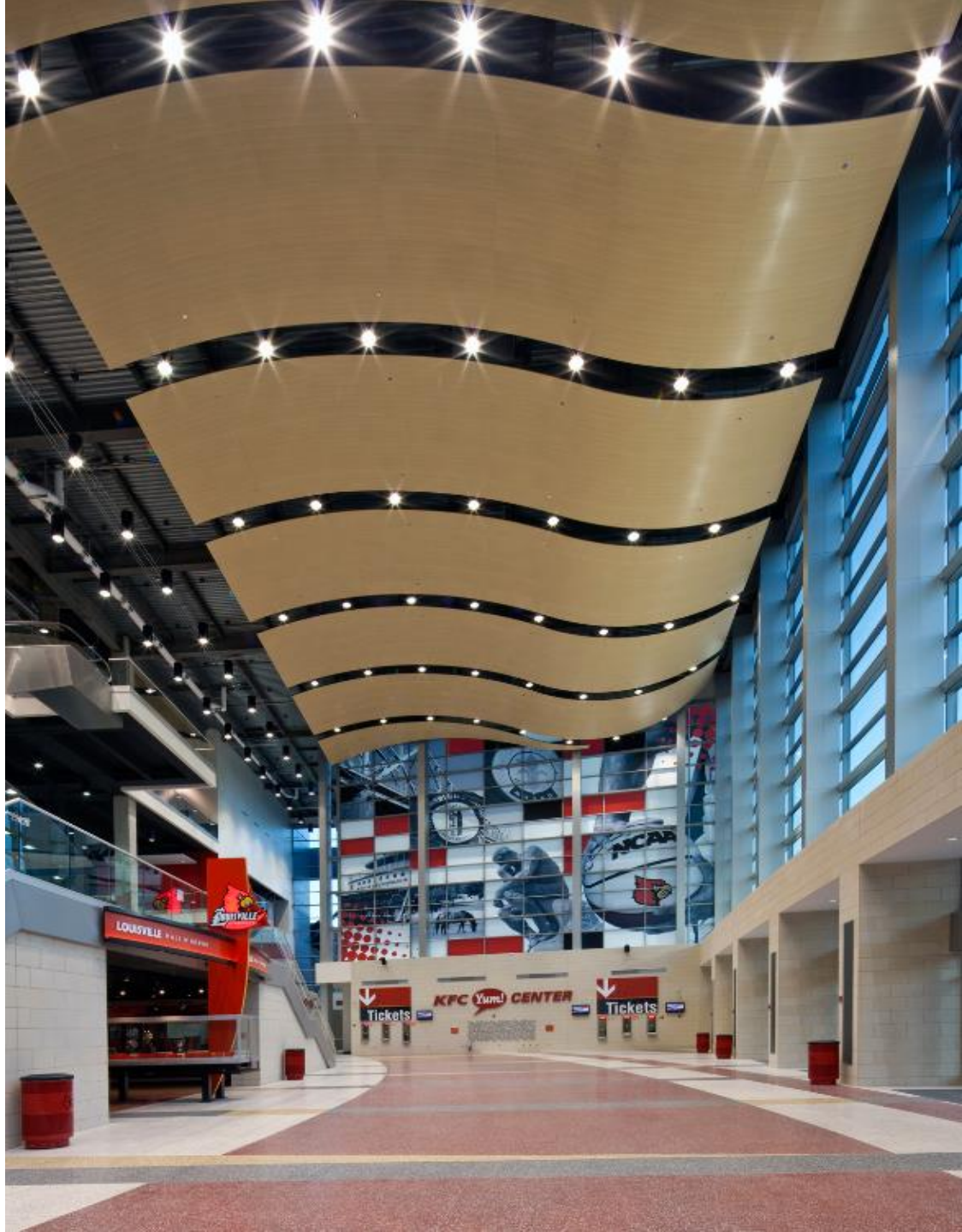
DISCLAIMER: THIS CERTIFICATE OF COMPLIANCE AFFIRMS THAT: 1) A SAMPLE OF THE LISTED PRODUCT WAS TESTED ACCORDING TO THE REFERENCED STANDARD; 2) THE MEASURED VOC EMISSIONS FROM THE SAMPLE WERE EVALUATED FOR THE DEFINED EXPOSURE SCENARIO(S); AND 3) THE RESULTS MEET THE ACCEPTANCE CRITERIA OF THE REFERENCED STANDARD(S). BERKELEY ANALYTICAL IS NOT RESPONSIBLE FOR ANY CLAIMS REGARDING A PRODUCT OR PRODUCTS ENTERED INTO COMMERCE THAT MAY BE BASED ON THIS TEST. BERKELEY ANALYTICAL PROVIDES THIS CERTIFICATE OF COMPLIANCE "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PURPOSE.

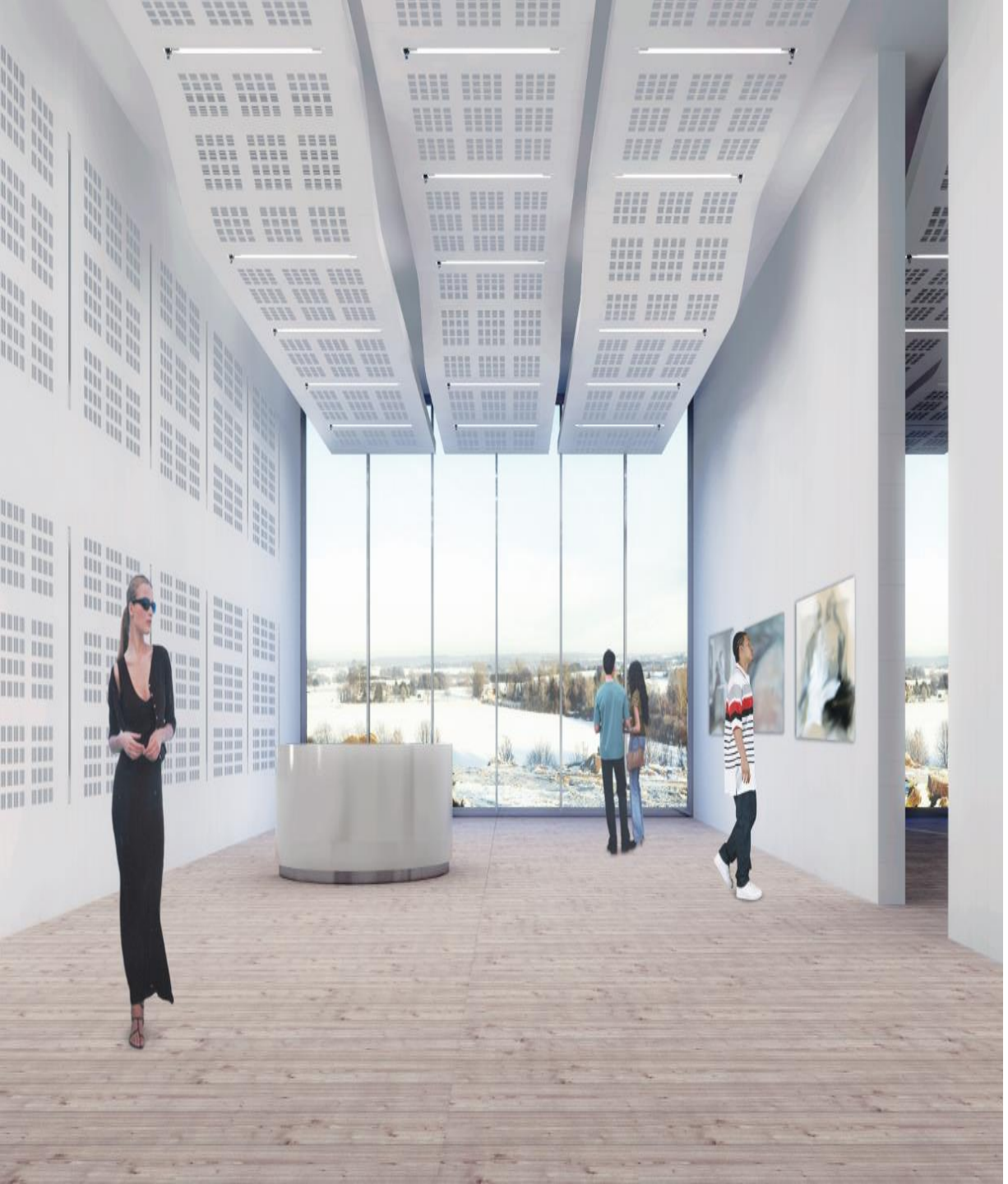
FC179.2

IMPLICATIONS
from acoustic studies

Open Office Noise (Task Motivation)

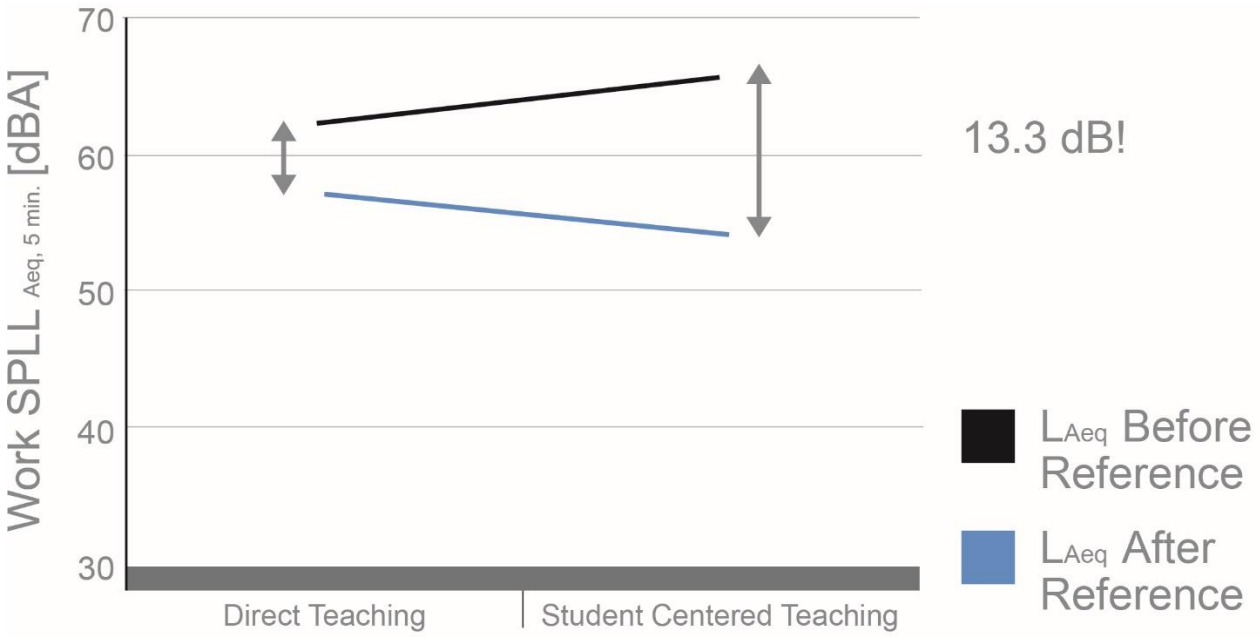






Quiet Spaces
(as they apply to Teaching Styles)

Sound levels Before and After acoustic renovation



Lombard Effect

- The louder the space gets, the louder people will talk
  - (think local taproom on Friday at 11pm)

- The “Reverse Lombard Effect”
  - If you build it quiet…
  - …the human occupants within the space will unconsciously make it quieter.

LEED and quiet schools

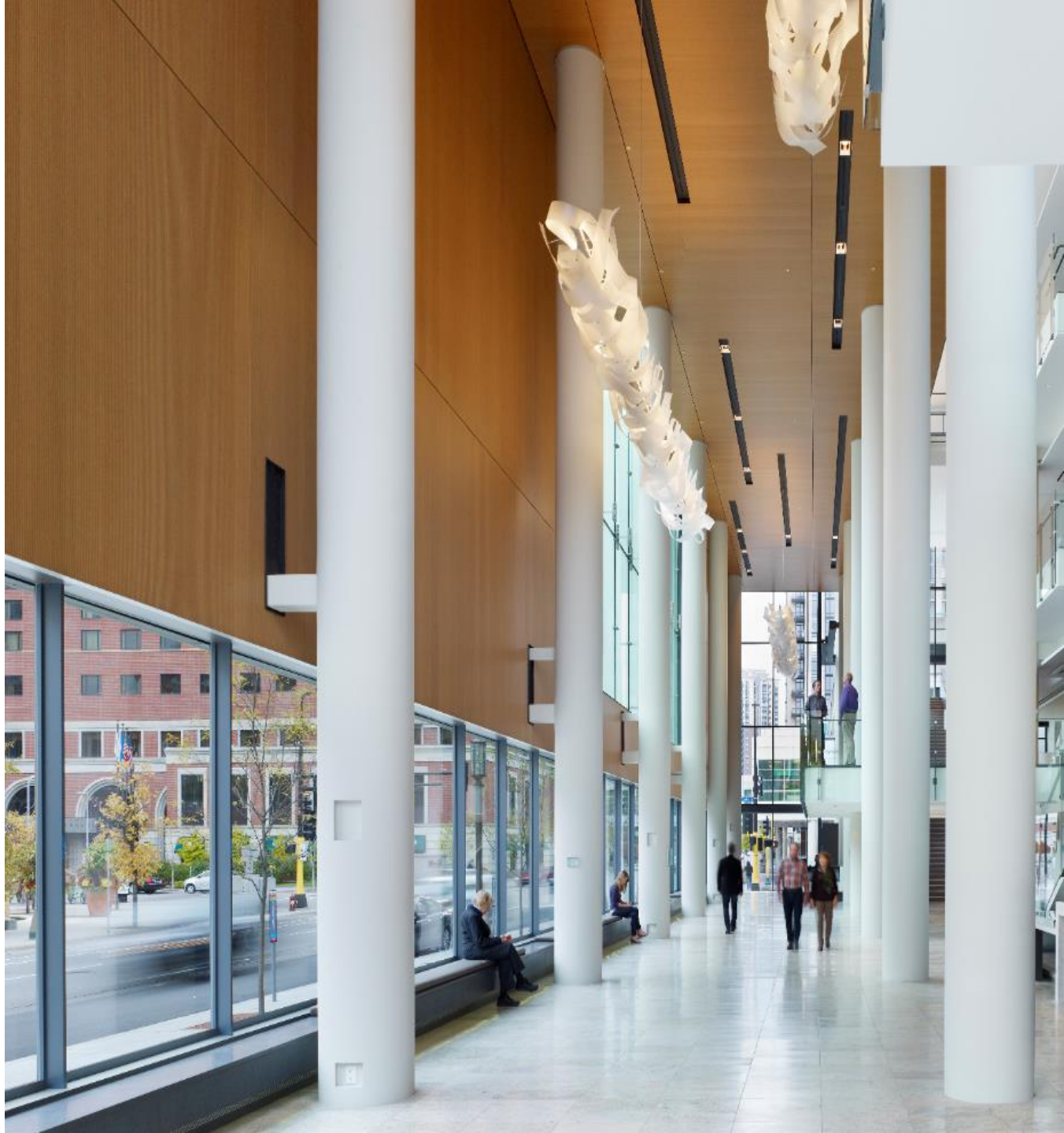
The implications of this important concept are potentially more far reaching

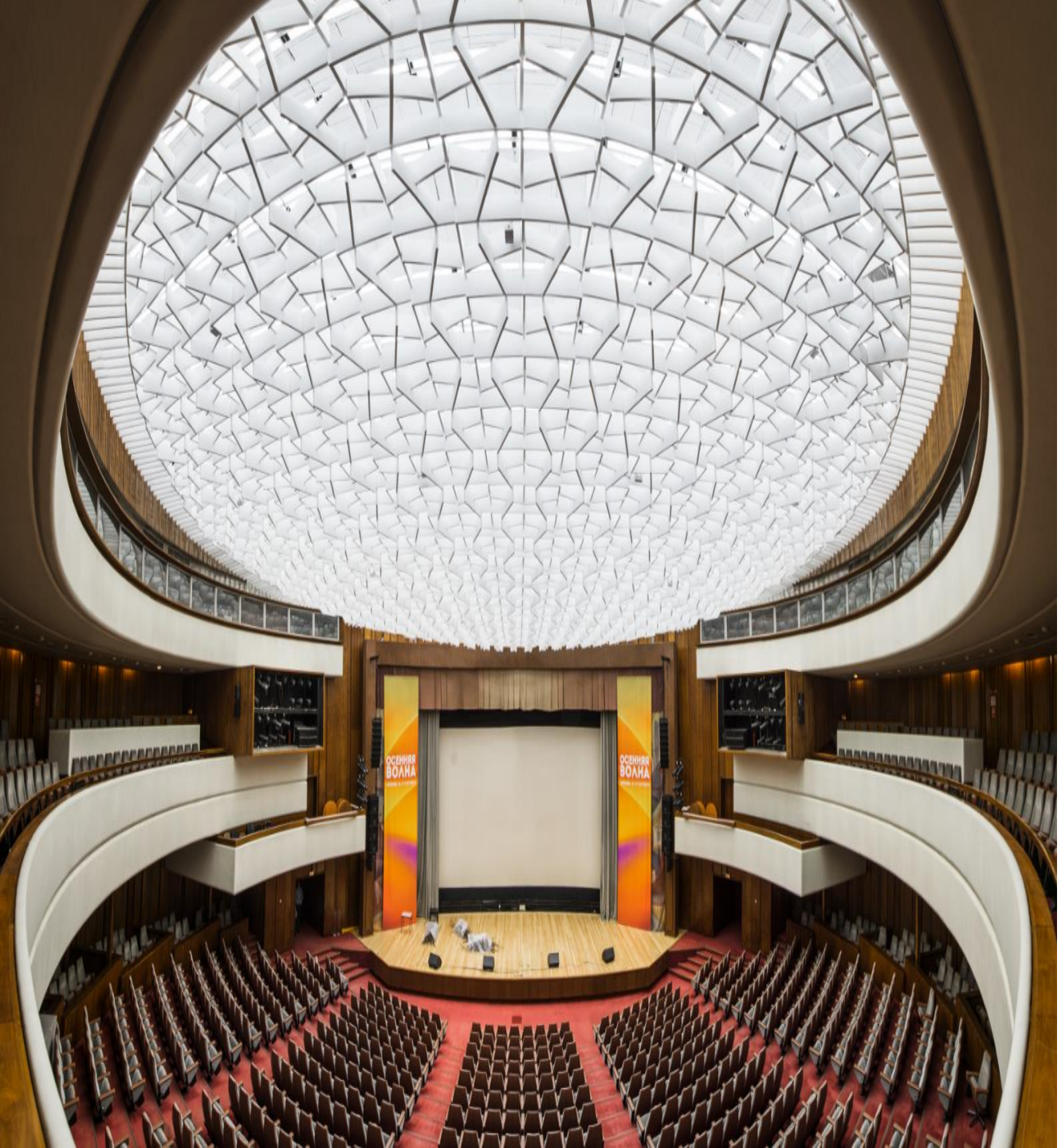
- **LEED for Schools** mandates classroom ceiling assemblies with minimum 0.70 NRC performance.
- How much better would the classroom performance be if the design goes BEYOND minimum performance?

LEED and quiet in health care facilities

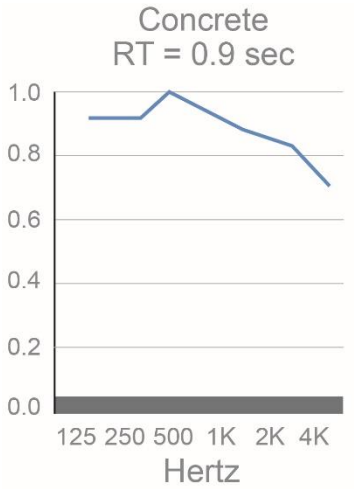
The implications of this important concept are potentially more far reaching

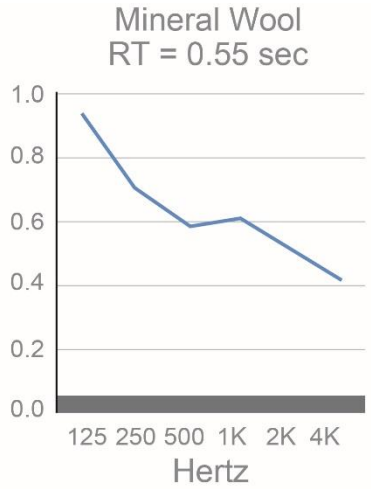
- **LEED for Healthcare** requires materials that meet minimum design room coefficient (for quiet).
- Would employee/patient stress be even lower in a space designed beyond the minimum requirement ?

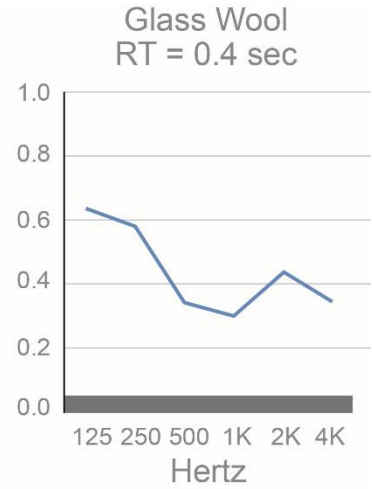




Three REVERBERATION Experiences



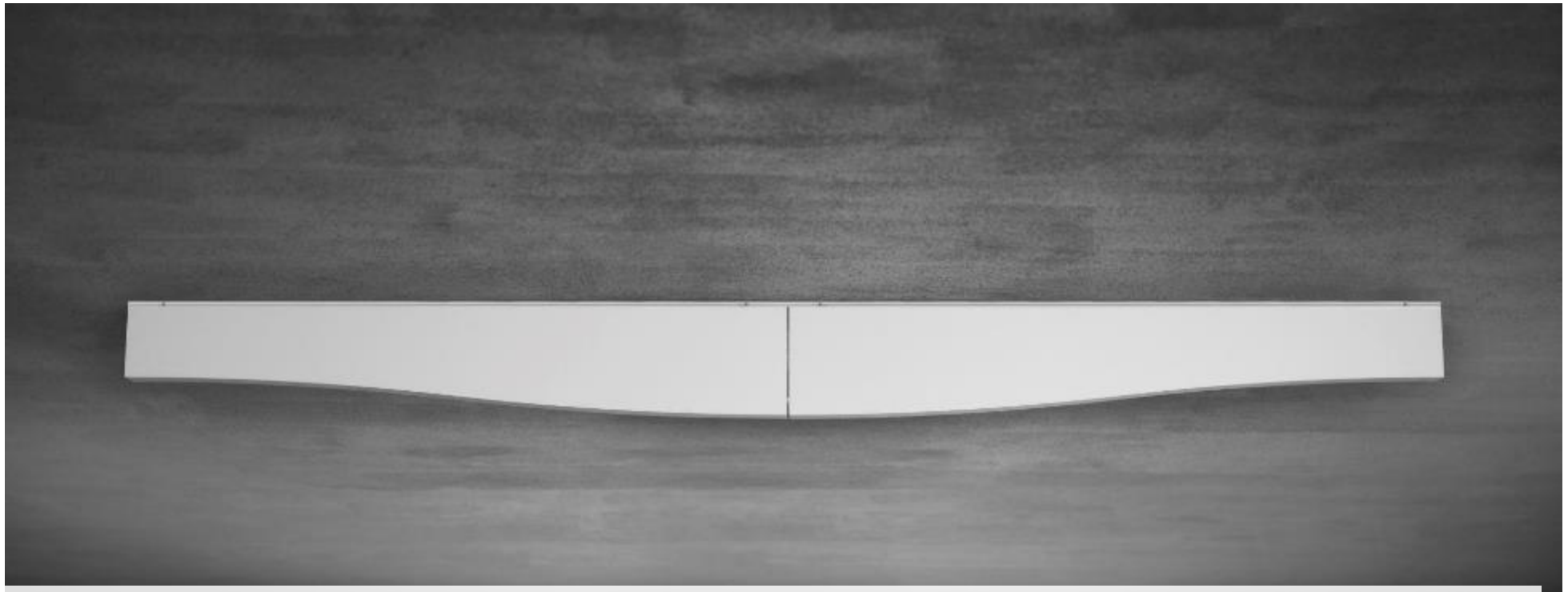




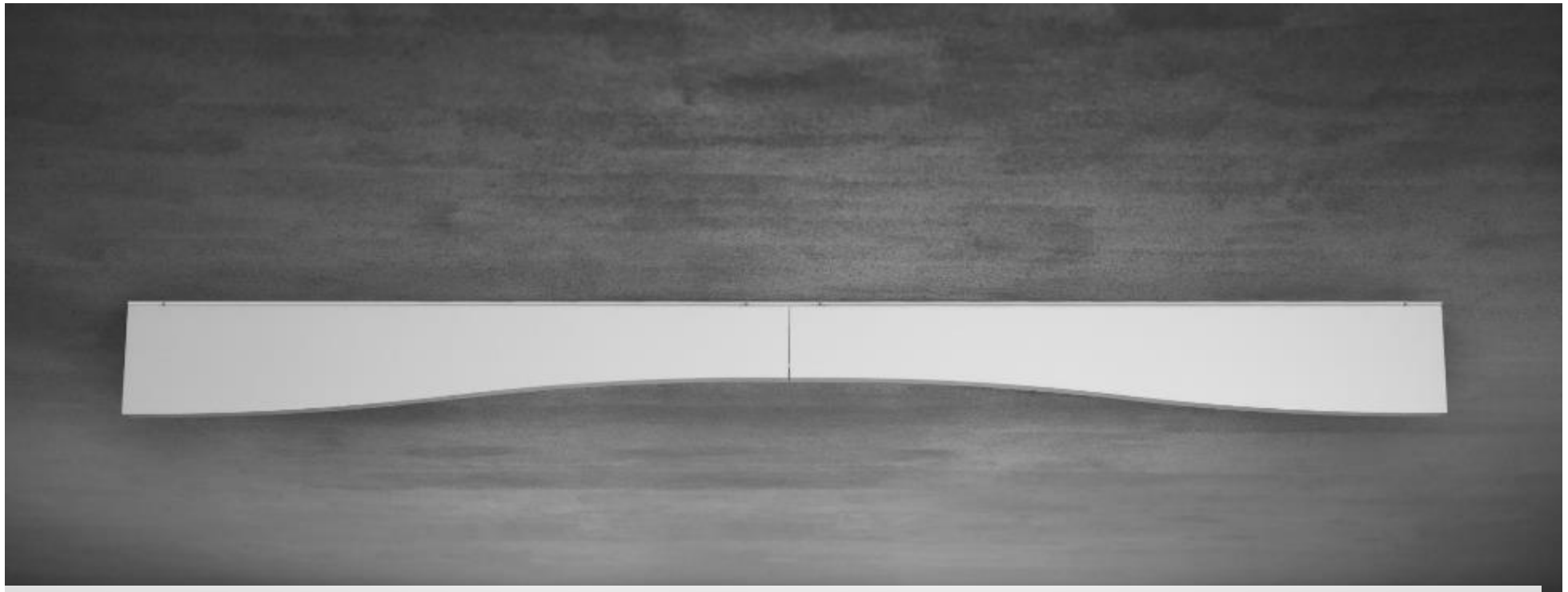

Questions?

BEAUTIFUL BAFFLES

- ✓ Waves
- ✓ Zig Zags – unique!!!
- ✓ 6’ long rectangles
- ✓ Solo on the wall



New – Baffle Wave 1’x6’ (300 x 1800mm) & 2’x6’ (600 x 1800mm)



New – Baffle Wave 1’x6’ (300 x 1800mm) & 2’x6’ (600 x 1800mm)

New – Baffle Wave 1’x6’ & 2’x6’

(300 x 1800mm) (600 x 1800mm)

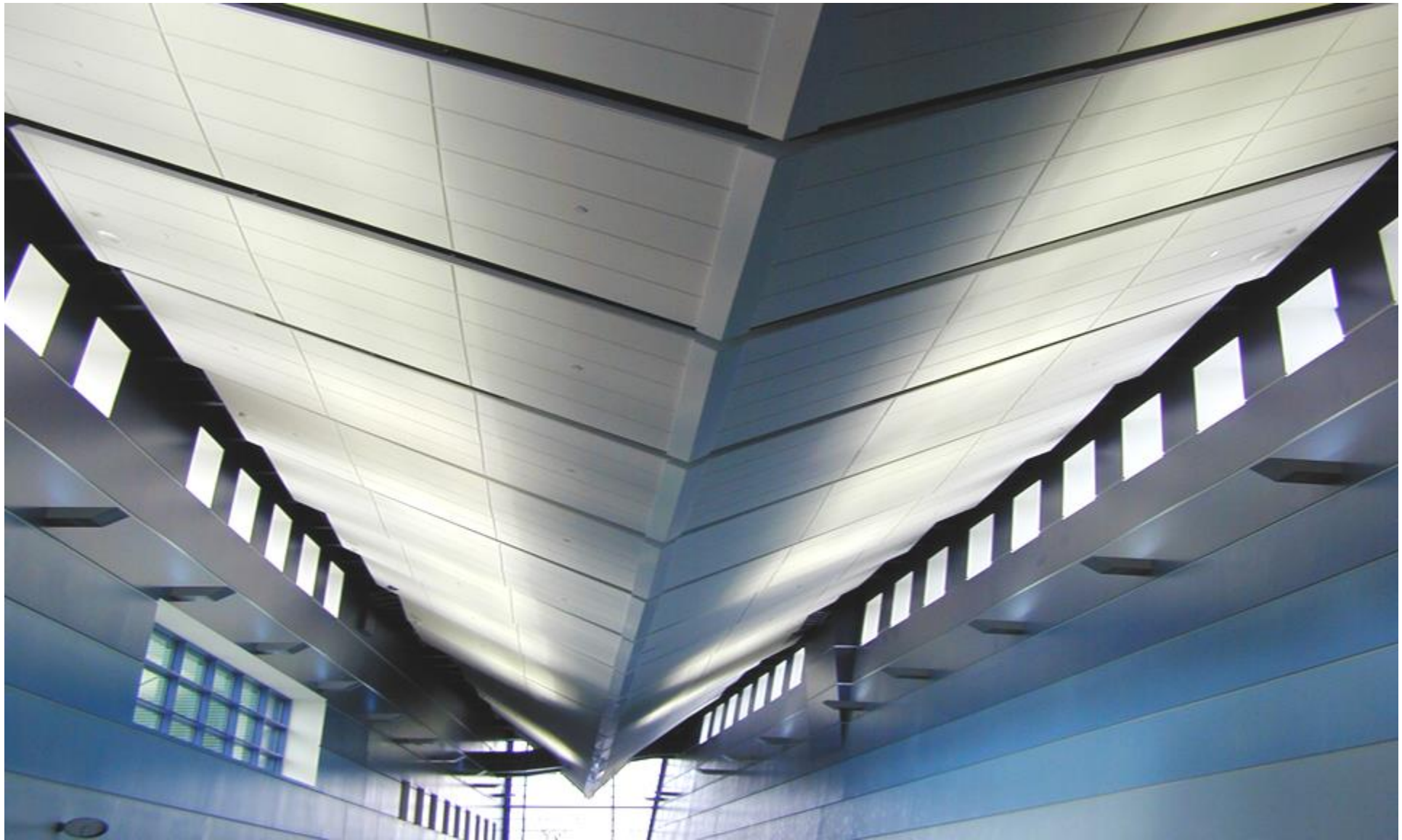
New – Baffle Wave 1’x6’ & 2’x6’

(300 x 1800mm) (600 x 1800mm)

New – Baffle Zig Zag 1’x6’ (300 x 1800mm) & 2’x6’ (600 x 1800mm)

New – Baffle Zig Zag 1’x6’ (300 x 1800mm) & 2’x6’ (600 x 1800mm)

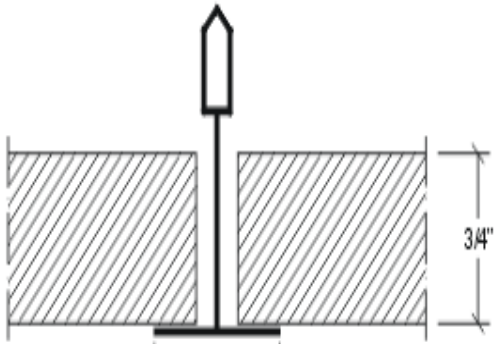
Ecophon ® Gedina ™E XL



Ecophon ® Gedina ™E 48” x 48”

AESTHETICS

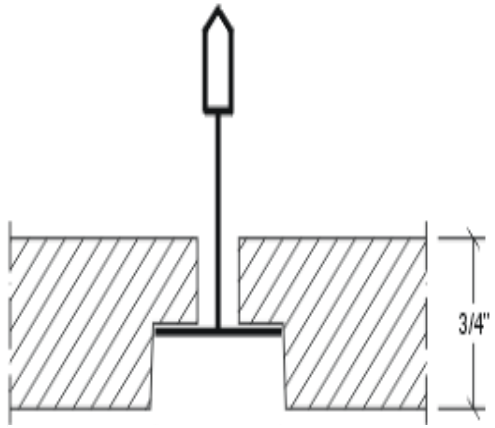
Demountable Edge Details



Square

(15/16” grid)

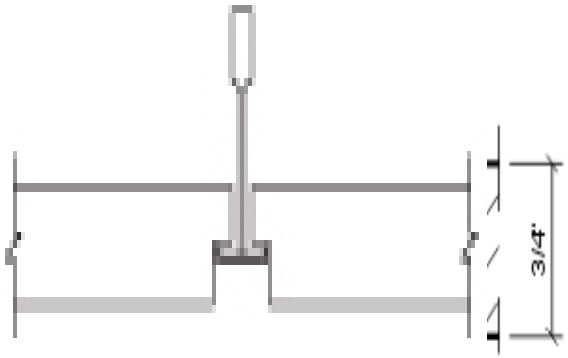
[A-edge]



Reveal

(15/16” grid)

[E-edge]



Narrow Reveal

(9/16” grid)

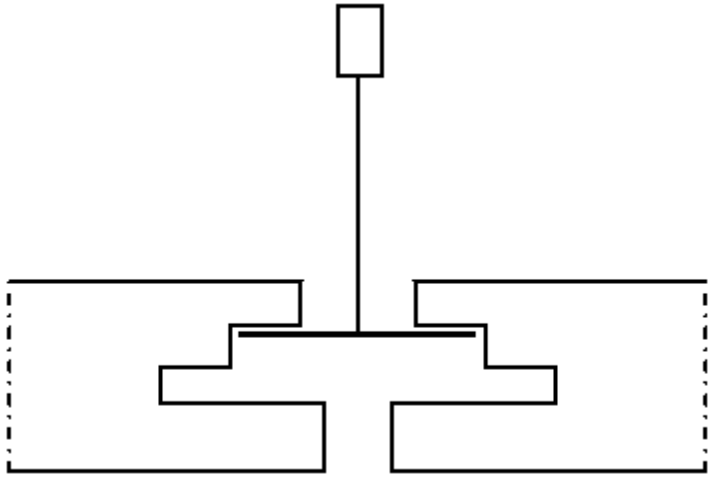
[E-edge]

Ecophon ® Focus ™Dg XL

Ecophon ® Focus ™Ds with
Ecohpon ® Focus ™Wing

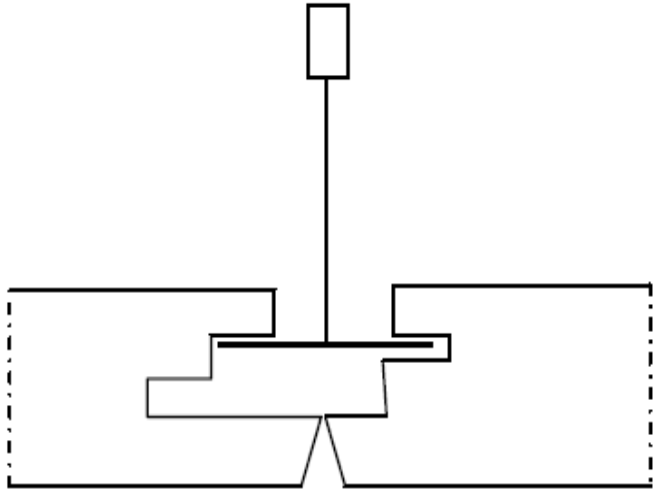
AESTHETICS

Demountable Edge Details



Semi-concealed Edge

[Focus DG]



Fully Concealed Edge

[Focus DS]

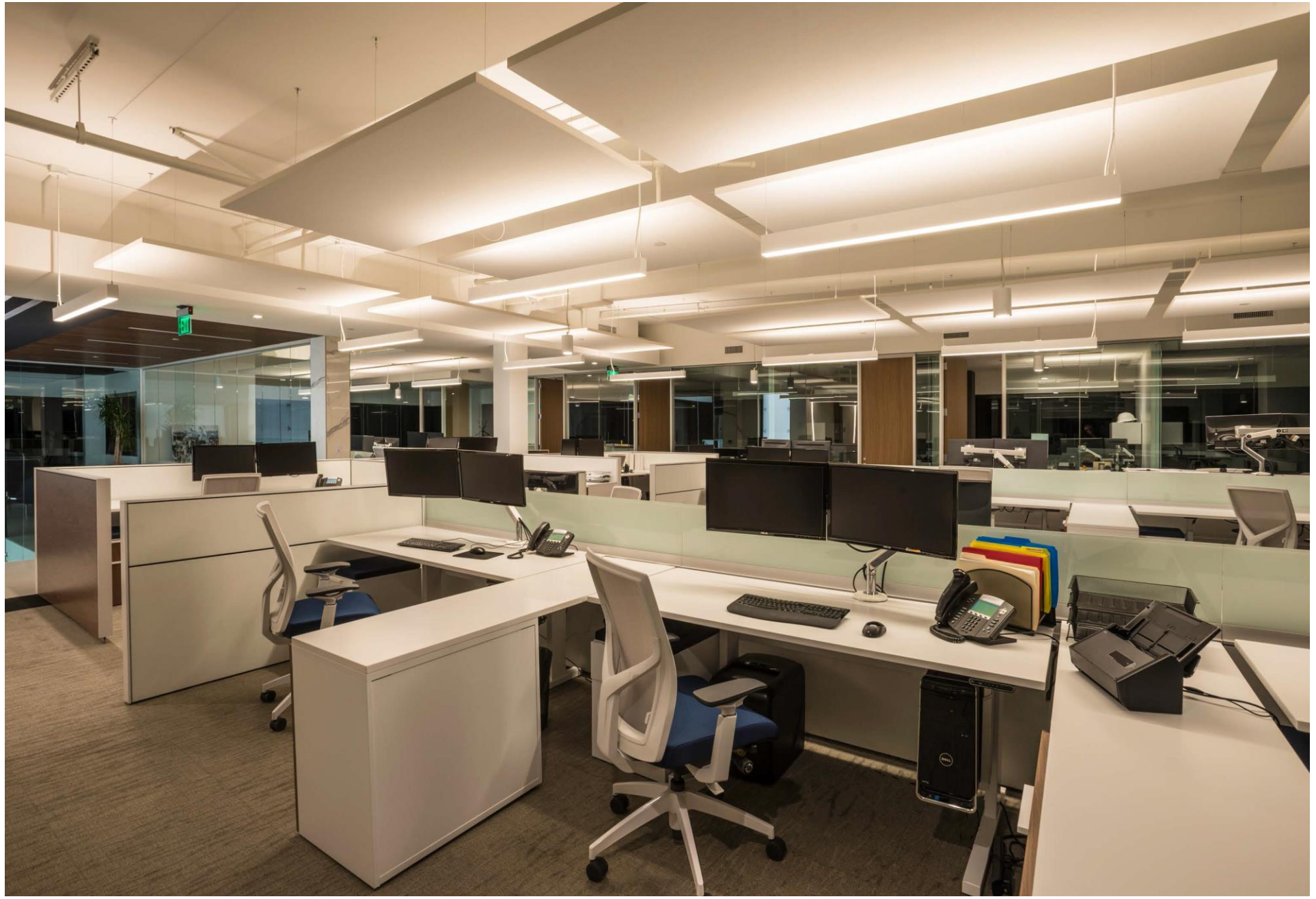
Gyptone ® BIG ™Line 6

Gyptone ® BIG ™Line 6

Gyptone ® Quattro20 ™

Ecophon ® Texona ™ Wall Panels

Ecophon ® Solo ™
for Walls and Ceilings


EXIT