

KINETIC ACOUSTIC CEILINGS IN OPEN MULTIPURPOSE SPACES

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PRECEDENT

- Pros of multipurpose rooms**
- openability enforces interaction, communication, and teamwork in multiple settings:
 - Classrooms
 - Offices
 - Studios
 - etc.
 - multiple uses, spaces don't have to rely on one function
- Cons of Multipurpose Rooms:**
- Can become too loud
 - too loud of a space can heighten:
 - stress
 - distractions
 - lack of focus
 - Can provide a lack of privacy

Prior Research/Precedent:

- Study: Kindergartens in Australia - presents multiple criteria and analyzes stress and focus levels of students and teachers based on different acoustical environments
- Study: Office Spaces and Speech Intelligibility - presents how the number of speakers in a given room can affect focus in a workplace setting (white noise vs. one speaker, etc.)

The Case of the Modern Library

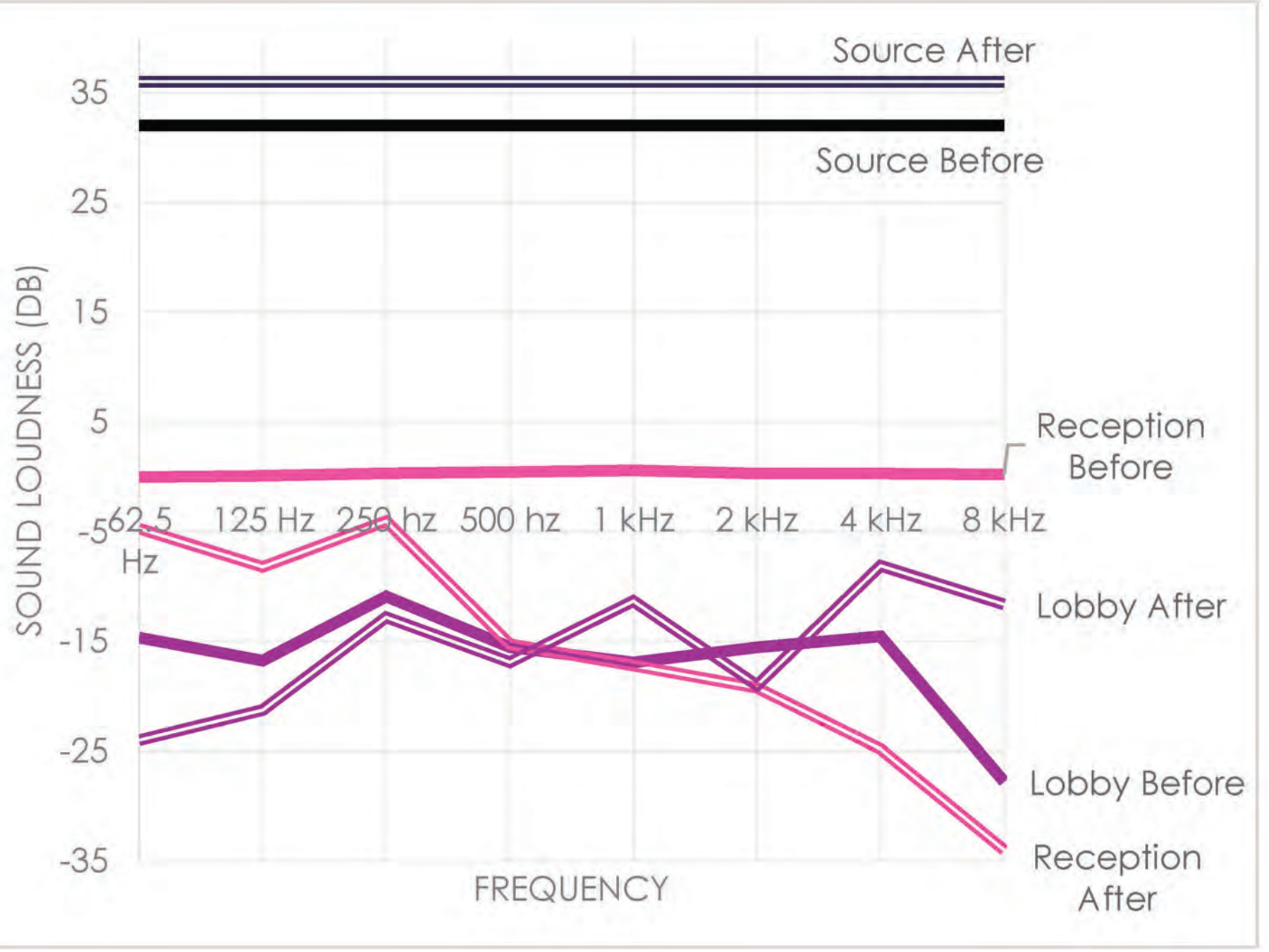
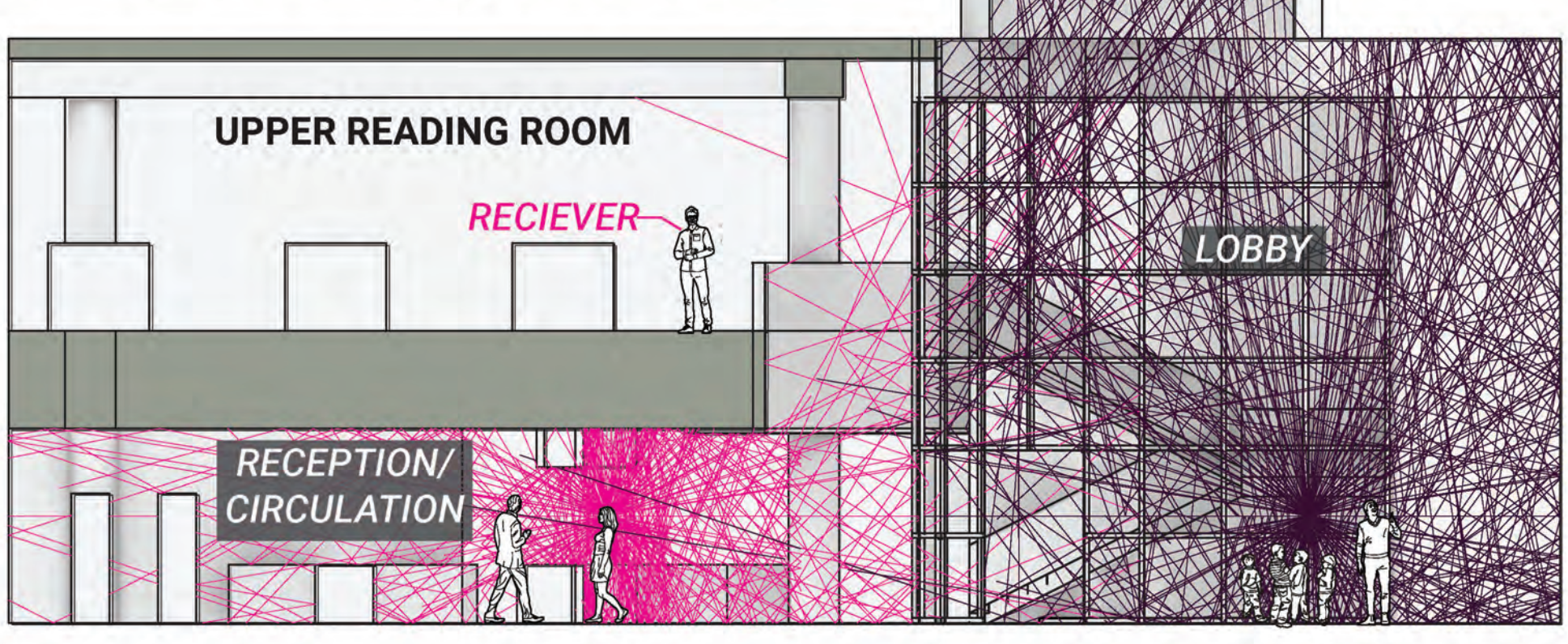
- the library is relatively an open space that are primarily used for studying, research, etc.
- the idea of the library is now changing by utilizing children development programs, utilizing cafe's and different vendors, etc, all of which removes the notion of a "quiet" library



Photo: Grand Library of Quebec

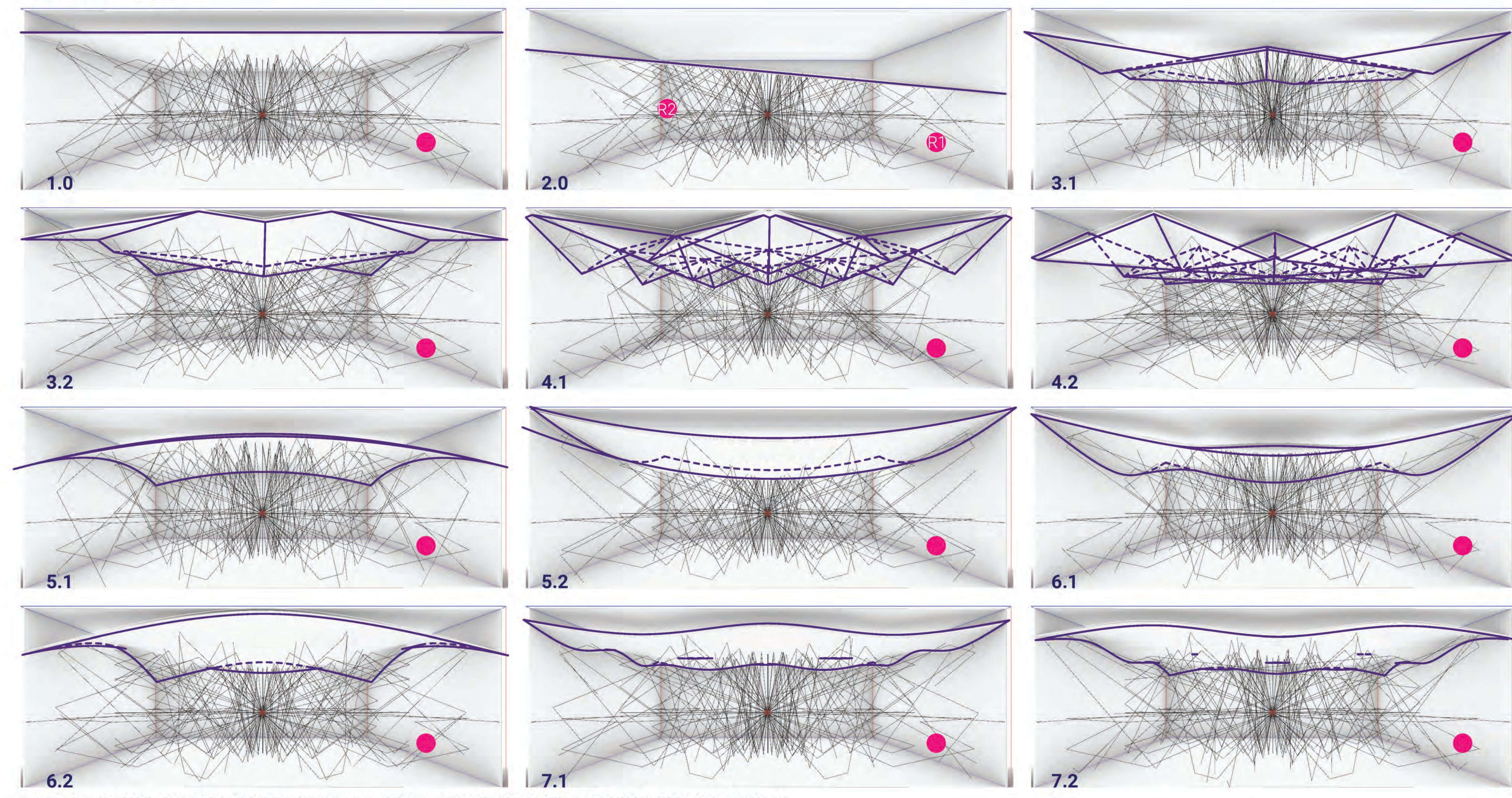
CASE STUDY

LOCATION: Orange Coast College Library
PROBLEM: Noise penetrating into upper reading room from lobby/reception area



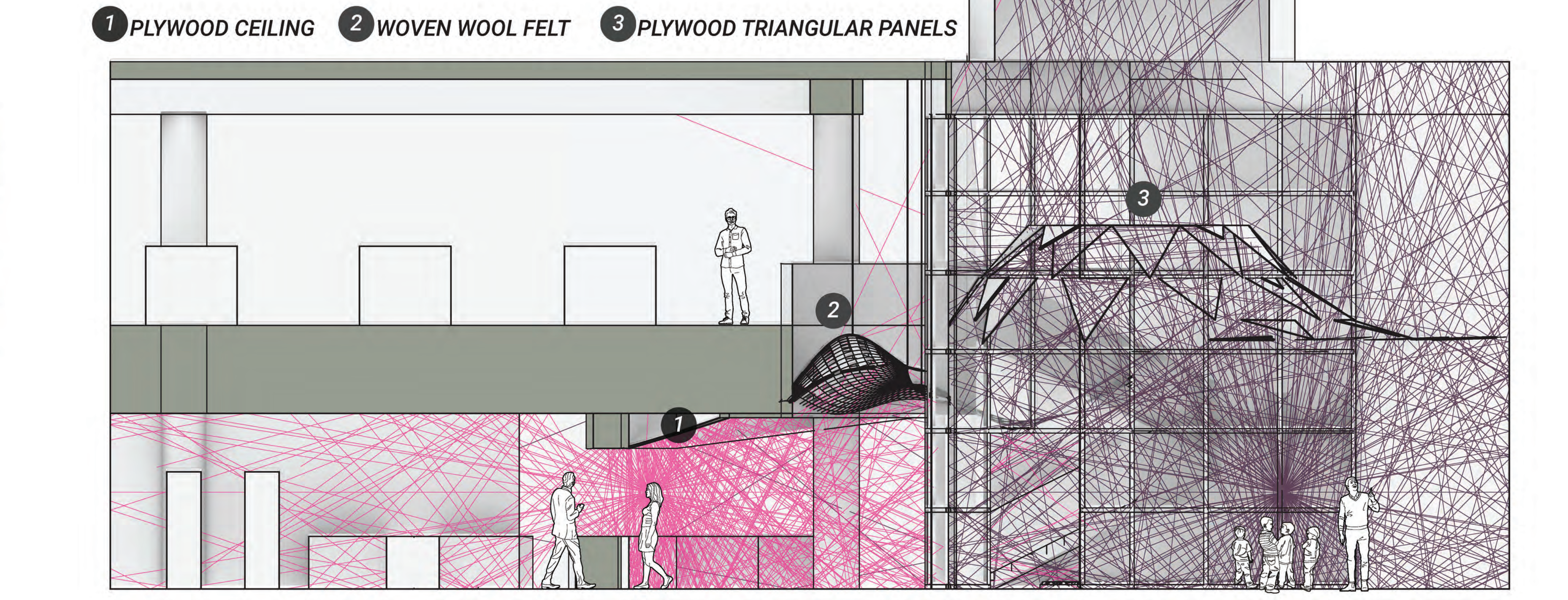
Based on the theoretical data, the sound should be mitigated significantly from sound sources in the lobby and reception area. Realistically, these sounds are still prevalent based on differing sound levels throughout different times of the day, activity, and other background noises. The data does not take into account any sound that could transfer between surfaces.

RESEARCH

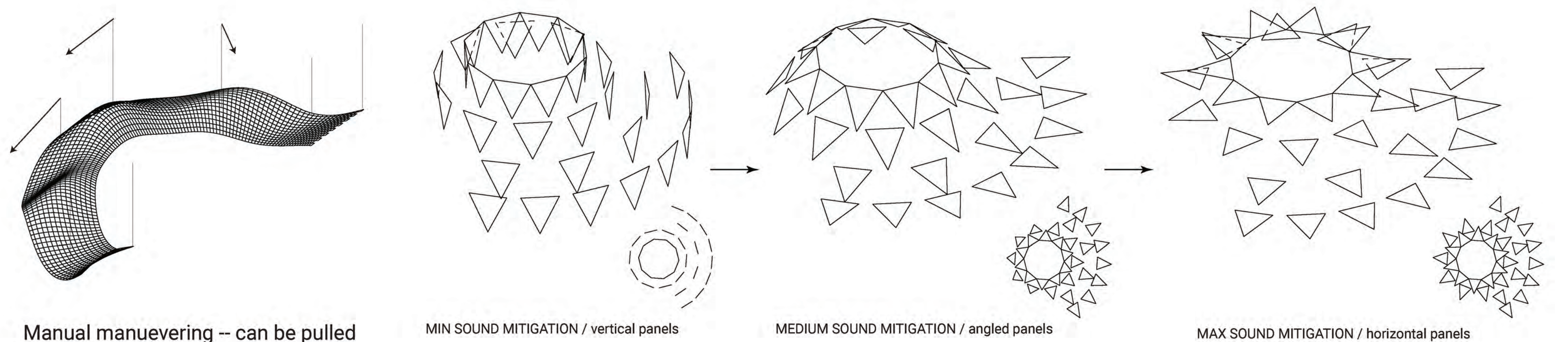


PATH OF SOUND WAVES EMITTED FROM A SINGLE SOURCE ONTO VARYING CEILING FORMS

LEGEND: 1.0 - FLAT, 2.0 - ANGLED, 3.1 - ANGLED, 3.2 - ANGLED, 4.1 - ANGLED, 4.2 - ANGLED, 5.1 - CURVED, 5.2 - CURVED, 6.1 - CURVED, 6.2 - CURVED, 7.1 - CURVED, 7.2 - CURVED. Sound Receivers



MECHANICABILITY



Manual maneuvering -- can be pulled by a string to change the shape of the form for increased sound mitigation and/or for maintenance.

Electronic maneuvering -- panels can automatically work on a pulley system to create a desired shape/effect. This system can work alongside sensors that read an environment and change form based on the environment.

MATERIALS:

- 1/4" PLYWOOD (LEFT)
- 3MM WOOL FELT (RIGHT)

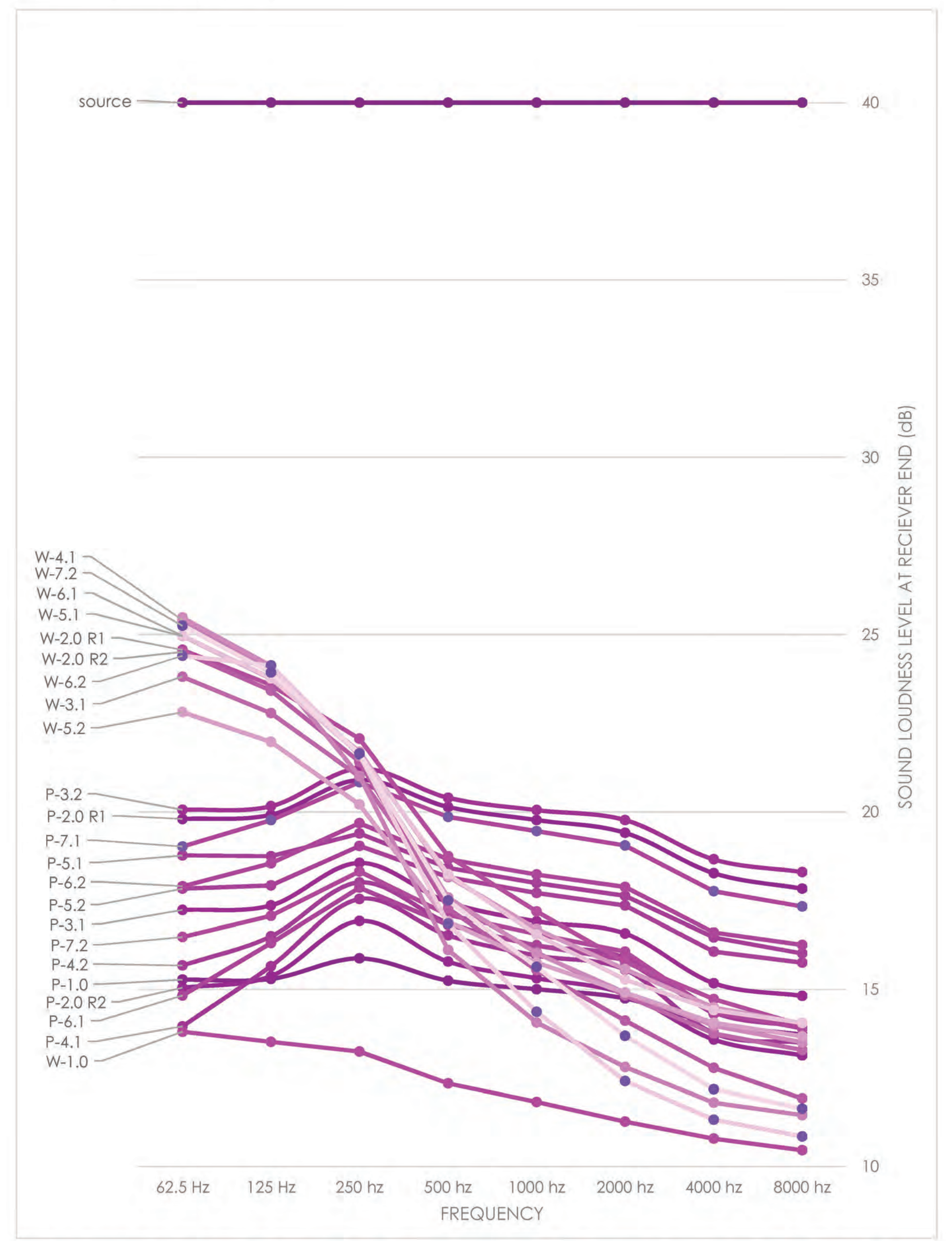


METHOD:

SOFTWARE: PACHYDERM
 ACOUSTIC IN RHINOCEROS 6.0

PARAMETERS:

- 40'X40'X15' ROOM WITH SAME WALL AND FLOOR SOUND ABSORPTION COEFFICIENTS
- 2 TYPES OF CEILING FORMS:
 - 1) ANGULAR
 - 2) CURVED
- SOUND EMITTED FROM CENTER OF THE ROOM AT 5'-6" ABOVE FLOOR
- SOUND EMITTED AT 65 dB (SOUND POWER LEVEL) IN ALL FREQUENCIES
- SOUND IS RECIEVED IN ONE CORNER OF THE ROOM AND CALCULATED BASED ON SOUND LOUDNESS (dB).



CONCLUSION & FUTURE IMPLICATIONS

- Data only represents theoretical studies and does not take into account any structural components or real time data of the space
- Data only represents one aspect of acoustics and does not take into account reverberation times or the quality of sound that is being recieved
- Weaved Wool Felt helped mitigate sound from reception area significantly.
- The new design within the lobby does not mitigate sound as much as is needed -- more testing should be done with on materials with open spacing or gaps and on the relationship of a volume of space with the properties of sound.
- As a basis for architectural acoustics, this research can help expand a market for ceiling acoustics that not only improves sound quality in a given space but also allows for a more interesting and more design worthy space.
- A solution for sound problems where removing walls/adding on to walls is not viable
- More research to be done on different materials and forms as well as operational properties of the ceiling

WORKS CITED

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