



STUDIO
SOUND
SERVICE



Small vs. Large Spaces: Two Acoustic Worlds in Contrast

The Studio Sound Service Experience

Who we are



Studio Sound Service is a well-established design and consultancy company that specialises in every aspect of acoustics and sound systems.

Founded in 1983

SSS has built an enviable reputation for the production of world class performance and recording spaces, from personal studios to large scale film, broadcast and corporate facilities.

By combining aesthetic and technical skills with decades for experience SSS strives to make every project successful, both sonically and visually.



Donato Masci
Physicist & Acoustic Designer - CEO



Cecilia Torracchi
Acoustic & Civil Engineer - Partner



Giulia Bondielli
Acoustic & Building Engineer - Partner



Elena Rossi
Acoustic & Building - Architectural Engineer



Niccolò Pizzamano
Architect & Acoustic Designer



Chantal Valdambrini
Communication Manager

ADR, Post & Broadcast. Cinema Mixing studios. Gaming Studios.

- Iyuno (ex SDI Media) Acoustic Designers (more than 15 countries)
- Cinecittà Studios (Postproduction Facility 2020 Renewal) @ Rome
- Dubbing Brothers (Italy, USA)
- 3Cycle postproduction Facility @ Rome
- FOX Dolby Atmos Studios @ Rome (IT), München (DE), London (UK)
- Netflix Facility @ Rome
- Disney Facility @ Warsaw (PO), Milan
- inHouse (Oscar winner Sorrentino) @ Roma

Music Studios (400+)

- Cicalto Recording – Francesco Ponticelli @ Arezzo
- Aemme Recording Studio – Salvatore Addeo @ Lecco
- D:POT Recording Arts @ Prato – Fabrizio Simoncioni
- Mulinetti Studio @ Genova – Alberto Parodi
Resolution Award 2015 Best Audio Facility
- The Garage @ Civitella v.d.C. (AR)
Resolution Award 2014 Best Audio Facility
- House of Glass @ Viareggio (LU) – Gianni Bini
Resolution Award 2013 Best Audio Facility
- SonicFab Studio @ Pioltello (MI)
- Waves Music @ Genova
- Marco Borsatti Studio @ Bologna
- Pop Fiction – Janie Price @ Firenze
- Sugarmusic @ Milano
- Experimental Studios @ Torino

Dolby Atmos Music Studios: 50+ rooms

Dolby Atmos Home Entertainment Studios: 80+ rooms

Dolby Atmos Theatrical Studios: 10+ Theatres

Personal Studios:

- Andrea Bocelli, Asaf Avidan, Biagio Antonacci, Daniele Silvestri, Damian Lazarus, Diego Calvetti, Enrico Cremonesi (Fiorello), Enrico Melozzi, Fabio Rovazzi, Federica Vincenti (Michele Placido), Gabry Ponte, Giorgia Angiuli, Irko (Kanye West sound engineer), Luca Agnelli, Marco Masini, Marco Messina (99 Posse), Merk & Kremont, Nari&Milani, Paolo Sandrini, Petra Magoni, Piero Pelù, Pino Iodice, Renato Zero, Vinai.

- Barys Arena (ice hockey) @ Astana, Kazakhstan
- Chorus Life (arena e cittadella) @ Bergamo
- Stadio Tardini @ Parma

- Hospitals: Nuovo Ruggi @ Salerno, Cesena

- George Lucas Home Theater, Italy
- Cinema Barberini @ Roma

- Chiesa Santa Maria Nuova (Arch. M. Botta) @ Terranuova B. (AR)
- Duomo di Siena new audio system

- Prada Auditorium and Conference Room via Orobia @ Milano
- Presentation room Ferrari HQ @ Maranello (MO)
- Siemens HQ @ Milano
- Heineken HQ @ Milano
- Leonardo Elicotteri @ Milano

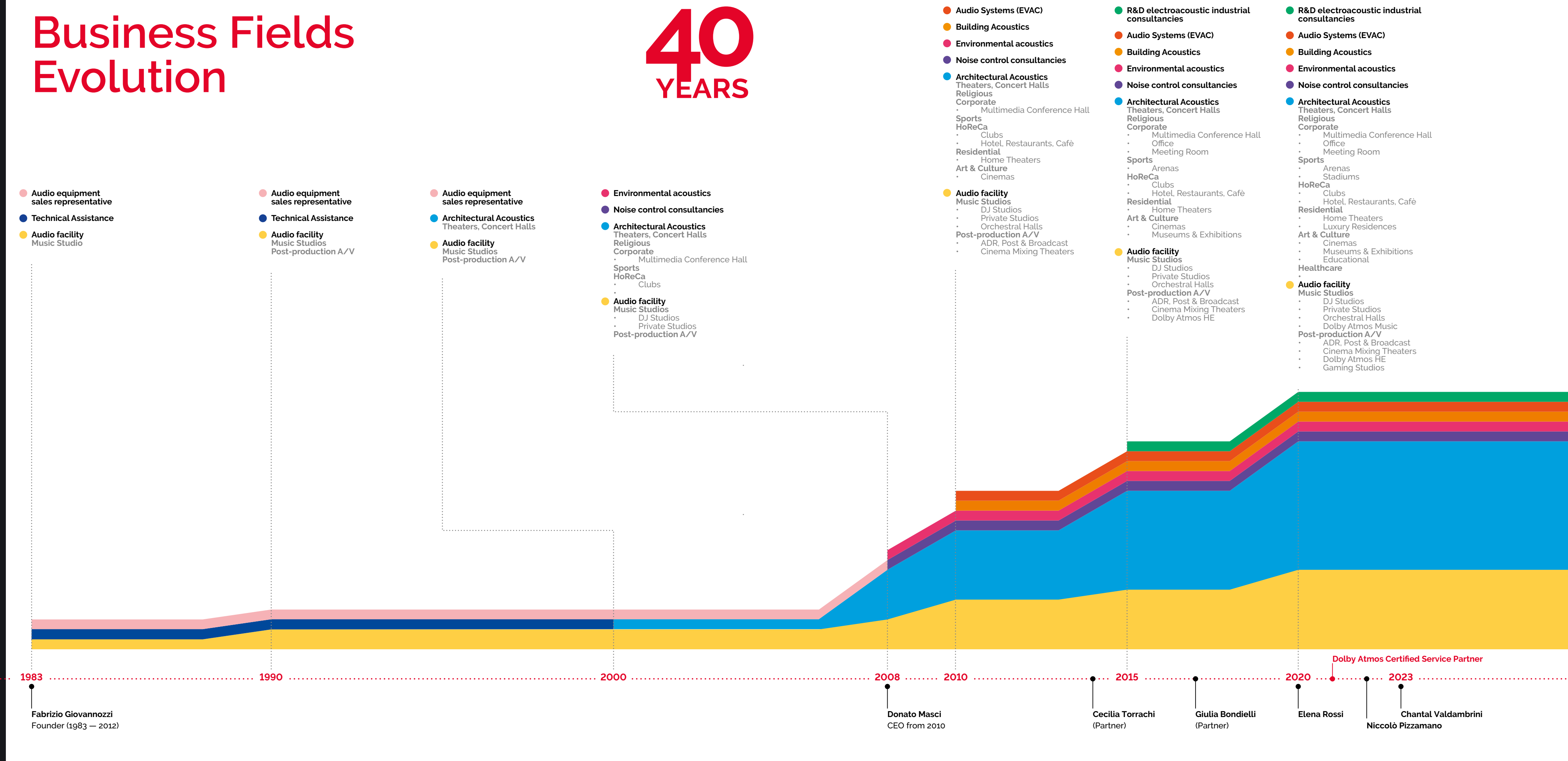
- Four Seasons Hotel @ Firenze
- Portrait Milano – Ferragamo @ Milano
- Caffè dell'Oro – Ferragamo @ Firenze
- Hotel Veronesi (Calzedonia) @ Verona

- EVAC Dubai Metro
- EVAC Bahrain and Islamabad airport (THALES)
- EVAC Scuola di Magistratura Castelpulci @ Scandicci Firenze

- Teatro del Popolo @ Castelfiorentino (FI)
- Teatro del Popolo @ Colle di Val d'Elsa
- Teatro del Popolo @ Poggibonsi
- Teatro il Ferruccio @ Empoli
- Teatro Marconi @ Pistoia
- Teatro Nazionale @ Firenze

Business Fields Evolution

40
YEARS





Studio Sound Service
is the only Italian
Dolby CSP.

We can provide
design,
commissioning and
consultancy services
worldwide with
Dolby's certified
quality standards.

The Dolby logo is displayed in white on a red rectangular background. It features the word "Dolby" in a bold, sans-serif font, preceded by a stylized "D" symbol consisting of two overlapping circles.

Certified service partner

CEDIA®

MEMBER 2024 - 2024

Studio Sound Service Srl

Industry-Related Professional

CEDIA Members are smart home professionals providing comfort, control, connection, and entertainment for clients to experience the best moment in life in their homes.

The Association for Smart home Professionals™

CEDIA Member Code of Conduct

Each member of CEDIA shall agree to adhere to the following:

1. Provide to all persons truthful and accurate information with respect to the professional performance of duties.
2. Maintain the highest standards of personal conduct to bring credit to the custom electronic and design industry.
3. Promote and encourage the highest level of ethics within the profession.
4. Responsibly uphold all laws and regulations relating to CEDIA policies and activities.
5. Strive for excellence in all aspects of the industry.
6. Use only legal and ethical means in all industry activities.
7. Protect the public against fraud and unfair practices.
8. Use written contracts clearly stating all charges, services, products and other essential information.
9. Demonstrate respect for every professional within the industry by consistently performing at or above the standards acceptable to the industry.
10. Make a commitment to increase professional growth and knowledge by participating in technical and industry business training.
11. Contribute knowledge to professional meetings and journals to raise the professionalism of the industry.
12. Maintain the highest standards of safety.
13. When providing services or products, maintain in full force adequate or appropriate insurance.
14. Cooperate with professional colleagues, suppliers and employees to provide the highest quality service.
15. Extend these same professional commitments to all persons supervised or employed.
16. Subscribe to CEDIA's Code of Ethics and abide by the CEDIA Bylaws.

PART 1: INTRODUCTION & PHILOSOPHY

Two Worlds, Two Philosophies



“

Every Italian journalist writes
“*acustica perfetta*” - they're always
wrong

”



This single misconception reveals the fundamental misunderstanding of acoustic design.

Perfect acoustics doesn't exist - only appropriate acoustics for specific purposes.

The truth is far more nuanced: what works brilliantly in a recording studio would be disastrous in a concert hall, and vice versa.

SMALL SPACES



"Reveal the truth"

- Reveal the truth
- The room disappears
- Microscope for sound
- Analytical precision
- Serve the content

LARGE SPACES



"Create the magic"

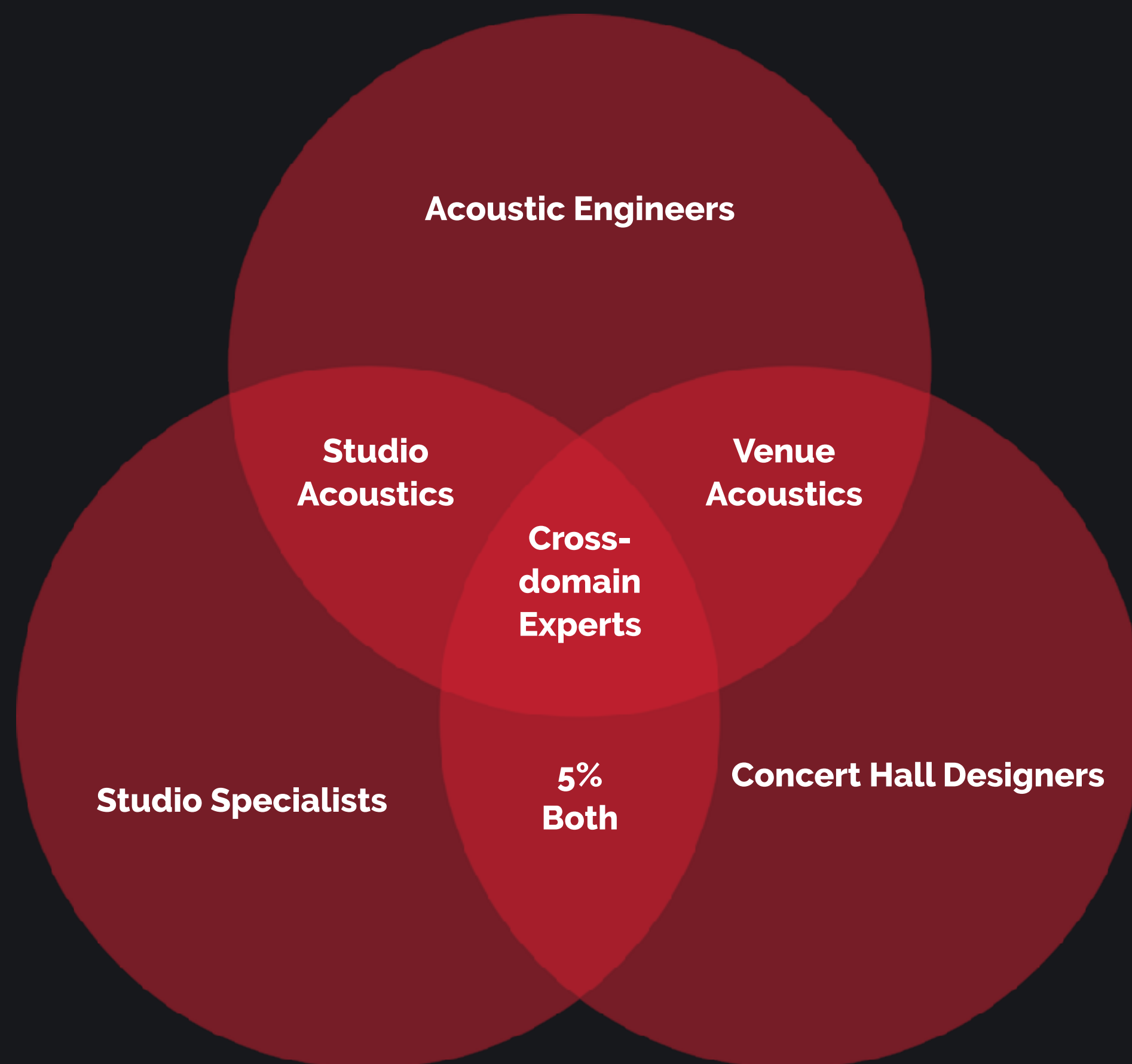
- Create the magic
- The room performs
- Cathedral for emotion
- Experiential immersion
- Enhance the content

Same Consultant, Opposite Roles

Aspect	STUDIO DESIGNER	THEATRE CONSULTANT
Philosophy	<i>"I am the architect"</i>	<i>"I serve the architecture"</i>
Modus Operandi	Create from nothing	Adapt to existing
Control	100%	30%
Listening area	One perfect point	800 acceptable points
Geometry	Geometry serves acoustics	Acoustics serves geometry
Materials	Materials selected first	Materials negotiated last
Space	Private creative space	Public performance space

The 95% Who Never Cross Over

The modal/statistical divide at Schroeder frequency creates different physics. Different physics requires different thinking patterns.



"A hammer sees everything as a nail"
studio designers see resonances to kill,
concert hall designers see energy to preserve.

Our advantage: 400+ studios, 50+ large spaces. We've failed enough in both to understand the principles.

"Experience in both worlds reveals what connects and what divides them."

PART 2: PHYSICS & TECHNICAL PRINCIPLES

When Physics Dictates Design

Where Physics Changes, Philosophy Must Follow

Aspect	Small Room (100 m ³)	Large Hall (10,000 m ³)
Schroeder frequency f_s	350 Hz	90 Hz
Below f_s	Modal Behaviour	Few modes, not critical
Above f_s	Statistical begins	Fully Statistical
Mode Audibility	Individual modes audible	Modes blend into reverberation
Analysis Method	Wave-based analysis critical	Ray-tracing sufficient
	Standing waves dominate	Geometric acoustics valid

$$f_s = 2000 \times \sqrt{\frac{RT_{60}}{V}}$$

The transition point where design philosophy must completely flip.
Below Schroeder: Count modes. **Above Schroeder: Statistics rule.**

Bass: Enemy vs Treasure

STUDIOS

"Every mode is an enemy" (bass: 20÷200 Hz)

- **Problem:** Modal resonances
- **Solution:** Membrane absorbers
- **Target:** <350ms decay @ 50Hz
- **Risk:** Boomy/muddy sound
- **Treatment:**
60-100cm depth
Membrane Absorbers
Perforated Panels

Key insight:

*"The seat dip effect eats 100-300Hz in halls -
we must preserve what remains or the hall sounds anaemic."*

CONCERT HALLS

"Bass is precious energy" (bass: 125÷250Hz)

- **Problem:** Seat dip effect
- **Solution:** Rigid construction
- **Target:** >1.5s warmth
- **Risk:** Thin/cold sound
- **Treatment:**
??? None desired !!!

Diffusion Strategy - Placement and Purpose

STUDIOS

- **First reflection points:** Always treat (break specular reflections, prevent flutter echo)
- **Rear wall:** Always treat (break specular reflections, prevent flutter echo)
- **Goal:** Scatter direct sound
- **Amount:** 15-30% of surfaces
- **Type:** 1D or 2D diffusers

Critical insight:

"Break specular reflections in studios, add brilliance to shadows in halls. Prevent flutter echo always, but preserve lateral energy in halls."

CONCERT HALLS

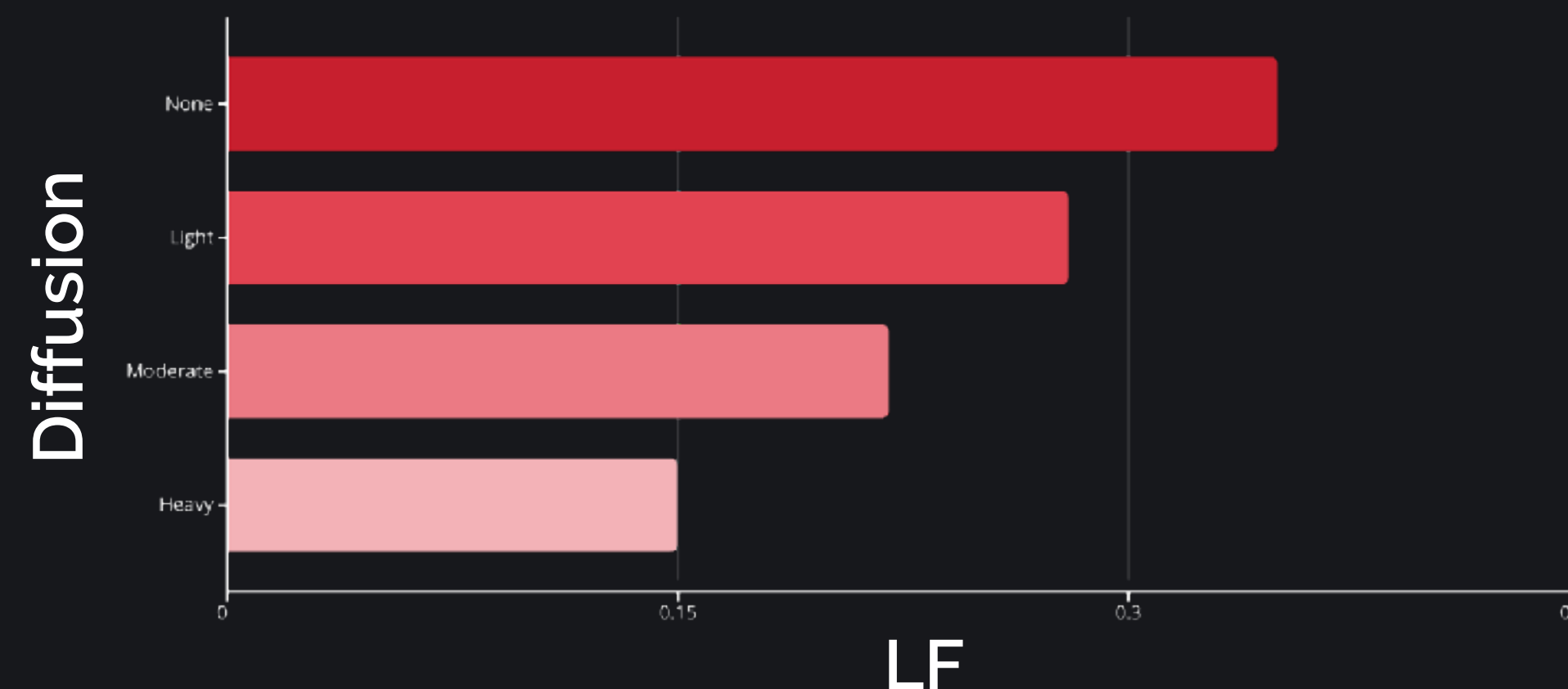
- **Under balconies:** add brilliance to shadows
- **Rear wall:** IF needed (prevent echo, keep energy)
- **Side walls:** specular reflection is better (preserve lateral energy)
- **Goal:** Enhance without destroying
- **Amount:** 5-10% of surfaces
- **Type:** Large-scale only

Why Side Walls Must Be Sacred in Halls

Key Revelation:
Diffusion on side walls destroys spaciousness in halls

STUDIOS

- Lateral energy = false stereo image:
must eliminate
- Lateral Energy Fraction (LF) targets:
<0.1 (mono compatibility)
- Interaural Cross-Correlation (IACC):
<0.3 (precise imaging)



CONCERT HALLS

- Lateral energy = envelopment:
must preserve
- Lateral Energy Fraction (LF) targets:
<0.25 (spacious feeling)
- Interaural Cross-Correlation (IACC):
<0.5 (envelopment)

Design impact: Side walls flat and reflective in halls, treated in studios

"Every diffuser on a side wall is stealing spaciousness from the audience"

Why Every Simulation Starts Wrong

SMALL SPACES

- Need impedance values
- Indirect impedance estimation
- 6-10 surfaces to calibrate
- FEM needs precision

LARGE SPACES

- Need absorption coefficients
- Historical materials = unknown
- 100+ surfaces to calibrate
- Ray-tracing needs statistics

Current reality: we guess, measure, adjust, repeat

Future need:

Systematic calibration approach

The Complete inversion

Aspect	Studios	Halls
Modes	Eliminate	Preserve
Diffusion	Strategic	Minimal
Lateral energy	Destroy	Preserve
Materials	Absorptive	Reflective
Panels Mounting	Decoupled (resonators)	Rigid

PART 3: THE CALIBRATION CHALLENGE – SMALL SPACES

Where Control Meets Precision

Small Rooms: The Luxury of Modal Control

THE SMALL ROOM ADVANTAGE

Below Schroeder Frequency (~350Hz):

- Individual modes are audible
- We can count them
- We can measure them
- **We can kill them (one by one)**

OUR WEAPON

- Wave-based simulation (FEM/BEM)
- *(?) Precise impedance control*
- Targeted treatment
- Mathematical certainty

Result: $\pm 5\%$ accuracy

Critical insight:

"In small rooms, we are gods"

From Empty Box to Validated Model



- Inverse problem: From MT60 to impedance
- 4 modes = 4 unknown = 4 impedance
- Modal participation factors (ϵ)
- Process:
Measure MT60 → Calculate ϵ → Assign Z
- *Works for 6 surfaces, doesn't scale to 100*
- *Controlled materials*
- *No aging, no surprises*

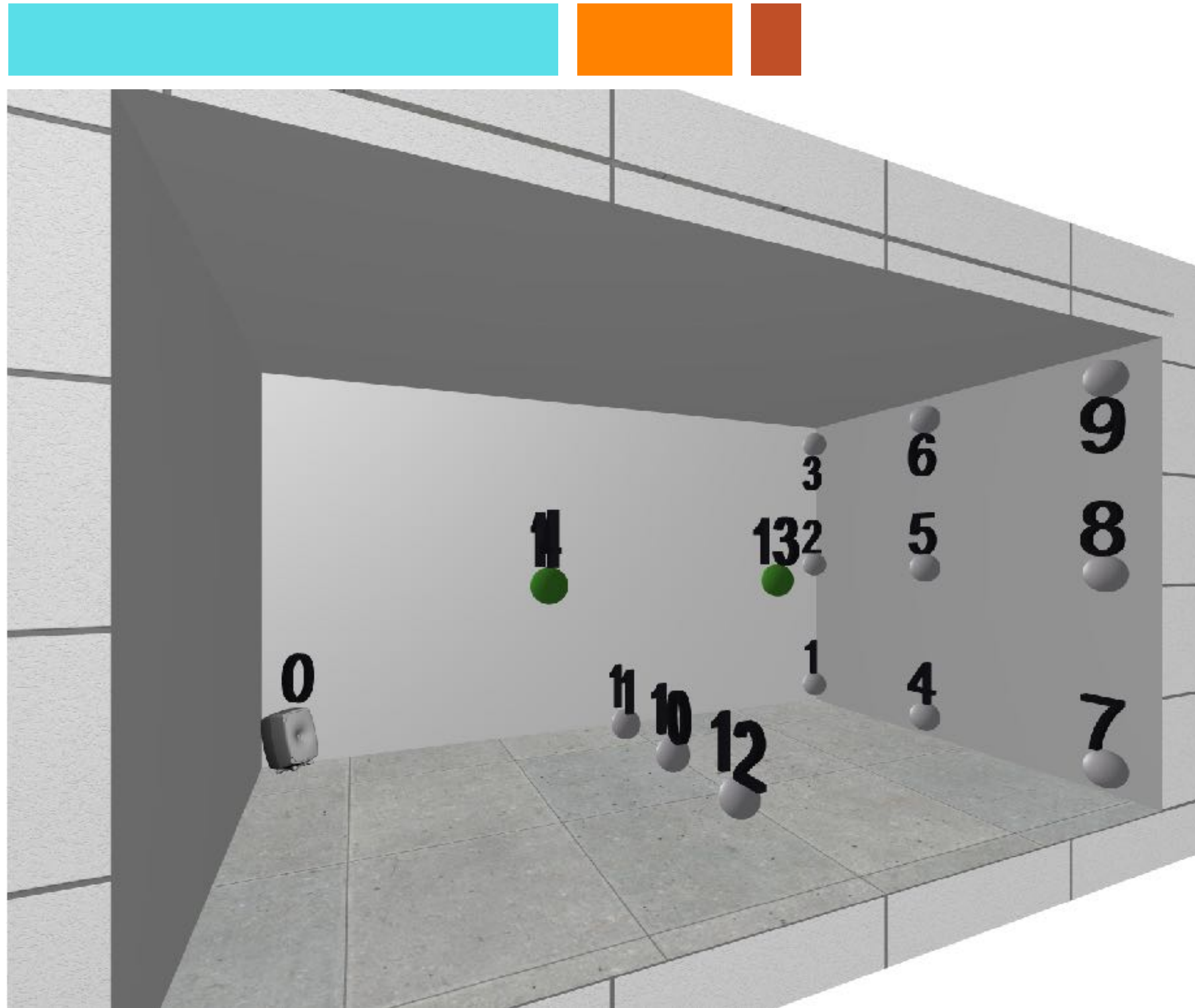
2025 ISE CEDIA Convention

We used the procedure from Roberto Magalotti and Valentina Cardinali's paper:
"A simulation test bench for decay times in room acoustic"

to indirectly estimate the acoustic impedance of the walls with COMSOL®

and we calculated it using a Mathematica® tool

Measurements in the SSStudio

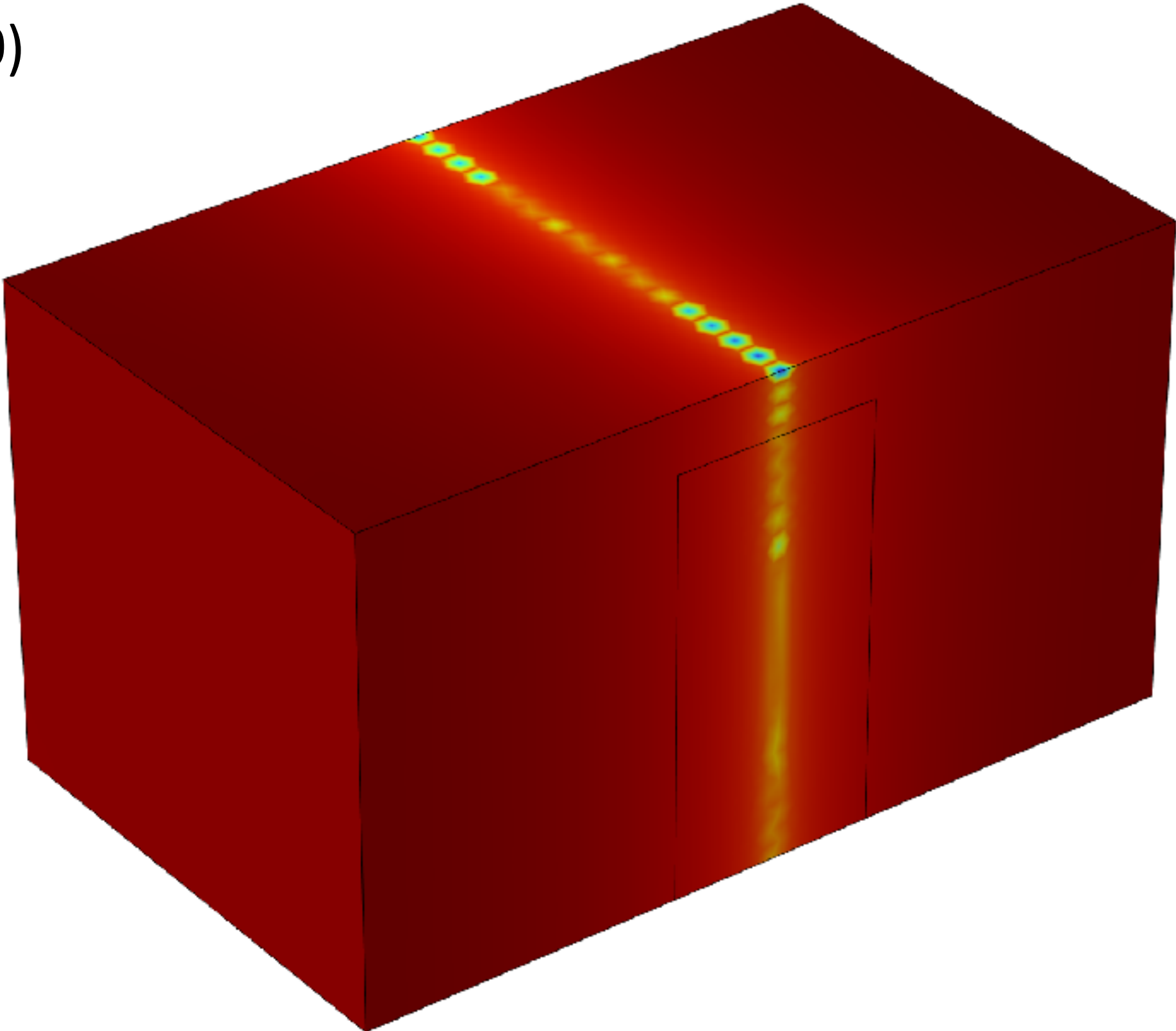


Points were selected

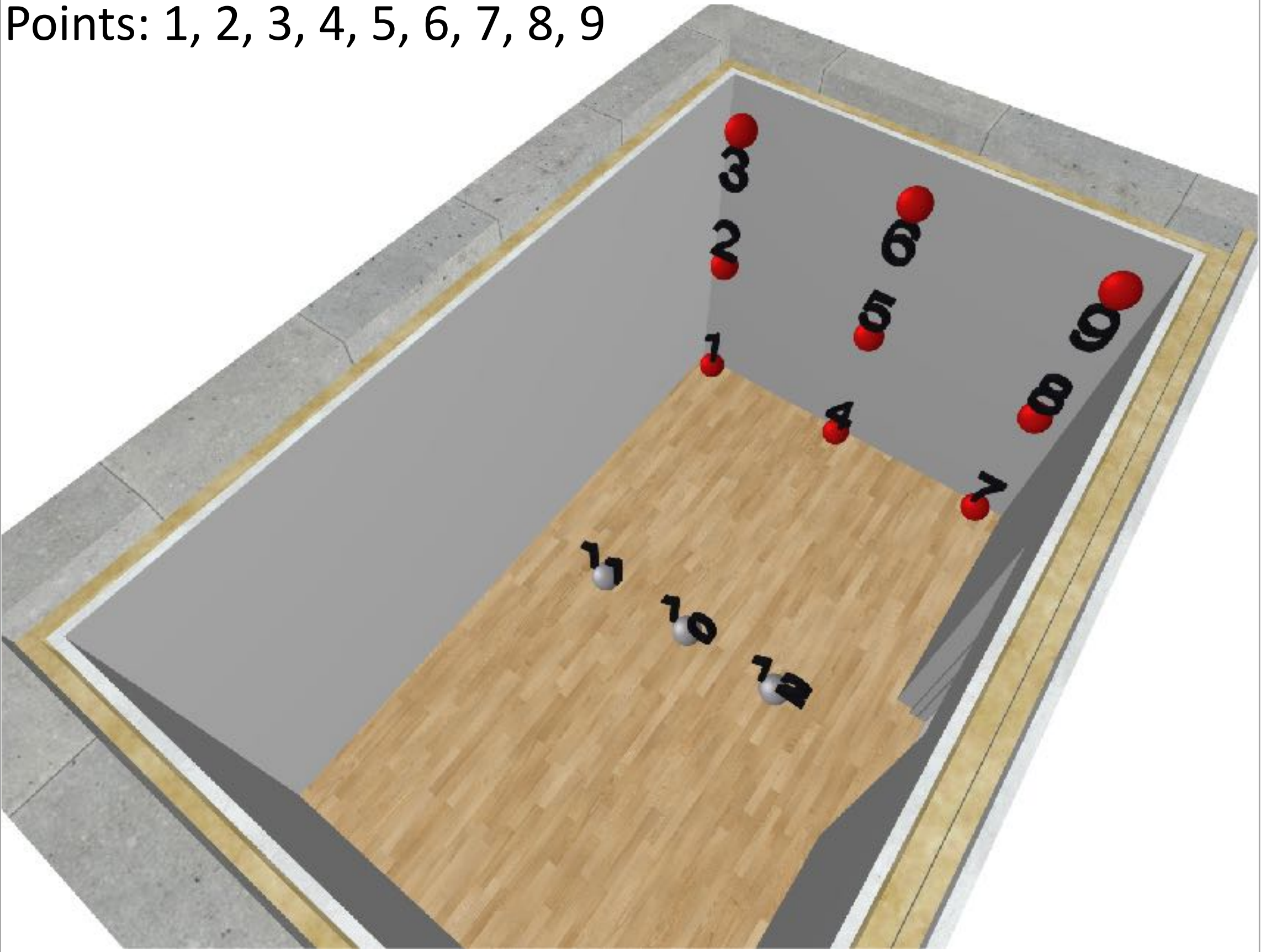
- 1. on the back wall (9 points)**
 - 4 in the corner (1,3,9,7)
 - 1 in the middle (5)
 - 4 at the midpoints of the sides (2, 4, 6, 8)
- 2. at the middle of the room to distinguish the modal responses**
 - 10
 - 11 and 12 at $1/4W$
- 3. Points at $1/3$ of the length as a control position (13, 14)**

Measurements - Room modes

38
(1,0,0)

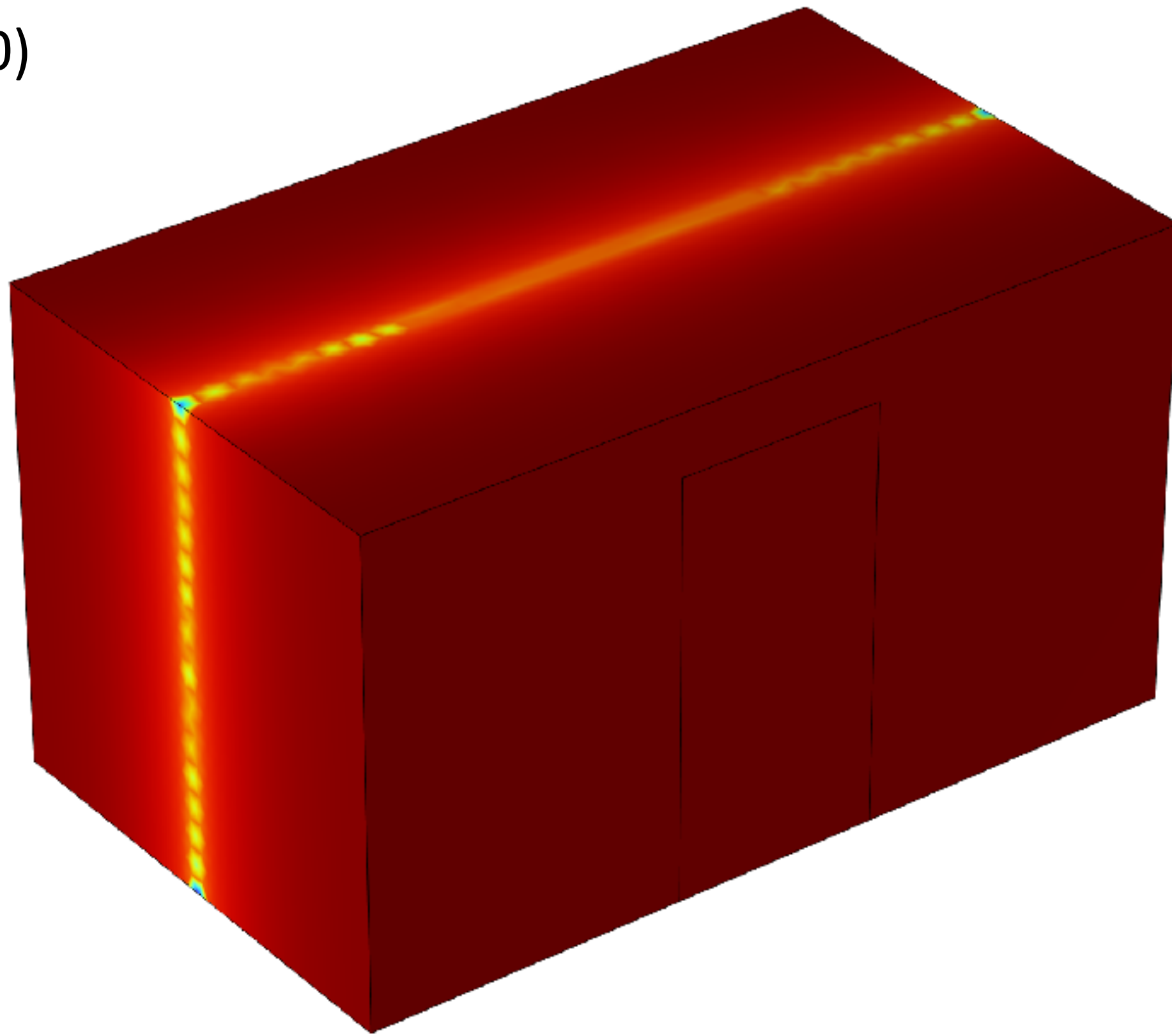


Points: 1, 2, 3, 4, 5, 6, 7, 8, 9

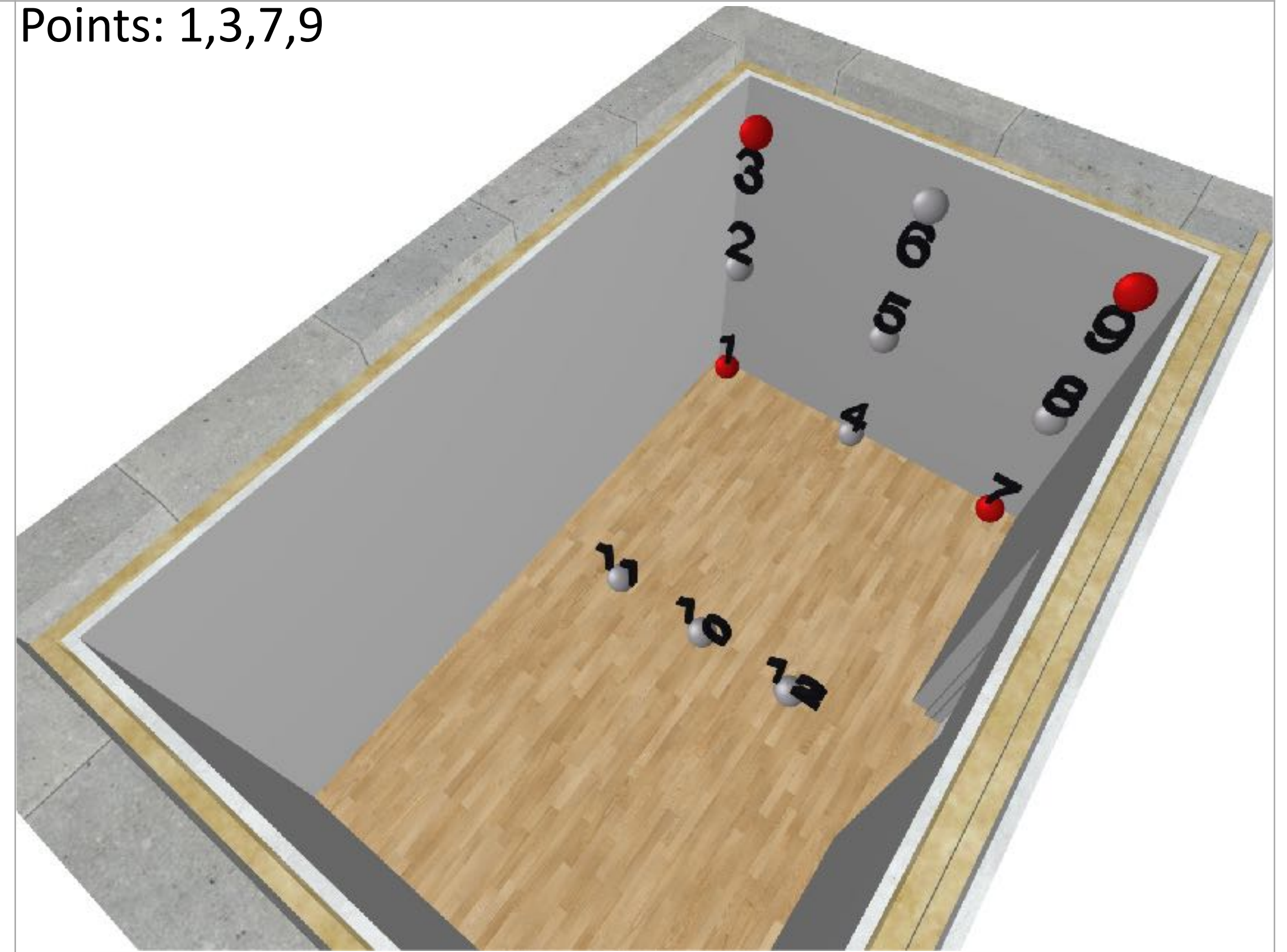


Measurements - Room modes

63
(0,1,0)

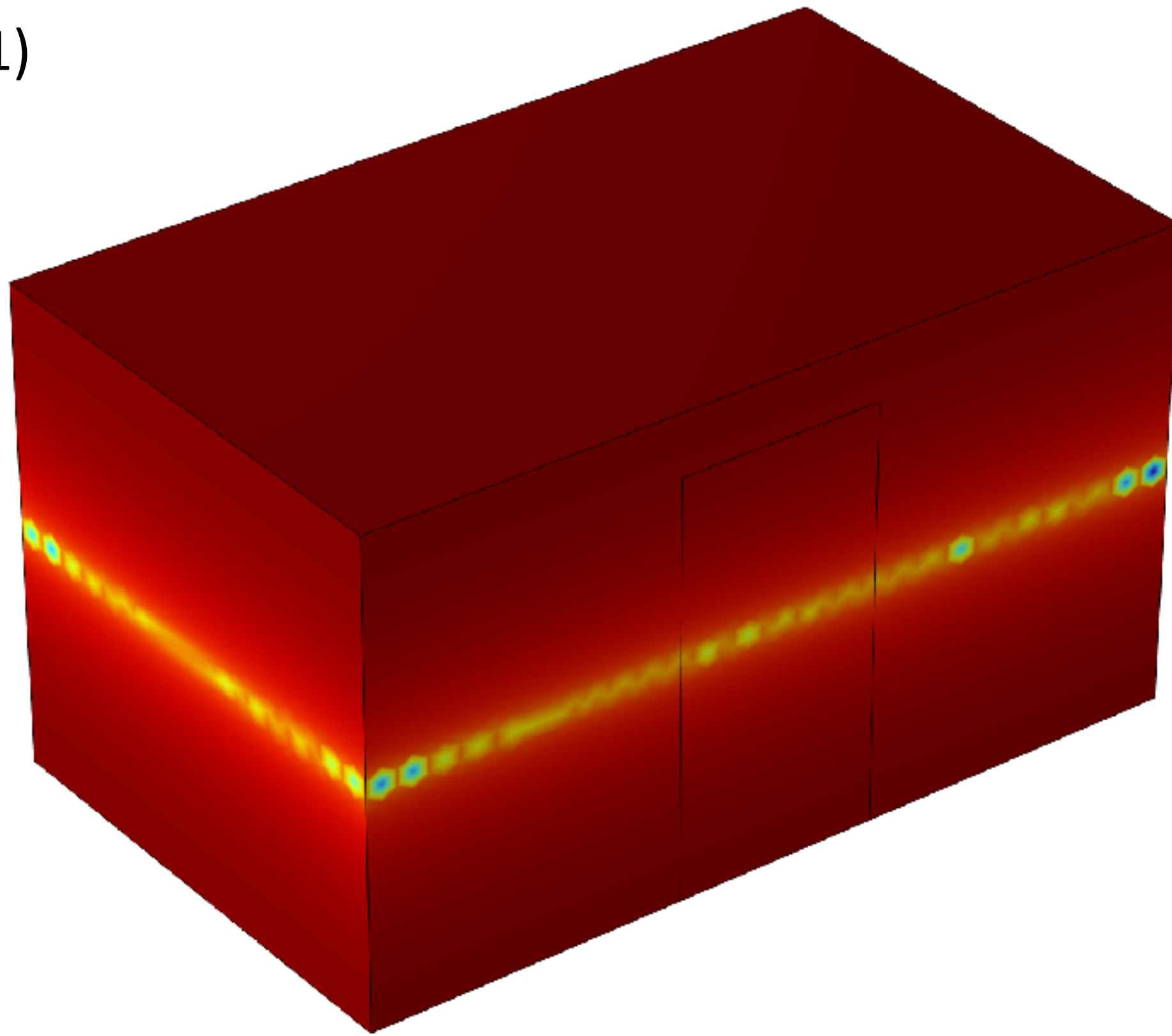


Points: 1,3,7,9

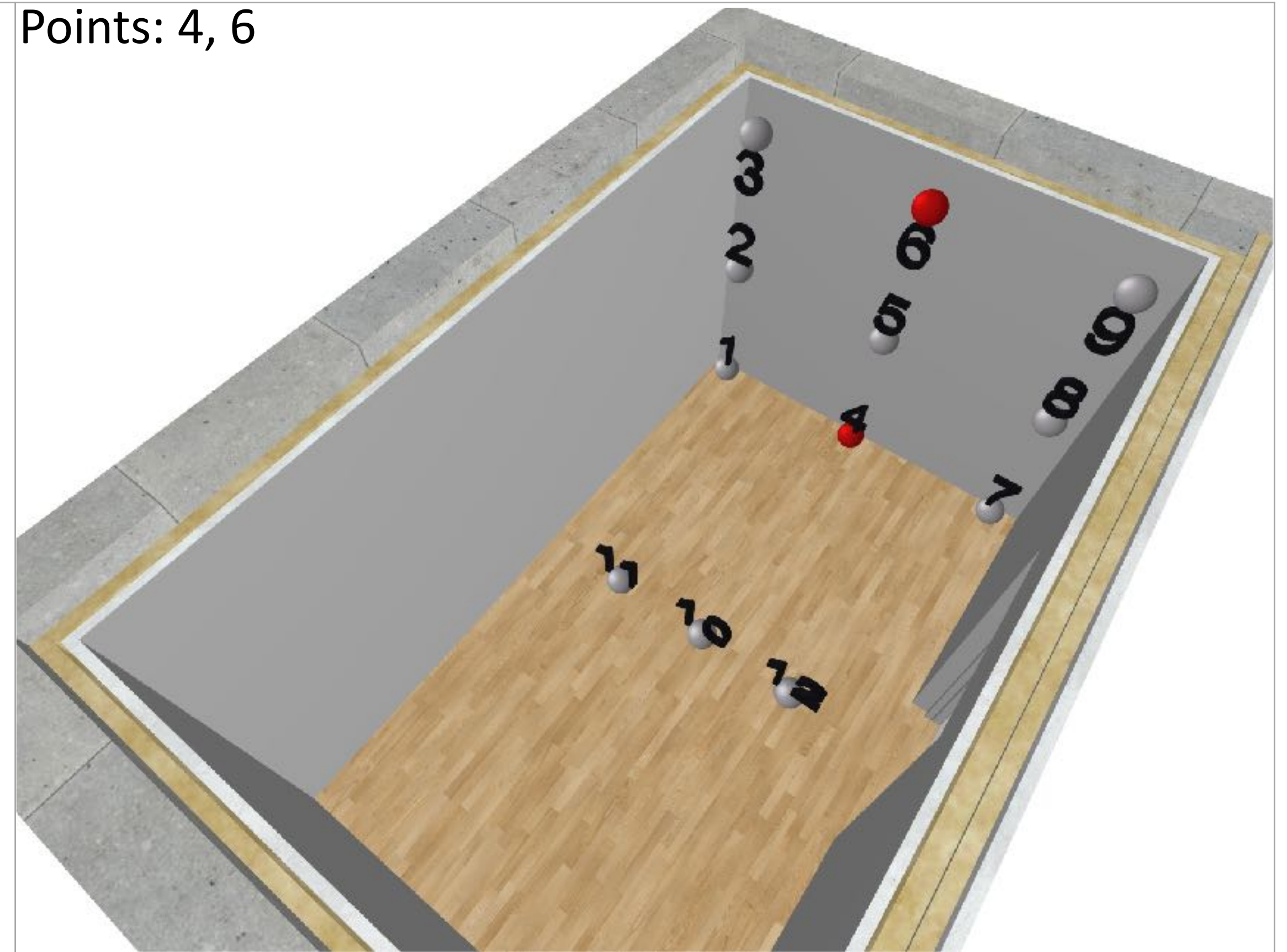


Measurements - Room modes

68
(0,0,1)

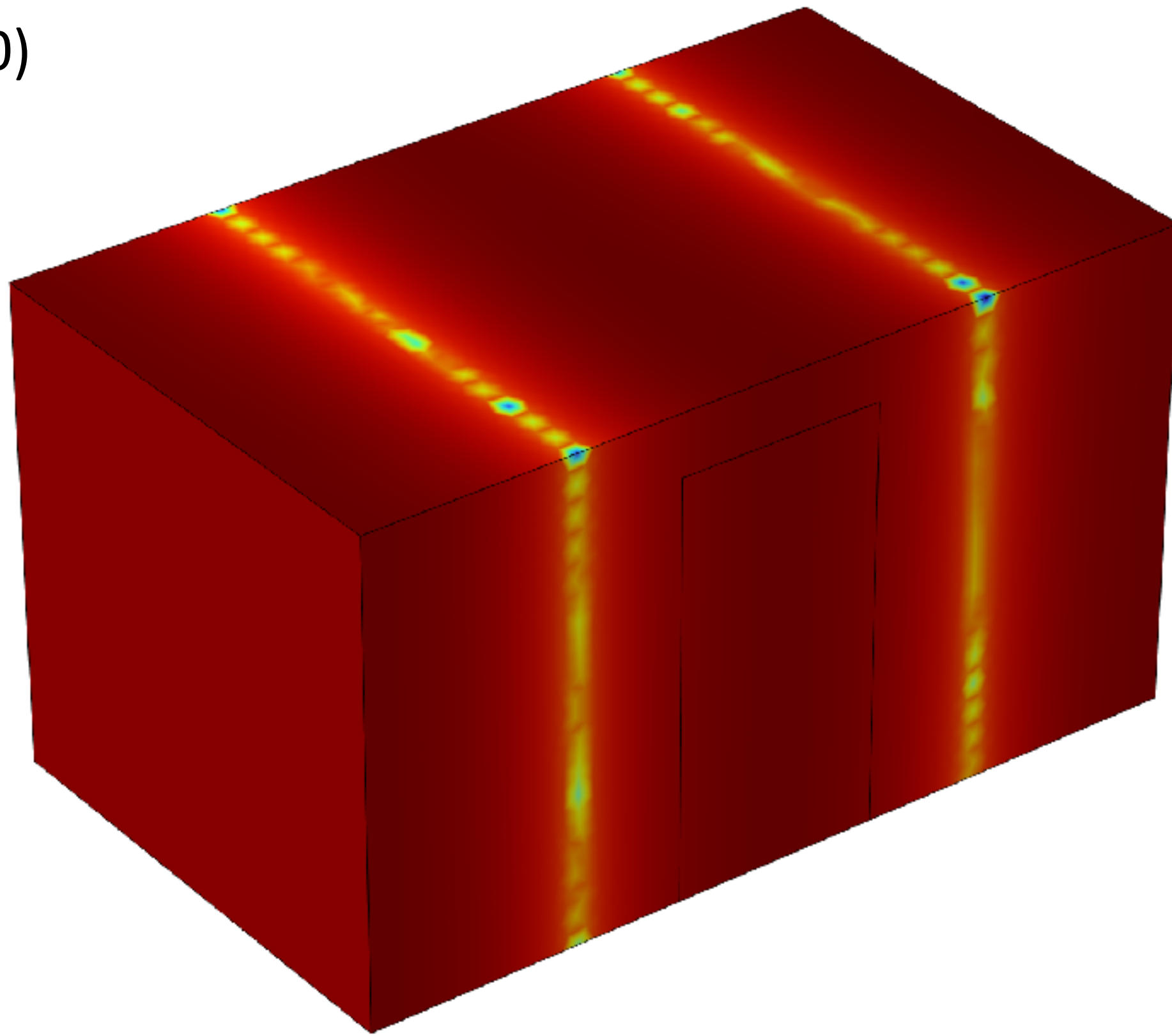


Points: 4, 6

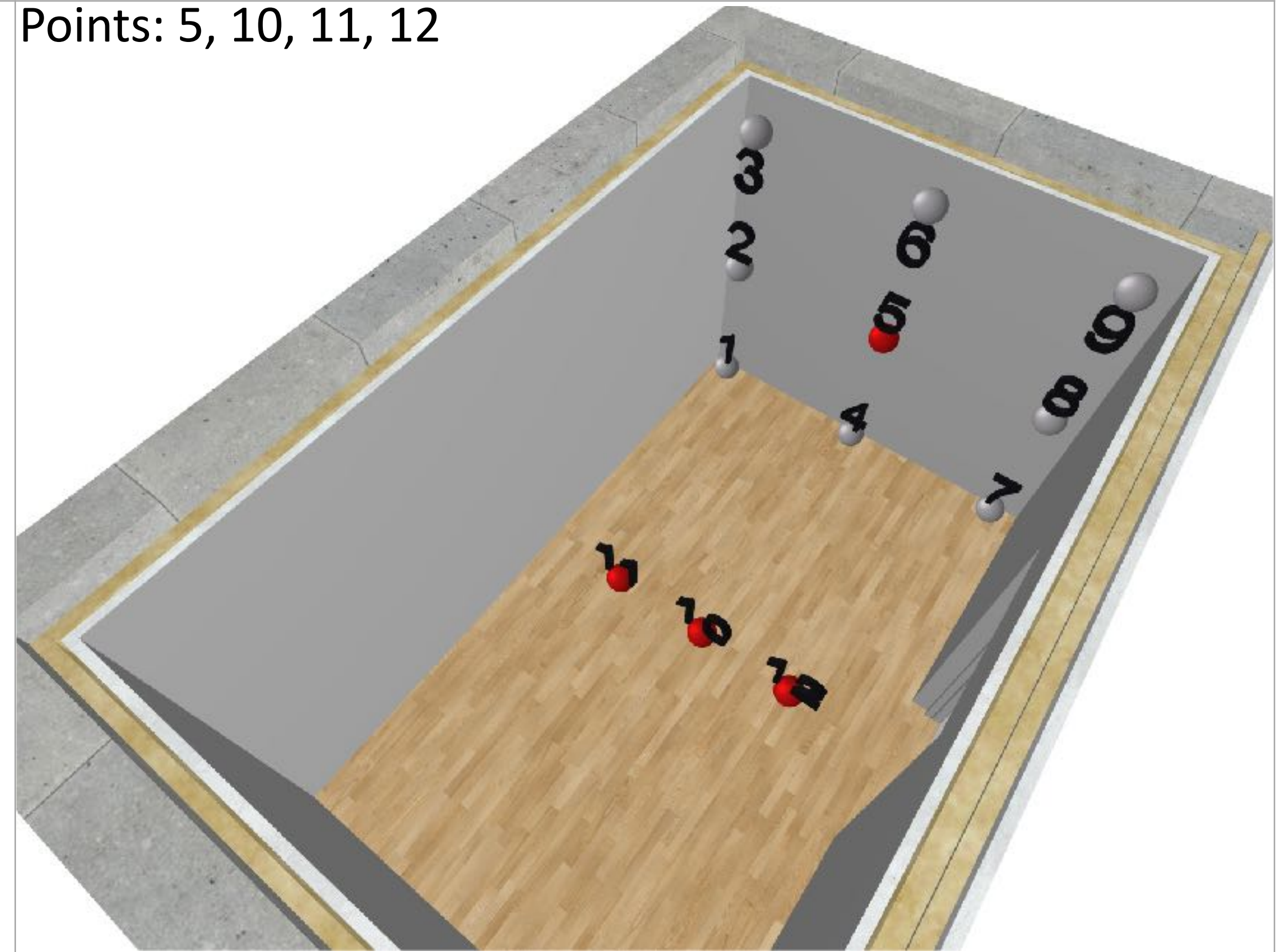


Measurements - Room modes

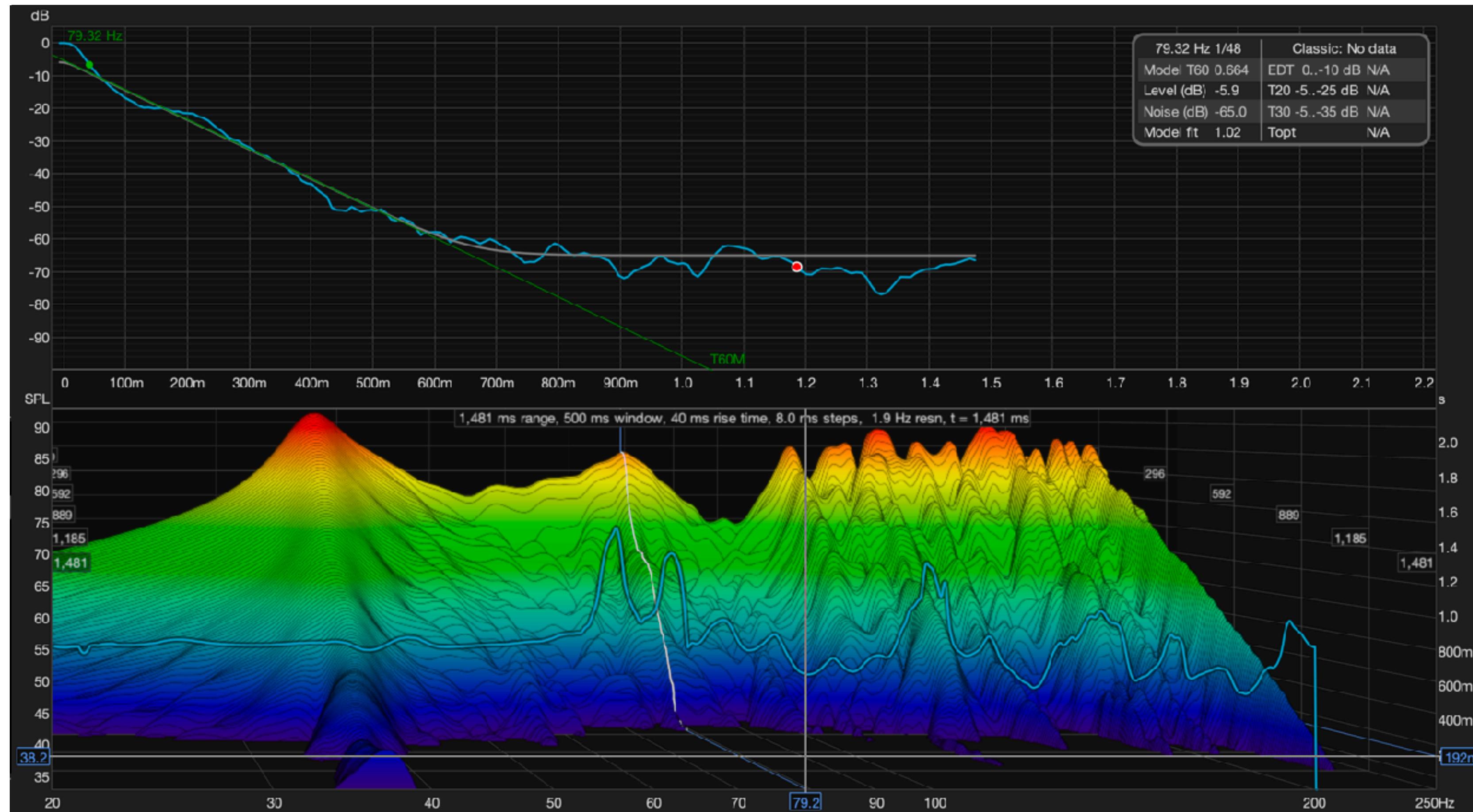
76
(2,0,0)



Points: 5, 10, 11, 12



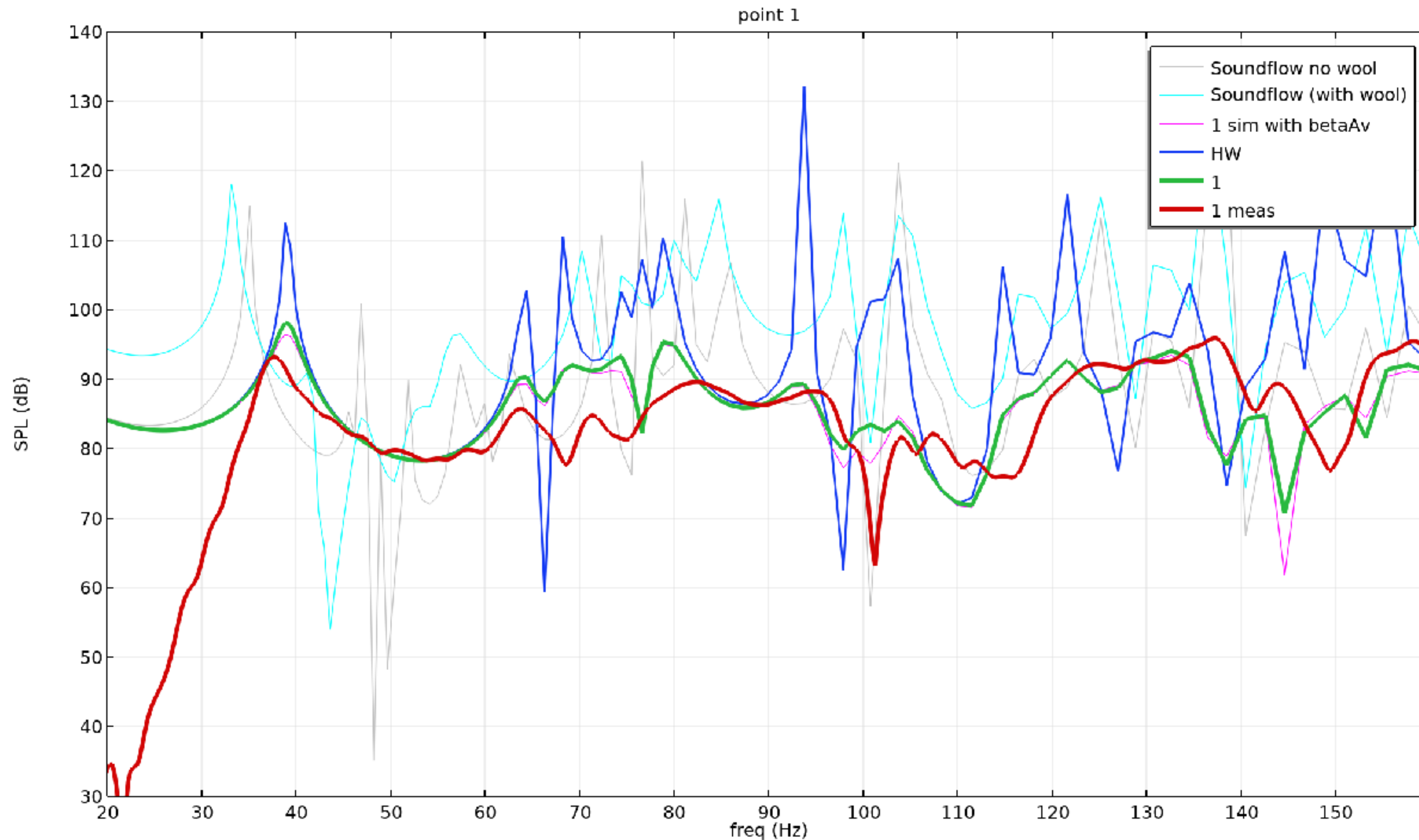
Post-processing - MT60 estimation



We estimated the MT60 for specific modes using measurements in different positions to isolate the modal decay response as much as possible.

For this analysis, we used REW's decay estimation tools.

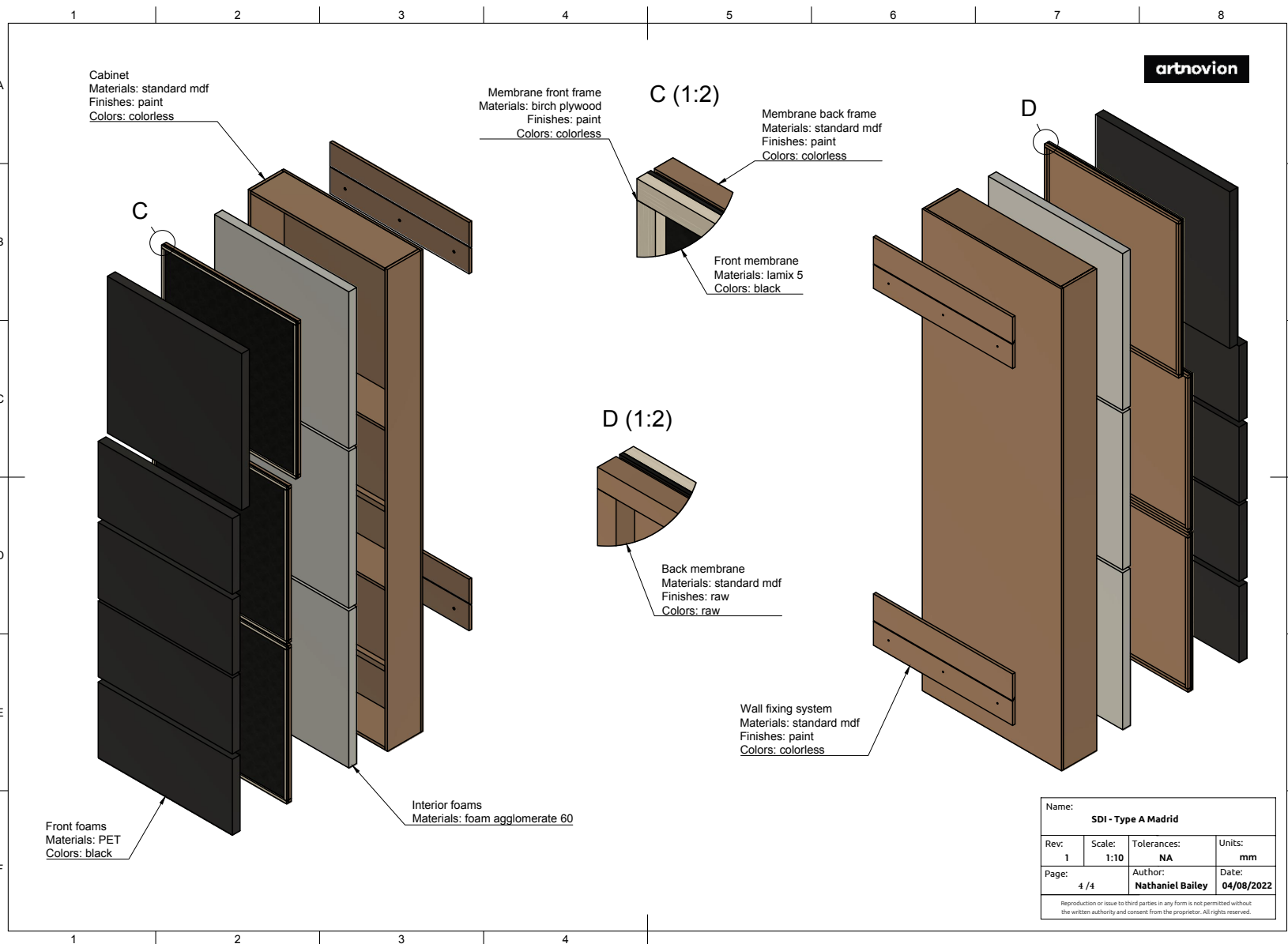
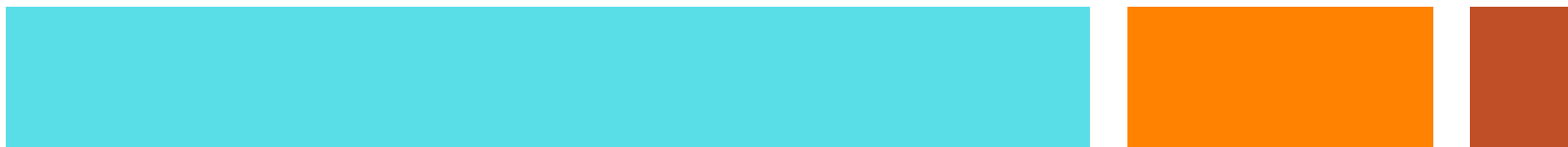
Modeling



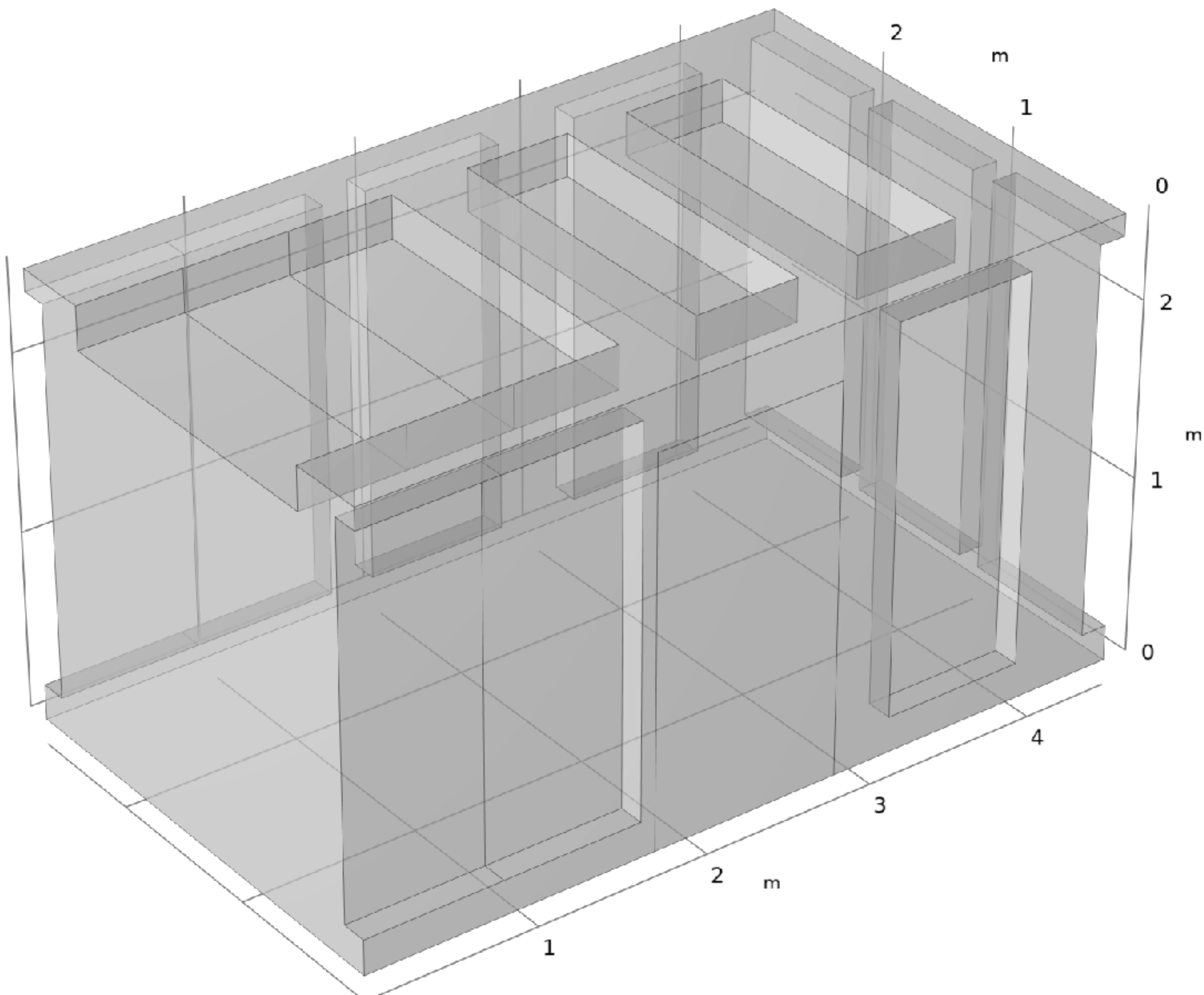
We applied the calculated acoustic impedance to the model walls and compared the frequency response results between:

- simulations using the calculated impedance
- rigid walls
- measurements

Treatment



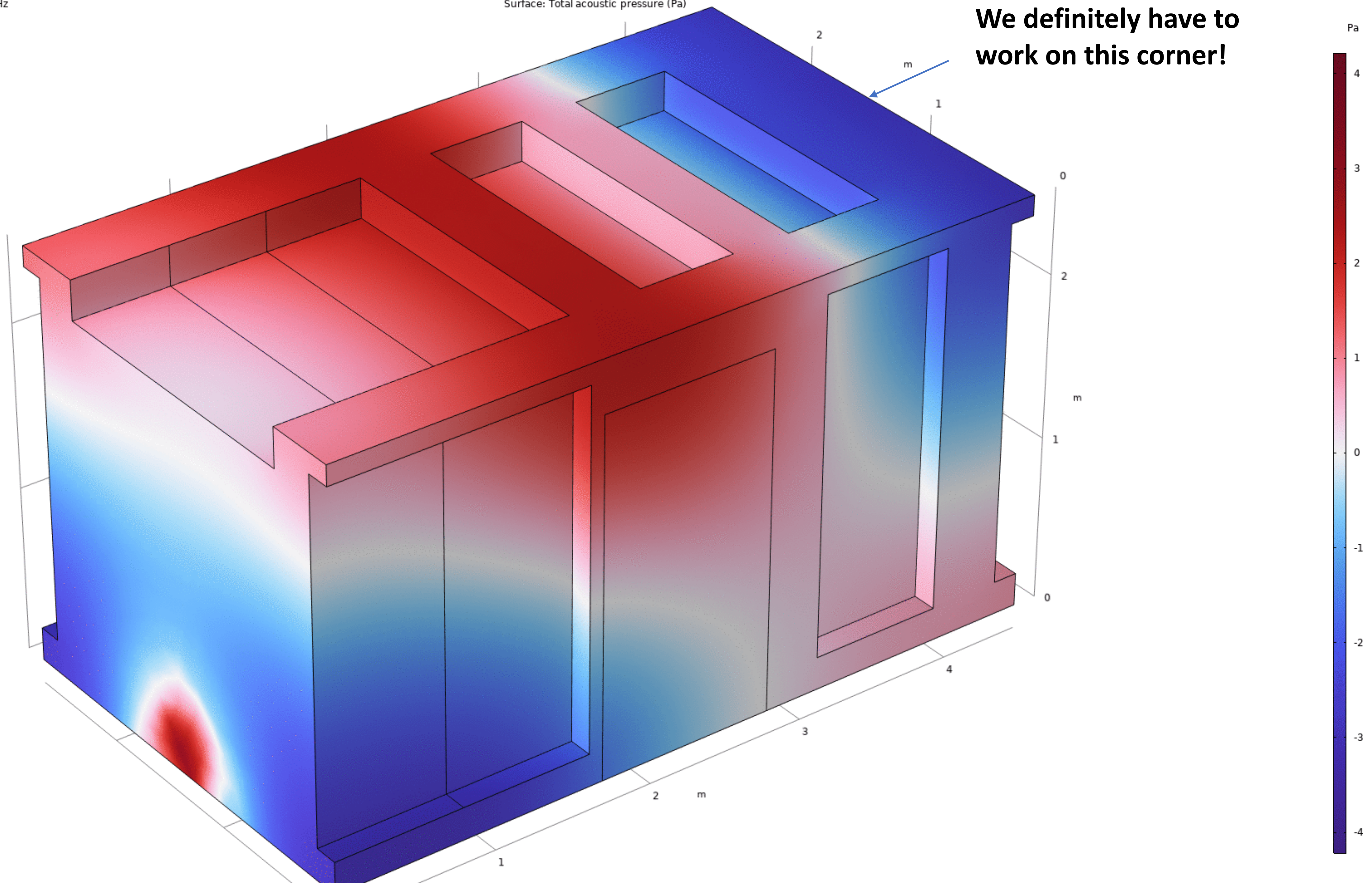
approximated constant
impedance and absorption
coefficient



f0(100)=83.542 Hz freq(1)=83.542 Hz

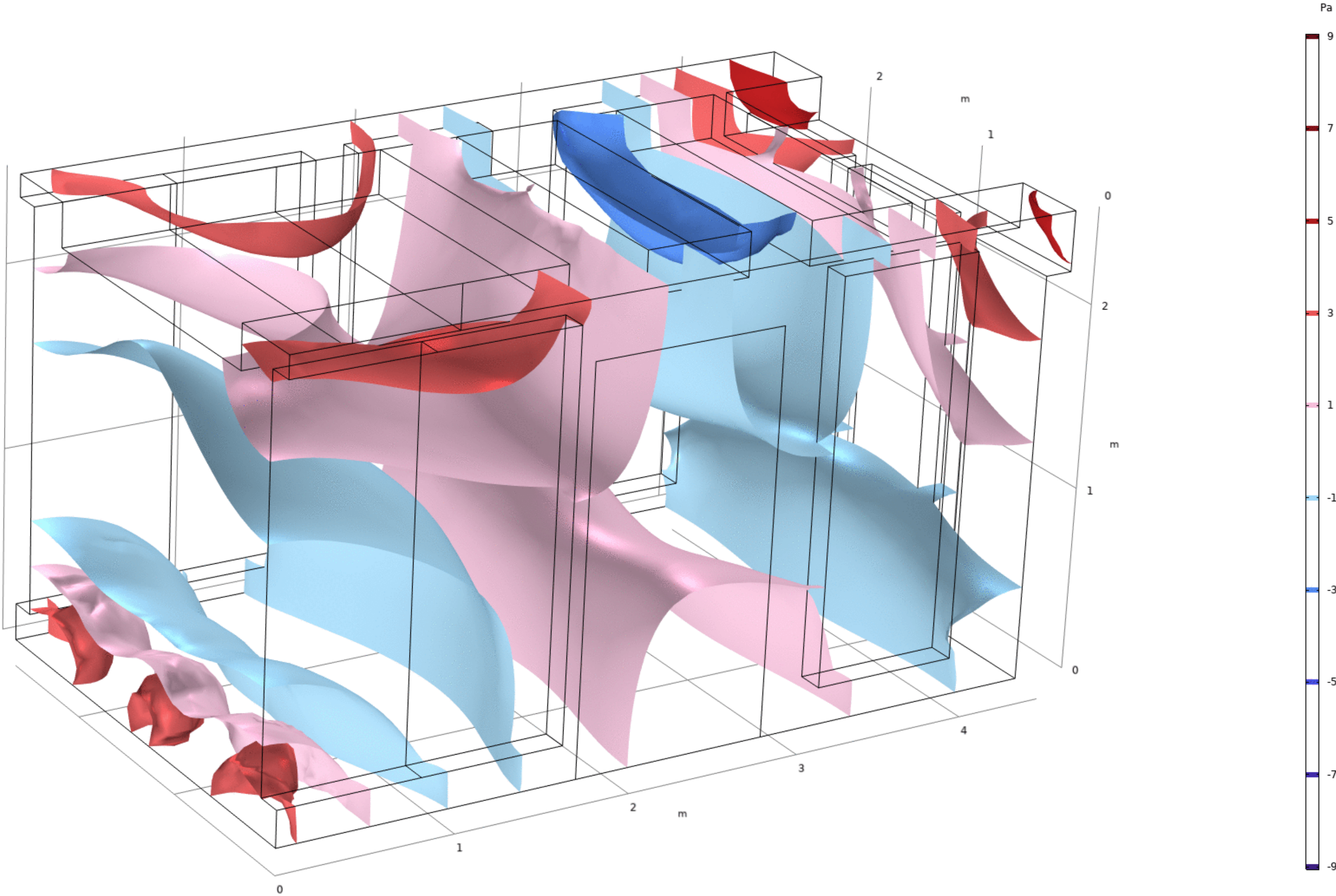
Surface: Total acoustic pressure (Pa)

**We definitely have to
work on this corner!**



f0(128)=125.17 Hz freq(1)=125.17 Hz

Isosurface: Total acoustic pressure (Pa)



Cinecittà Sala A

Roma



Cinecittà Sala A

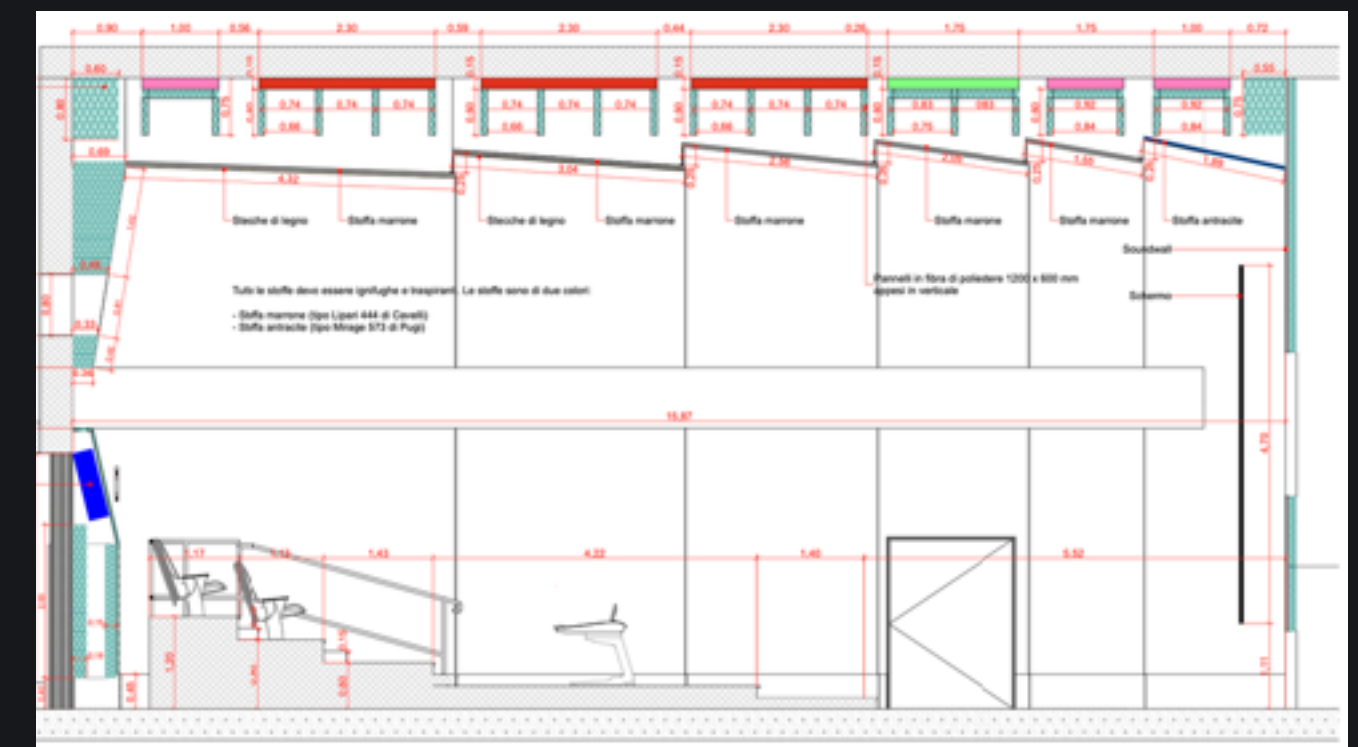
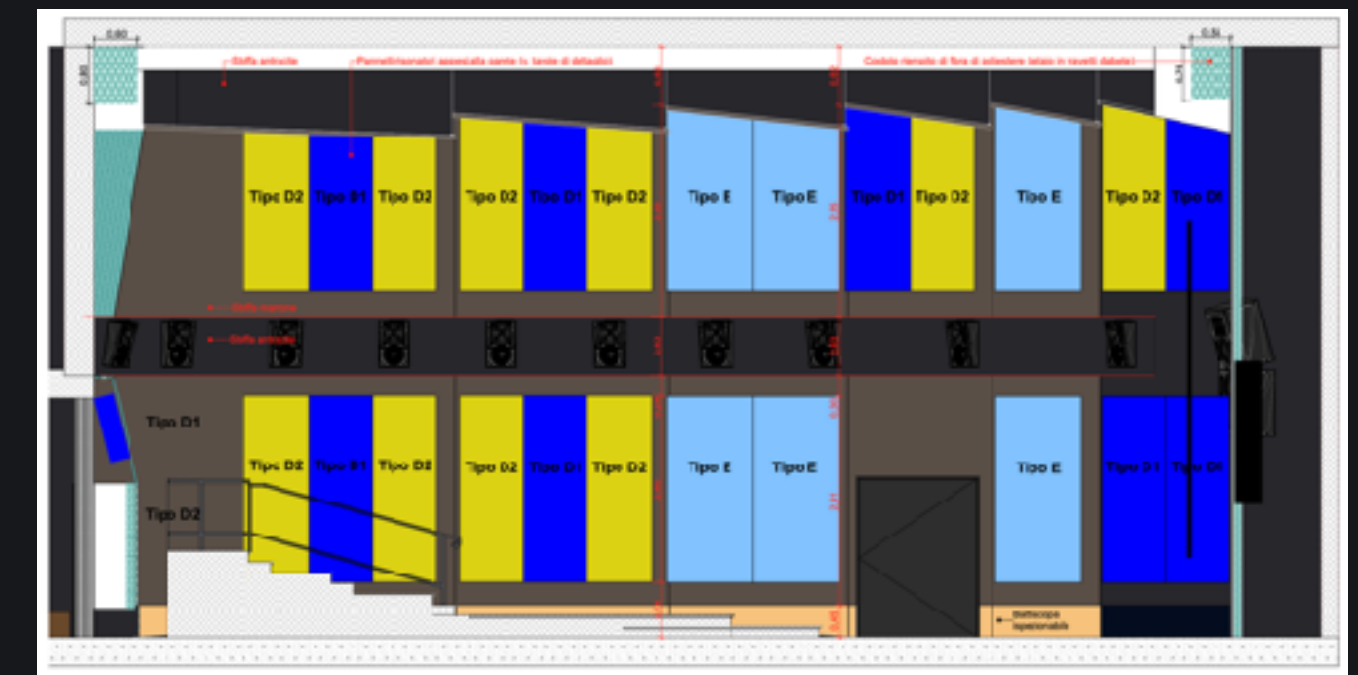
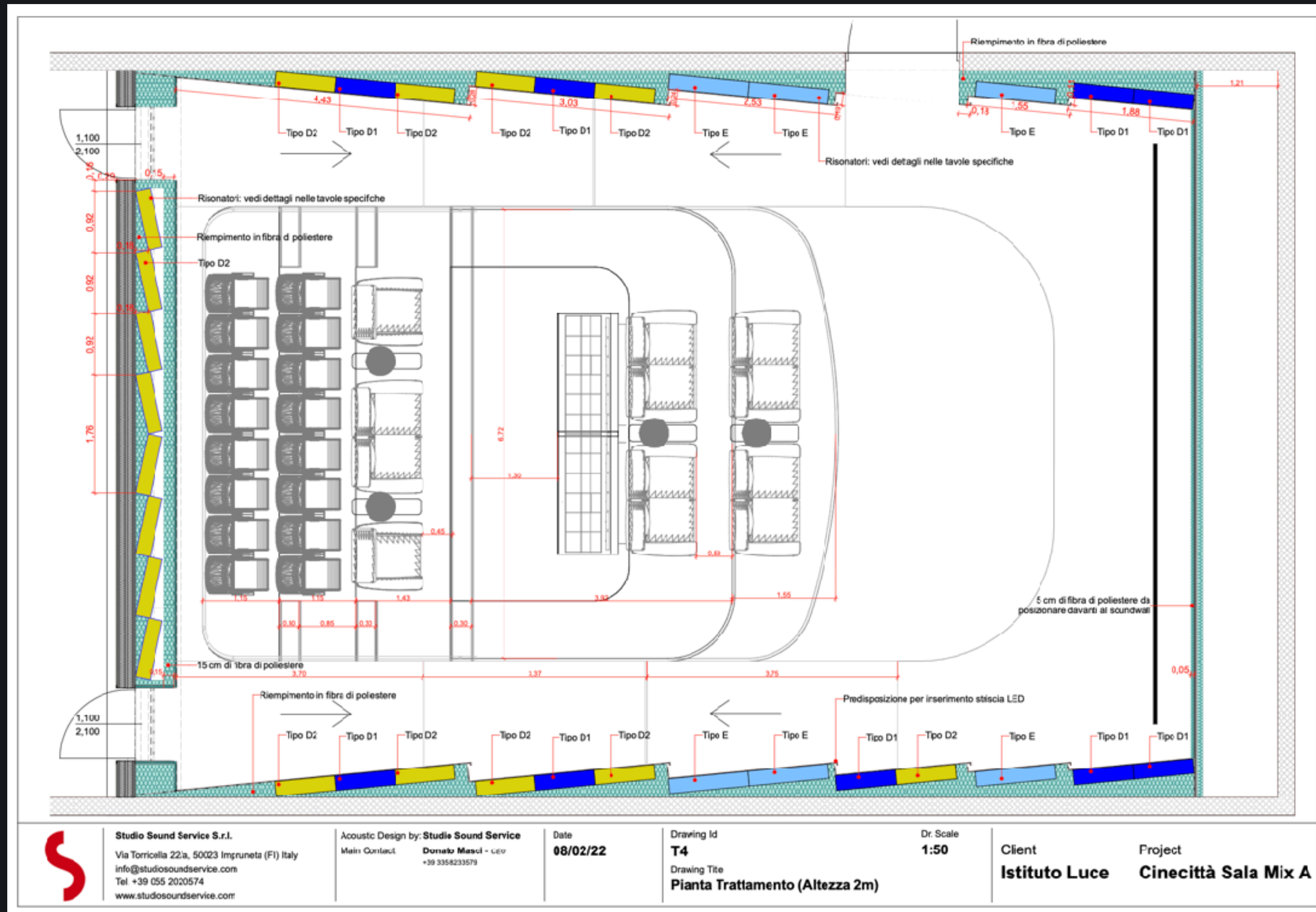
Roma



Cinecittà Sala A

Roma





Low Frequency Absorption



Cinecittà Sala Color Blu

Roma



Cinecittà Sala Color Blu

Roma

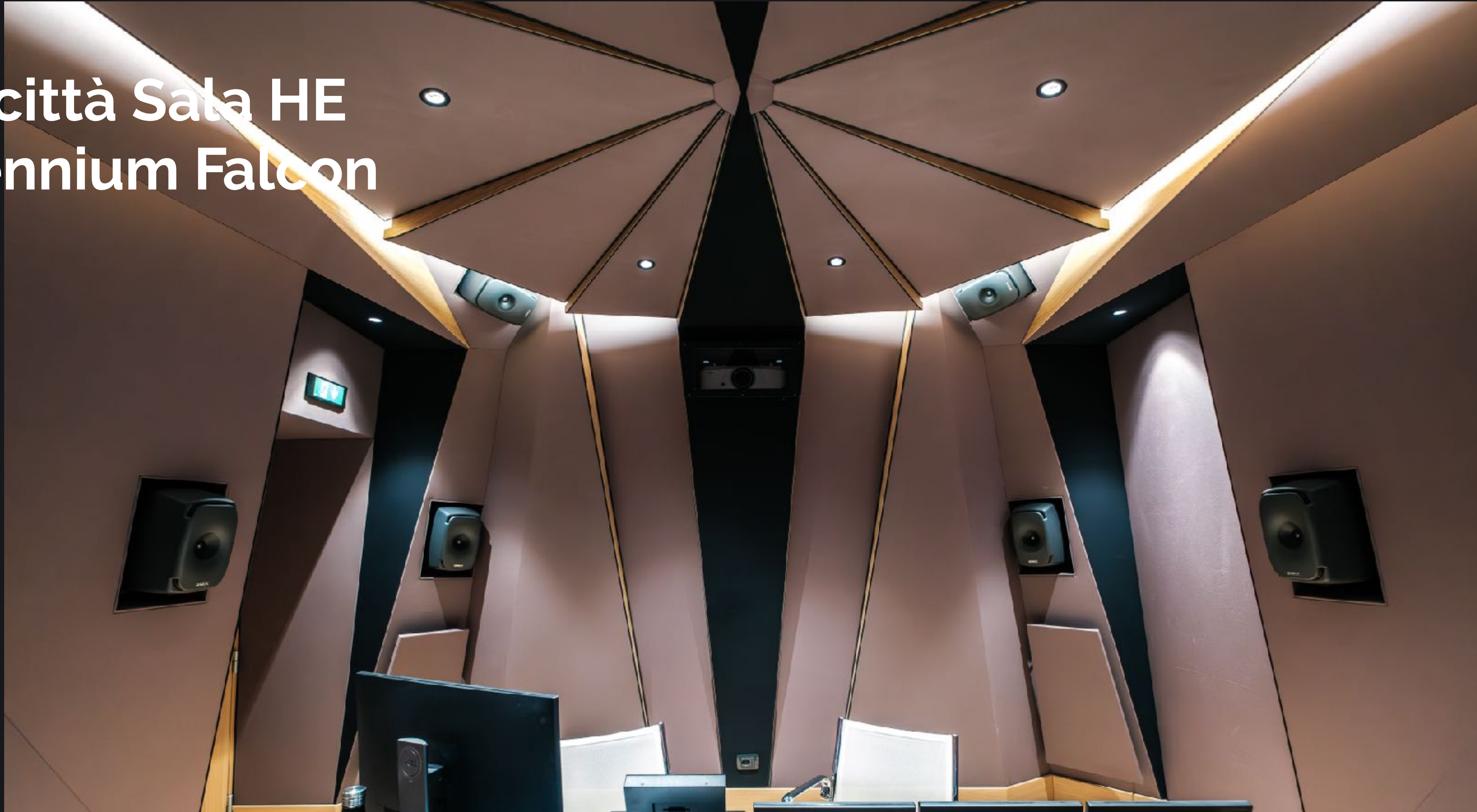
Cinecittà Sala HE Millennium Falcon

Roma



Cinecittà Sala HE Millennium Falcon

Roma



Cinecittà Sala E

Roma



Cinecittà Sala E

Roma



Cinecittà Sala E

Roma



Marco Borsatti Studio

Bologna



Marco Borsatti Studio

Bologna





SoundBeat 3 - IRKO (Kanye West)

Pasadena, USA



Fabio Piazzalunga

Florence



SonicFab

Pioltello



Sudestudio

Guagnano – LE



Cicaleto Recording

Arezzo



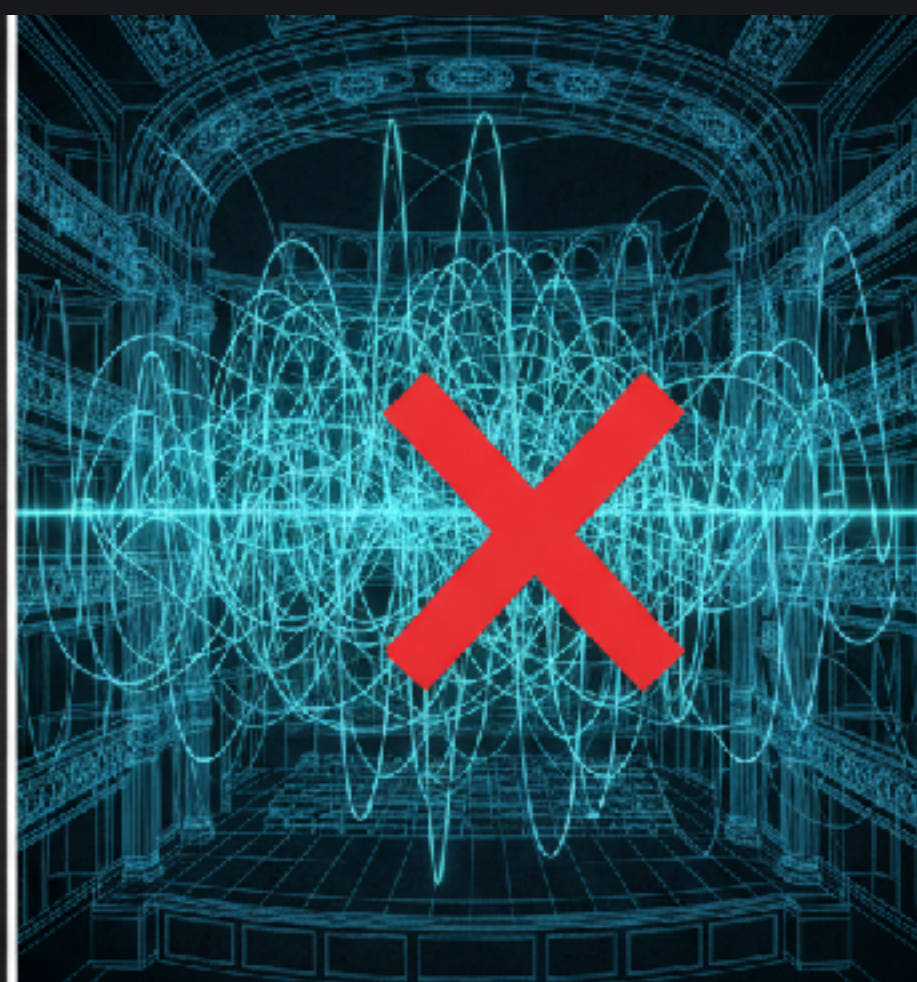
PART 4: THE CALIBRATION CHALLENGE - LARGE SPACES

Where Statistics Replace Certainty

Why Large Spaces Break Our Methods

SMALL ROOMS

- 6 surfaces
- 4 modes matter
- Wave behavior
- We control materials



CURRENT SOLUTION

- 600+ surfaces
- 1000+ modes blur together
- Statistical behavior
- Materials control us

Critical insight:
"In large spaces, we negotiate with physics"

The Hidden Surface Problem

What We Draw:

- Simple column = 10m^2
- Flat wall = 100m^2
- Smooth dome = 500m^2

$2,000\text{m}^2$

Architectural

What Sound Sees:

- Fluted column + capital = 18m^2 (+80%)
- Wall + pilasters + moldings = 145m^2 (+45%)
- Coffered dome = 850m^2 (+70%)

$3,200\text{m}^2$

Acoustic (+60%)

FUTURE:
AI pattern recognition?



When Theory Meets Centuries of History

THEORY (every book ever)

- Marble book value: $\alpha = 0.01$
- Highly reflective

WHY

- Hidden surface problem
- 800 years of aging
- Micro-cracks everywhere
- Centuries of candle soot
- Humidity cycles
- Previous "restorations"

REALITY (Duomo di Siena)

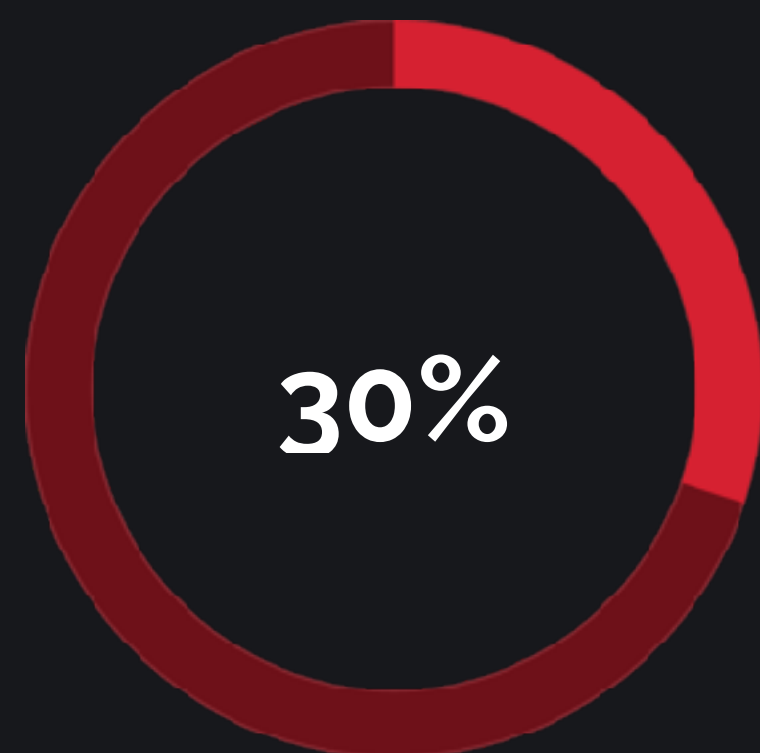
- Measured reality: $\alpha = 0.08-0.12$
10x more absorptive!

VISION:

**AI-guided calibration from
strategic measurements**

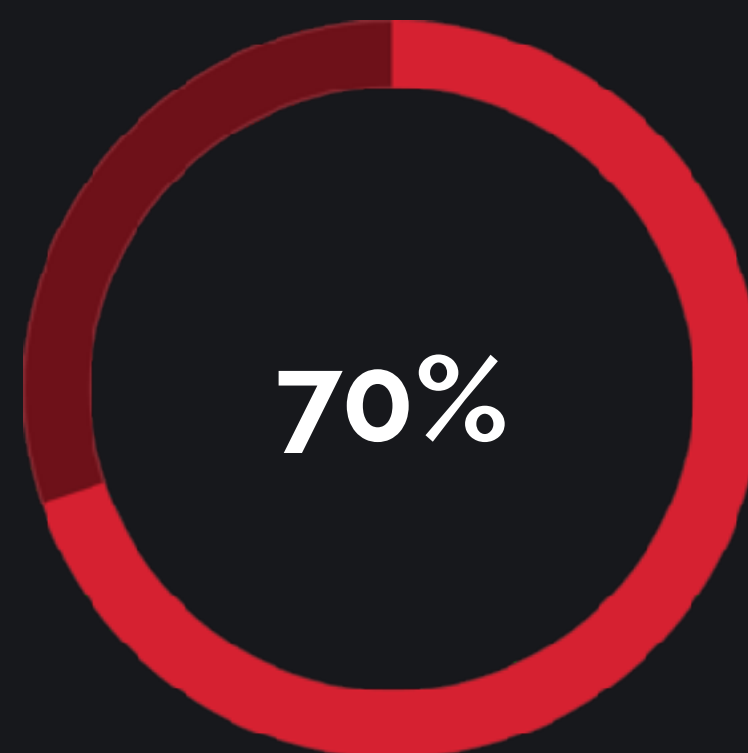
The 70% We'd Rather Skip

Where Our Time Goes



Actual Acoustic Design

30 hours ✓



The Rest

70 hours of waste

100-Hour Project Breakdown:

- Point cloud cleanup: 15 hours
- Geometry fixing: 10 hours
- Material calibration: 20 hours
- Stakeholder therapy: 15 hours
- Re-simulations: 10 hours

Fact:

"We're acousticians who spend 70% of our time not doing acoustics"



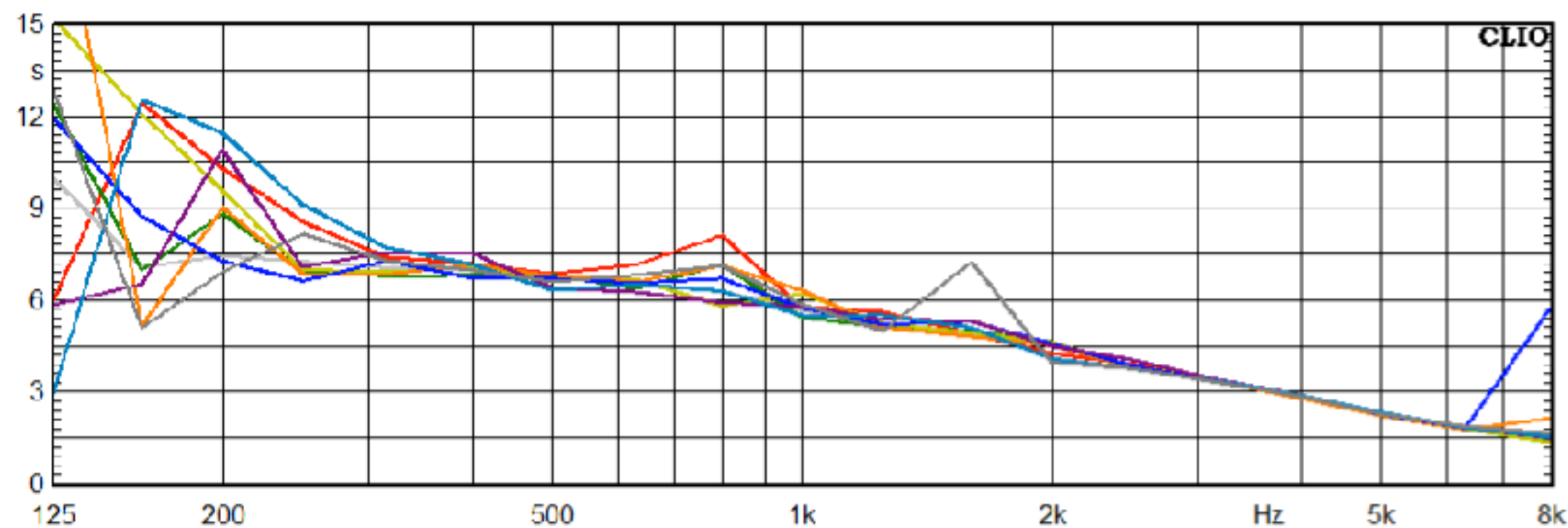
Duomo di Siena

Cattedrale di Santa Maria
Assunta



Acoustic Measurements - Pre-existing Conditions

Reverberation time (T20)



500-1000 Hz: > 6.5 seconds
Low frequencies: > 12 seconds

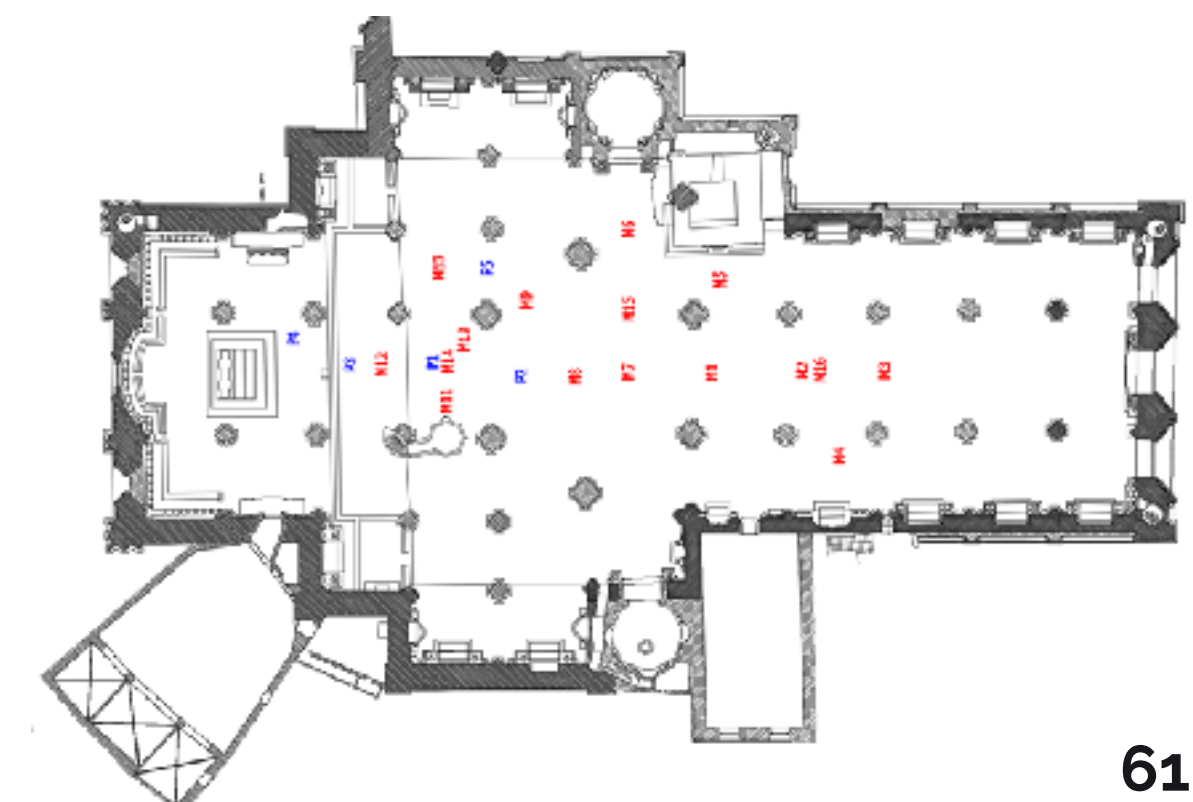
Main problems:

- Large volume
- Vaulted ceilings amplifying reflections
- Highly reflective surfaces

Speech Intelligibility (STI)

MISURA	STI (MALE)	STI (FEMALE)
1	0,46	0,48
2	0,48	0,49
3	0,29	0,3
4	0,24	0,25
5	0,26	0,28
MEDIA	0,346	0,36

Average: 0.35
Required for intelligibility: > 0.5



Simulation Calibration Process

CALIBRATION PROCESS:

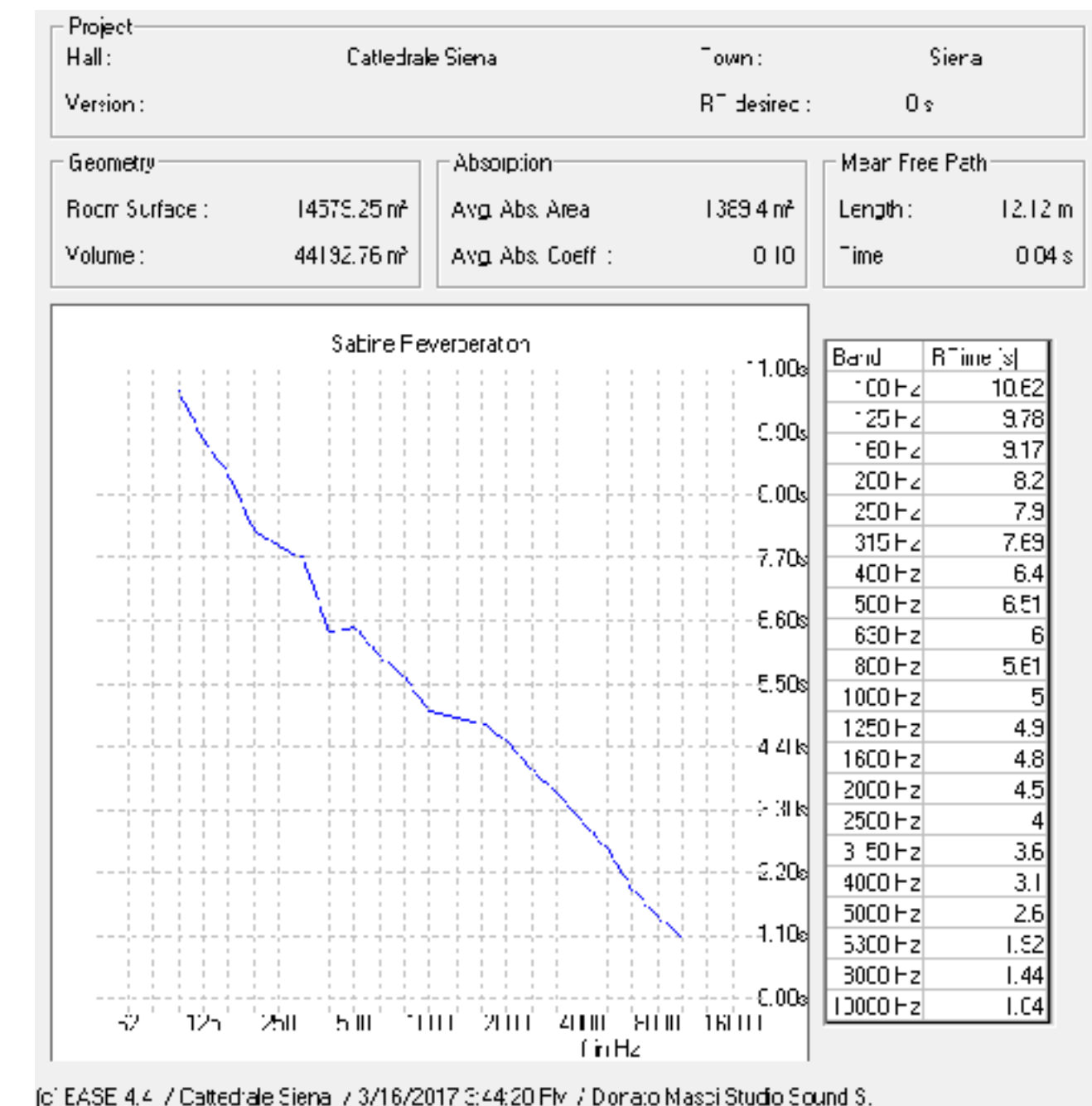
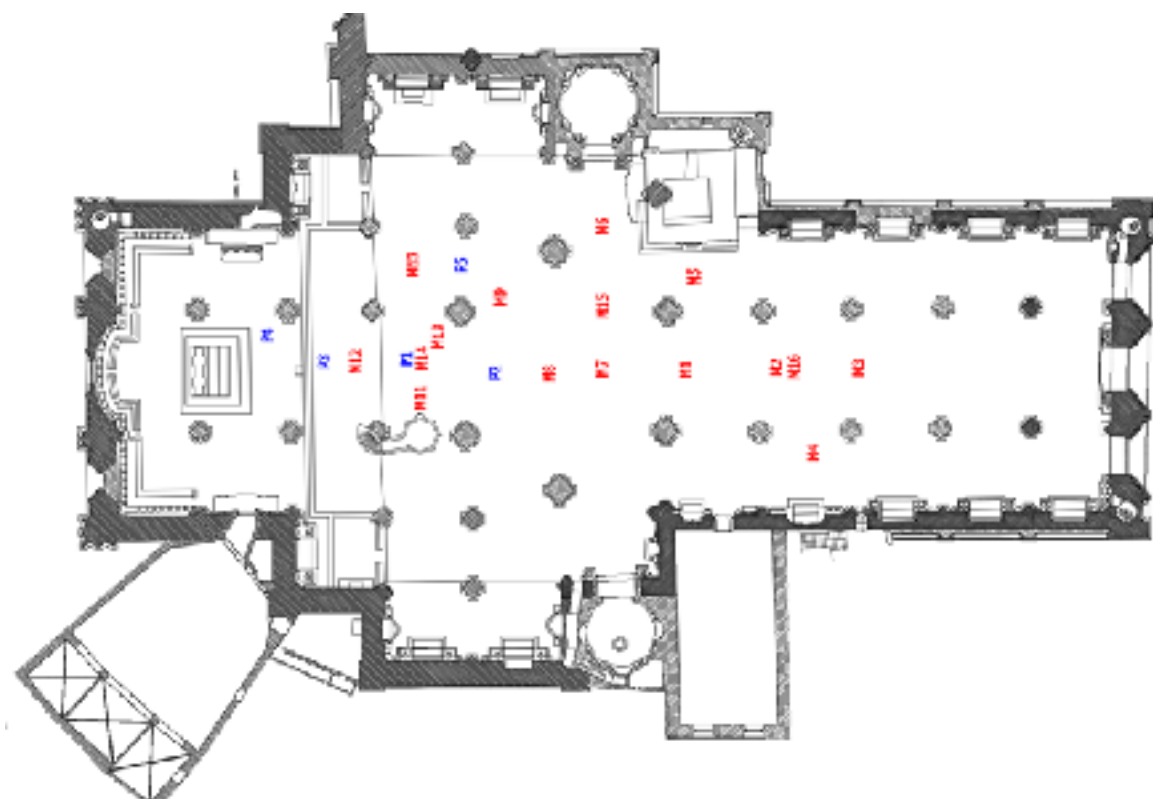
Initial simulation (book values): RT60 = 11s

Measured reality: RT60 = 7.2s

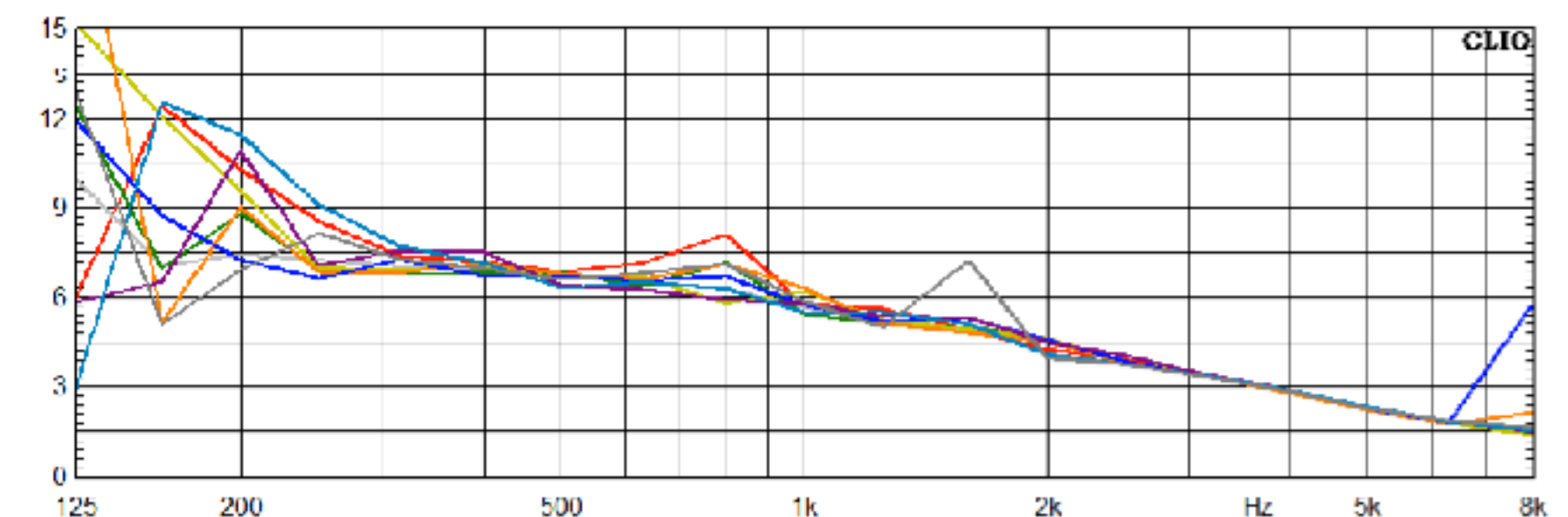
Discrepancy: 52%

Iterative adjustment process:

- 200+ surface materials adjusted
- 3 weeks of calibration
- Final accuracy: $\pm 2\%$



Simulazione (EASE)



Misurazione (CLIO)

Audio System Design

OBJECTIVES:

- Minimize number of speakers
- Ensure uniform sound pressure
- Focus energy on listening areas

SOLUTION:

- Narrow vertical dispersion speakers
- Beam-steering technology
- 14 strategically positioned units

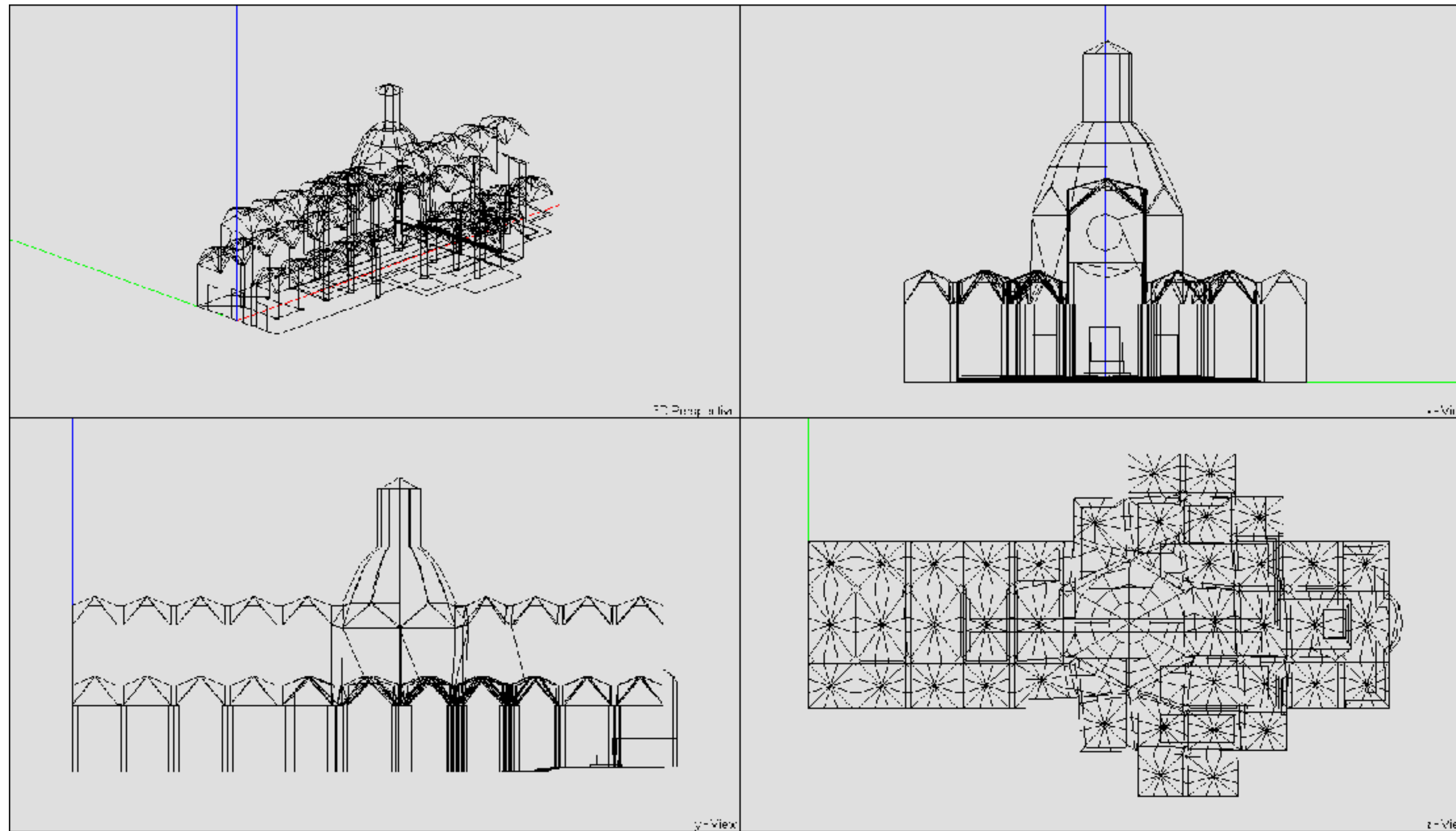


Speaker Position

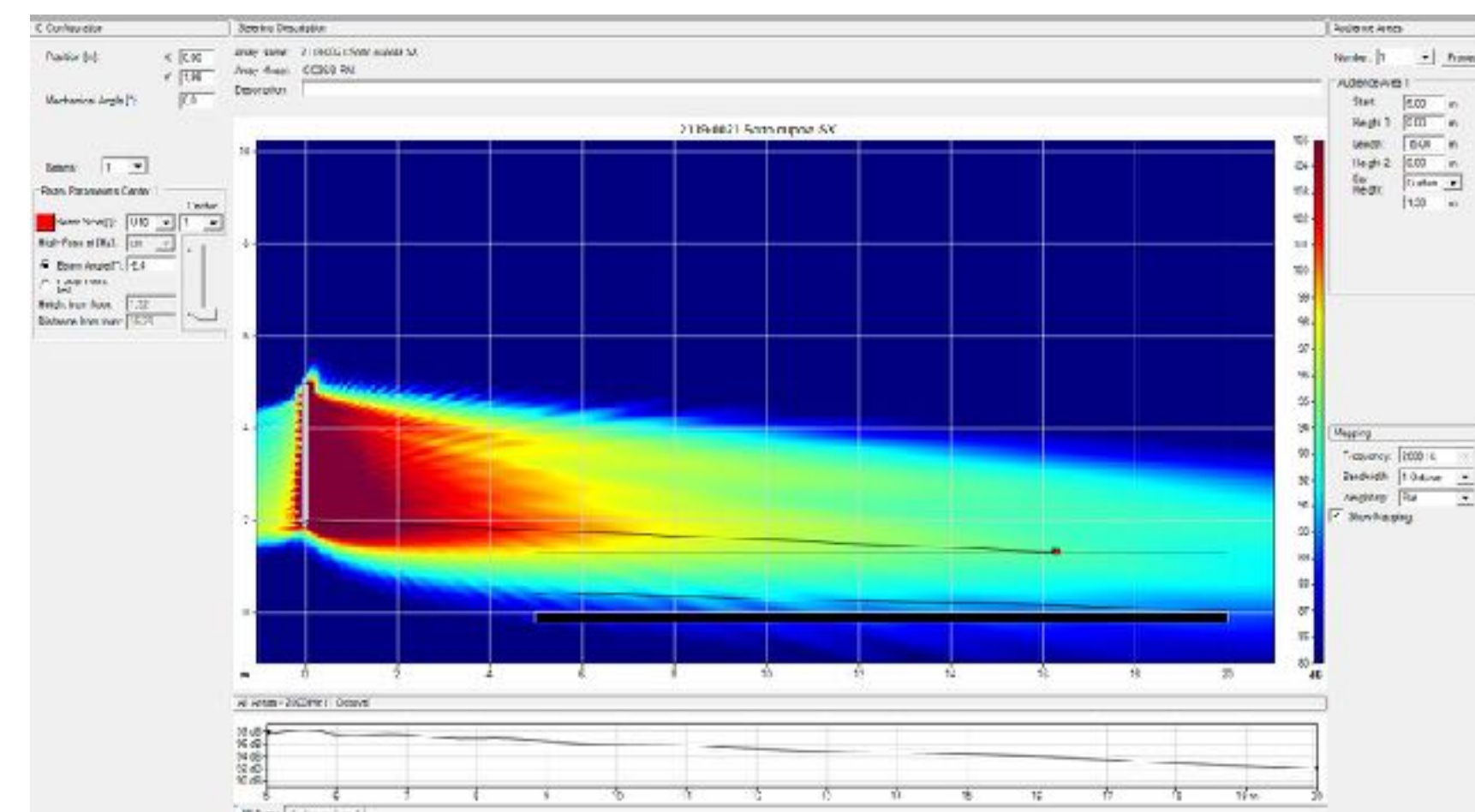
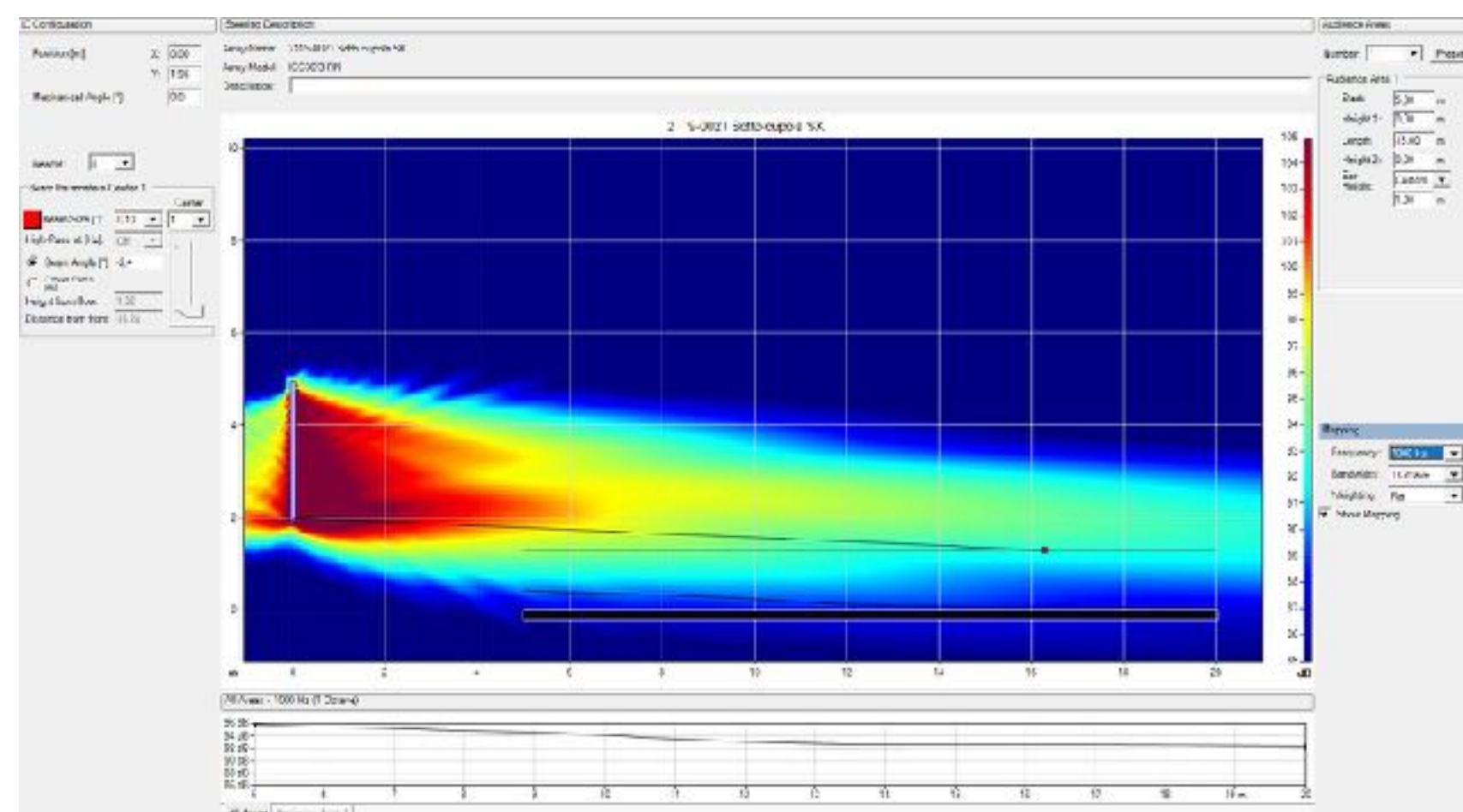
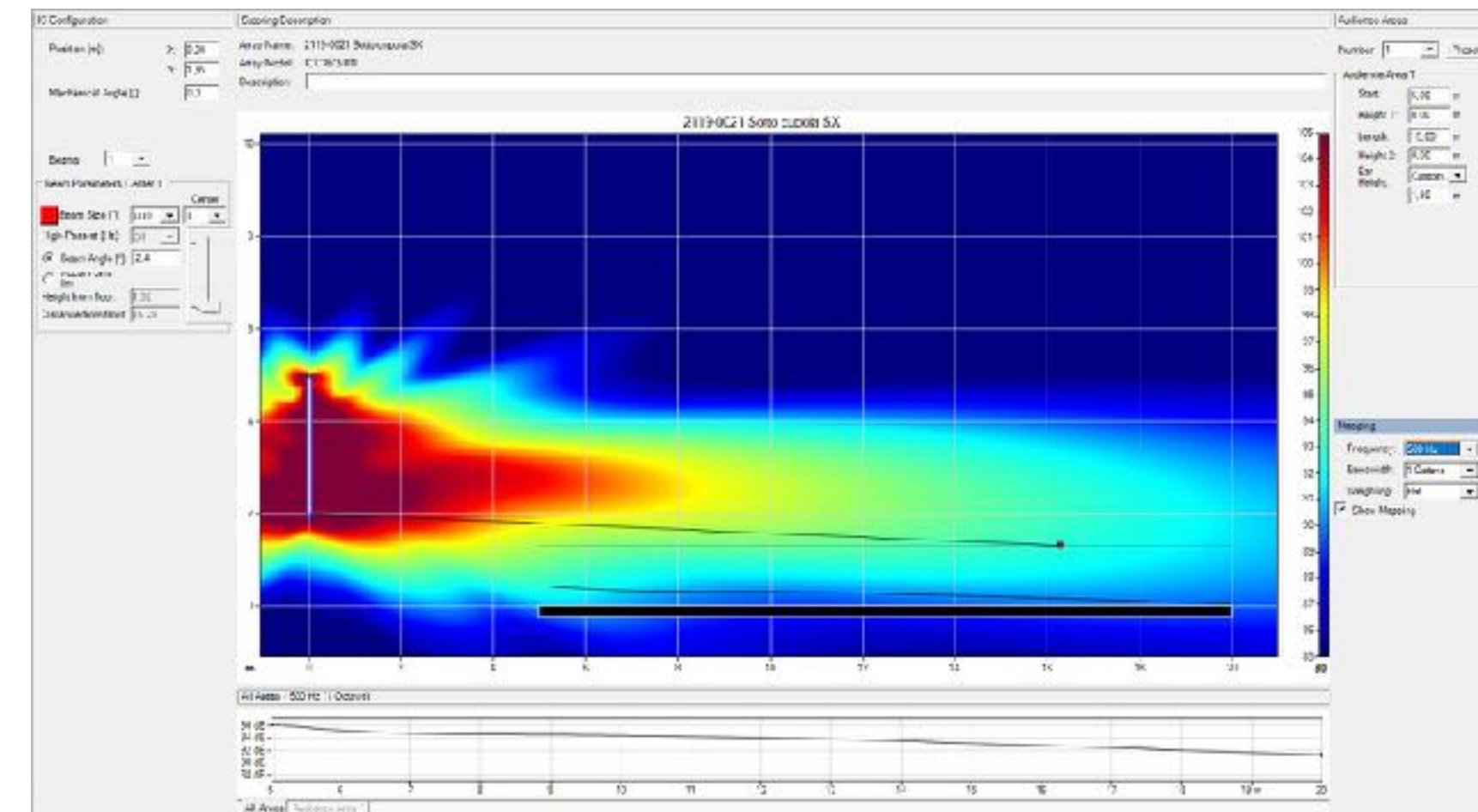
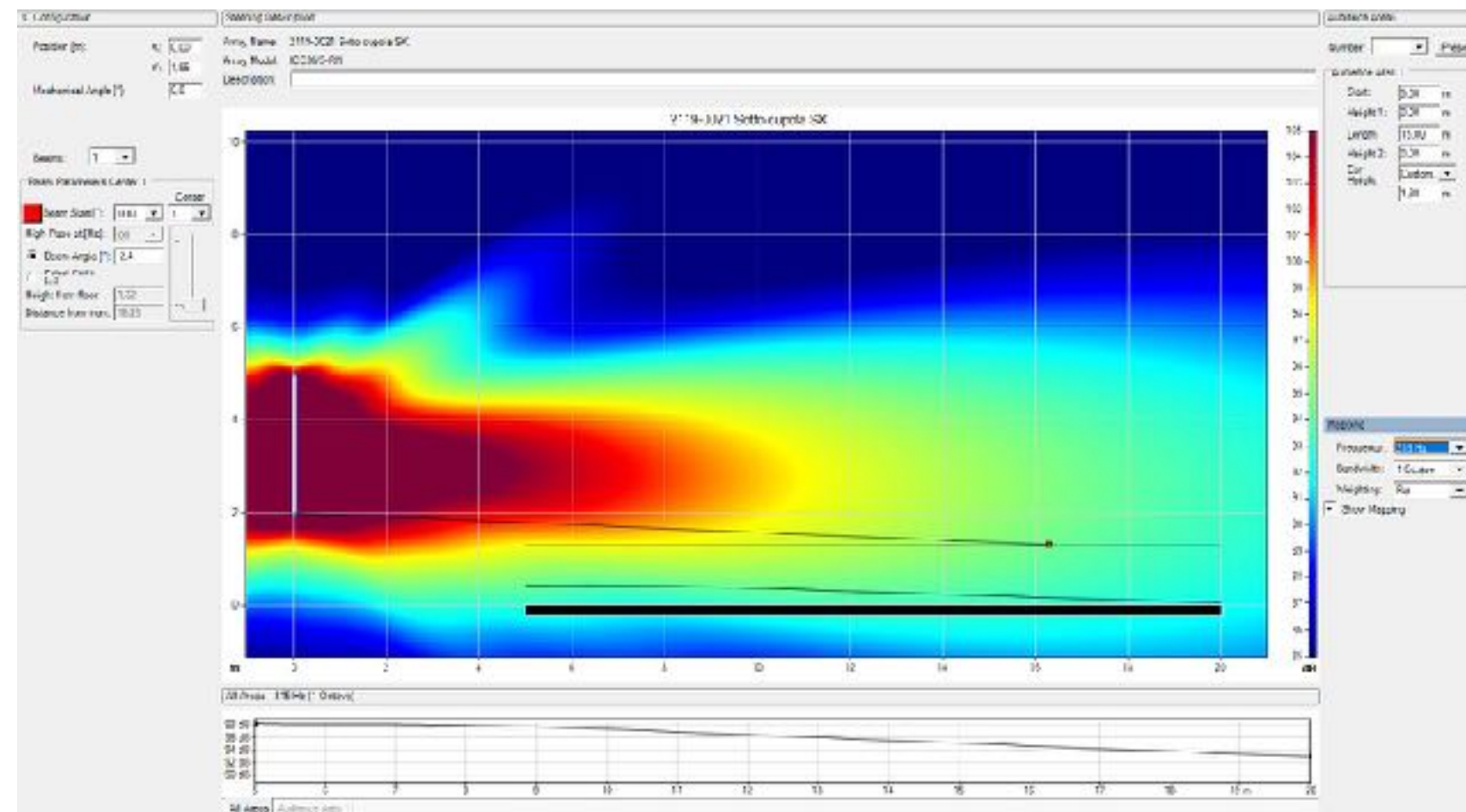
Acoustic Modeling and Simulation

Building the Simplified Model:

Simplification is required to reduce computational load and prevent artifacts from excessive variables.



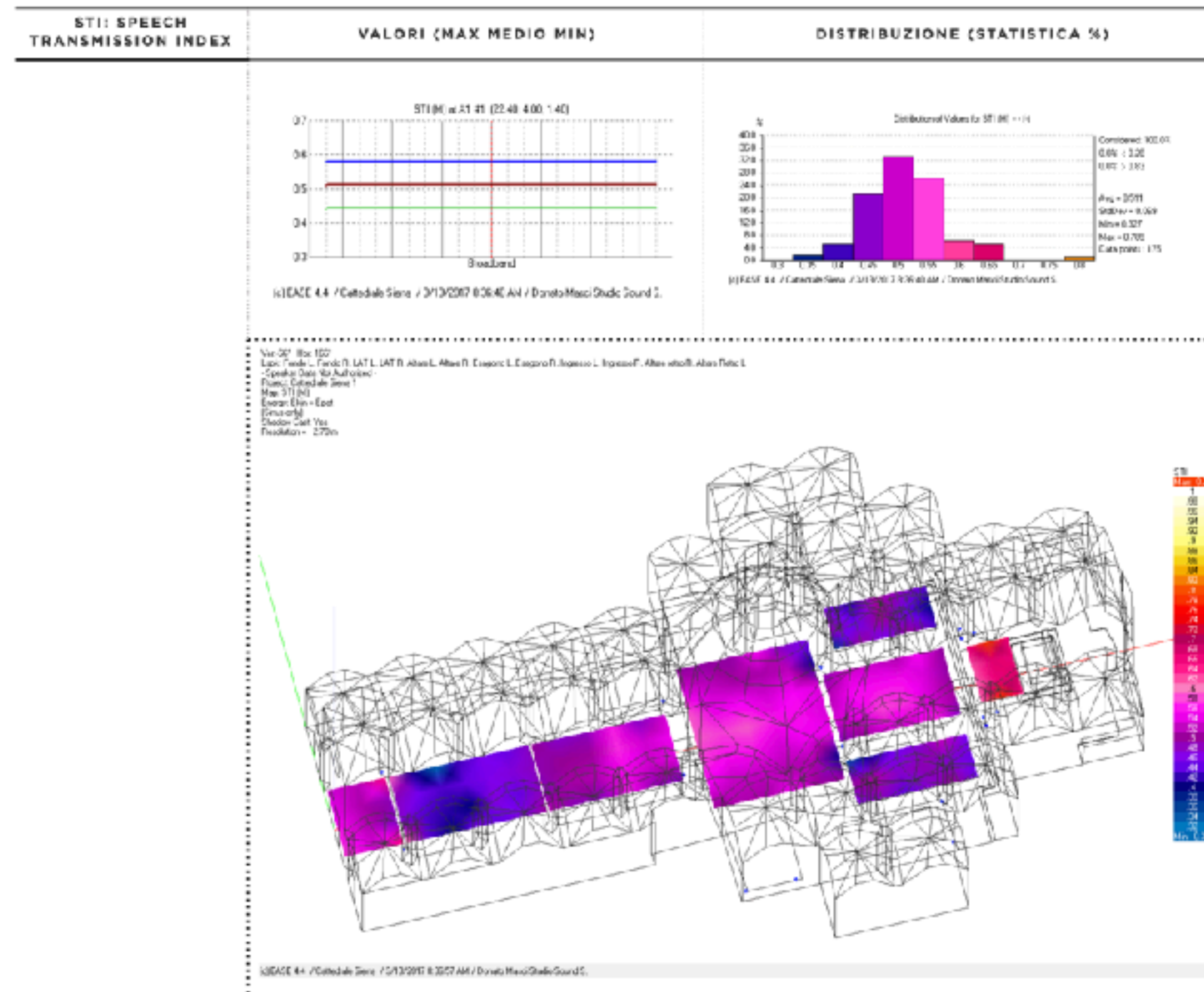
Directivity Optimisation, Under-dome line arrays:



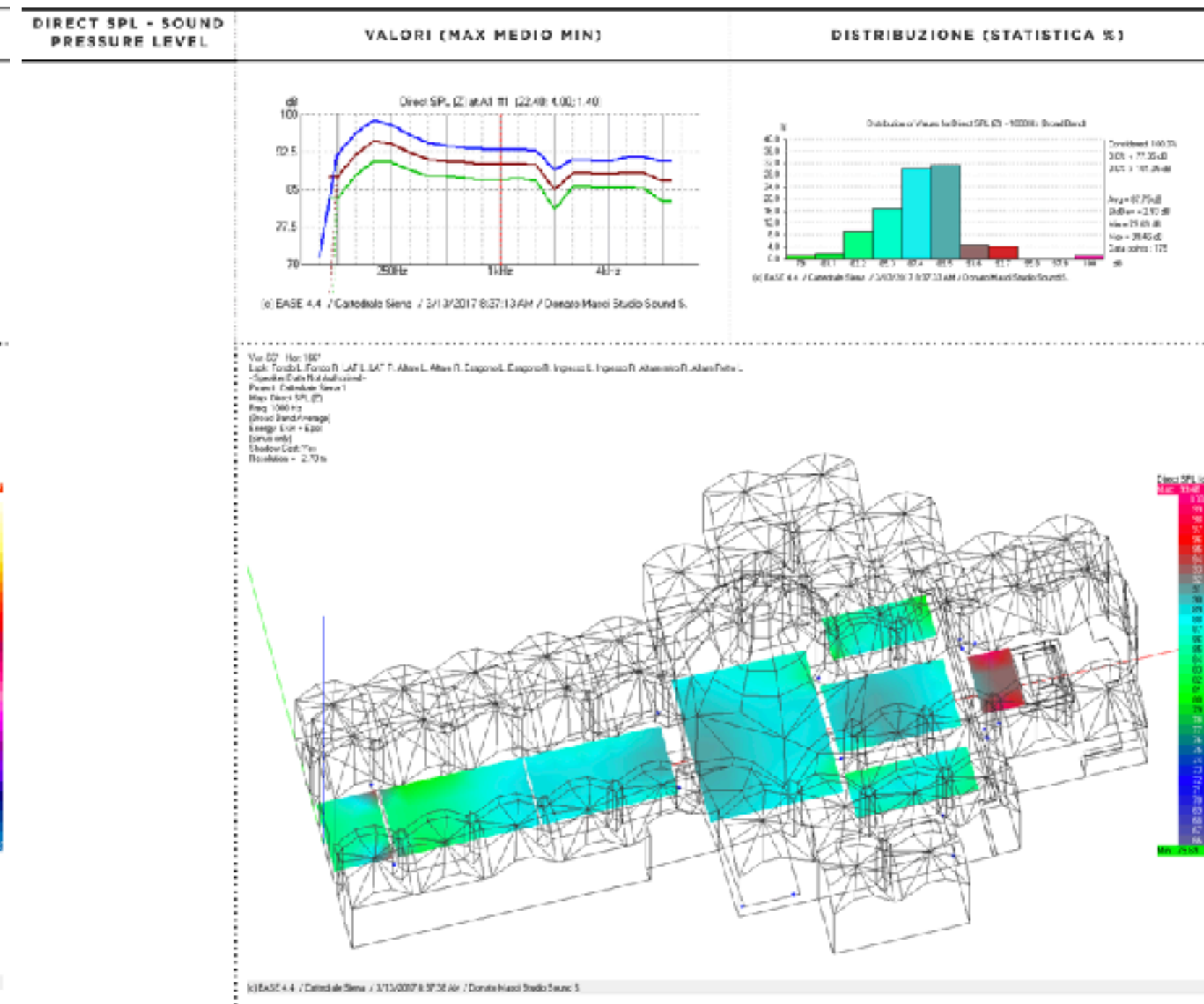


Simulation Results

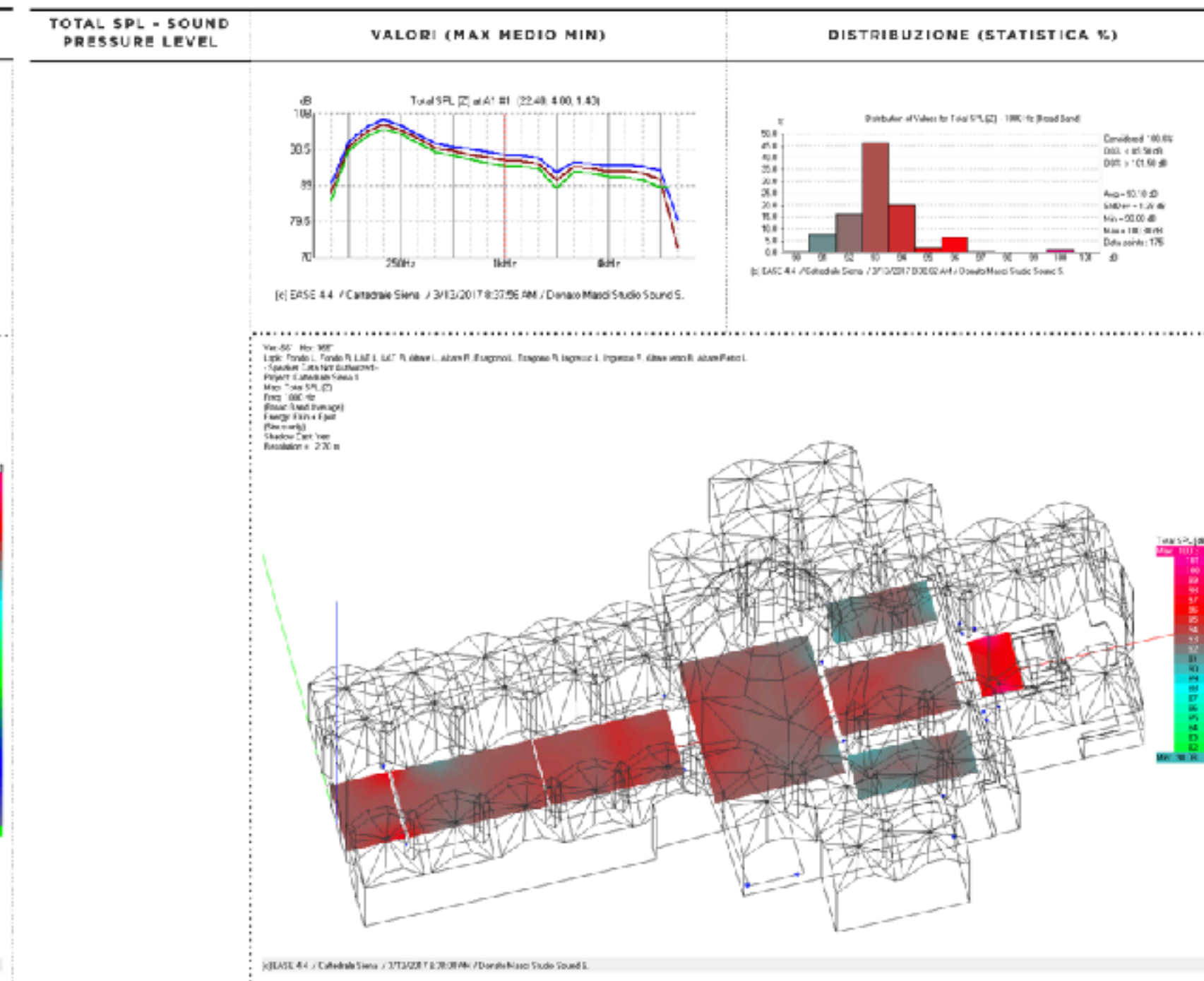
STI - Speech transmission index - Indice di intelligibilità del parlato



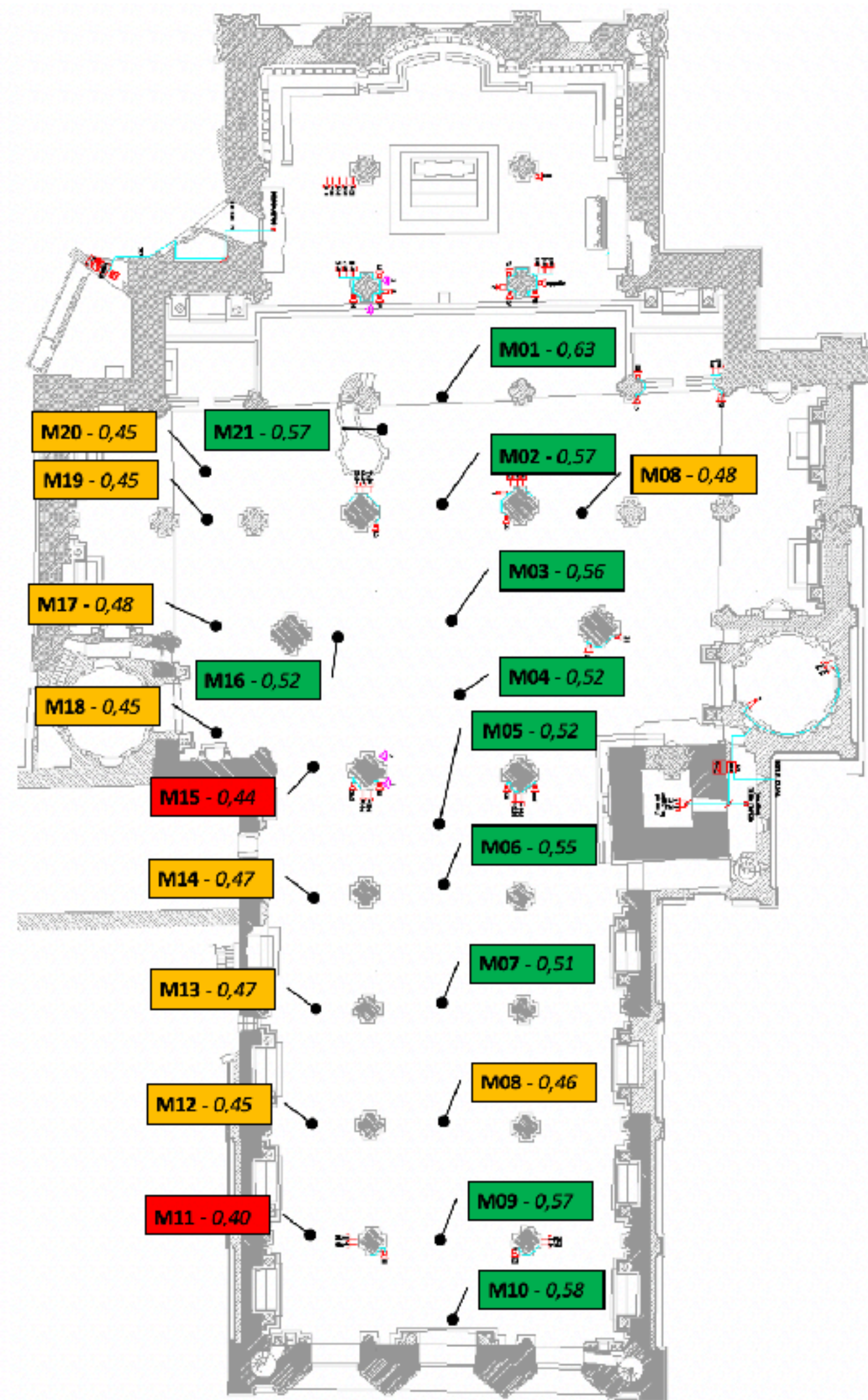
Direct SPL - Sound Pressure Level - Livello di pressione sonora diretta



Total SPL - Sound Pressure Level - Livello di pressione sonora totale



Acoustic measurement of the final condition



- The difference between speech intelligibility in the side aisles (which have no benches) and the central aisle is clear.
- Intelligibility is good in the central aisle (listening area).
- The directional audio system is efficient and optimized.

Teatro del Popolo

Castelfiorentino



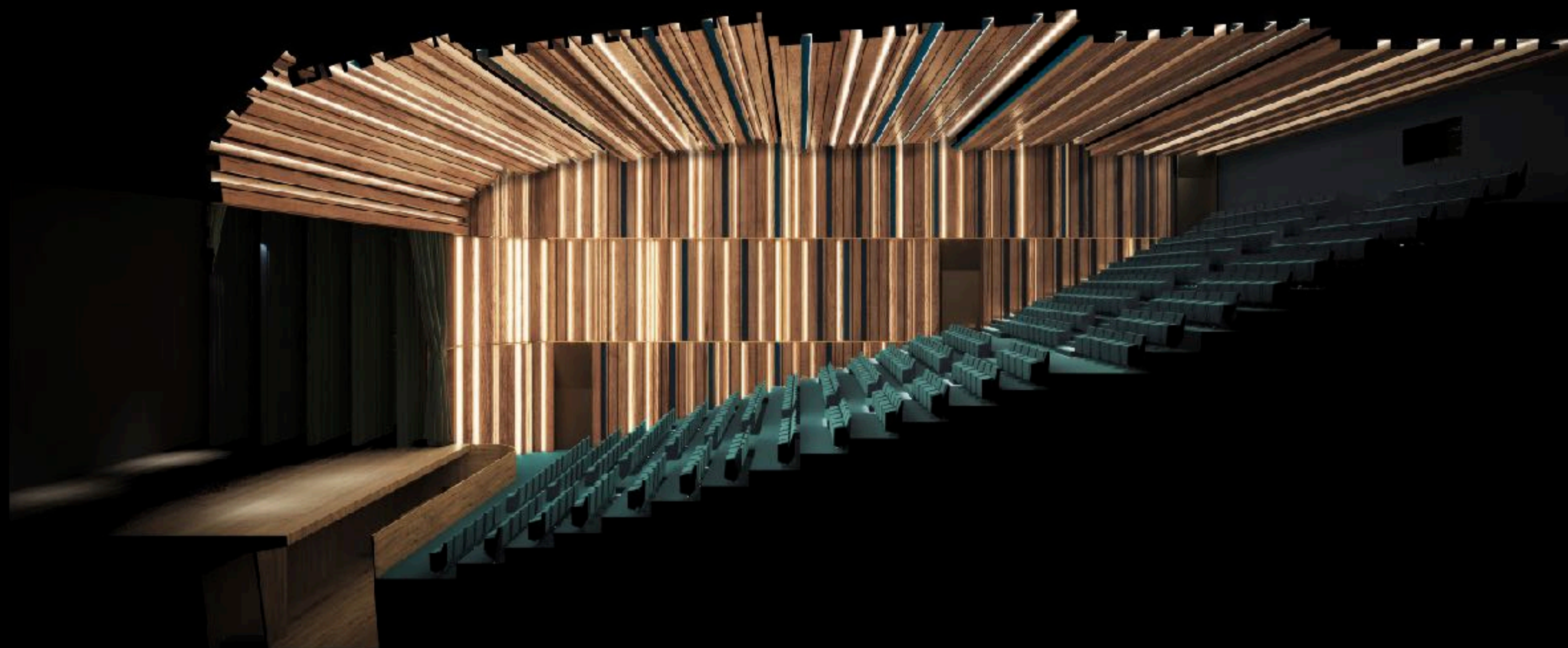
Teatro Manzoni

Pistoia



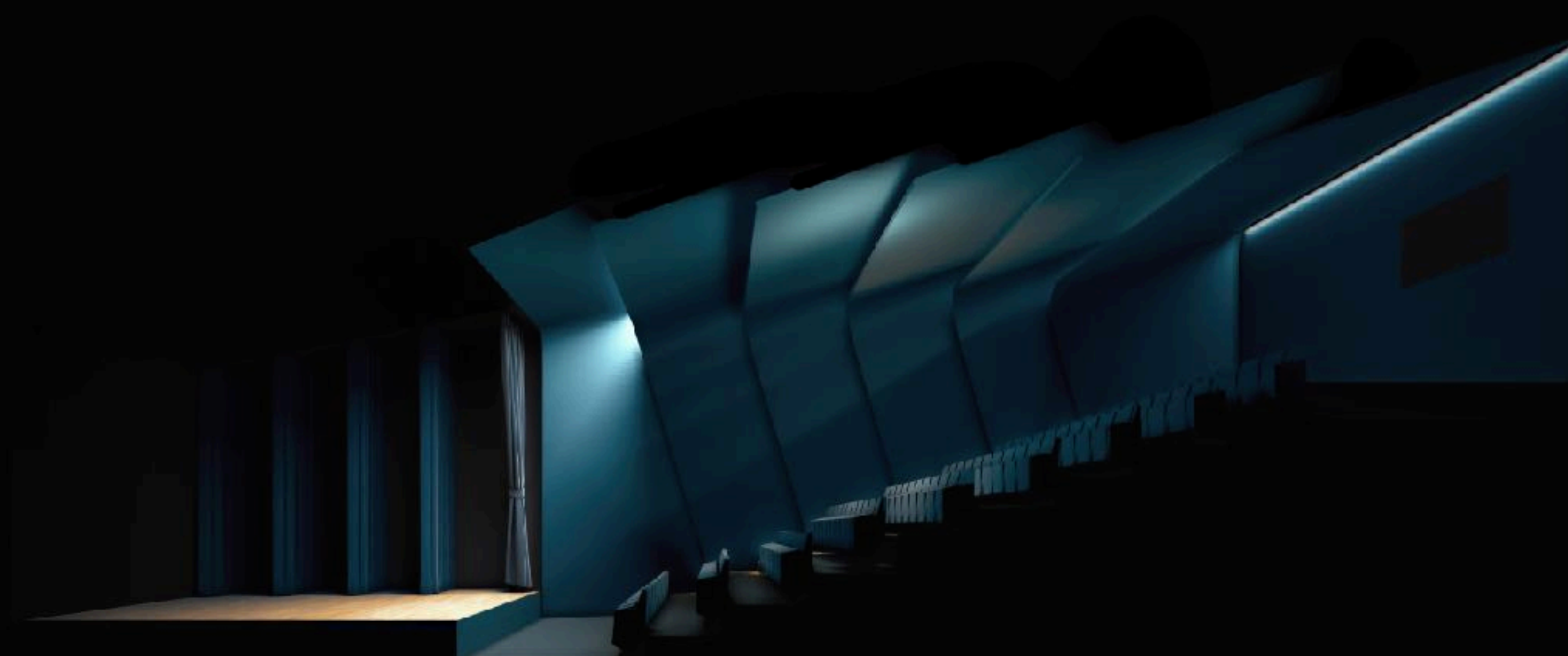
Teatro il Ferruccio

Empoli



Teatro il Ferruccio

Empoli



PART 5: THE HERITAGE CHALLENGE

When History Has The Final Word

From Single Client to Political Negotiation

RECORDING STUDIO

Artist → Engineer → Done

"Make it sound good"

Decision time: 1 hour

THEATER / HISTORIC VENUE

- Multiple stakeholders
- Complex negotiations
- Political dynamics

Decision time: 3 years (!!!)



What You Can't Touch (Everything)

THE RULES

- ✗ NO drilling
- ✗ NO visible treatments
- ✗ NO color changes
- ✗ NO modern elements
- ✗ NO permanent fixtures
- ✗ NO touching frescoes

WHAT'S ALLOWED

- ✓ Reversible installations
- ✓ Transparent materials
- ✓ Hidden treatments



Villa Favard

Florence Conservatory



Ante Operam



Project Target Definition

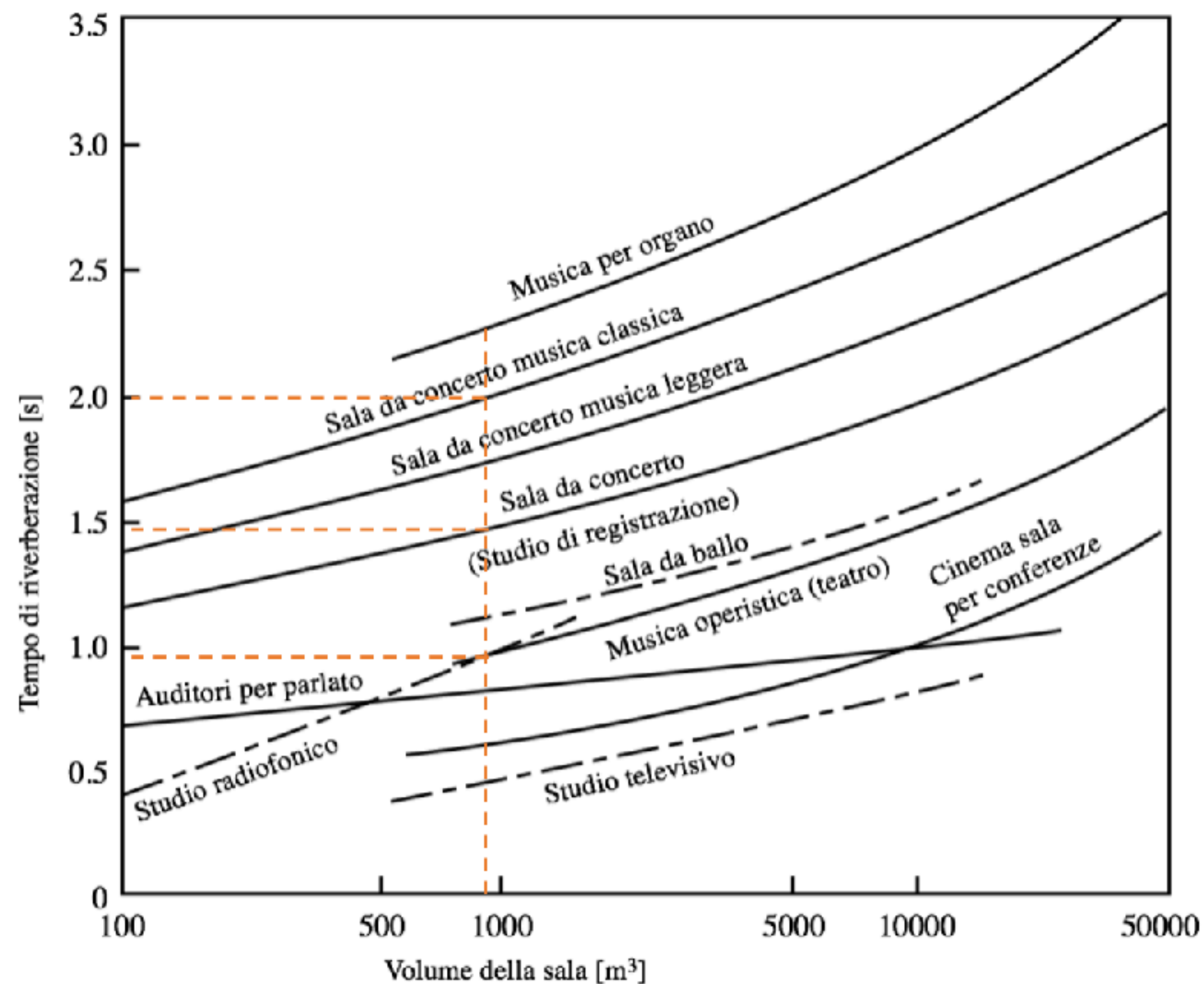
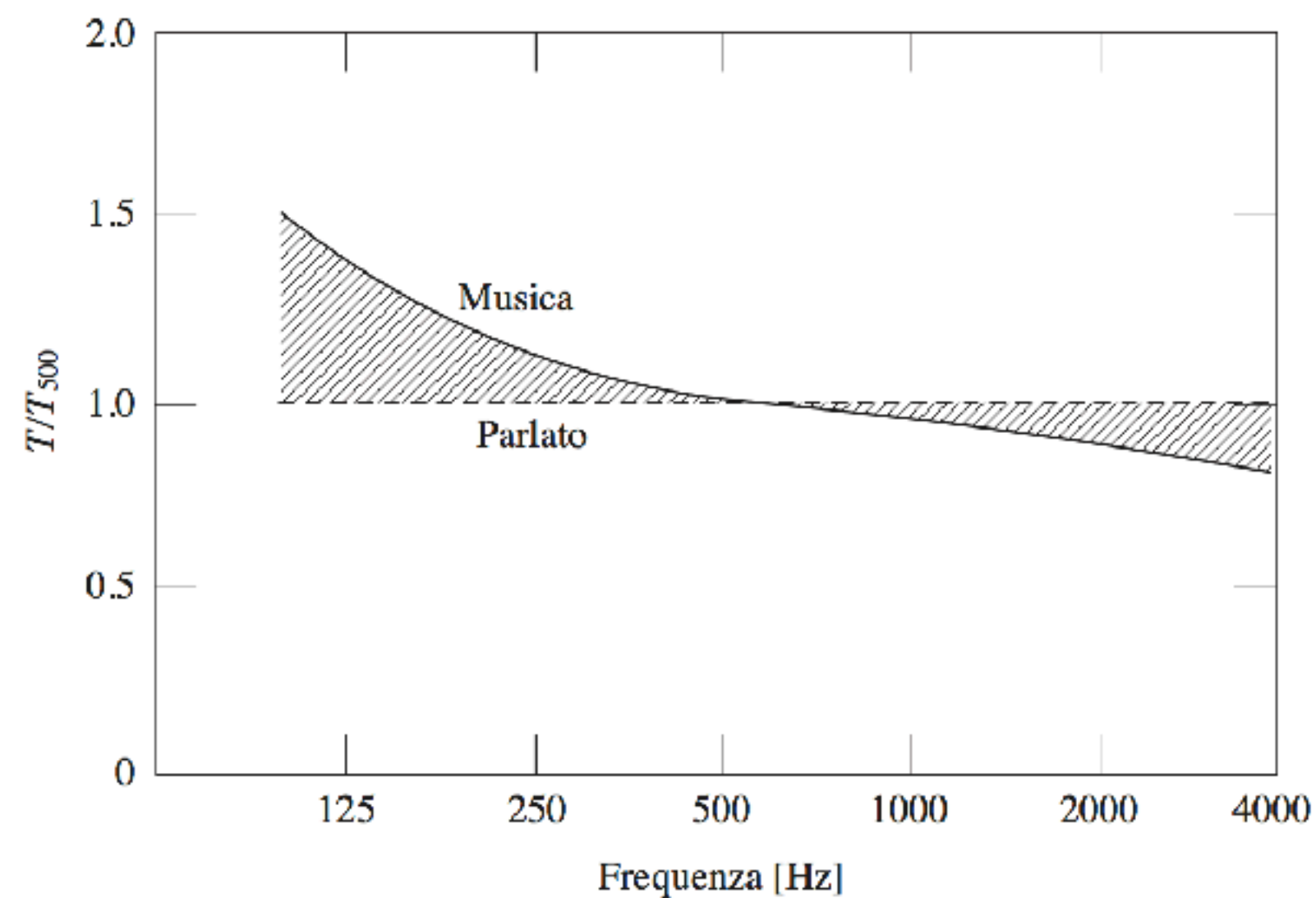


Figura 3 – Tempi di riverberazione di riferimento.

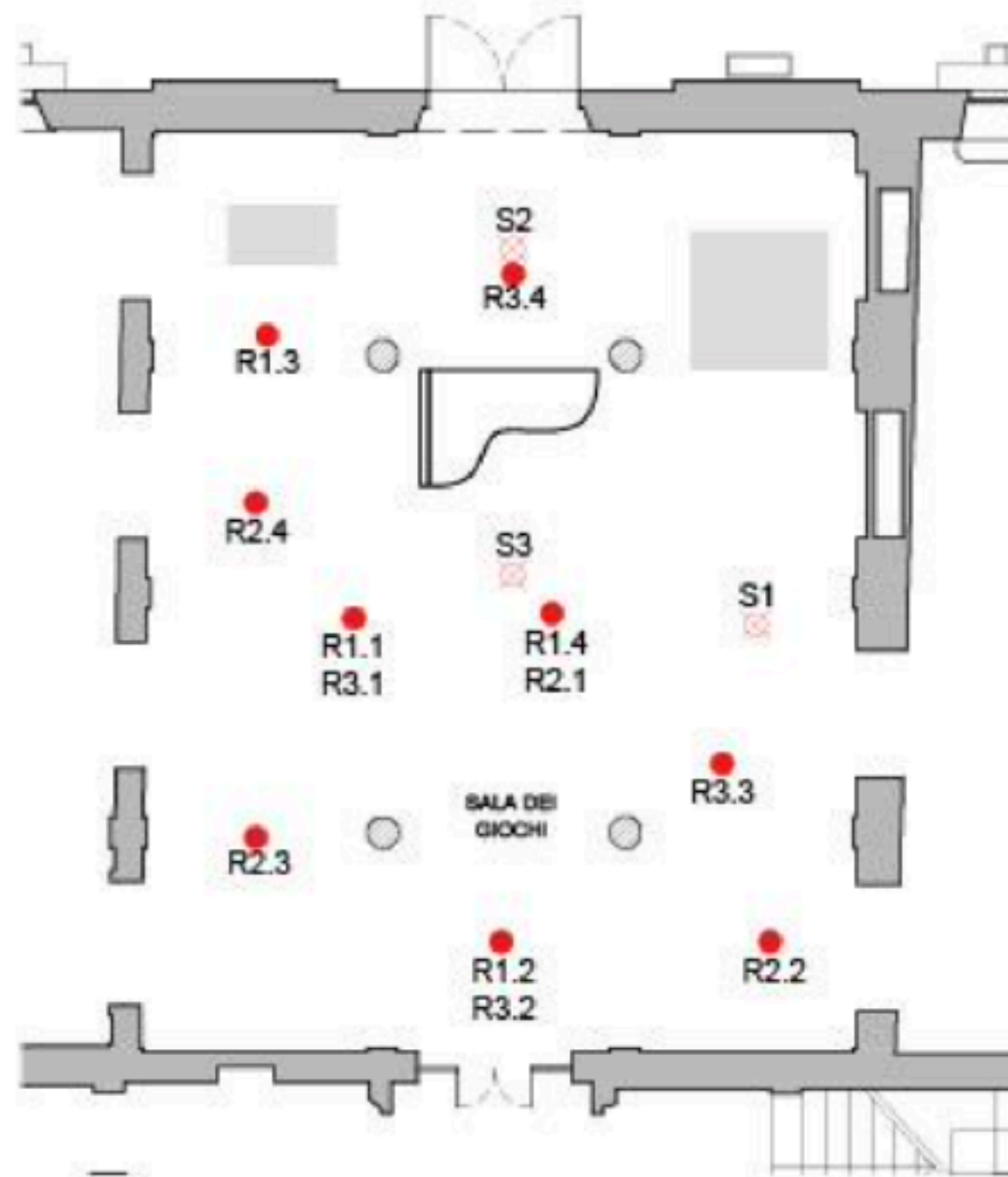
Room Volume: 900 m³

Optimal RT: 1÷2 s (depends on the musical event)

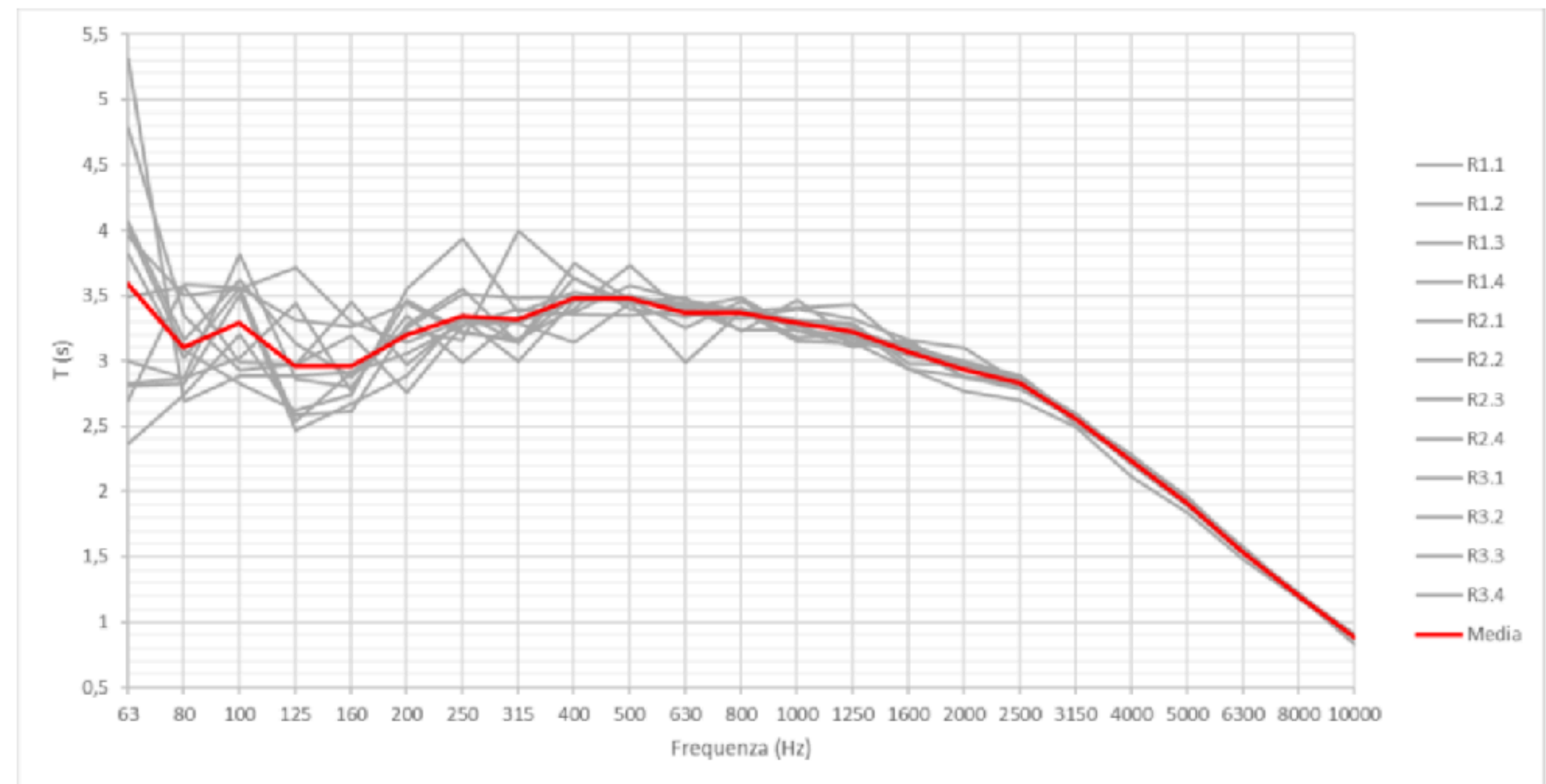
Optimal tonal behavior of reverberation time, approximately 1.5 times longer at low frequencies than @500Hz



Measurement of pre-existing conditions



· Pianta della Sala dei Giochi: individuazione della posizione di sorgenti e ricevitori.



Reverberation times (T_{30}) measured in pre-existing conditions

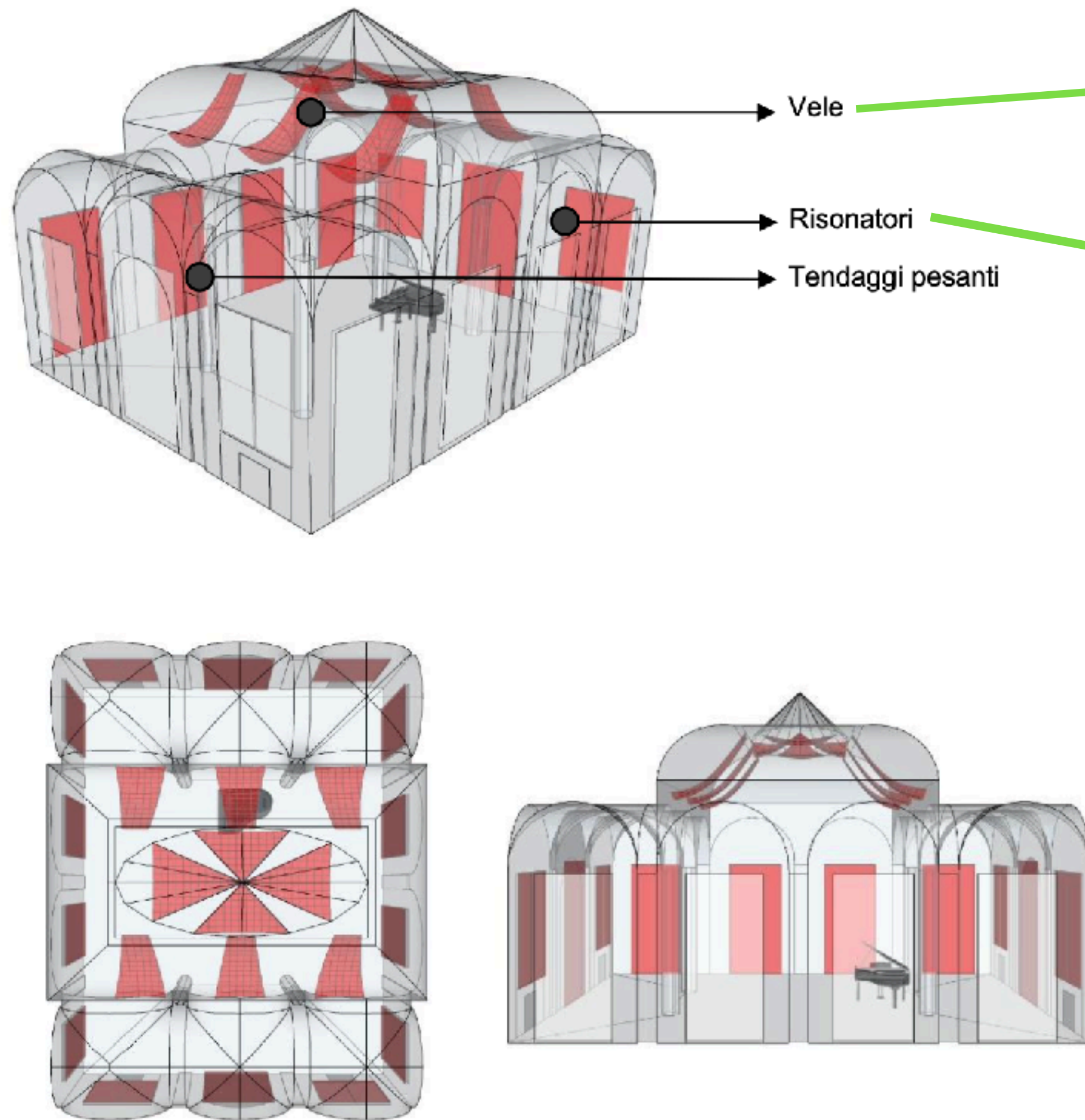
Measured RT @ 500 - 1000 Hz : 3.4 s
Optimal RT: 1÷2 s (depends on the musical event)

Even at low frequencies, the reverberation is very high and causes harmful emphasis during musical performances.

Acoustic Treatment Design



Acoustic Treatment Design



Acoustic Treatment Design

Resonators

The correction of low frequencies is achieved using acoustic resonators tuned to specific frequencies.

The resonators are rectangular box-shaped elements that contain a resonating membrane and sound-absorbing material inside. The elements are covered with acoustically transparent fabric.

This type of solution allows for the absorption of a range of low frequencies through elements with reduced thickness.



Acoustic Treatment Design

Heavy Curtains

Heavy velvet curtains (fabric heavier than in pre-existing conditions) were installed in front of each opening to control the reflection caused by glass doors.

The use of curtains allows for variable acoustics: with open curtains, the room will be more reverberant, while with closed curtains, high frequencies will be more controlled.



Acoustic Treatment Design

Transparent canopies



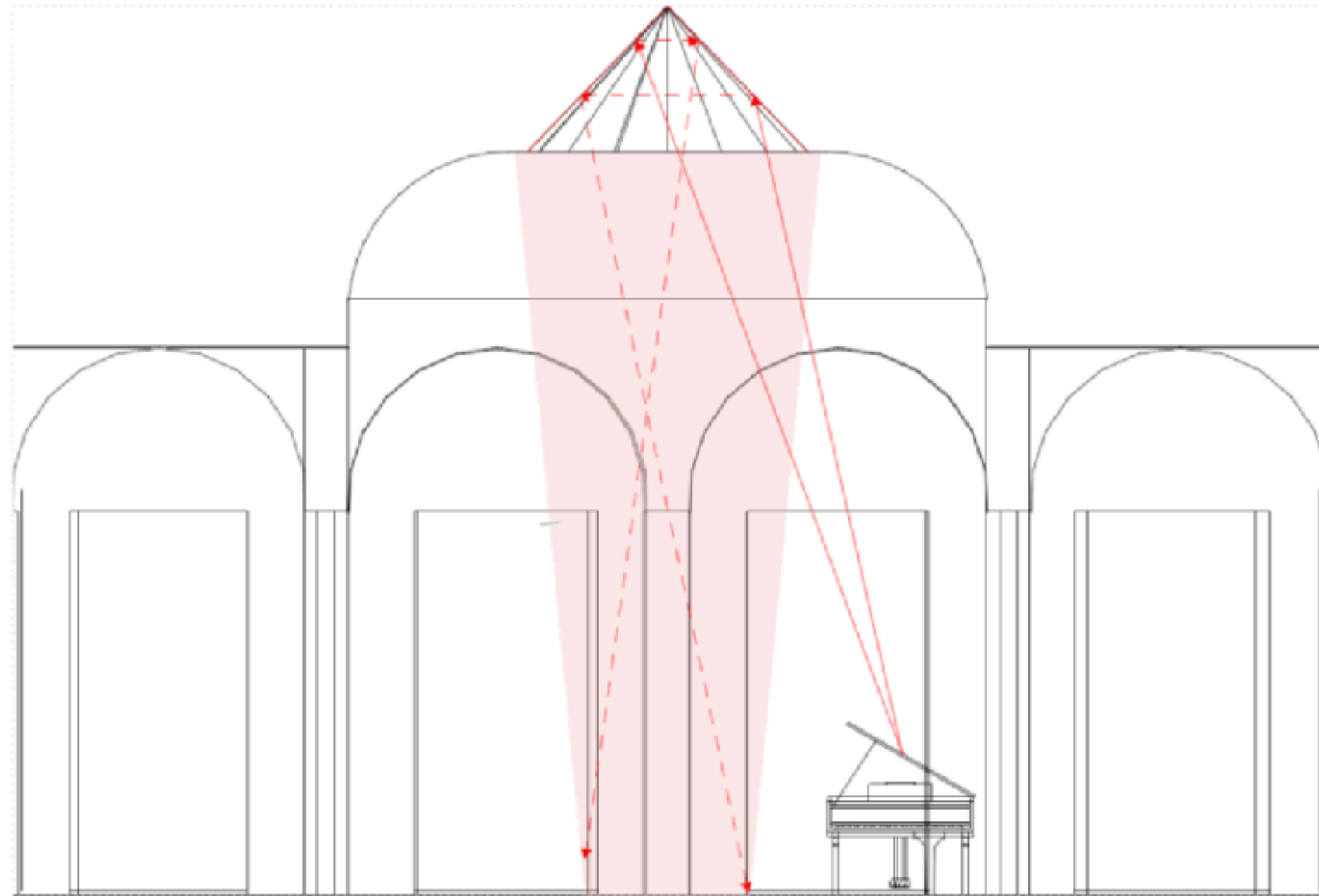
Acoustic Treatment Design

Transparent canopies

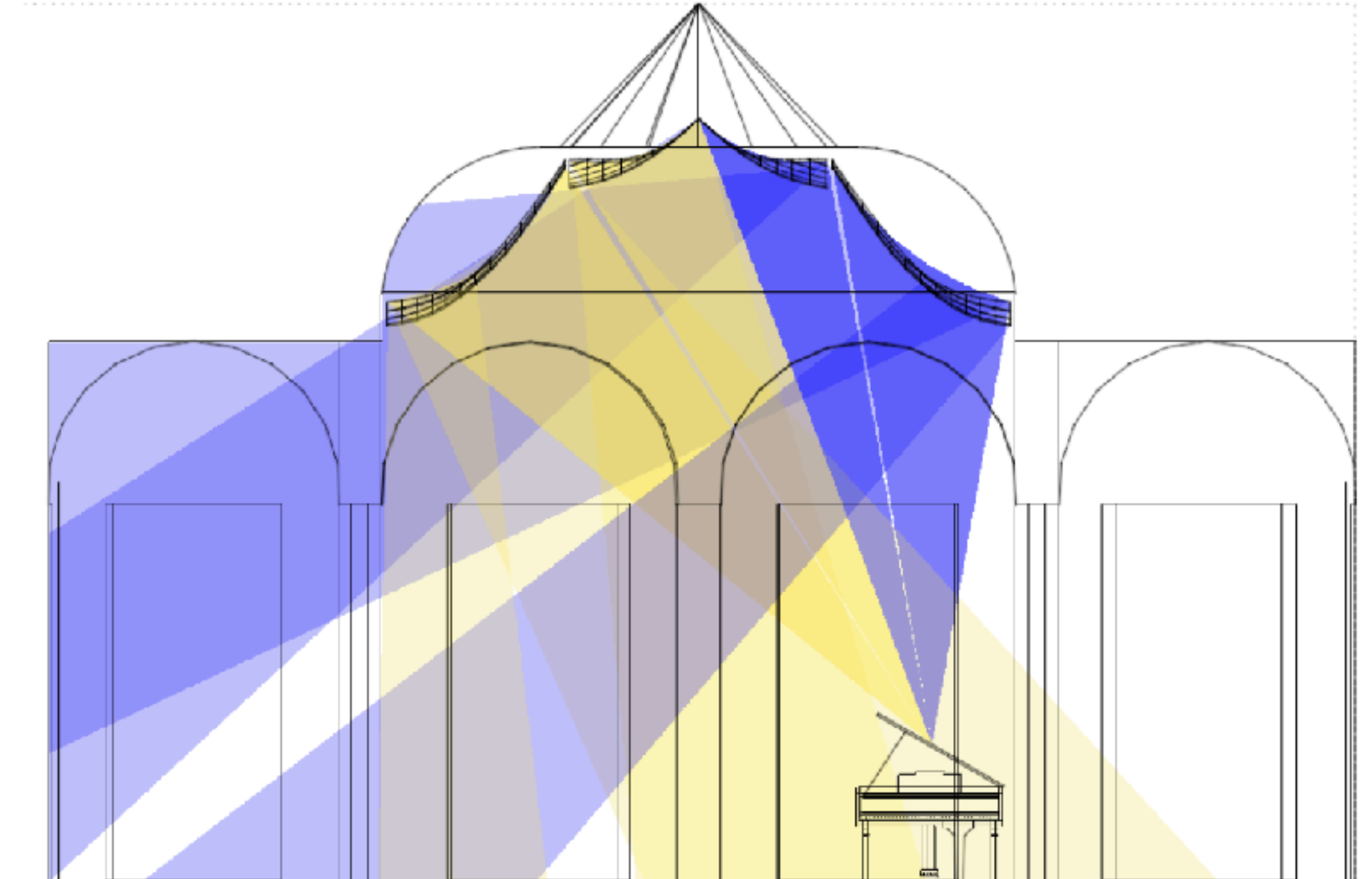


Acoustic Treatment Design

Transparent canopies



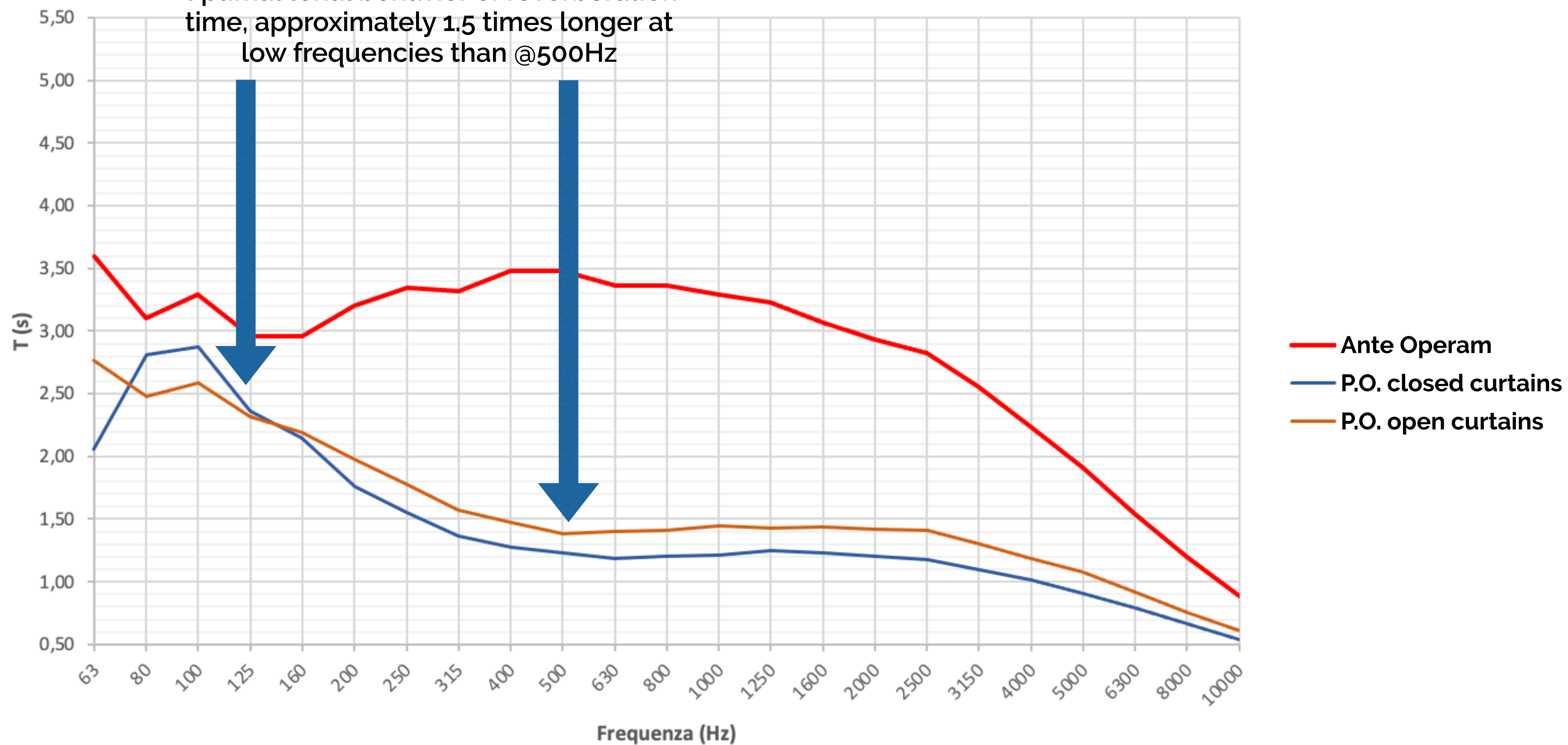
The concave roof caused significant sound focusing in the central part of the room



The convex canopies correct the focusing problem, transforming it into an opposite phenomenon of diffusion and distribution of sound. Listening becomes more uniform and enjoyable throughout the room.

Final results

Optimal tonal behavior of reverberation time, approximately 1.5 times longer at low frequencies than @500Hz



PART 6: THE FUTURE OF ACOUSTIC DESIGN

From Guesswork to Science (Maybe)

What Machines Could Do Better

AI Opportunities



GEOMETRIC INTELLIGENCE

Point cloud → Acoustic model (1 hour)

"This is a column, not 10,000 points"



MATERIAL RECOGNITION

Photo → Absorption coefficient

"This marble is 800 years old, $\alpha=0.10$ "



CALIBRATION AUTOMATION

Measurements → Adjusted model

"No more 3-week marathon"

Not Replacing Expertise, Enhancing It

The Future We're Building

SMALL SPACES

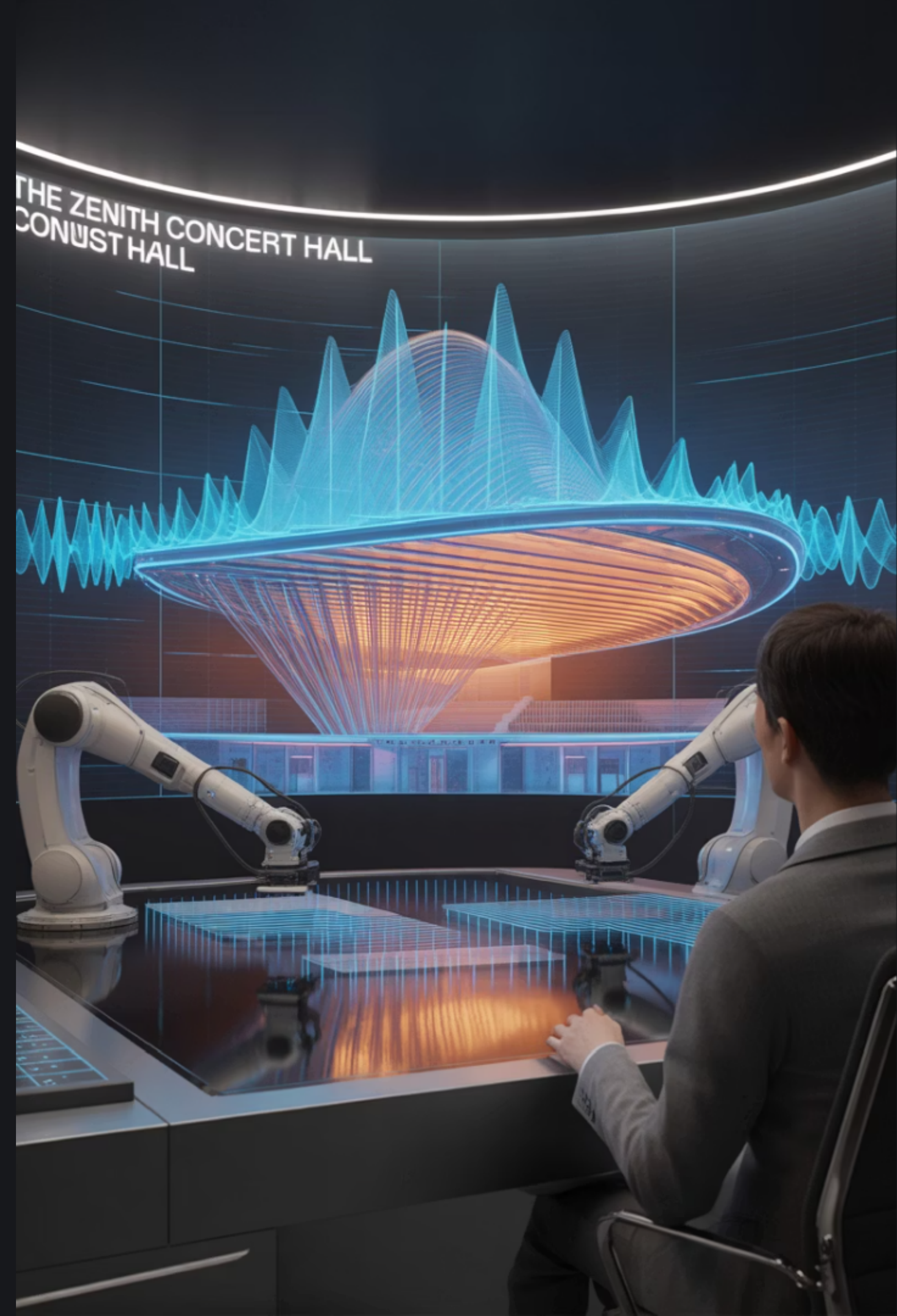
- AI helps with modes
- Faster impedance finding

LARGE SPACES

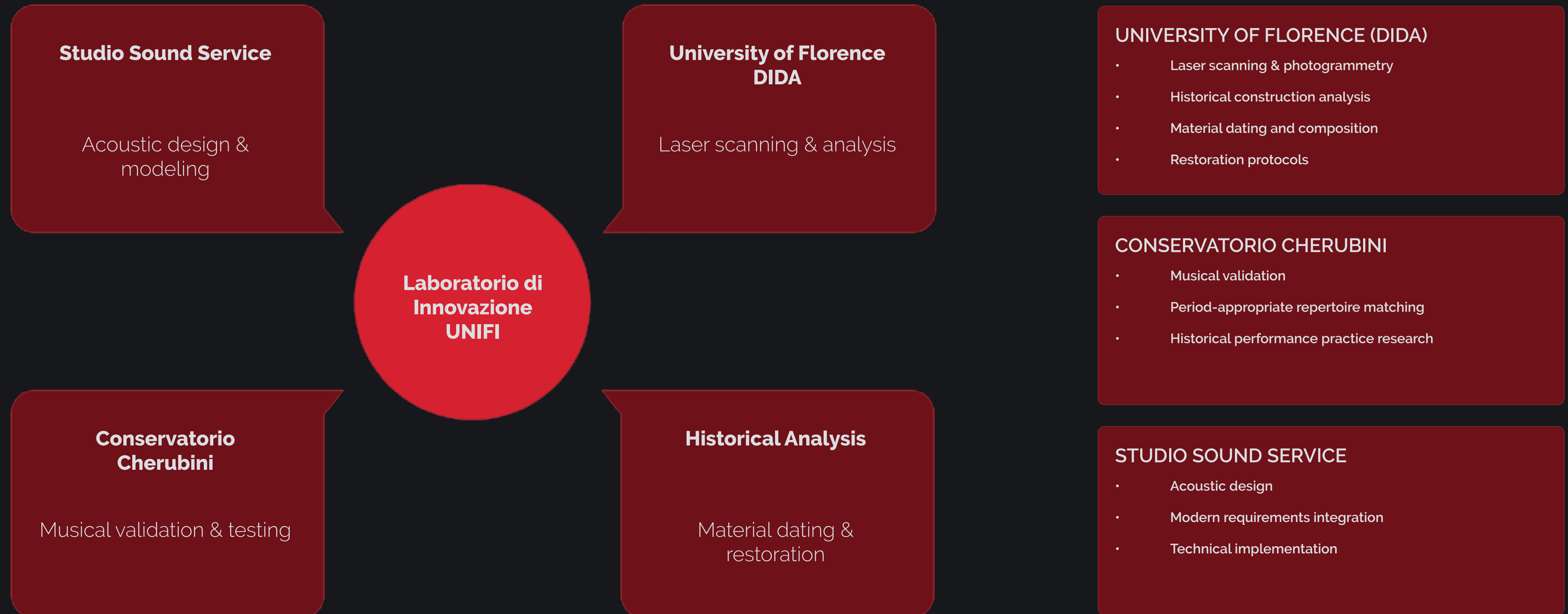
- AI helps with complexity
- Automatic calibration

COMMON FUTURE:

- Less modeling time, more design time
- Less guessing, more precision



Laboratory for Historical Indoor Acoustics



Mission: "Acoustic archaeology meets living heritage"

Focus: "Making historical spaces work for modern use without destroying their acoustic signature"

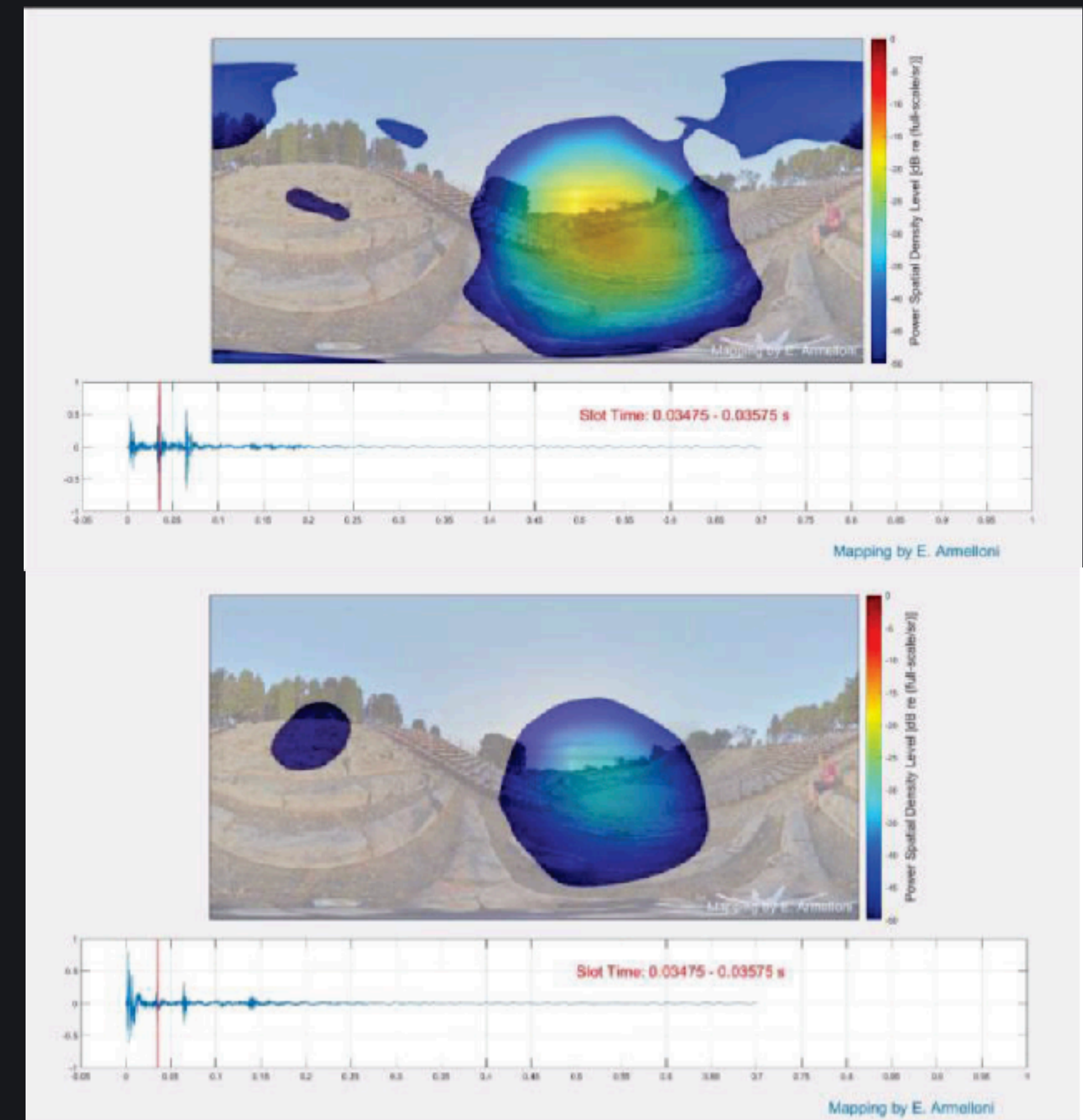
Making the Invisible Visible

Angelo Farina's Spatial Sound Visualization Revolution

AMBISONIC + 360° CAMERA

Interactive 3D model showing Real-time Sound Visualization:

- **Spatial Sound Mapping:** It allows for the mapping of sound pressure levels to specific points in space, using a color-coded representation.
- **Time-Domain Analysis:** Users can observe the origin and intensity of sound pressure at specific instants within an impulse response.
- **Source Localization:** The system visualizes the spatial origin of sound over time.
- **Comprehensive Acoustic Insight:** Offers a dynamic way to understand sound propagation in both spatial and temporal dimensions.



Beyond the Omnidirectional Dogma

Angelo Farina's MIMO Revolution

TRADITIONAL:

One Omnidirectional Source → Mono Impulse Response

MIMO Innovation:

Directional source array → Matrix of Responses

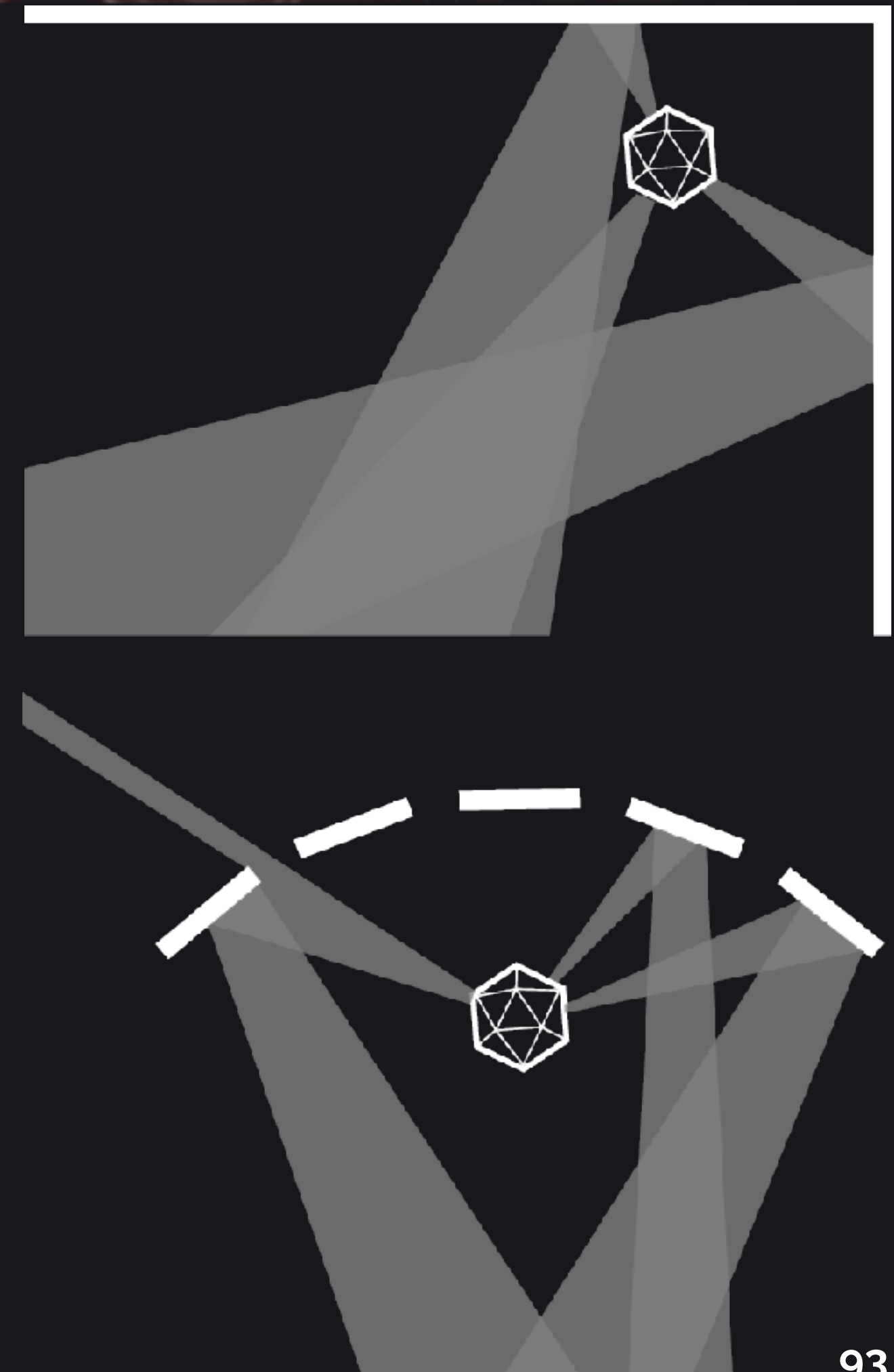
**32 source patterns × 32 receiver channels =
1,024 transfer functions**

**Each combination represents a unique
source-receiver relationship!**

Real-world application:

*"Now we can predict how a soprano turning her head
changes the entire hall acoustics"*

"A cello is omnidirectional at 100Hz but beams at 2kHz"



Acoustic Archaeology for the 21st Century

The 'Angelo Project' - Drone Acoustic Mapping



Named in honour of Angelo Farina (recently passed)

System "Flowrence" (Flow + Florence):

Hardware Stack:

- DJI Matrice 300 RTK ($\pm 2\text{cm}$ positioning)
- Zylia ZM-1 (3rd order ambisonic)
- Dodecahedron source (ESS sweep)
- 360° camera (visual correlation)

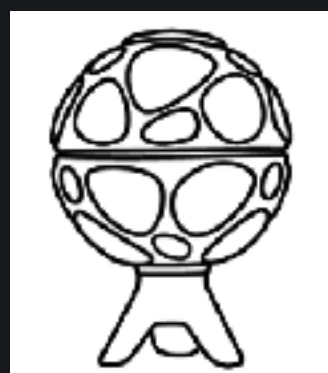
Data Richness

TRADITIONAL

Impulse response with omnidirectional microphone

DRONE

Full spatial impulse response per seat



3

Traditional Days

800 points, 2 operators

8

Drone Hours

800 points, 1 operator

100%

Efficiency Gain

Revolutionary improvement



Thank you

*40+ years of
Acoustic
Adventures*

*Remember:
In studios we kill the room, in concert halls we let it sing.
Both are right.*

Presentation Download

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www.studiosoundservice.com

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