MASS TIMBER+ SM

OFFSITE CONSTRUCTION CONFERENCE

PRODUCED BY WOODWORKS FEA Forest Economic Advisors

Acoustic Considerations for Mass Timber/Light-Frame Wood Hybrid Projects

Credits: 1.0 AIA/CES HSW LUs, 1.0 PHD credit, 0.10 ICC credit

Toban Bradlynn

HGC Noise Vibration Acoustics

HGC

NOISE | VIBRATION | ACOUSTICS

ACOUSTIC CONSIDERATIONS FOR MASS TIMBER/LIGHT-FRAME WOOD HYBRID PROJECTS

MASS TIMBER + BOSTON, MA

October 30, 2025

Toban Bradlynn, Project Consultant

tbradlynn@hgcacoustics.com

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.

Who is HGC Noise Vibration Acoustics?

Toronto // Calgary // Montreal // Dallas // Charlotte, since 1994

Built Environment

We actively support developers, planners, architects and engineers in addressing all issues pertaining to noise, vibration and acoustics within a structure and in its relationship to environmental zones of influence nearby.

Industrial

We assist industries in every business sector to complete requirements for their Environmental Compliance Approvals. We conduct accurate surveys to identify all significant noise and vibration sources associated with large industrial facilities, plants and operational complexes.

Transportation

Whether rail, road or air, transportation represents a major potential source of environmental noise and vibration for neighboring communities. We work with all relevant stakeholders conducting impact studies and developing mitigation solutions that facilitate the approval process and alleviate community concerns.

Defence & Security

Defence and Security related technologies and support systems represent potential occupational noise and vibration hazards for their operators and the public at large. We work with officials to research and develop noise abatement strategies and solutions that alleviate exposure concerns.

Product R&D

We have partnered with manufacturers across multiple industries to investigate and incorporate effective acoustic best practices into their product design for greater consumer preference and comfort.

WoodWorks | The Wood Products Council is a registered provider of AIA-approved continuing education under Provider Number G516. All registered AIA CES Providers must comply with the AIA Standards for Continuing Education Programs. Any questions or concerns about this provider or this learning program may be sent to AIA CES (cessupport@aia.org or (800) AIA 3837, Option 3).

This learning 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 or product.

AIA continuing education credit has been reviewed and approved by AIA CES. Learners must complete the entire learning program to receive continuing education credit. AIA continuing education Learning Units earned upon completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

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

AIA Approved Continuing Education

Course Description

This session explores acoustic design strategies unique to projects with mass timber floors and light-frame wood walls. This hybrid approach is often used to leverage the strengths of each system, combining the aesthetic of exposed wood ceilings with the economy of light-frame bearing walls—but understanding the acoustic nuances is critical to achieving both code compliance and occupant comfort. This session will examine how sound transmits through wood-based assemblies and where challenges commonly arise in designs that combine mass timber with light-frame wood or steel elements. Attendees will learn how to apply best practices in detailing, material selection, and assembly design to control airborne and impact sound transmission. Discussion will also include relevant building codes and acoustic rating systems, to help participants develop integrated solutions that support both performance and aesthetic goals in modern timber construction.

Learning Objectives

1. Describe the acoustic performance characteristics of mass timber and light-frame wood construction, including how sound is transmitted through different structural systems.
2. Identify common acoustic challenges in hybrid designs that combine mass timber with light-frame wood or steel, and how they affect airborne and impact sound control, as well as their potential effects on mental health, productivity, and safety.
3. Apply best practices in acoustic detailing, material selection, and assembly design to improve sound isolation and meet performance expectations in wood-based construction, with the goal of enhanced occupant experience.
4. Interpret relevant acoustic codes and standards—such as Sound Transmission Class (STC) and Impact Insulation Class (IIC)—and integrate these requirements into design strategies for hybrid timber buildings.

Mass timber structures are weak for acoustics.

~~Mass timber~~

Poured concrete structures are weak for acoustics.

~~Mass timber~~

~~Poured concrete~~

Steel deck structures are weak for acoustics.

~~Mass timber~~

~~Poured concrete~~

~~Steel deck~~

Lightweight wood structures are weak for acoustics.

~~Mass timber~~

~~Poured concrete~~

~~Steel deck~~

~~Lightweight wood~~

All structures are weak for acoustics.

(…if not properly designed)

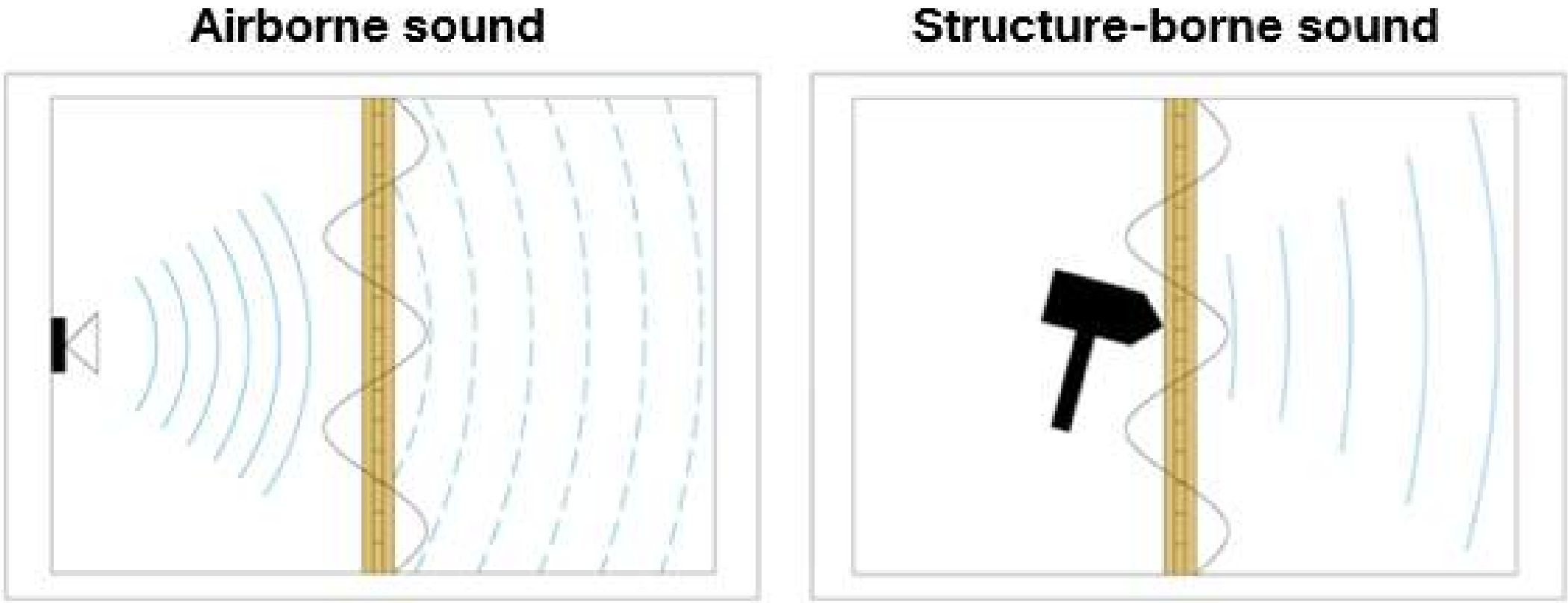
Order

1. Intro to Acoustics
2. MT Direct Transmission
3. MT Flanking Transmission
4. HGC CLT Flanking R&D Study

"I couldn't sleep."

1. Intro to Acoustics

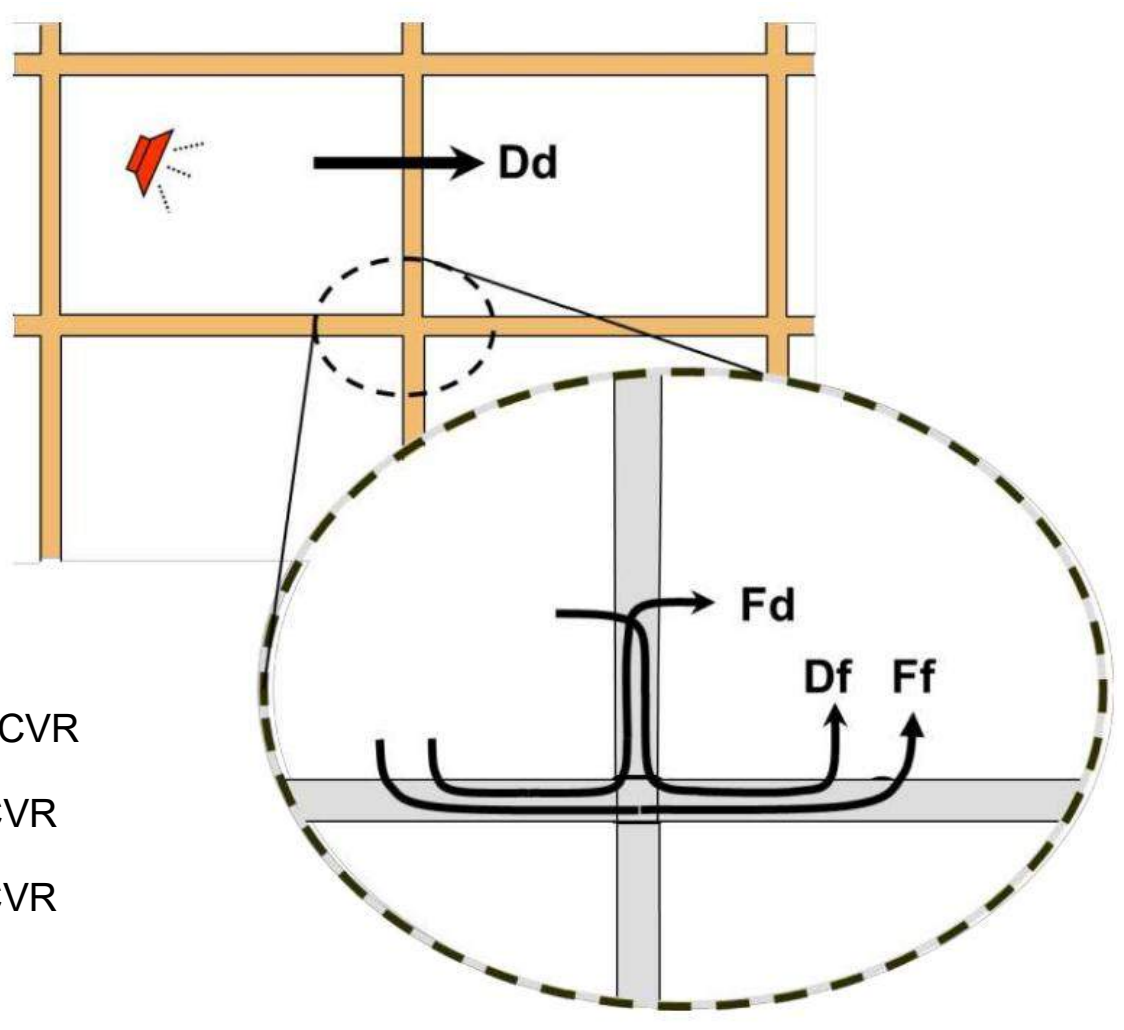
How does sound travel?



Music Box Demonstration

a. Airborne sound only
b. Airborne and Structure-Borne sound
c. Structure-Borne only (enclosed unit)
d. Airborne only (isolated unit)
e. Neither (isolated and enclosed)

Structural Flanking Paths



$Floor_{SRC}$ to $Floor_{RCVR}$
$Floor_{SRC}$ to $Wall_{RCVR}$
$Wall_{SRC}$ to $Floor_{RCVR}$

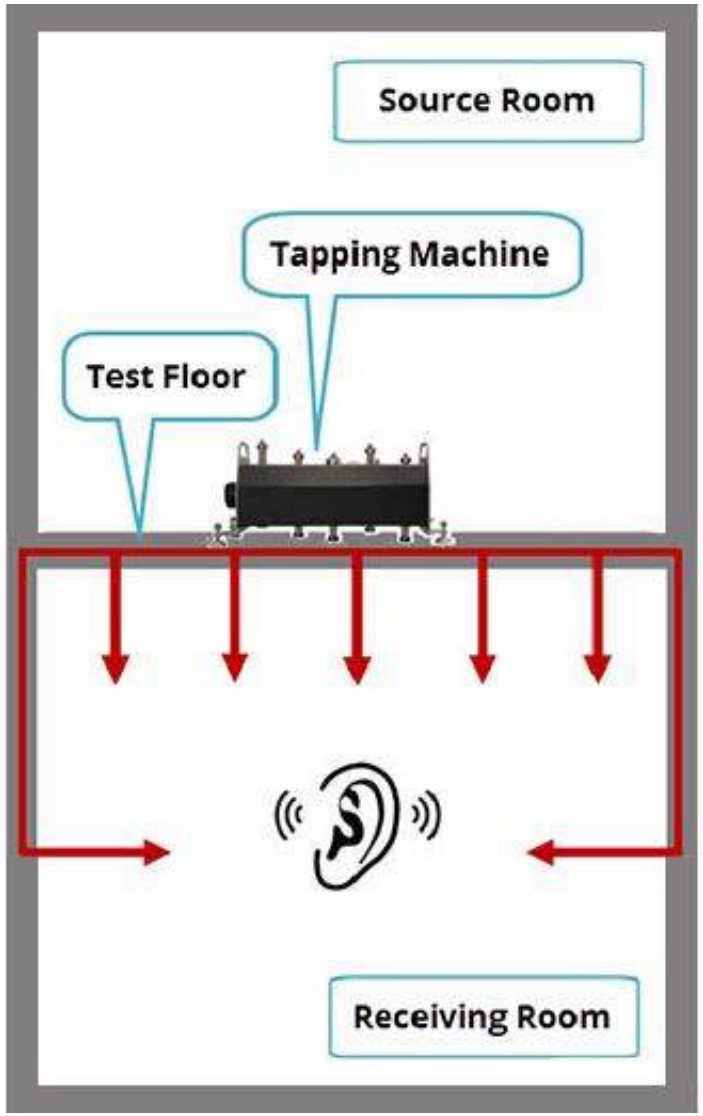
(Apparent) Sound Transmission Class (STC/ASTC)

Airborne Sound

- Voices
- Music
- High frequencies

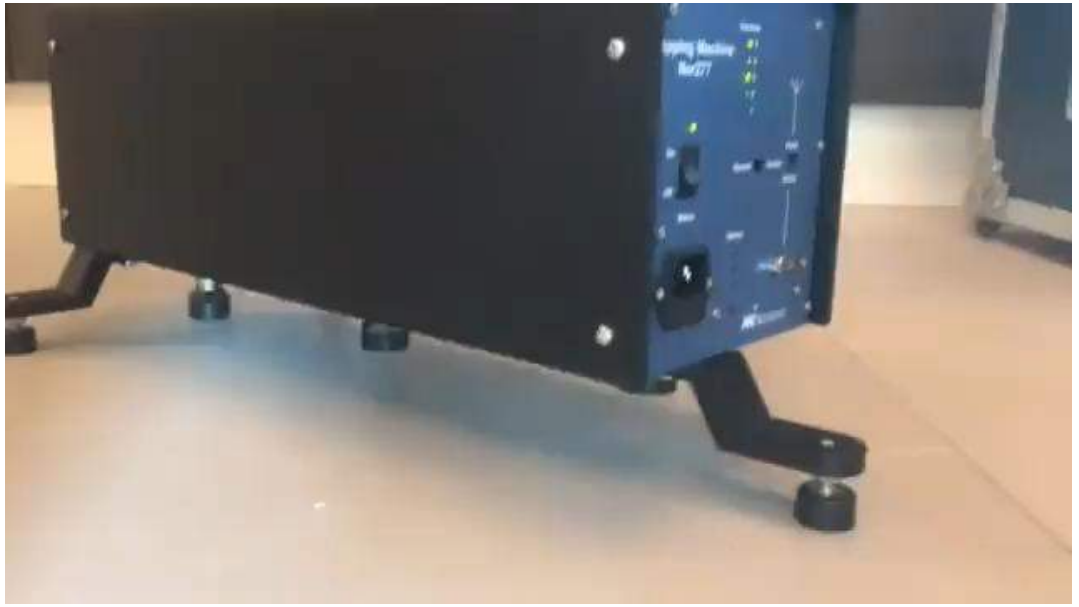
- *Not footsteps*

(Apparent) Impact Insulation Class (IIC/AIIC)

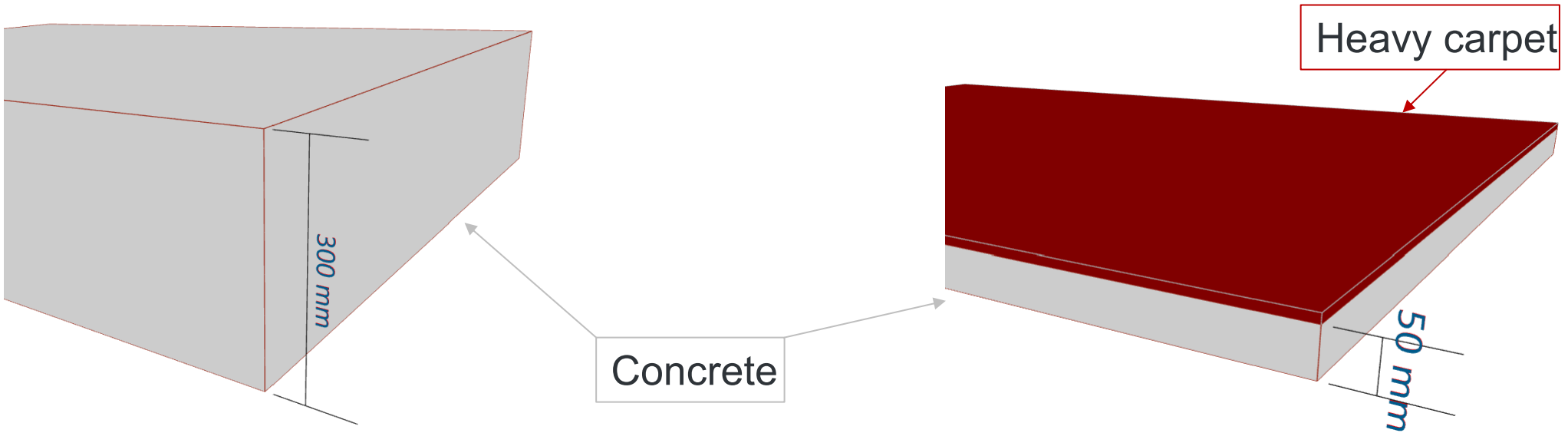


Structure-Borne Sound

- Footsteps
- Dropped Items
- Furniture Movement



IIC and STC are unrelated!



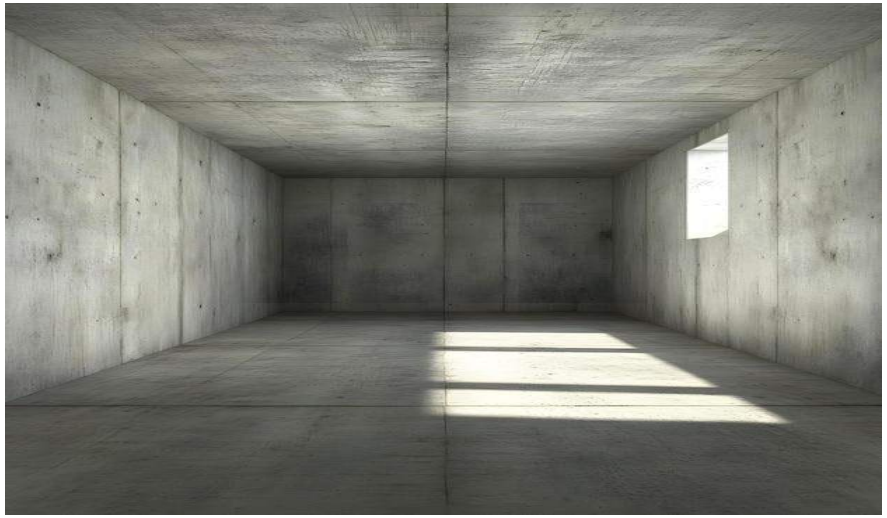
STC-65, IIC-38

STC-42, IIC-59

2. MT Direct Transmission

Mass Timber vs Poured Concrete

- Vertical STC is a bit lower, vertical IIC is generally similar
- Lateral STC is often better (compared to drywall laminated to concrete)
- Modularity = less vibration transmission beyond the panel



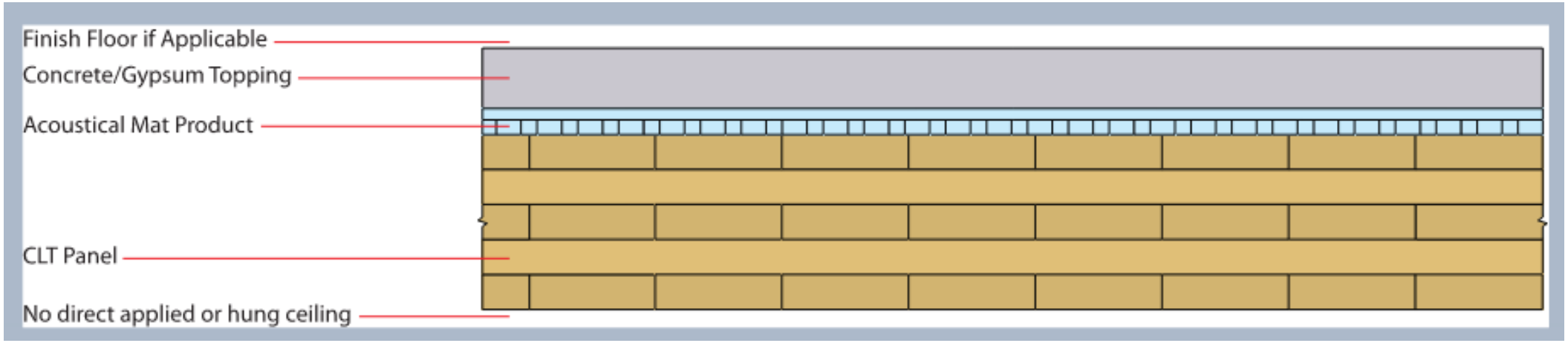
Start With STC/IIC

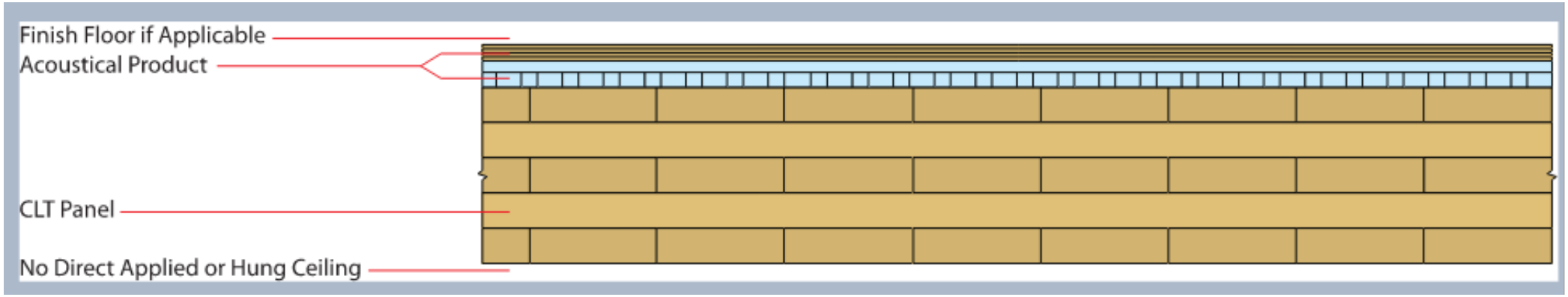
Learn Tools Events WOODWORKS Design Awards Why Wood? About

Mass Timber Fire & Acoustic Database: Acoustic Assemblies

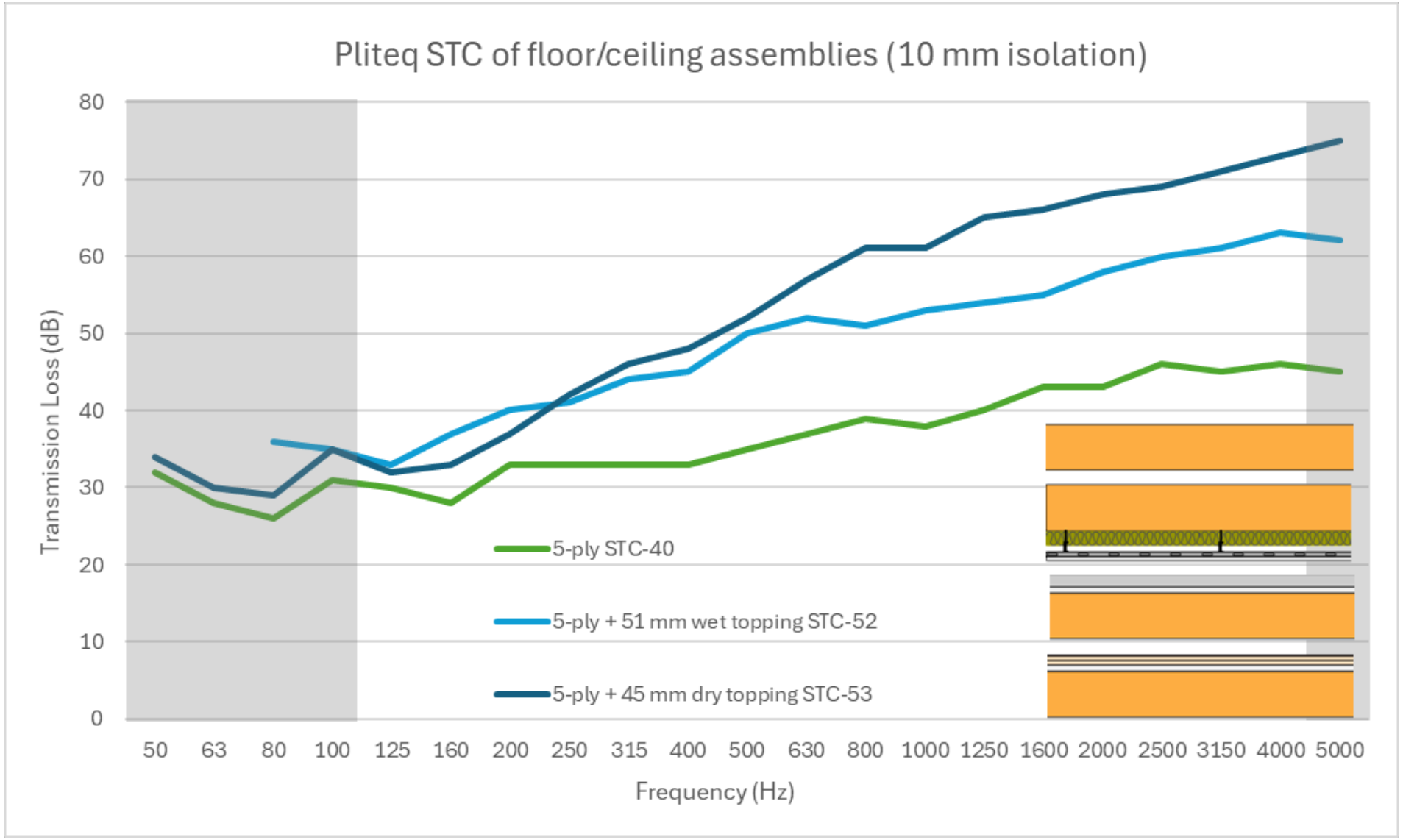
Topping	Finish Floor	Sound Rating	Impact Rating
2" Gyp-Crete®	None	58 STC	49 IIC
2" Gyp-Crete®	LVT on Shaw GroundWorks	57 STC	54 IIC

Wet vs Dry Build-ups

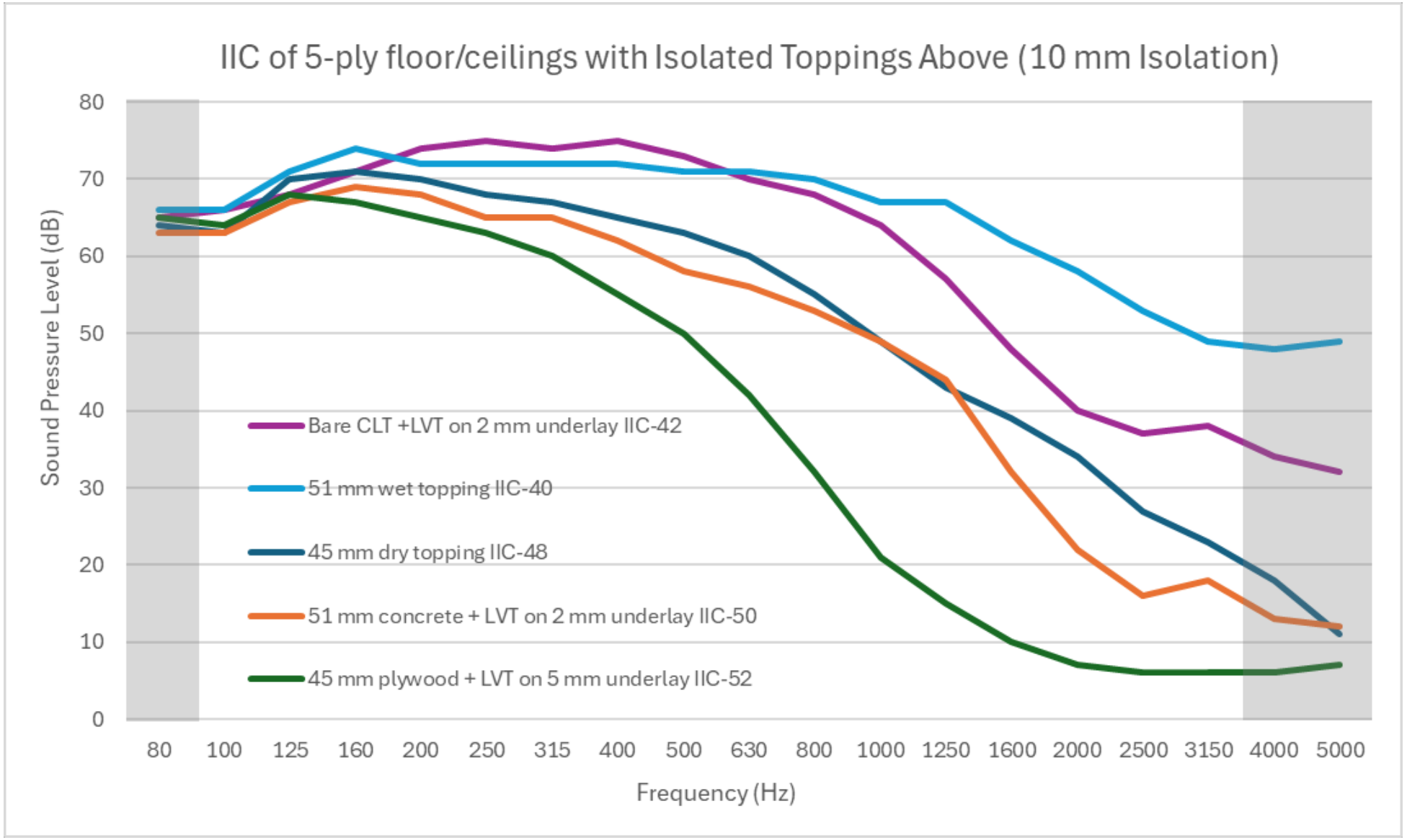




STC Ratings for 5-ply CLT

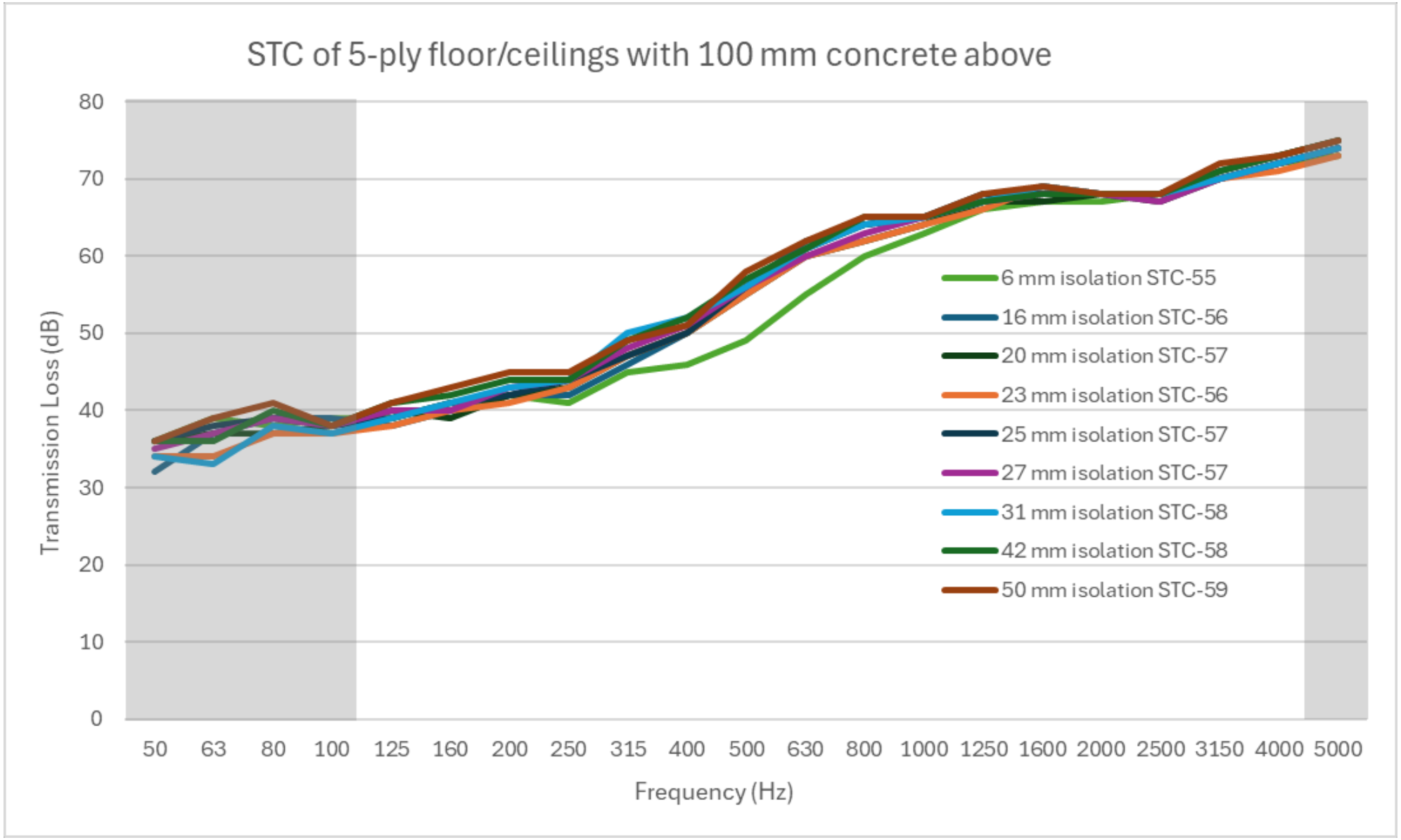


IIC Ratings vs Finish Flooring

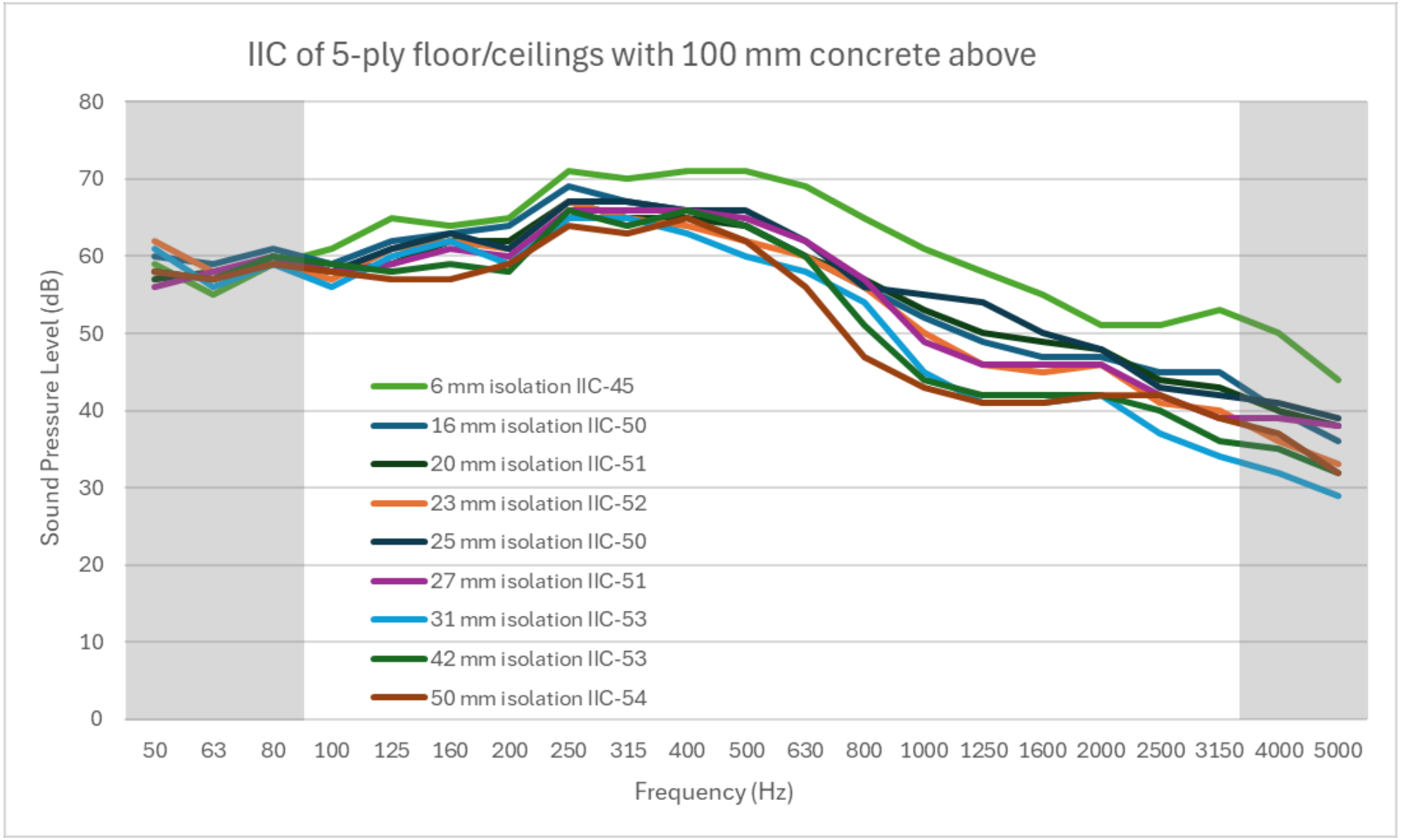


2. MT Direct Transmission

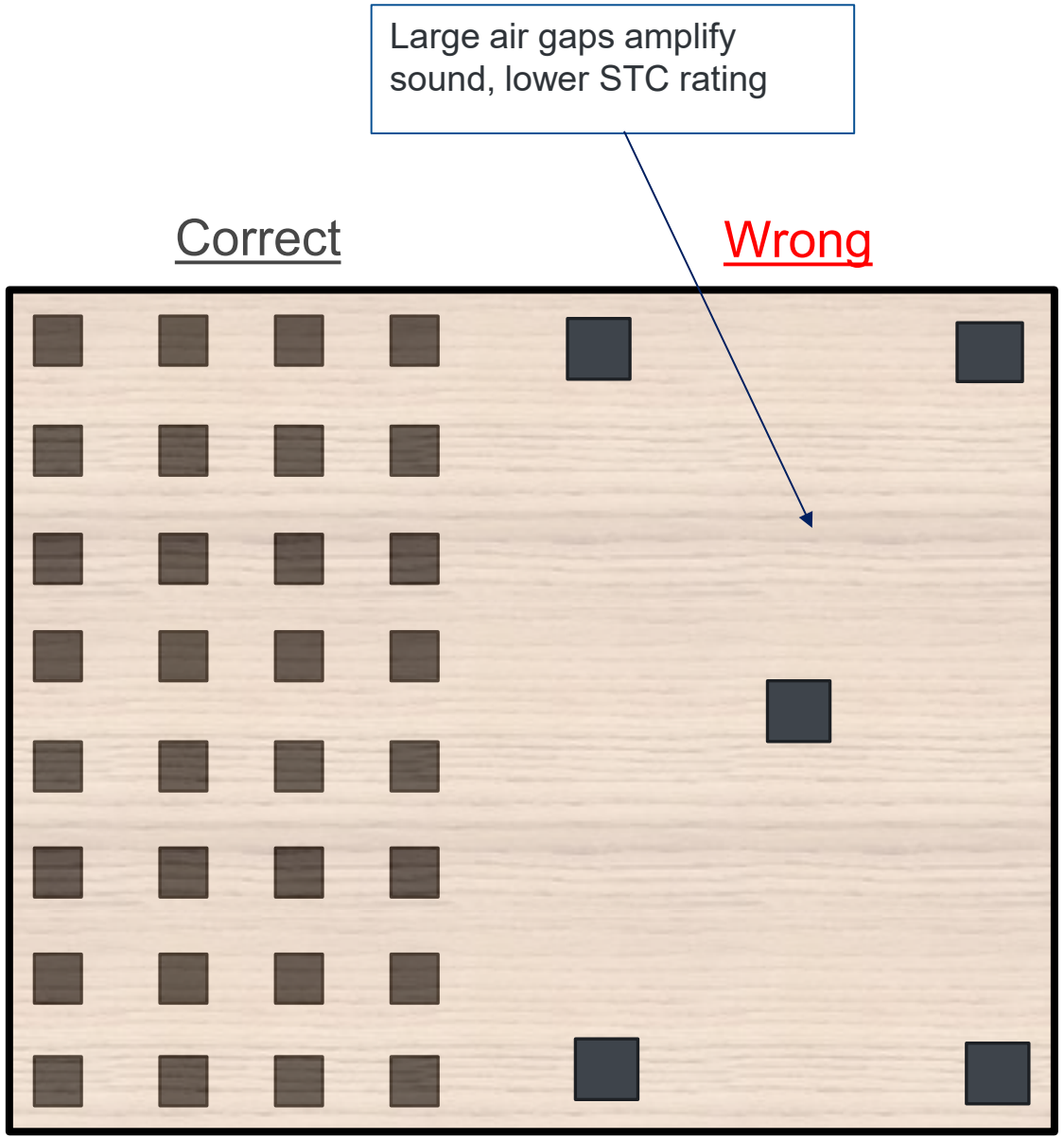
STC Ratings vs Isolation Thickness



IIC Ratings vs Finish Flooring

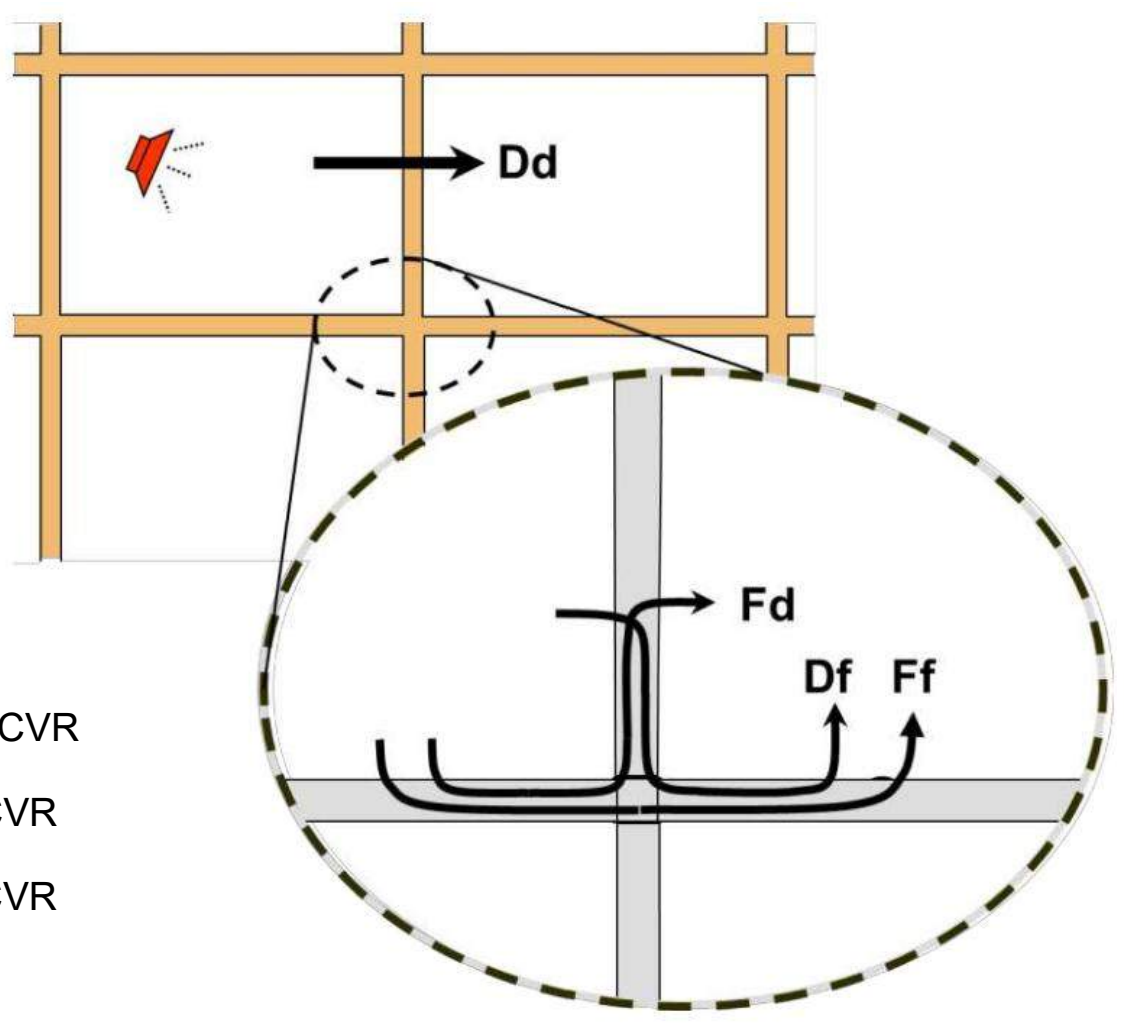


Laminated GWB Ceilings




3. MT Flanking Transmission

Structural Flanking Paths



$Floor_{SRC}$ to $Floor_{RCVR}$
$Floor_{SRC}$ to $Wall_{RCVR}$
$Wall_{SRC}$ to $Floor_{RCVR}$

Flanking + Direct = Overall

12 Flanking ASTCs

Direct (Lab) STC

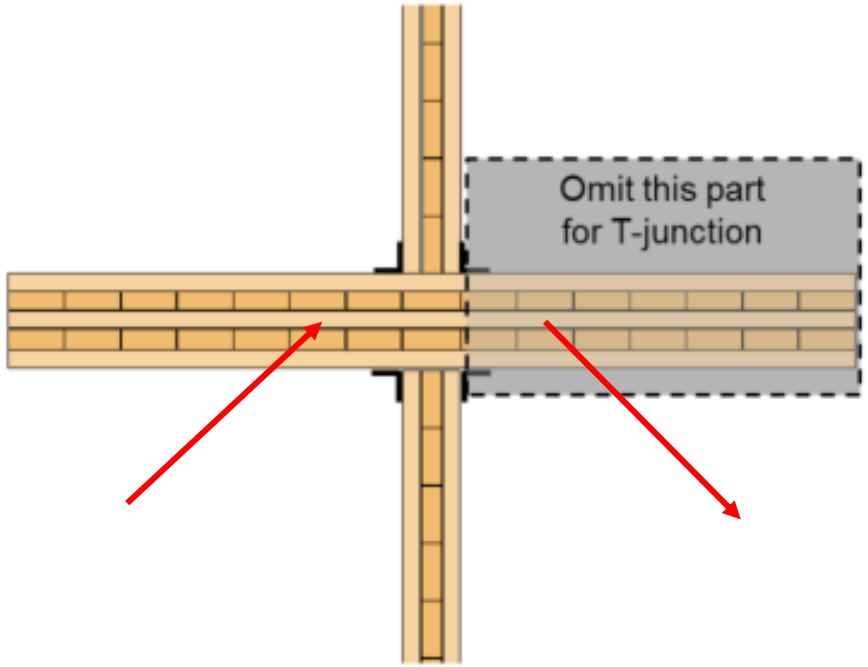
*Rw is like ASTC (ISO vs ASTM)

Frequency	Separating floor					Ext. wall 1		Ext. wall 2		Int. wall 1		Int. wall 2		Total
	R_{Dd}	R_{1d}	R_{2d}	R_{3d}	R_{4d}	R_{D1}	R_{11}	R_{D2}	R_{22}	R_{D3}	R_{33}	R_{D4}	R_{44}	R'
Hz	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
50	31,8	41,2	39,5	45,0	43,9	41,2	44,8	39,5	42,4	45,0	47,2	43,9	46,1	**28,8**
63	33,8	41,5	39,9	45,0	44,0	43,8	45,7	42,2	43,4	47,3	47,5	46,3	46,4	**30,4**
80	41,4	42,8	41,3	46,6	45,6	48,2	43,8	46,8	41,8	52,1	46,4	51,0	45,3	**33,4**
100	45,9	47,0	45,2	45,7	44,7	55,3	50,5	53,6	47,9	54,0	42,8	53,0	41,7	**35,3**
125	50,3	48,7	47,0	47,8	46,5	60,0	52,4	58,2	49,8	59,0	45,3	57,7	43,7	**37,6**
160	55,2	50,5	48,7	49,9	48,6	64,9	54,2	63,2	51,6	64,4	48,0	63,1	46,4	**40,0**
200	60,7	52,6	50,8	53,2	51,9	69,9	55,8	68,2	53,3	70,6	52,0	69,3	50,4	**43,1**
250	66,5	55,3	53,9	56,6	55,3	75,6	58,3	74,1	56,3	76,9	55,8	75,6	54,2	**46,4**
315	72,5	58,4	56,9	59,9	58,6	81,6	61,4	80,2	59,5	83,2	59,3	81,9	57,7	**49,7**
400	78,5	61,4	60,0	63,1	61,8	87,8	64,5	86,4	62,6	89,5	62,8	88,2	61,2	**52,9**
500	84,1	64,3	62,8	66,0	64,7	93,6	67,4	92,1	65,5	95,3	65,8	94,0	64,3	**55,9**
630	89,9	67,2	65,7	69,0	67,7	99,5	70,4	98,0	68,5	101,3	68,9	100,0	67,4	**58,9**
800	95,8	70,1	68,7	72,0	70,8	105,5	73,4	104,1	71,6	107,4	72,1	106,2	70,6	**61,9**
1 000	101,3	72,9	71,5	74,8	73,6	111,2	76,2	109,8	74,4	113,2	75,1	111,9	73,6	**64,8**
1 250	106,9	75,3	73,9	77,7	76,4	116,5	78,3	115,1	76,5	118,9	78,0	117,7	76,5	**67,3**
1 600	112,9	76,7	75,3	80,8	79,6	121,1	78,1	119,8	76,4	125,2	81,2	124,0	79,8	**69,0**
2 000	118,5	78,0	76,7	83,6	82,4	125,4	78,0	124,0	76,3	131,0	84,2	129,8	82,8	**70,2**
2 500	123,6	79,1	77,8	85,8	84,7	129,4	77,9	128,1	76,3	136,1	86,3	134,9	84,9	**71,0**
3 150	126,2	79,0	77,7	85,8	84,6	132,3	77,9	131,0	76,2	139,0	86,3	137,9	84,9	**70,9**
4 000	129,0	78,9	77,7	85,7	84,6	135,3	77,9	134,0	76,3	142,1	86,4	141,0	85,0	**70,9**
5 000	131,6	78,9	77,6	85,7	84,6	138,2	77,9	136,9	76,3	145,0	86,4	143,9	85,1	**70,9**
R_w (dB)	**75,1**	**67,3**	**65,7**	**68,0**	**66,7**	**84,5**	**70,6**	**82,8**	**68,4**	**84,3**	**66,7**	**83,1**	**65,1**	**57,8**

Overall ASTC

3. MT Flanking Transmission

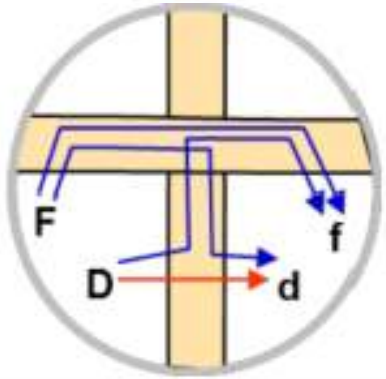
K_{ij} Ratings

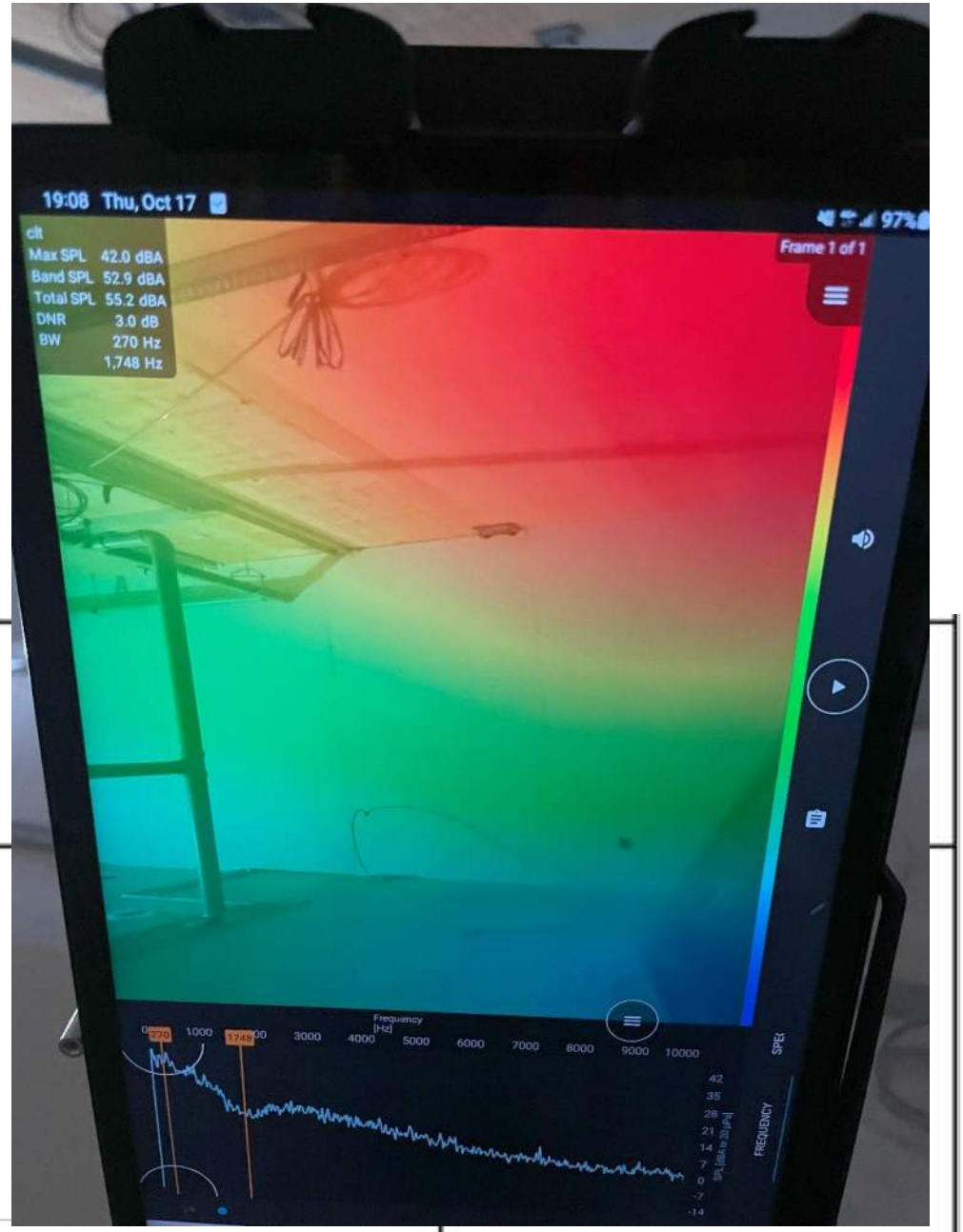


CLT-WC-Xa-01

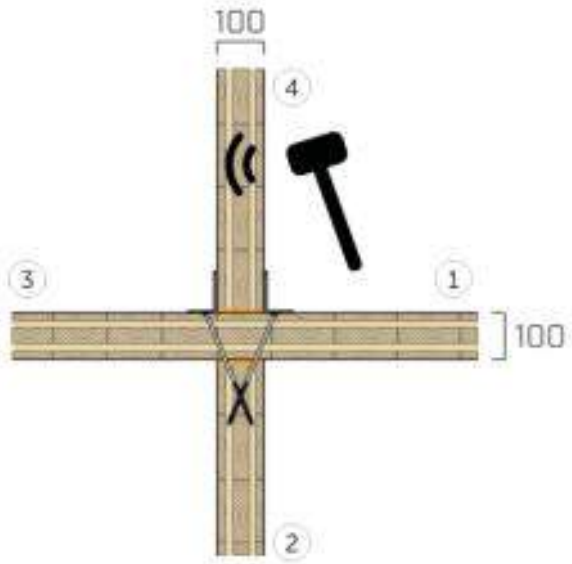
Wall-Ceiling

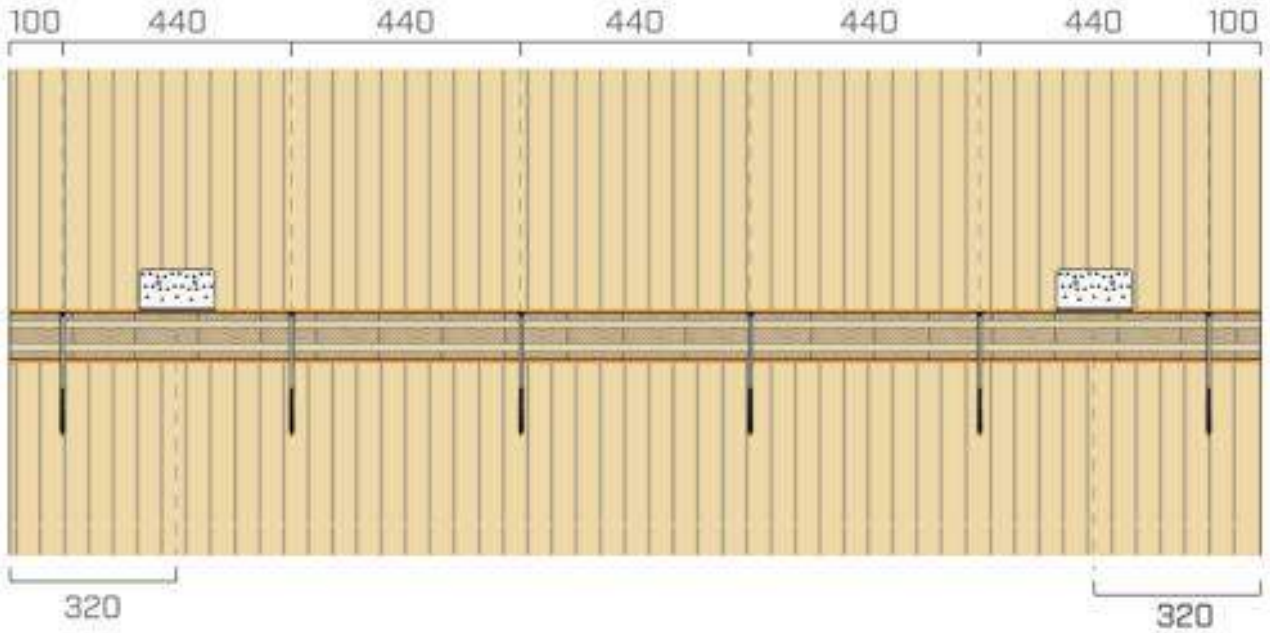
X-junction





Elbow Junctions

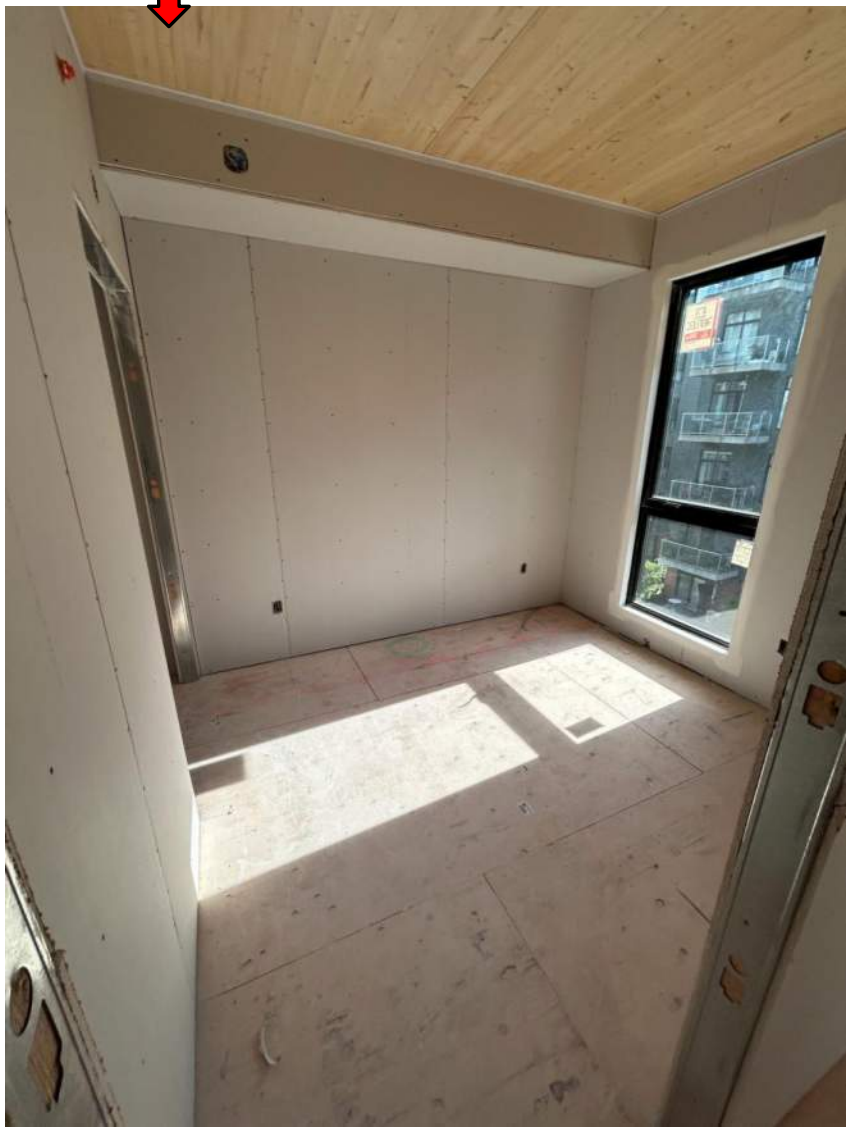




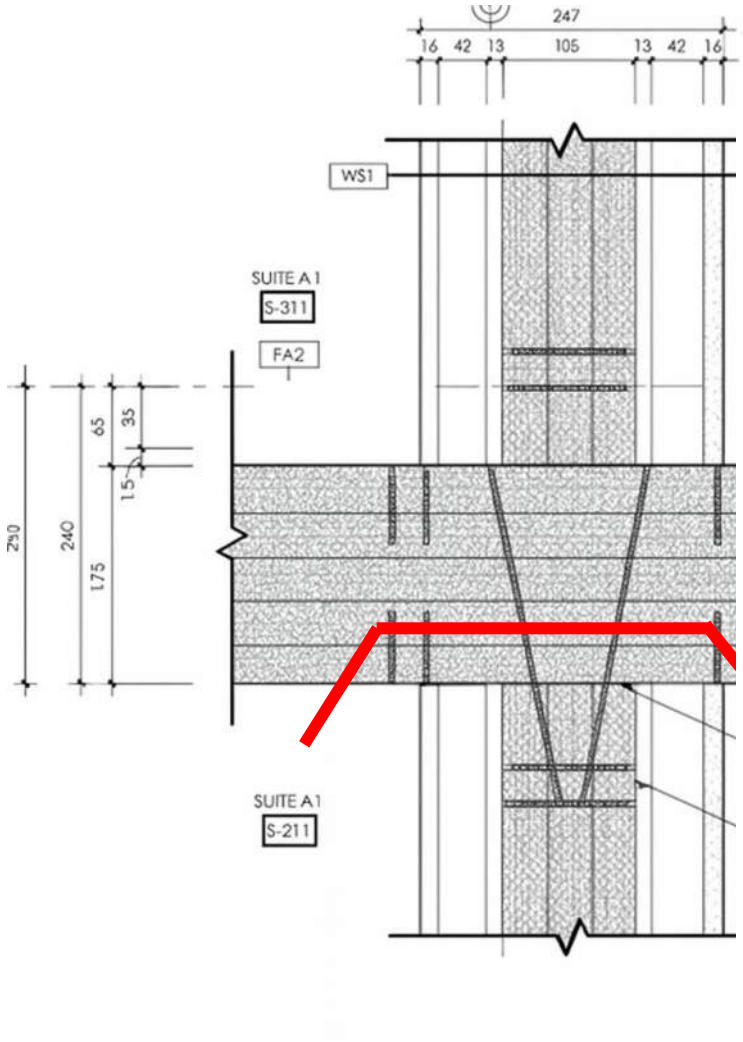
f [Hz]	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
K_{14} [dB]	19,5	21,5	19,6	17,0	17,5	14,7	19,1	21,0	20,8	19,3	22,2	23,2	22,6	20,4	19,8	19,9

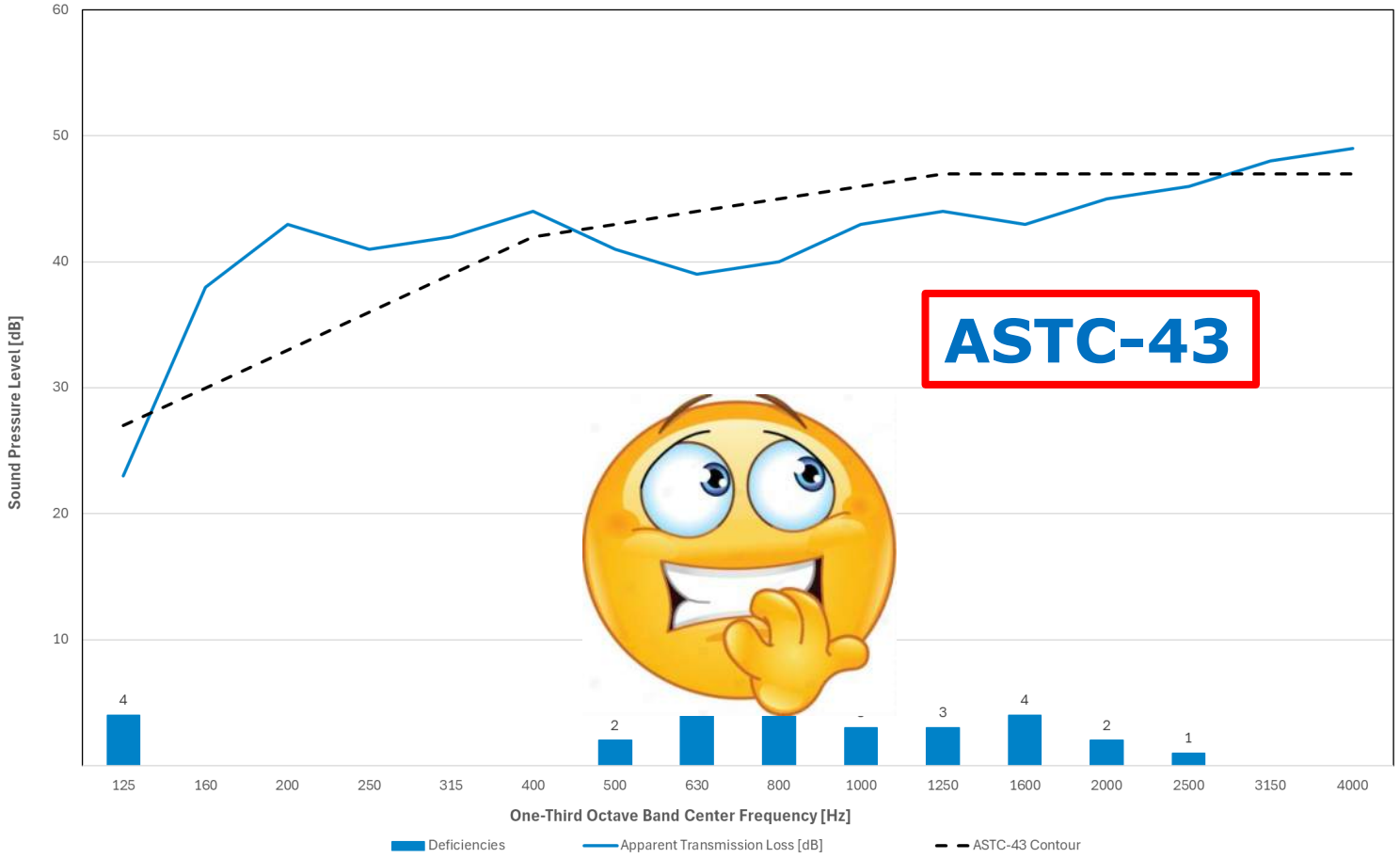
$\overline{K_{14}} = 19{,}9$ dB $\quad \overline{K_{14,0}} = 17{,}0$ dB $\quad \Delta_{l,14} = 2{,}9$ dB

Field Results

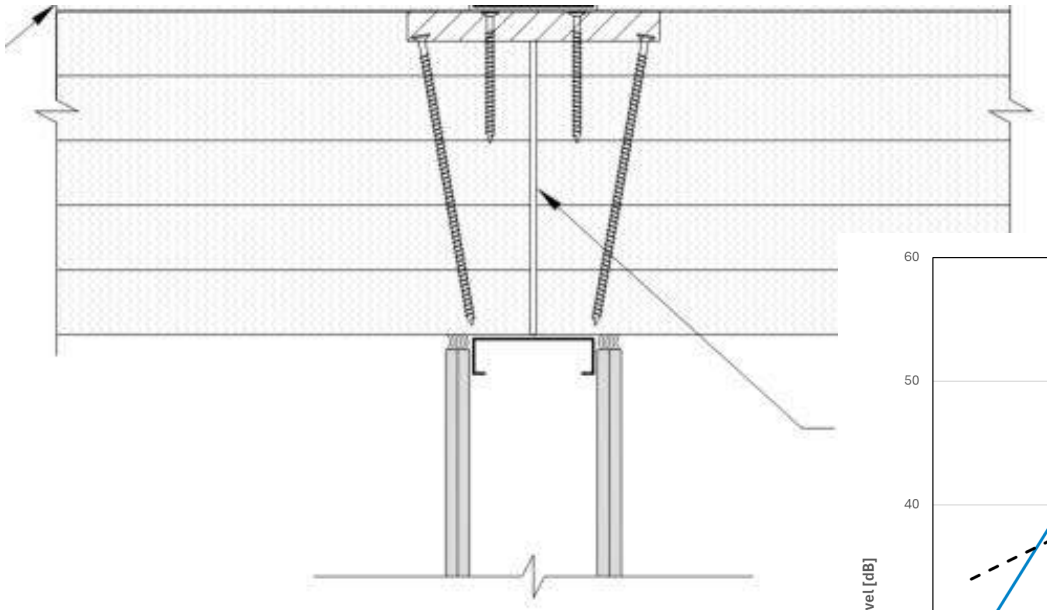


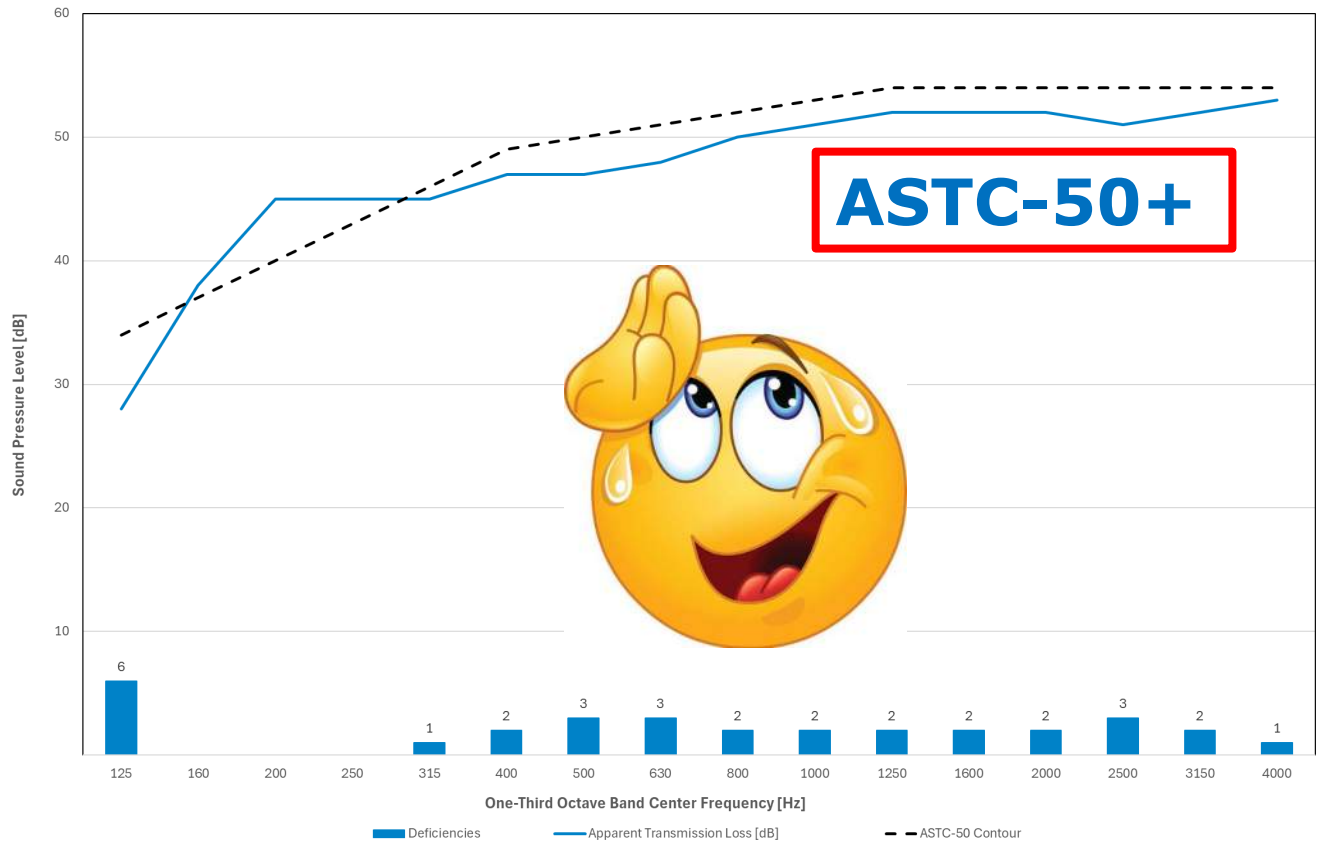
Field Results





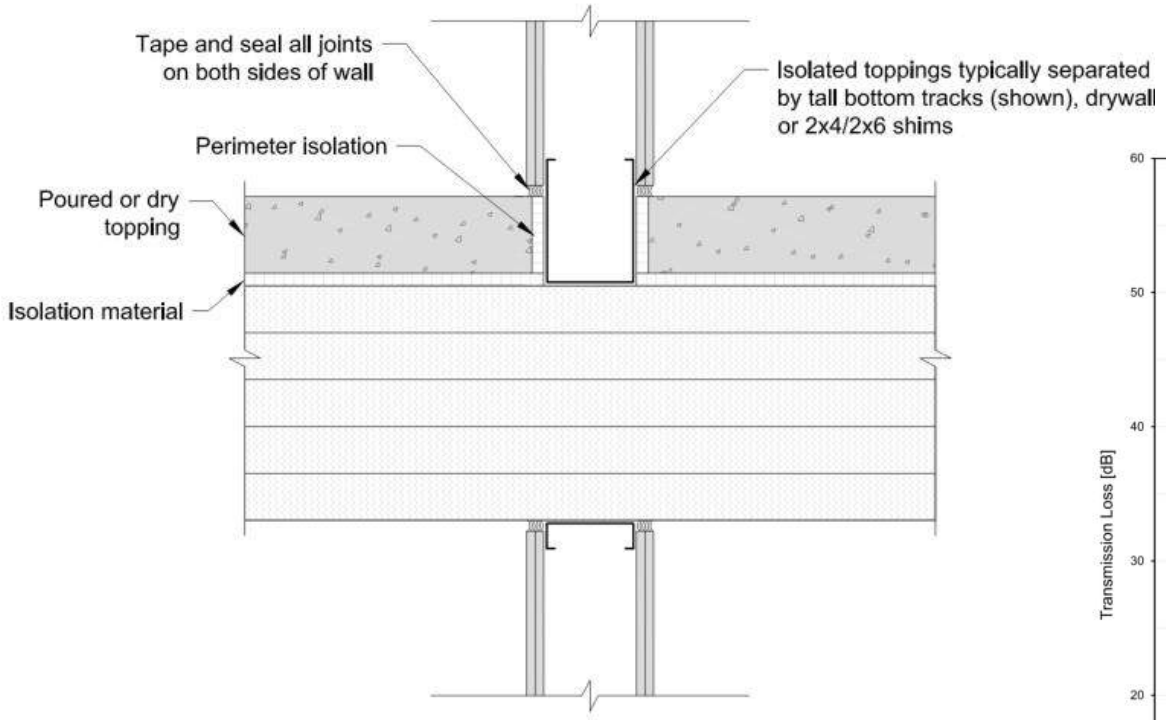
Field Results





3. MT Flanking Transmission

Field Results



3. MT Flanking Transmission

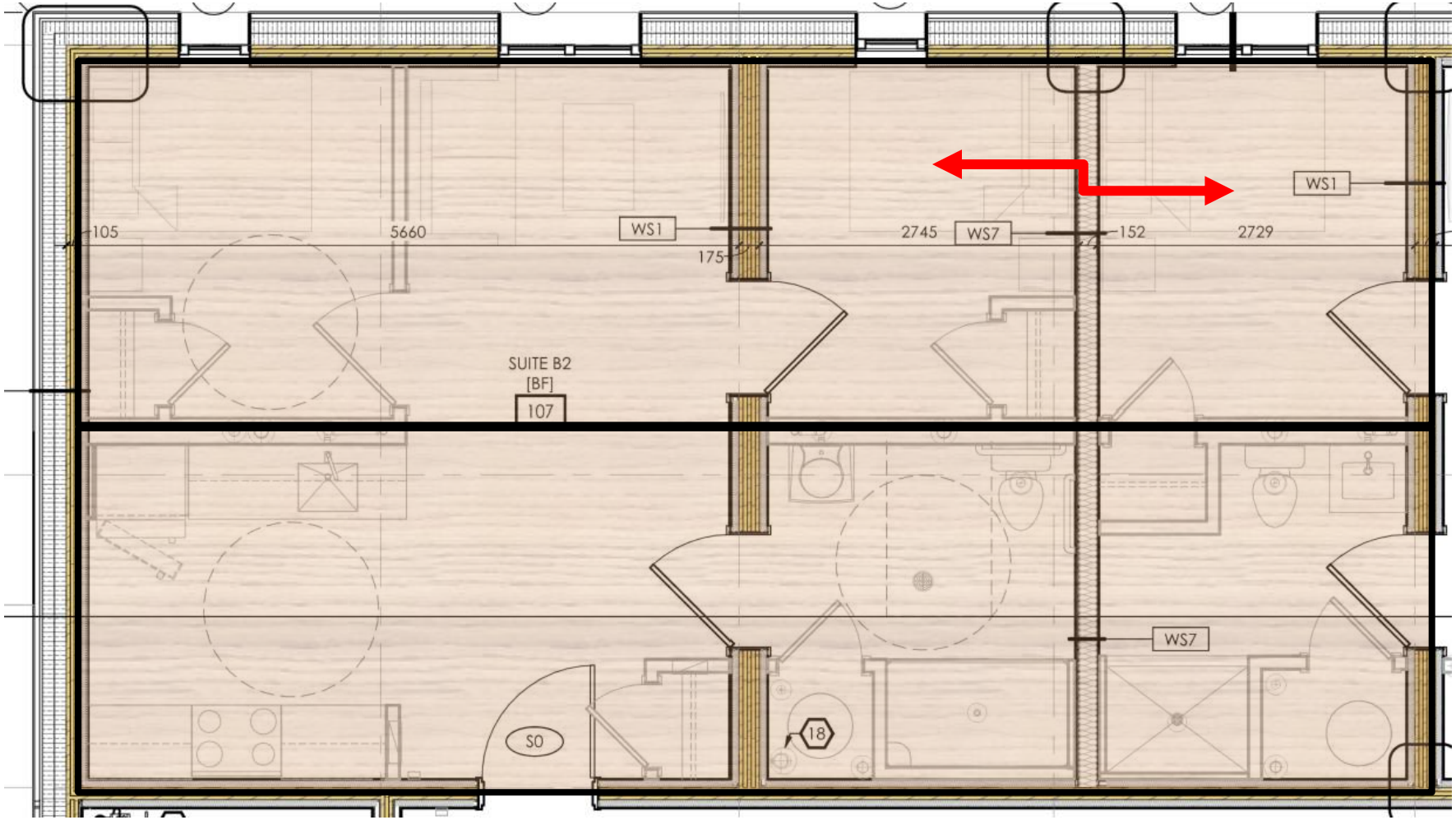
How Do K_{ij} Ratings Change With:

- Wet Build-ups?
- Dry Build-ups?
- Roof Build-ups?

- Intermediary Rooms?
- Bulkheads?
- Wall Loading?

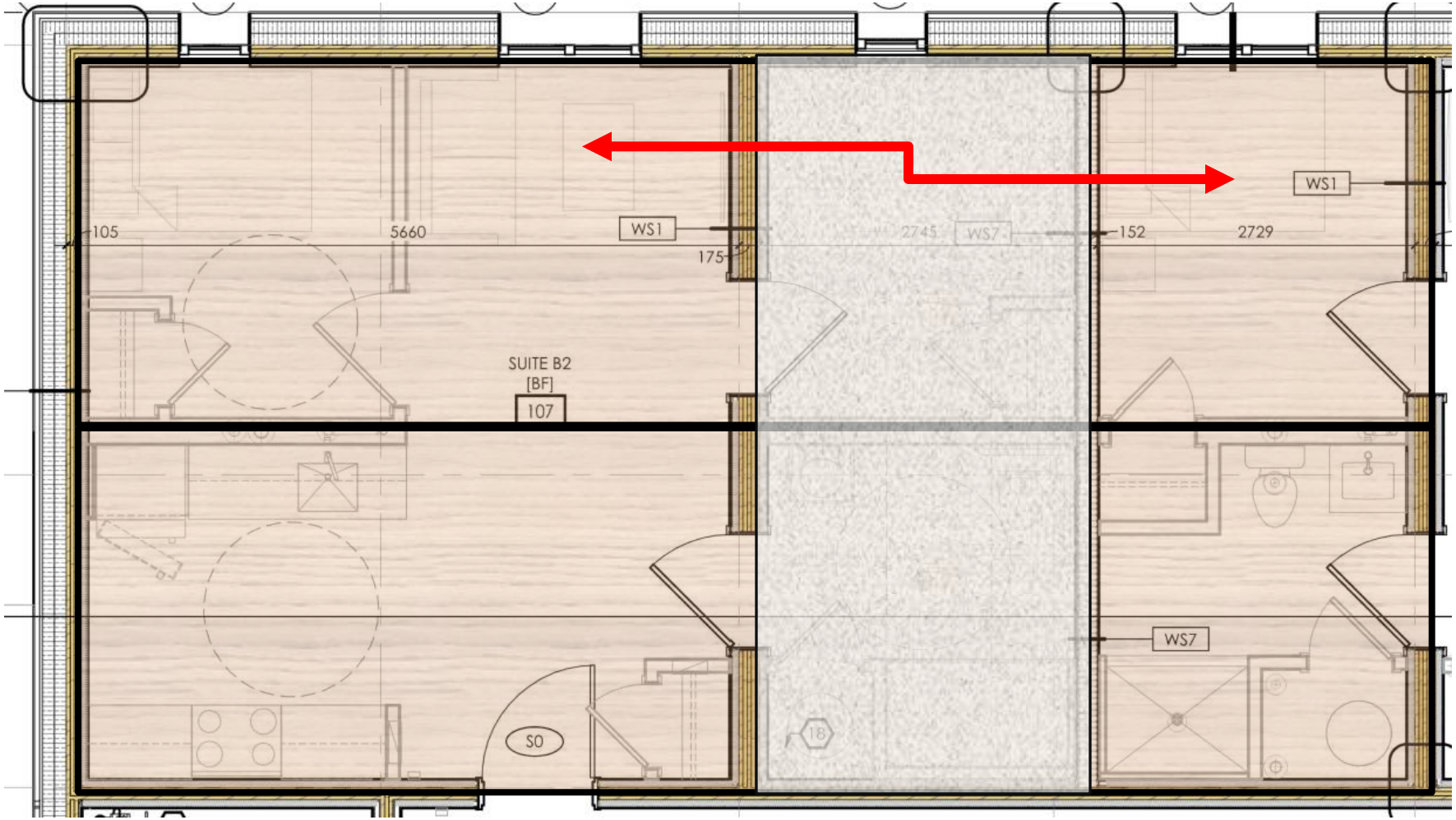
- 3-ply CLT
- NLT?
- DLT?

Intermediary Room

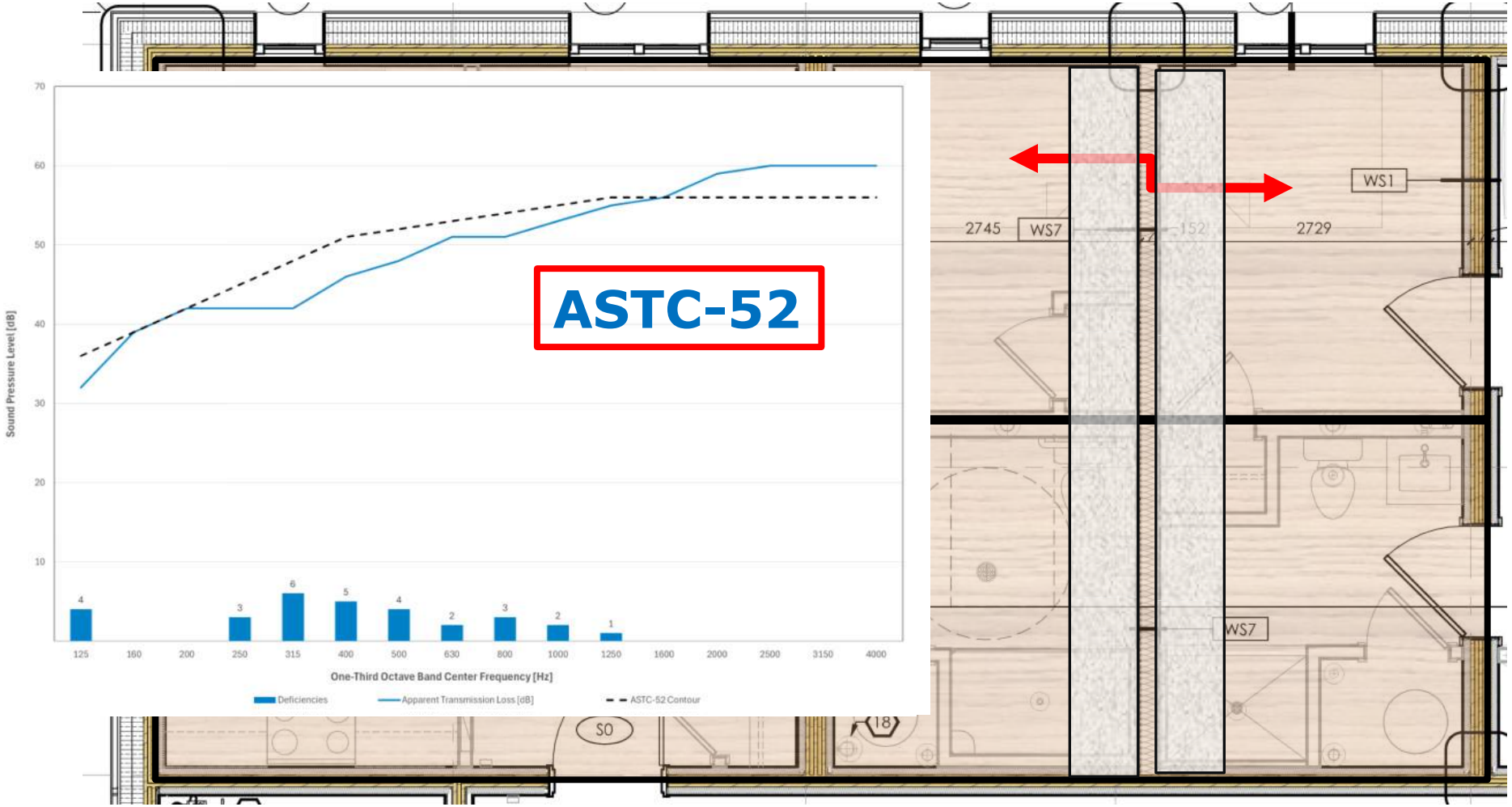


Intermediary Room

+11 ASTC points



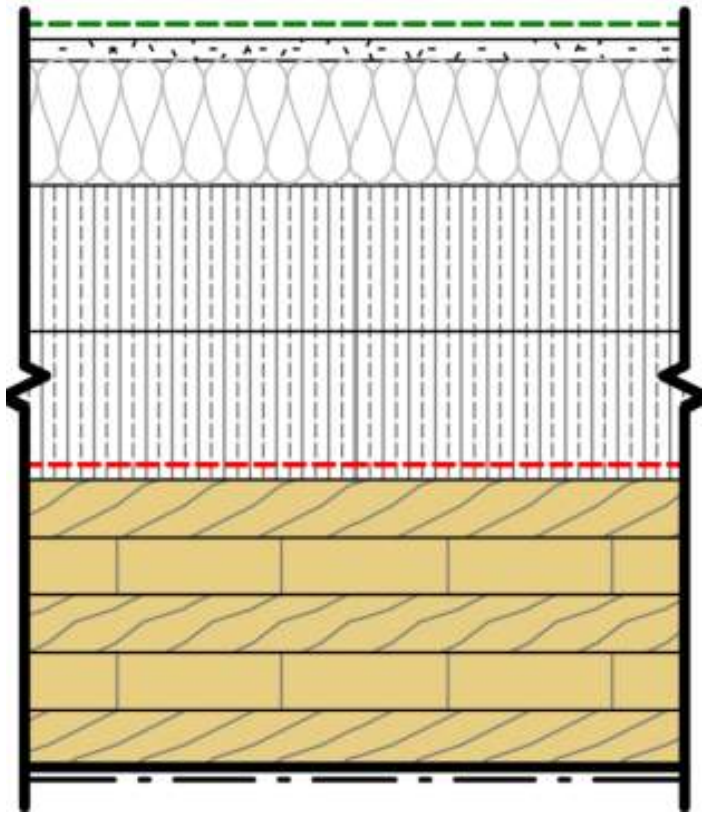
Bulkheads

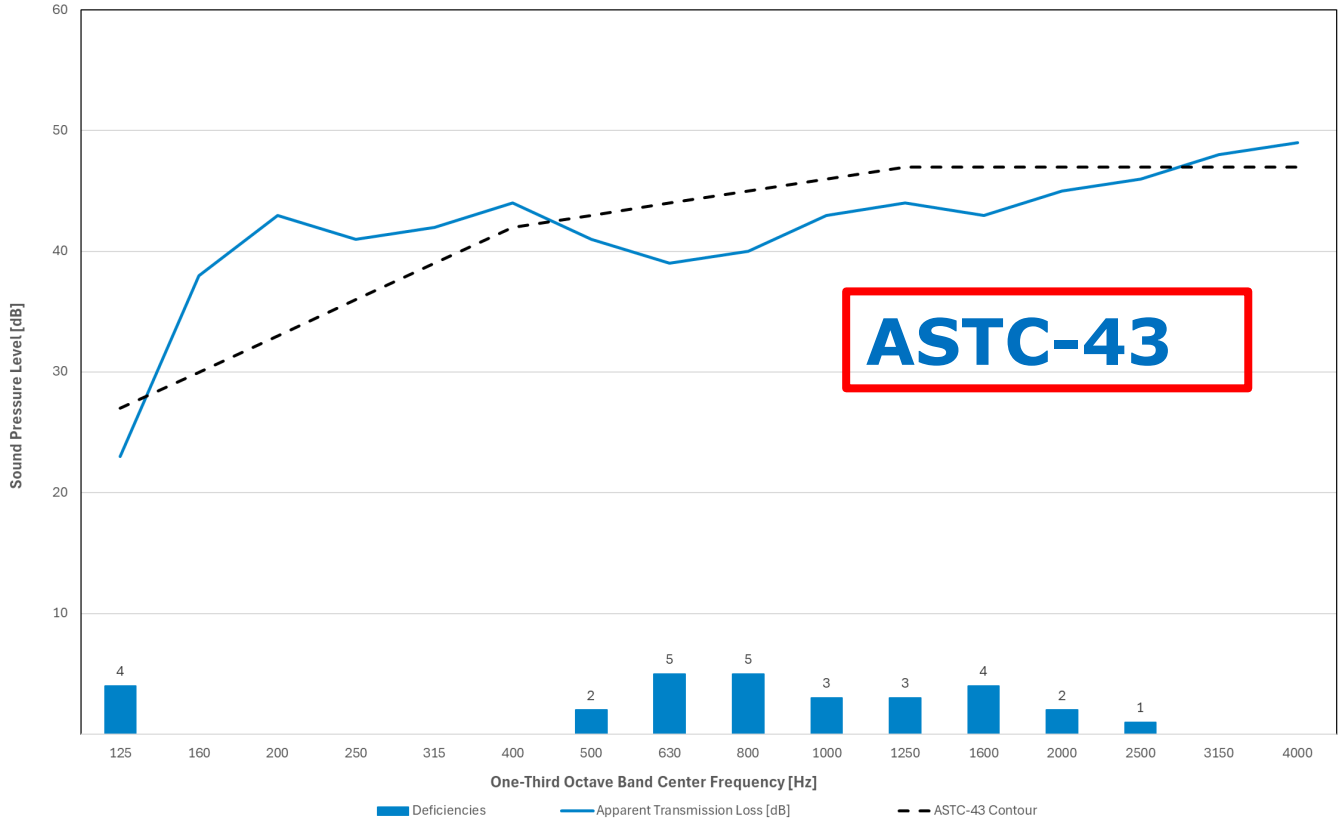

ASTC-52
Sound Pressure Level [dB]
One-Third Octave Band Center Frequency [Hz]
Deficiencies
Apparent Transmission Loss [dB]
ASTC-52 Contour
WS1
WS7
2745
2729
S0

Overview

- Wet toppings ***CAN*** meet code
- Dry toppings ***MAY*** be sufficient to meet code
  - Dry toppings + bulkheads ***CAN*** meet code
- No toppings? ***SAD*** times!
- Thicker isolation ≠ better flanking performance (Opposite???)
- Walls located off centre of panels are more risky

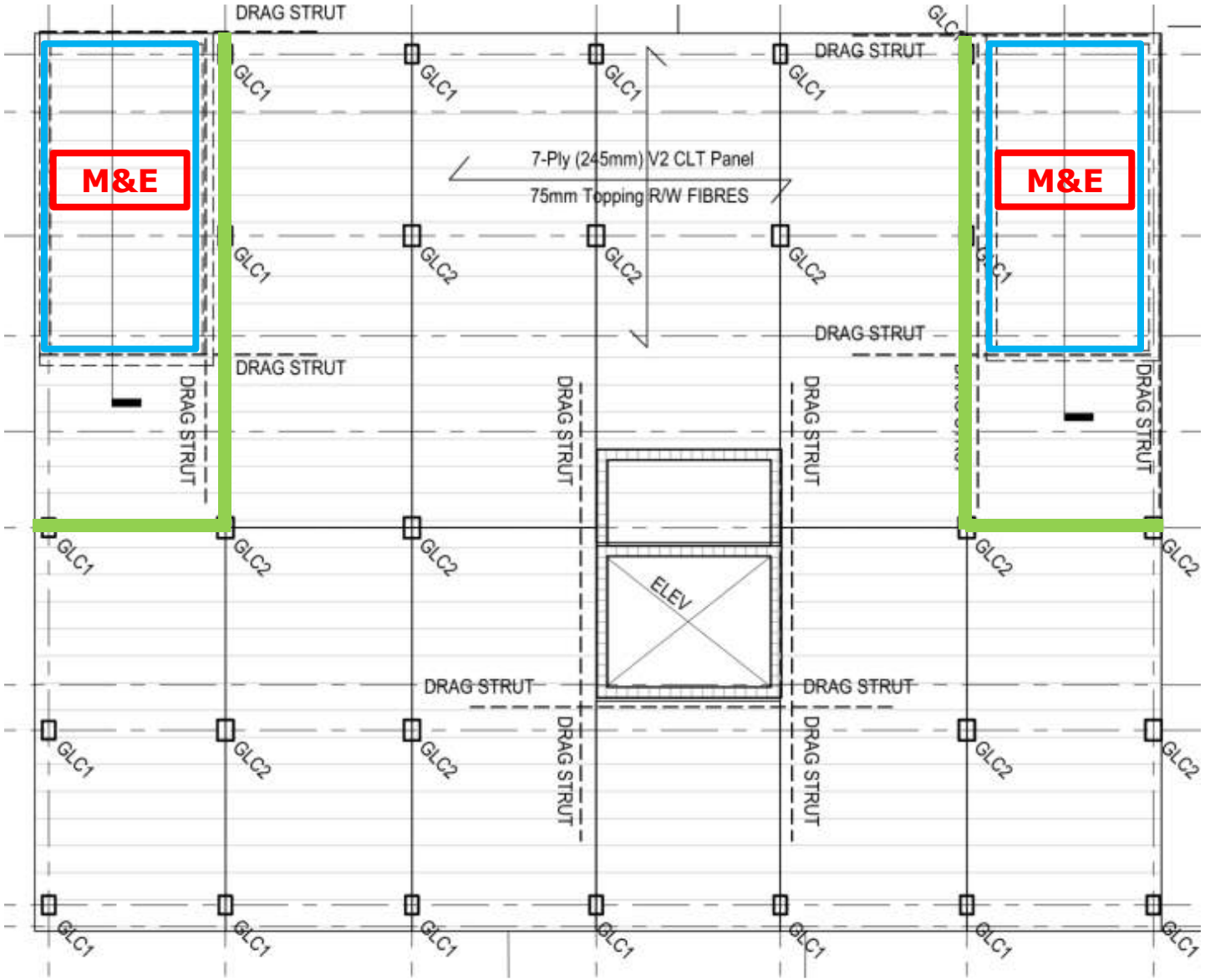
Roof Toppings





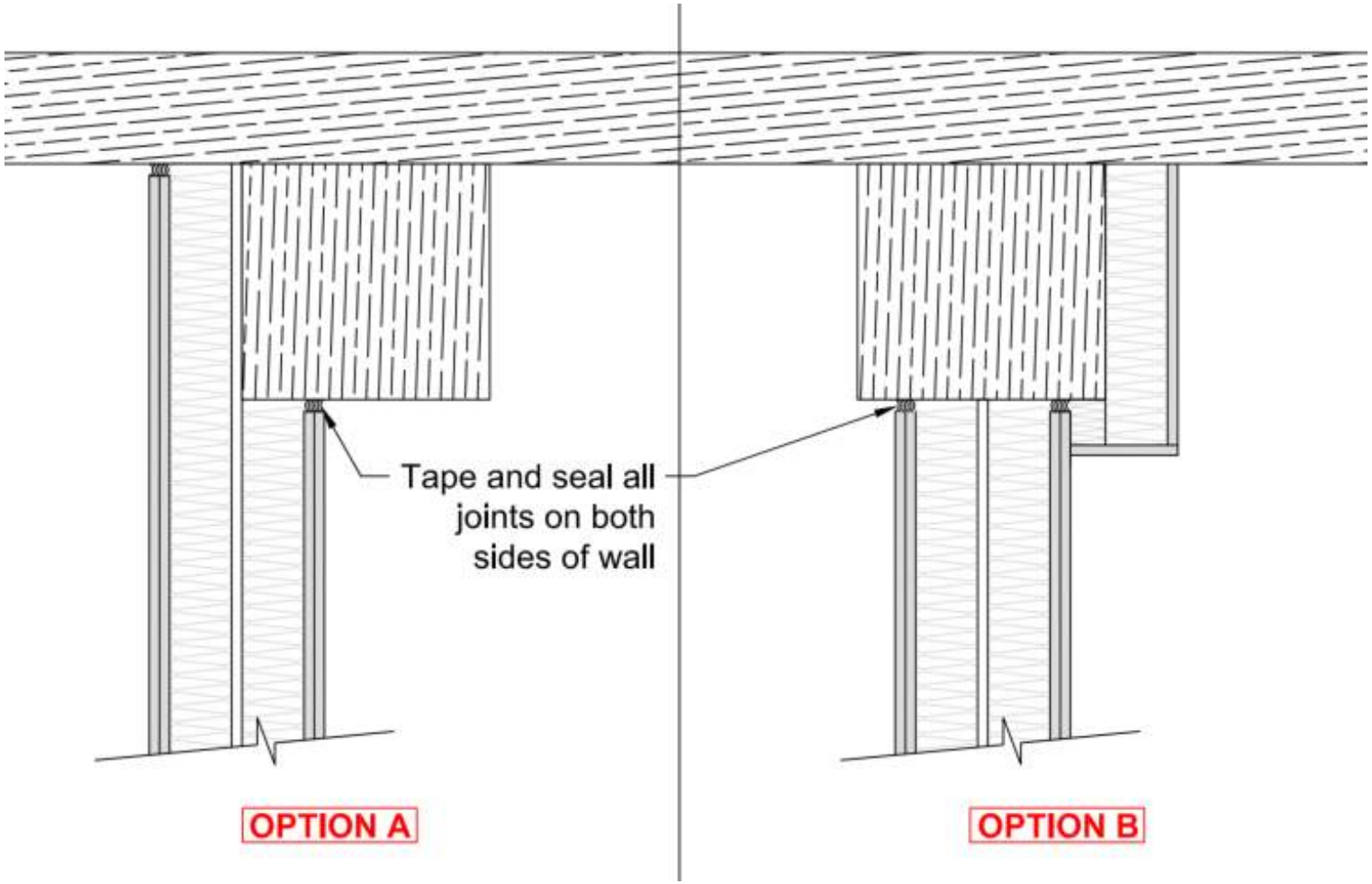
- Cut Panels, Drywall Ceilings, or Isolated Topping on Roof

Roof Equipment



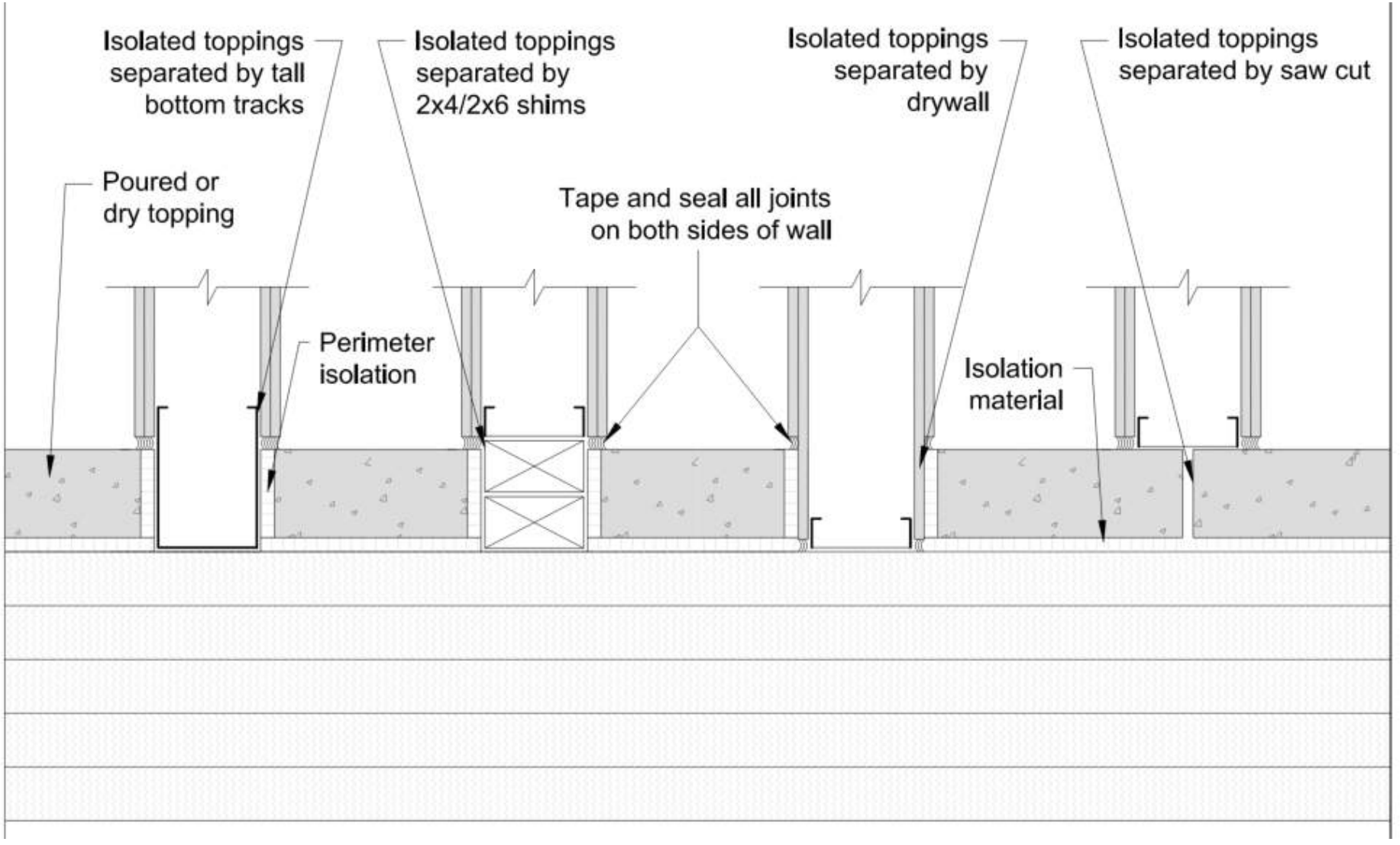
Flanking Details: Columns and Beams

Either the demising wall is adjacent to the column/beam, or it's protected with a partition



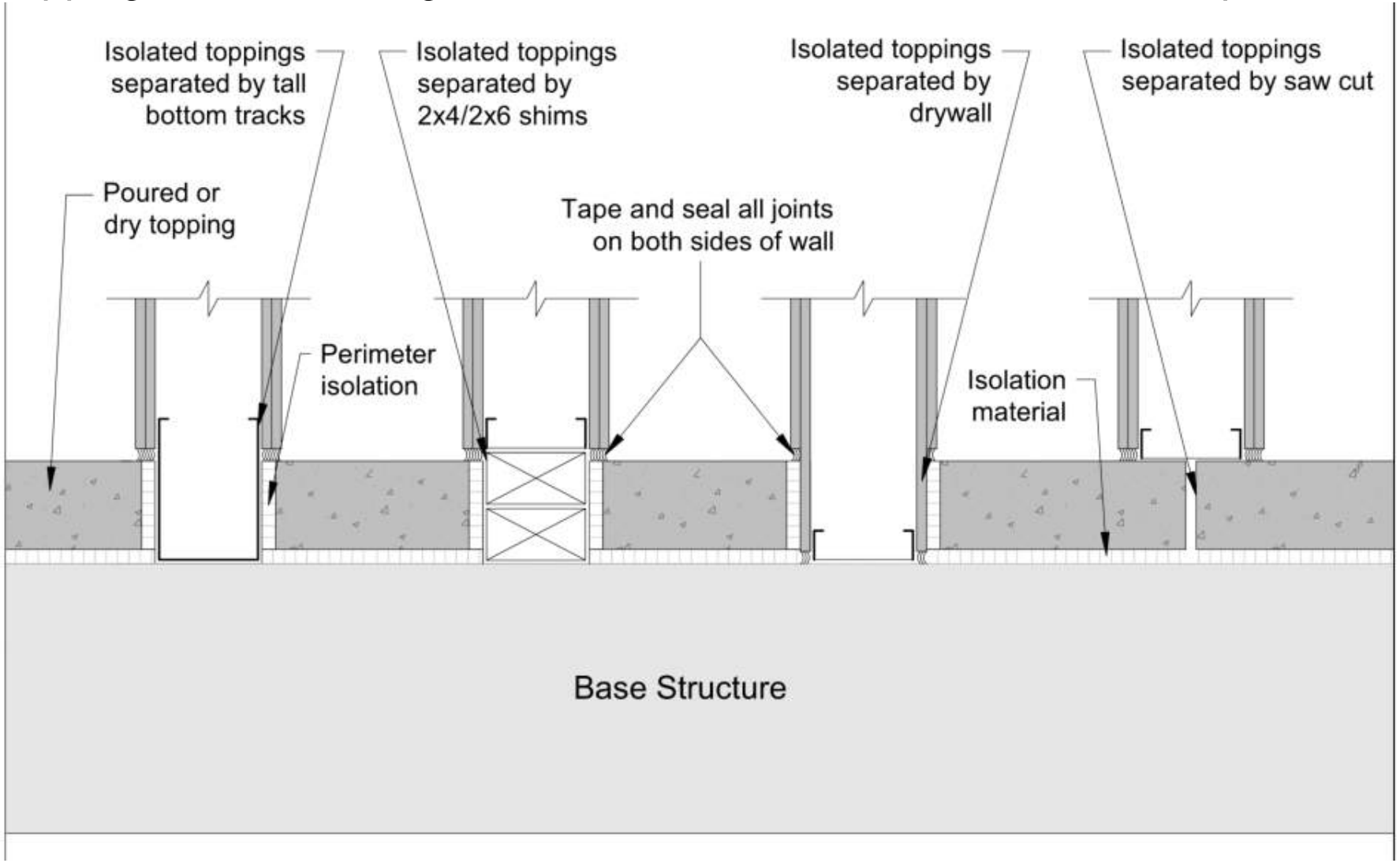
Flanking Details: Separated Floor Toppings

Isolate toppings from demising walls with: tall bottom tracks, wood 2x6s, pre-installed GWB



Flanking Details: Separated Floor Toppings

Isolate toppings from demising walls with: tall bottom tracks, wood 2x6s, pre-installed GWB



Flanking Details: Isolated Spline

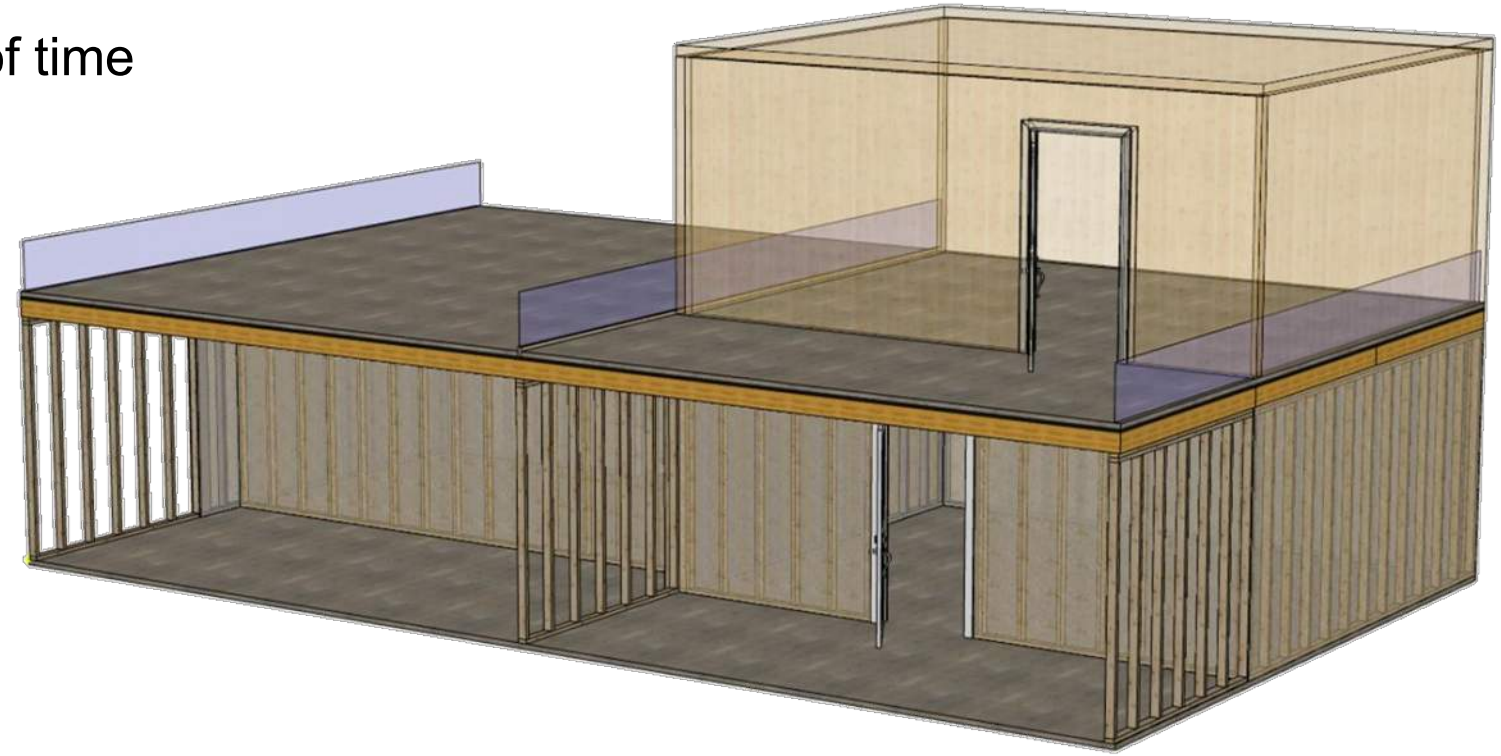
4. HGC CLT Flanking R&D Study

HGC CLT Flanking Study R&D

<u>Why avoid cutting CLT panels at each demising wall?</u>

→ Less CLT panels to manufacture, deliver, and install
→ Less structural supports for panel edges
→ Less junctions to fire-stop/waterproof

Savings: $$$$ and plenty of time

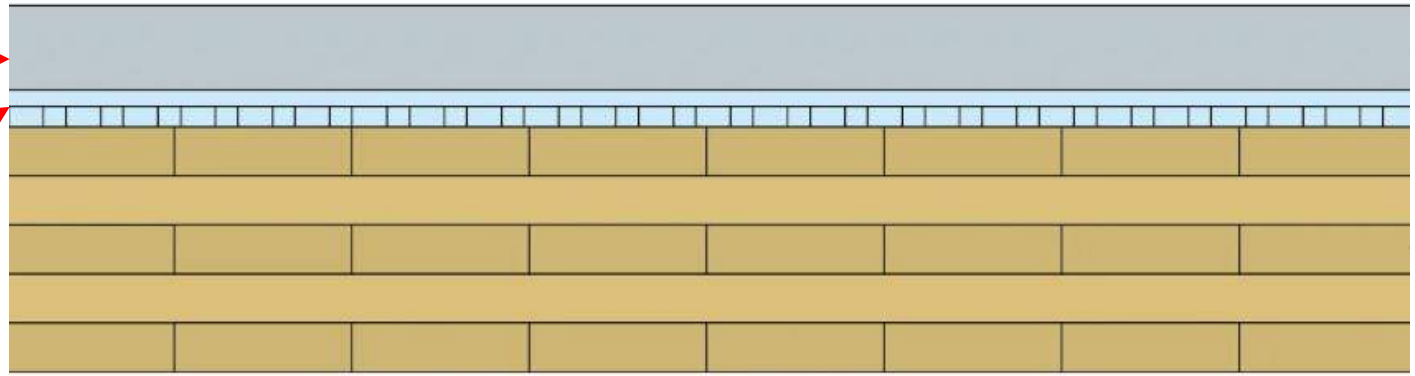


HGC CLT Flanking Study R&D

We know *some* toppings allow for continuous CLT, but missing much info:

What happens if this changes?

What happens if this changes?

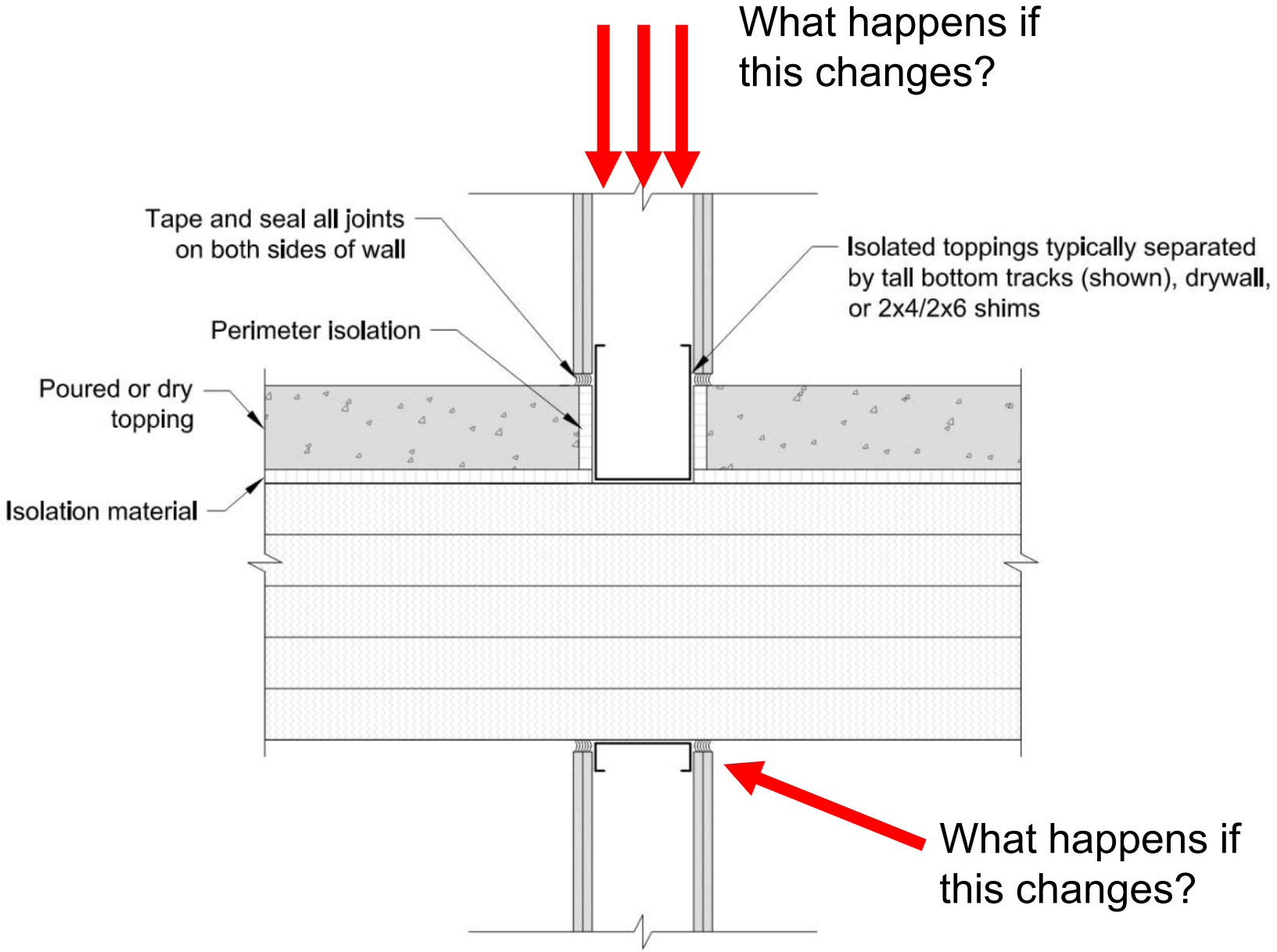


By changing topping <u>mass</u> and <u>stiffness</u>, how does the flanking change?

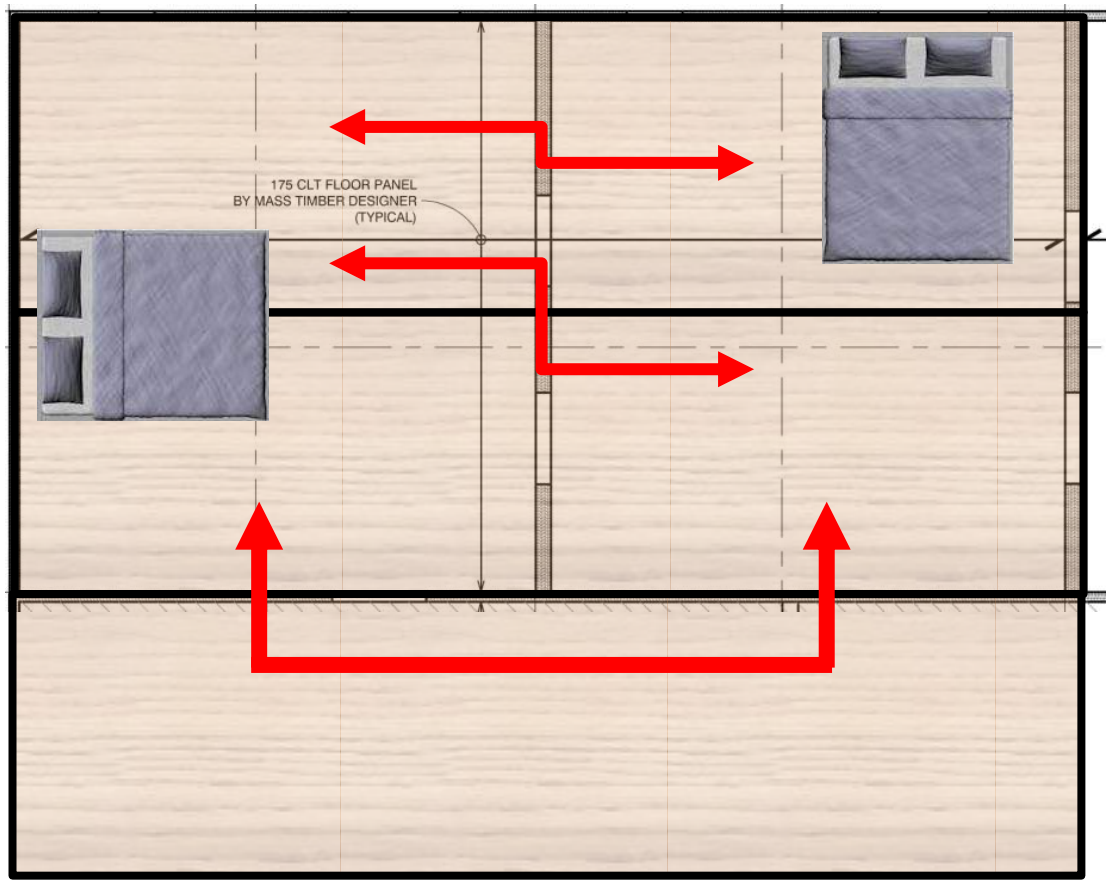
Toppings Comparison

Overall Topping #	Type	Topping Description
1	Dry	Two layers of plywood above isolation material #1
2	Wet	1.5" concrete above isolation material #1
3	Wet Added	0.5" concrete ADDED (2" total) above isolation material #1
4	Wet Added	1" concrete ADDED (3" total) above isolation material #1
5	Wet	1.5" gypcrete above isolation material #1
6	Wet Added	0.5" gypcrete ADDED (2" total) above isolation material #1
7	Wet Added	1" gypcrete ADDED (3" total) above isolation material #1
8	Wet	2" concrete above isolation material #2
9	Wet	2" concrete above isolation material #3
10	Dry	Two layers of plywood on isolation material #4
11	Dry	Plywood-cement board-plywood on isolation material #5
12	Wet	2" gypcrete on isolation material #5
13	Dry	Plywood-cement board-plywood on isolation material #6
14	Dry	Plywood-cement board-plywood on isolation material #7
15	Dry	Plywood-plywood on isolation material #7

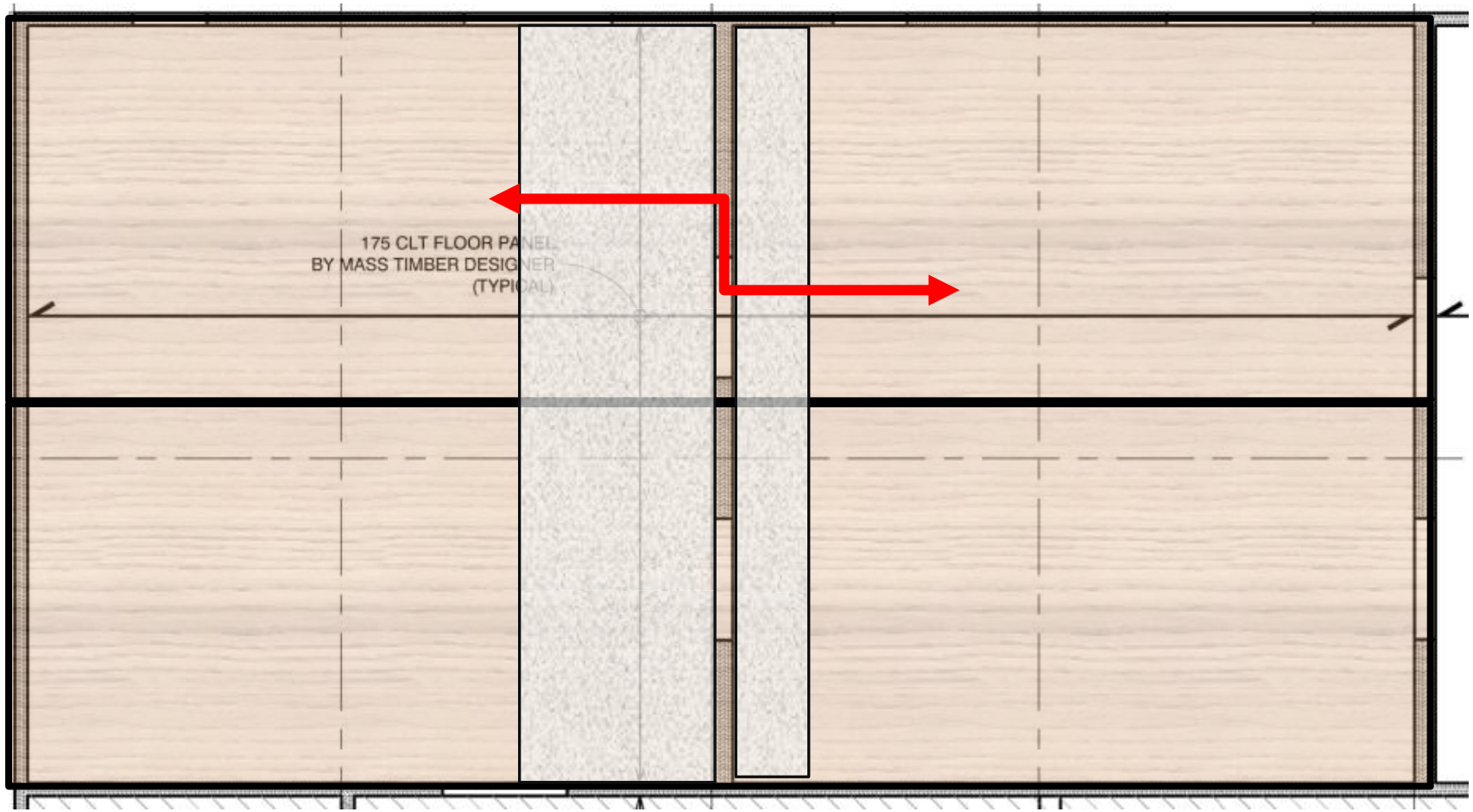
Structural Environment



Field vs. Lab Conditions



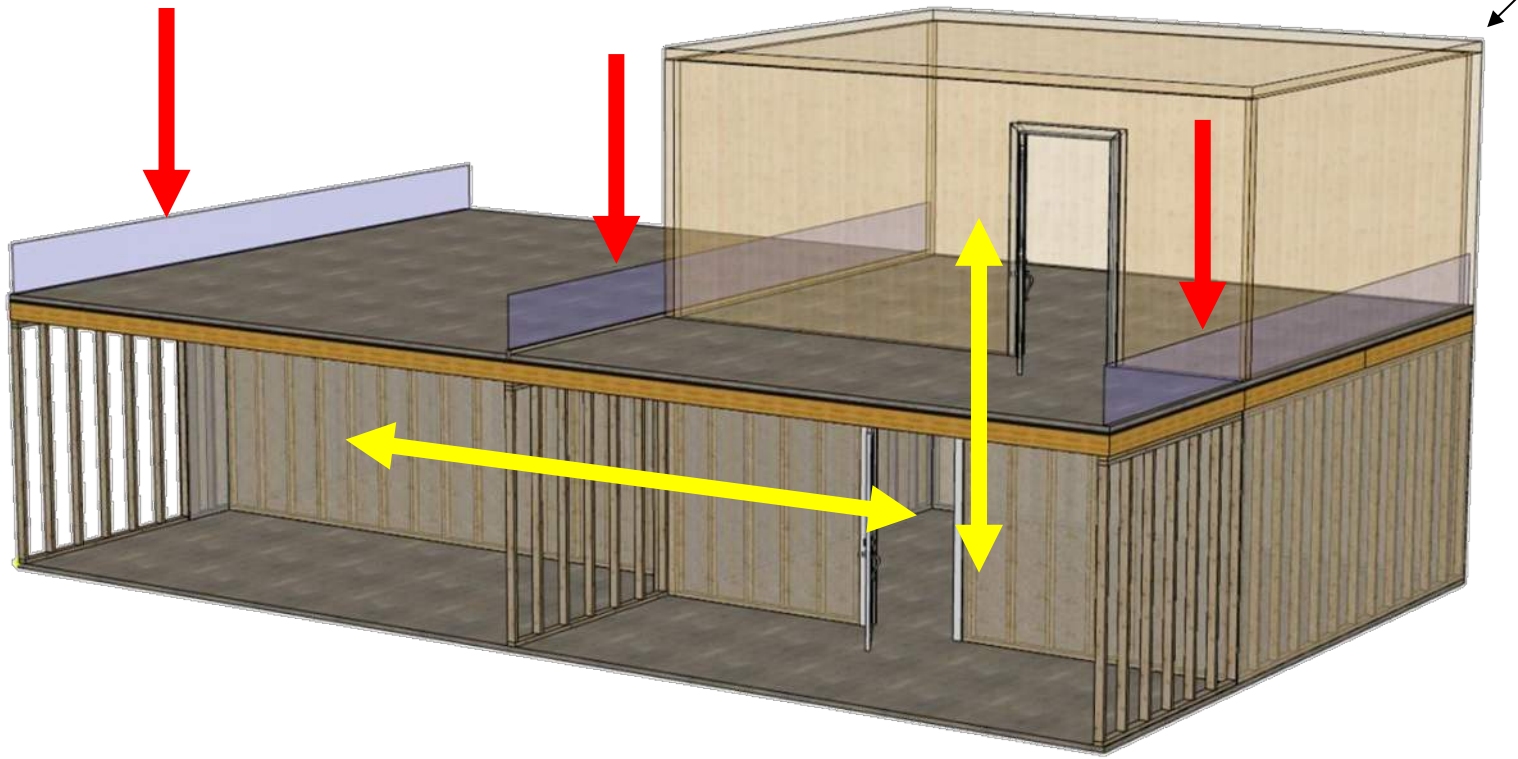
Effect of Bulkheads



Direct Floor/Ceiling Transmission

ASTC, AIIC testing of each floor topping

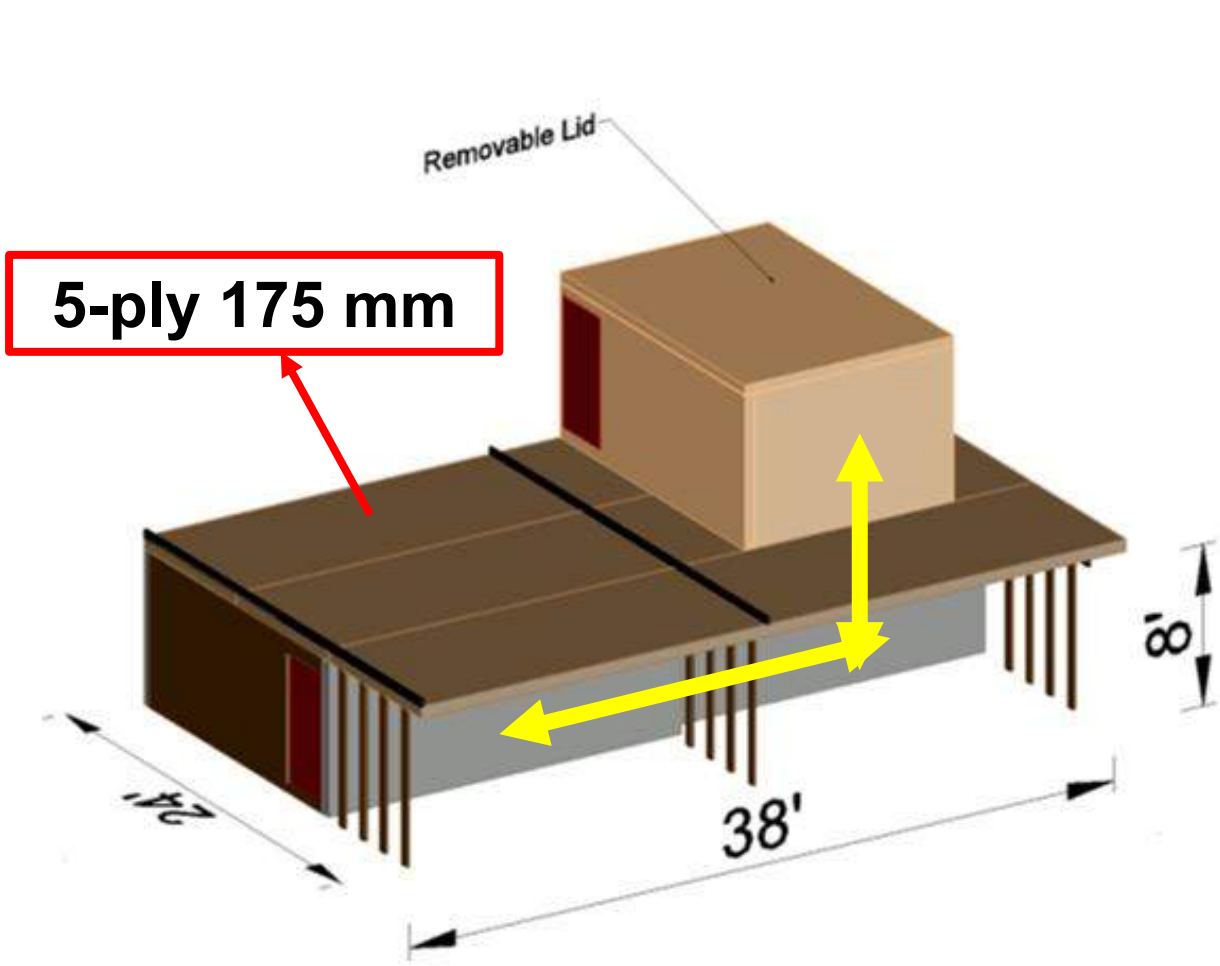
Structural floor vibration tests of each floor topping

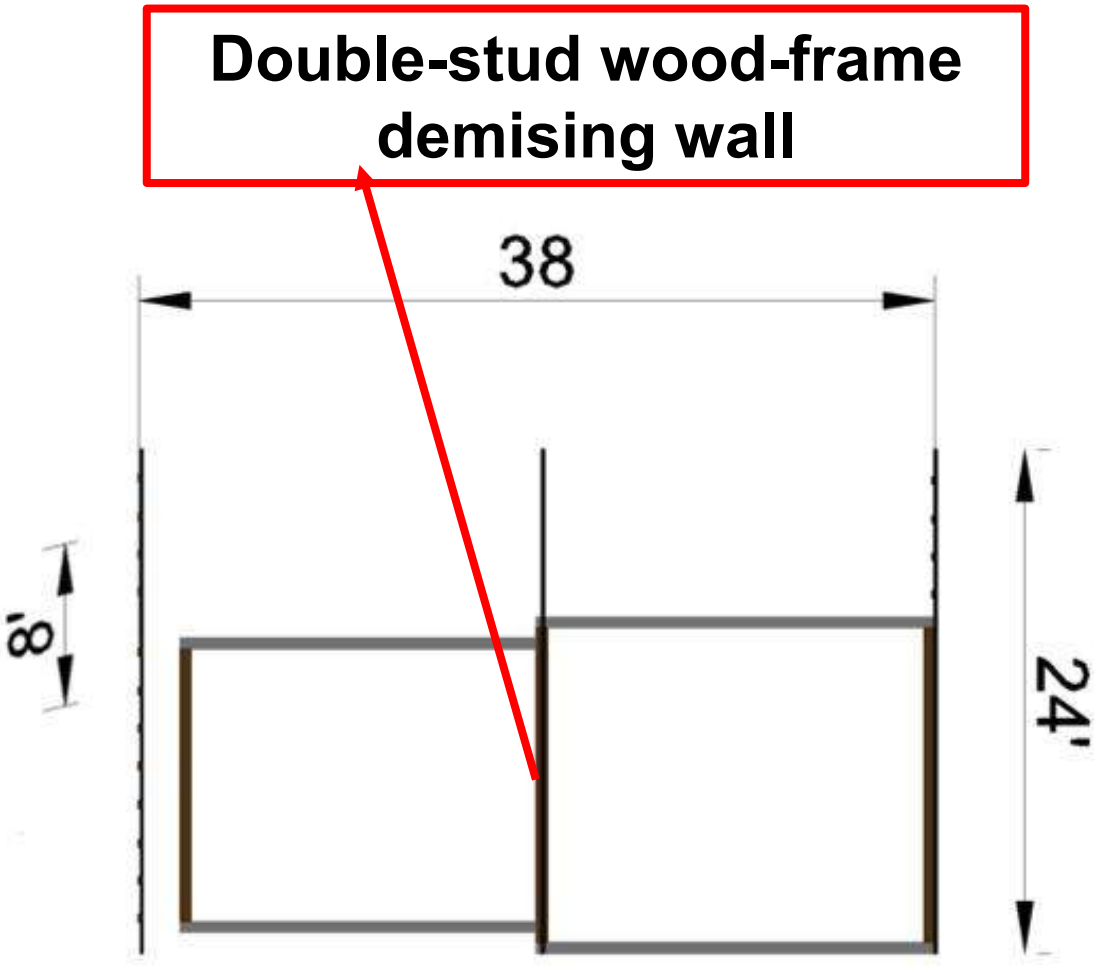


Removable Lid
(only for direct testing)

Partners and Collaborators

Test Structure





Floor Topping Logistics

Approach A: Install each topping one at a time, wait to dry/cure, test, remove, and install next one.

- How long does gypcrete take to dry for stable acoustic properties?
- How long does concrete take to cure for stable acoustic properties?
- How much dust is generated each time the topping is removed in the lab?

We're currently testing gypcrete dry time and concrete cure time…

Test schedule depends on these results.

Floor Topping Logistics

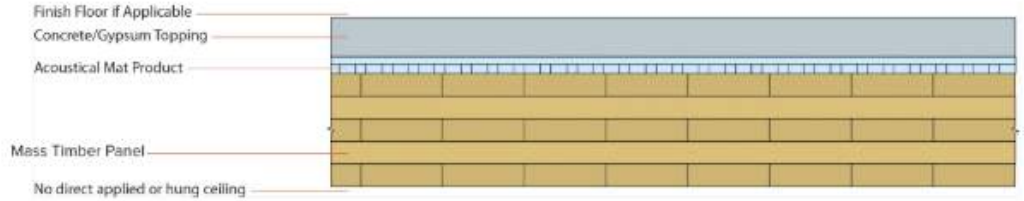
Approach B: Pre-install toppings on each 8-ft-wide CLT panel, then cycle through multiple sets of CLT panels to allow toppings to dry/cure (and be removed) away from the mock-up.

- How will the install/removal of CLT panels affect the acoustic properties?
- How will the breaks in topping every 8-feet affect the performance?
- How will the different sets of CLT panels vary in acoustic performance?
- What are the safety factors associated with so much crane use?

Not as ideal, but may be the only practical way to complete the research…

Final Report

CLT Floor Assemblies with Concrete/Gypsum Topping, Ceiling Side Exposed



This illustration shows typical applications and construction for the assemblies listed below. See tested assembly for specific construction materials, connections, required dimensions, and assembly requirements.

Mass Timber Panel	Acoustical Product Between MT Panel and Topping	Topping	Finish Floor	Sound Rating	Impact Rating
5-layer 6.88" CLT	Maxxon Acousti-Mat® SBR over Maxxon Acousti-Mat® 3/4 Premium	2" Gyp-Crete®	None	58 STC	49 IIC
5-layer 6.88" CLT	Maxxon Acousti-Mat® SBR over Maxxon Acousti-Mat® 3/4 Premium	2" Gyp-Crete®	LVT on Shaw GroundWorks	57 STC	54 IIC
5-layer 6.00" CLT	Maxxon Acousti-Mat® 3/4 Premium	2" Gyp-Crete®	Click LVT	52 STC	47 IIC
5-layer 6.00" CLT	Maxxon Acousti-Mat® 3/4 Premium	2" Gyp-Crete®	Glue Down LVT	53 STC	47 IIC
5.00" CLT(SCL)-MPP	Maxxon Acousti-Mat® 3/4 Premium	1.5" Gyp-Crete®	LVT on Acousti-Top®	53 STC	44 IIC
5.00" CLT(SCL)-MPP	Maxxon Acousti-Mat® SBR over Maxxon Acousti-Mat® 3/4	2" Concrete	None	57 STC	47 IIC
5.00" CLT(SCL)-MPP	Maxxon Acousti-Mat® SBR over Maxxon Acousti-Mat® 3/4	2" Concrete	LVT on Acousti-Top®	57 STC	51 IIC
6.37" CLT(SCL)-VLT	Maxxon Acousti-Mat® 3/8 Premium	2" Gyp-Crete®	None	53 STC	41 IIC

FAQ / Details

5-ply 175 mm (6.88”) CLT panels

Double stud wood demising walls, single stud wood perimeter walls

30-60 different floor toppings, 100s of tests

Testing to start Q2 2026, run to end of 2026.

Results to be publicly available Q2 2027.

Not testing: 3-ply CLT, roof toppings, drop ceilings

Awaiting results of various funding applications

Toban Bradlynn, BEng
tbradlynn@hgcacoustics.com

This concludes The American Institute of Architects Continuing Education Systems Course

Questions?

HGC Blog Post: Acoustic Design Strategies for Mass Timber Buildings