Imagination Works Studio construction guide

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For

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Introduction

This project is to design and construct a professional studio in the given space. In this report, it included the soundproofing instructions, wall structures, materials, ventilation concepts and room acoustic treatments.

Suggested Room layout

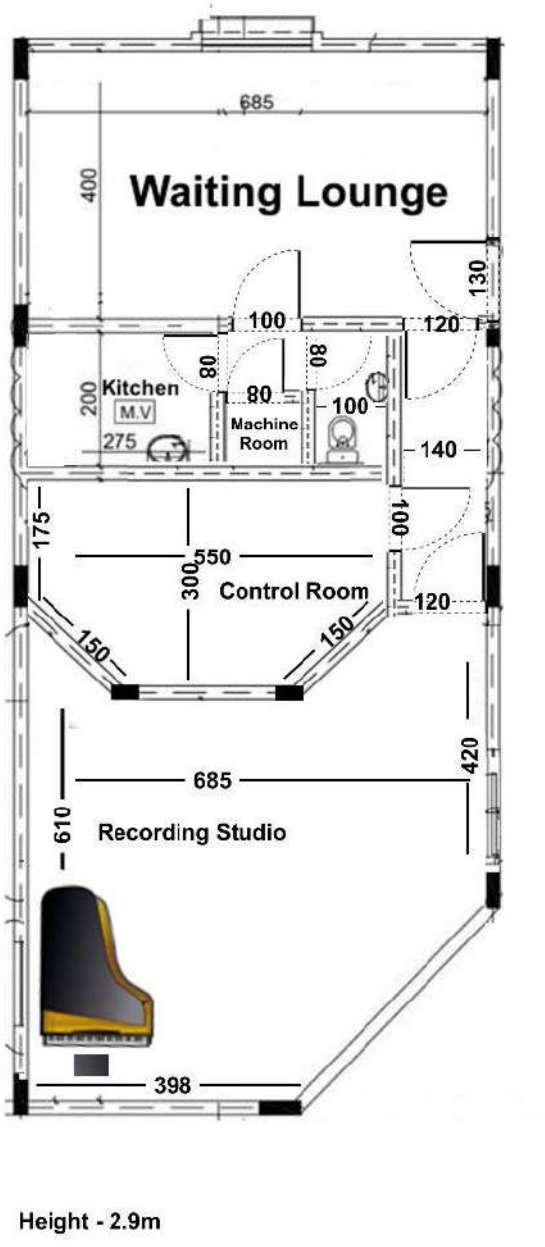


Figure 1 - Suggested room layout

Sound Proofing and HVAC system

A basic requirement of a studio is silence and fresh air. Therefore it's required to isolate sounds through the doors, windows, walls, floor and ceiling as much as possible and install a proper HVAC system.

HVAC refers to heat, ventilation and air conditioning. Plan for a proper HVAC system before constructing the sound proofed room.

Following is the basic concept of an HVAC system.

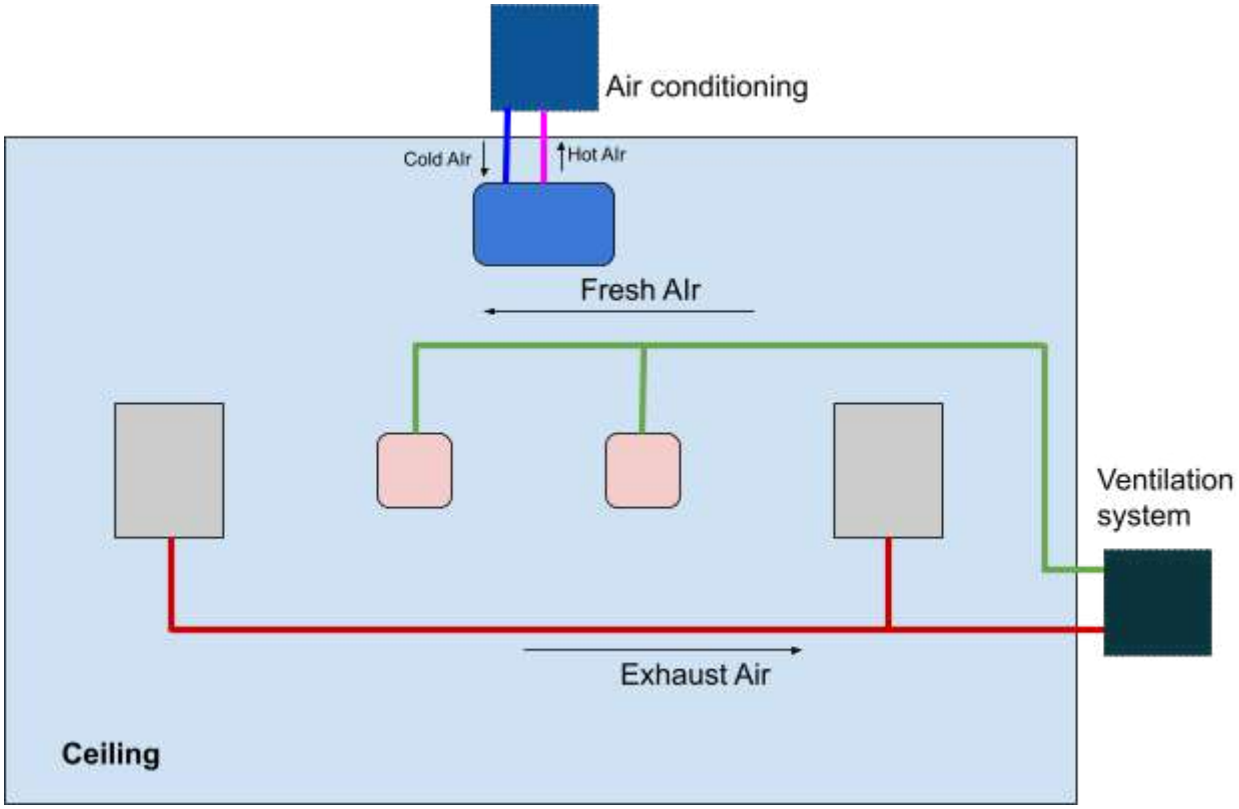


Figure 2 - Concept of an HVAC

***Please contact a qualified technician to optimize the HVAC system with your requirement with this room and power system.*

*** DO NOT establish any noisy units of Air conditioning system or Ventilation system on the studio room wall. Move them away as possible.*

As discussed, the soundproofing of this studio may require some additional attention due to the nearby airport.

Soundproofing guide

First it's required to consider the sound isolation from the floor. Walls will be constructed on the floor structure.
By considering the height of 2.9m, it's not possible to initiate much complicated structures to keep the height of the studio at the maximum possible level.

It's suggested to follow the floor structure below with STC of 48.

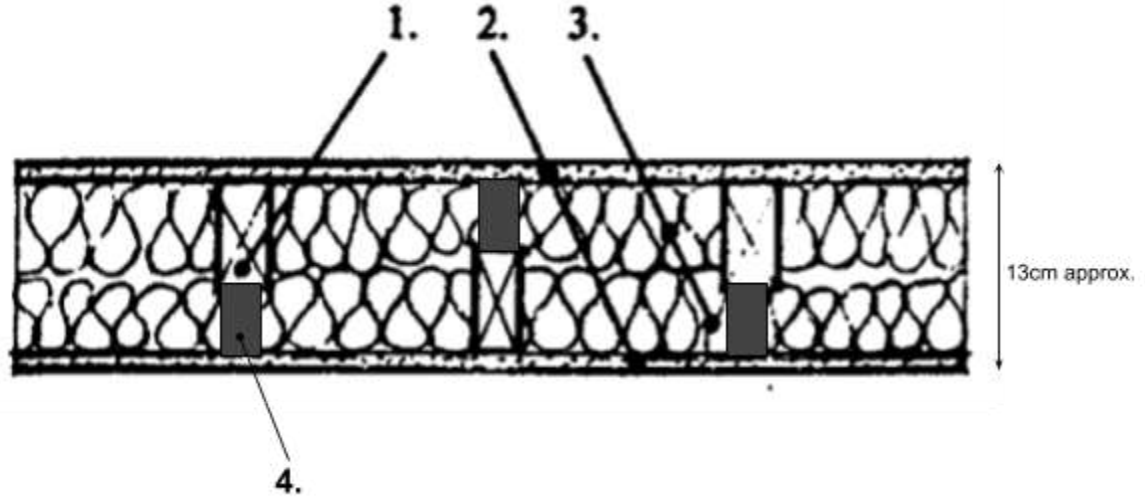


Figure 3 - Floor structure (Side view)

1. 2x2 wood studs 24" o.c.
2. ⅝" gypsum layer on both sides
3. Rockwool layer of 4"
4. 2" thick Rubber isolation

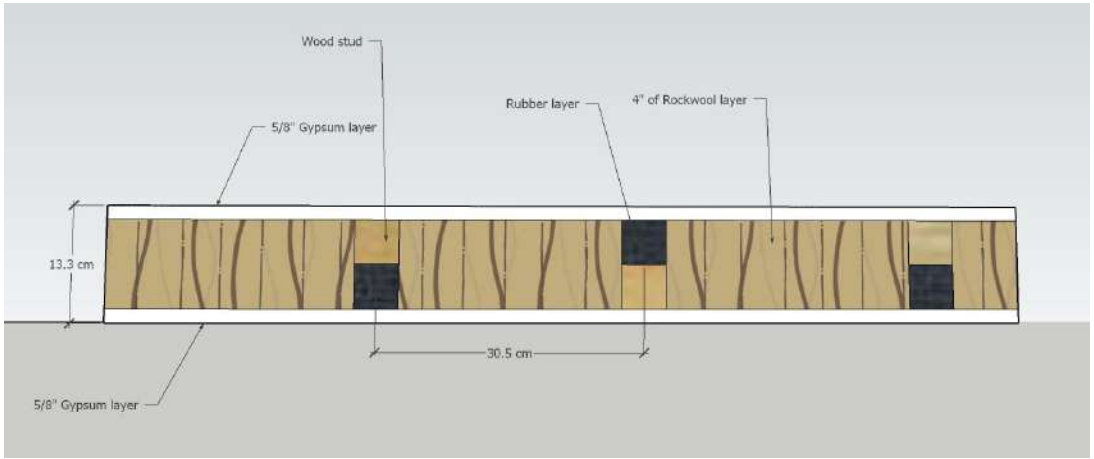


Figure 4 - Floor structure drawing for more understanding (Side view)

This floor will be bouncy to absorb vibrations from the ground. A layer of thick carpet is recommended to the floor to get the premium finishing without reducing the height.

Floor layout

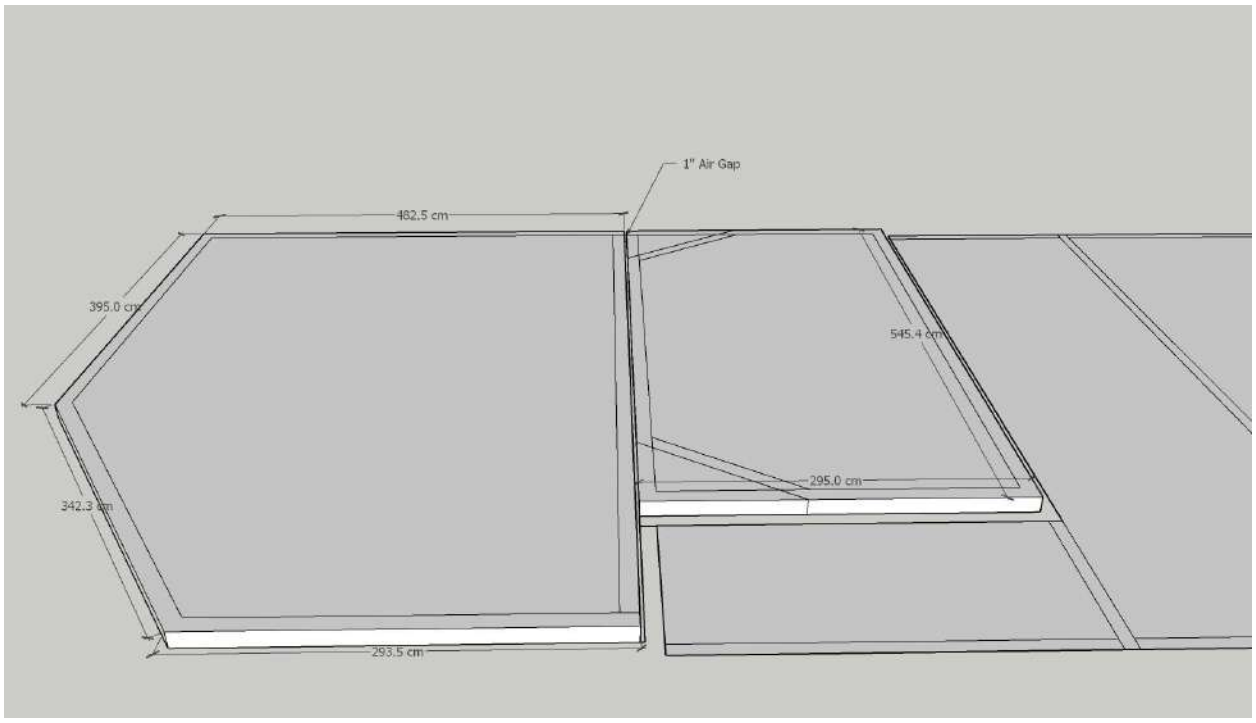


Figure 5 - Floor layout

After the construction of the floor according to above dimensions, it's required to have walls. The wall structure of STC 63 will be as follows.

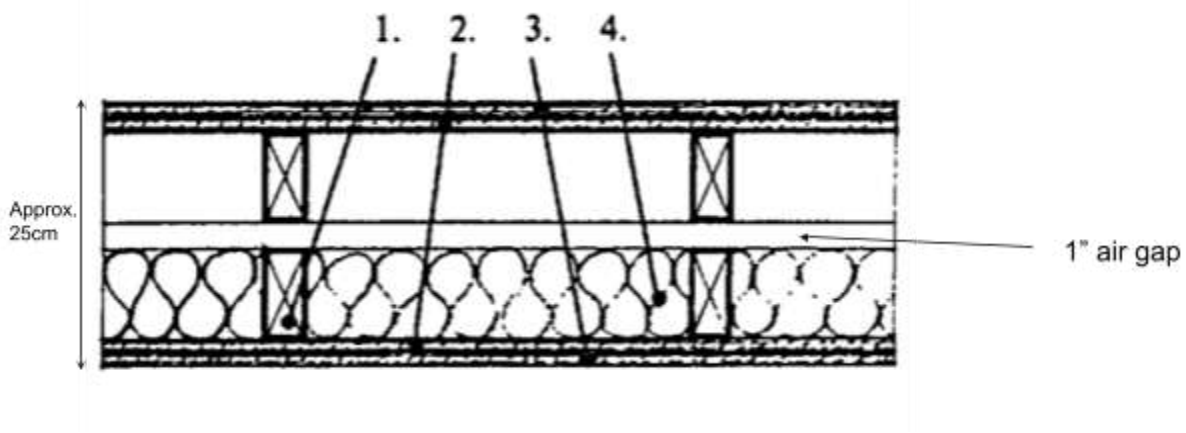


Figure 6 - Suggested wall structure (Top view)

1. 2x4 wood studs 24" o.c.
2. ½" gypsum layer on both sides
3. ½" gypsum layer on both sides
4. Rockwool layer of 4"

As you see, the wall structure consists of 2 layers with an air gap of 1”. You can decide what layer will come to the inner side of the studio. Inner layer should be on the edge of the floor structure and the outer layer must have a separated structure on the cement floor.

Wall layout

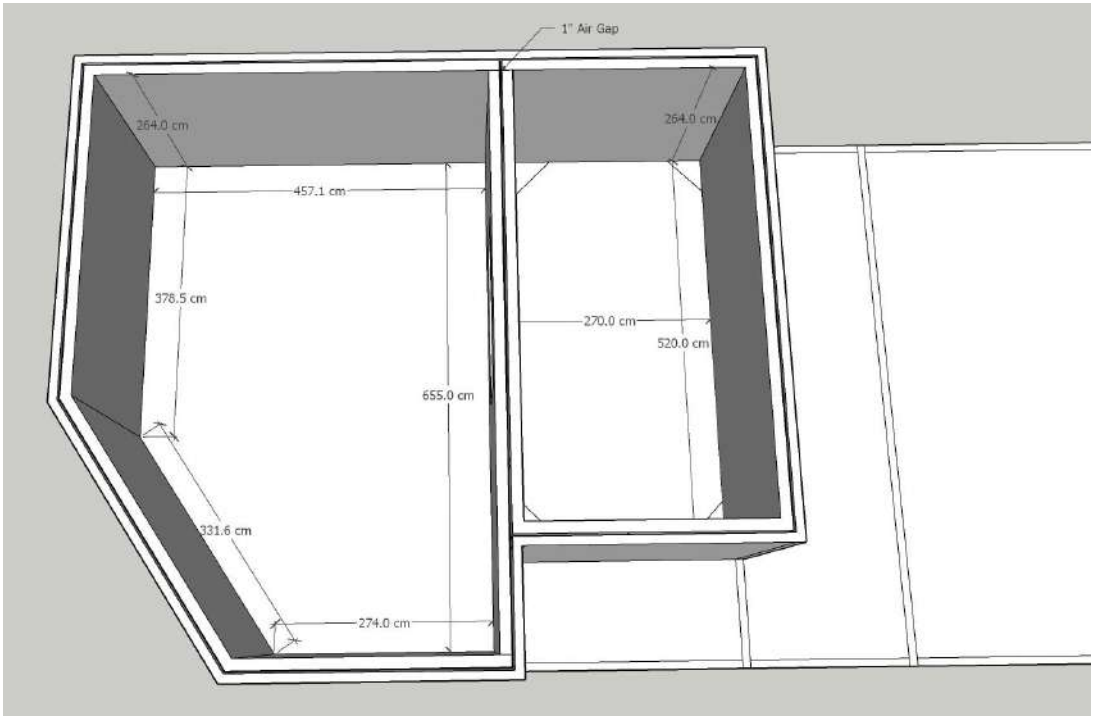


Figure 7 - Suggested wall layout (Top view)

Next step is to construct a soundproof ceiling. You can simply follow the structure of the floor as the ceiling. Always limit the ceiling area to the inner wall to maintain the air gap separation from all ends.

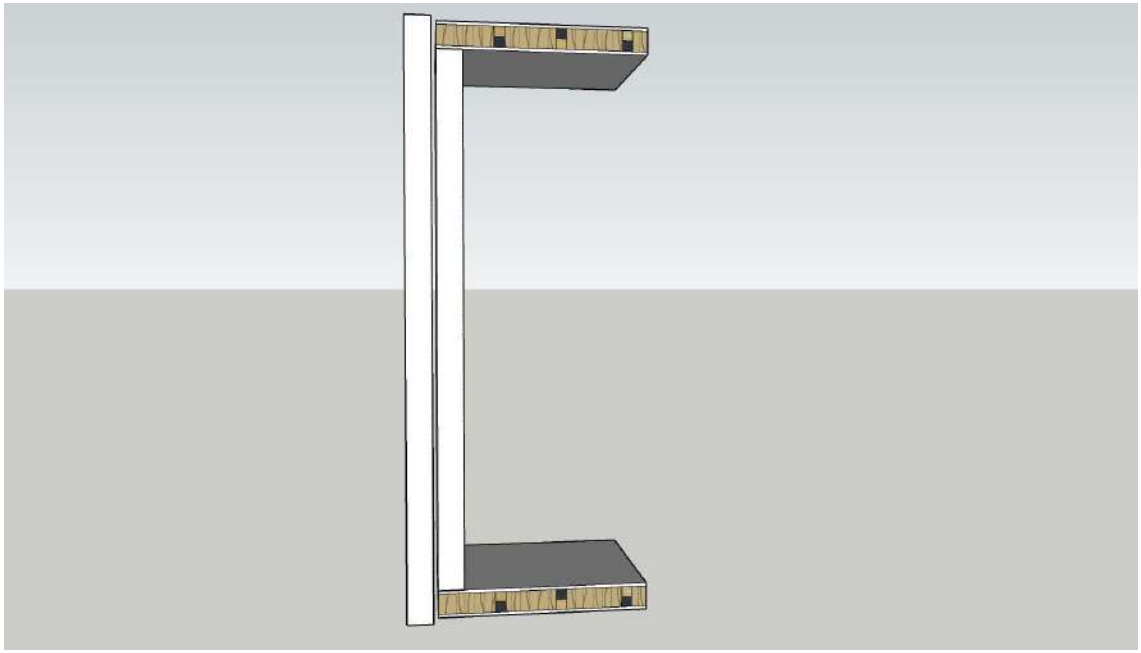


Figure 8 - Overall soundproofing layout (Side view)

Reminder
You have to plan the audio cable layout, power distribution and HVAC system air vents before the floor, ceiling and wall construction.

Please watch this video for a basic idea about structures in soundproofing
3 Layers For Perfect Soundproofing | DIY

Important - Please maintain the given dimensions for the live room and the control room for better results in acoustics.

Soundproofing window
Control room should have a transparent window to communicate with the live room easily.

Use an angled 2 layers (Each from the live room and control room) of tempered glass of 5mm as follows.

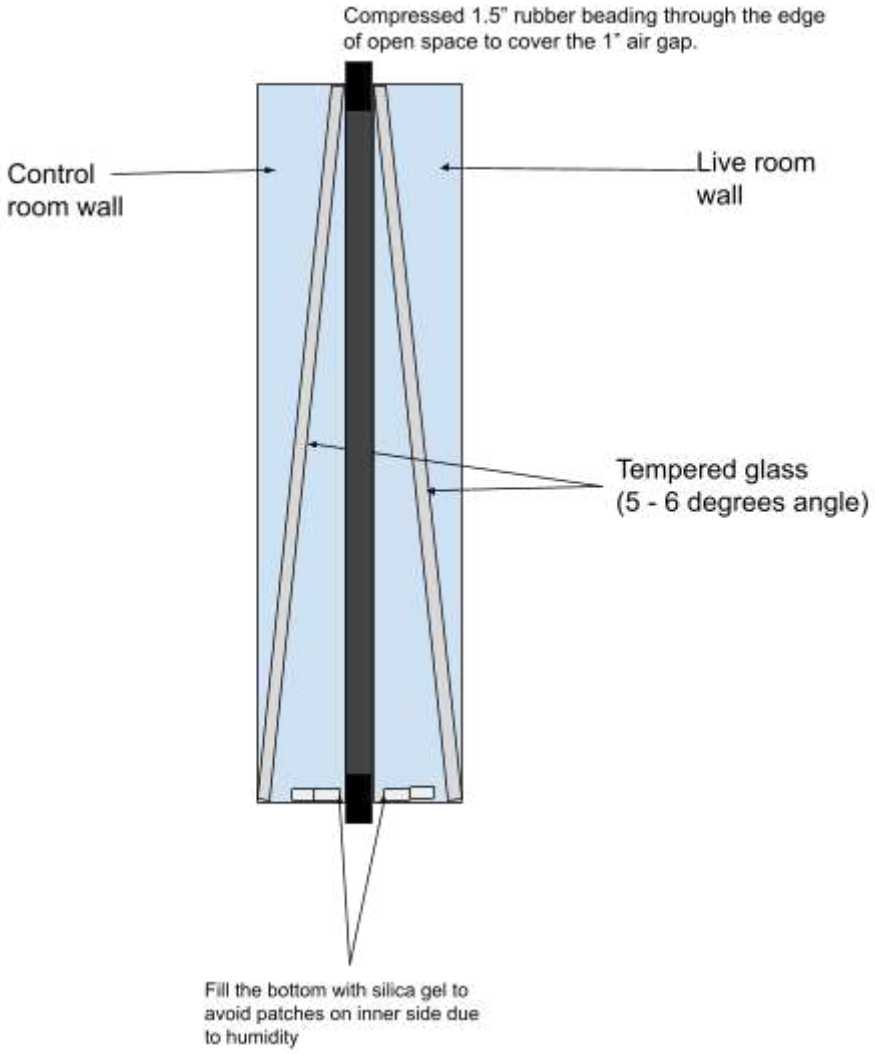


Figure 9 - Communication window (Side view)

Note -
Use a suitable method to install glasses and seal the edges of the glasses with **silicone** perfectly to maintain the soundproofing between the control room and live room.

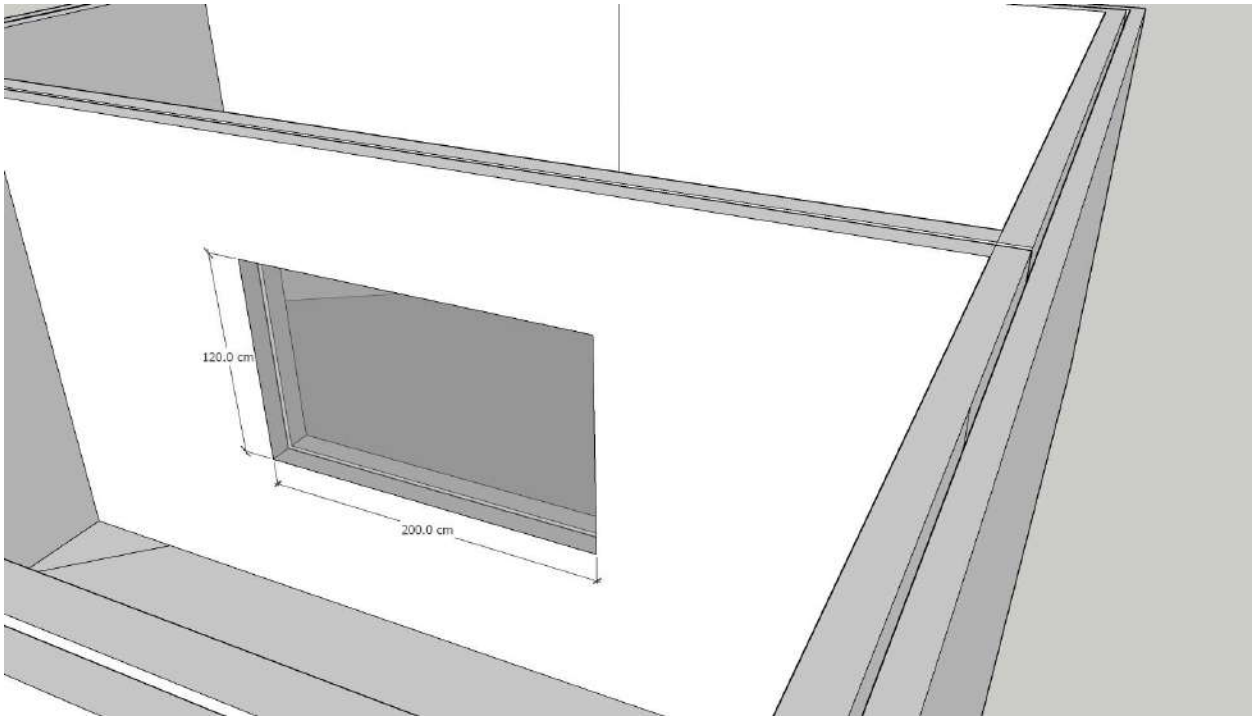


Figure 10 - Communication window dimensions

Door Layout

Doors are required to be customized to soundproof the rooms. Size of the doors can be changed according to the requirement too.

Basic structure for a soundproof door as follows. Always use beadings to seal doors with walls if there are any gaps.

Figure 11 - Soundproofing door structure

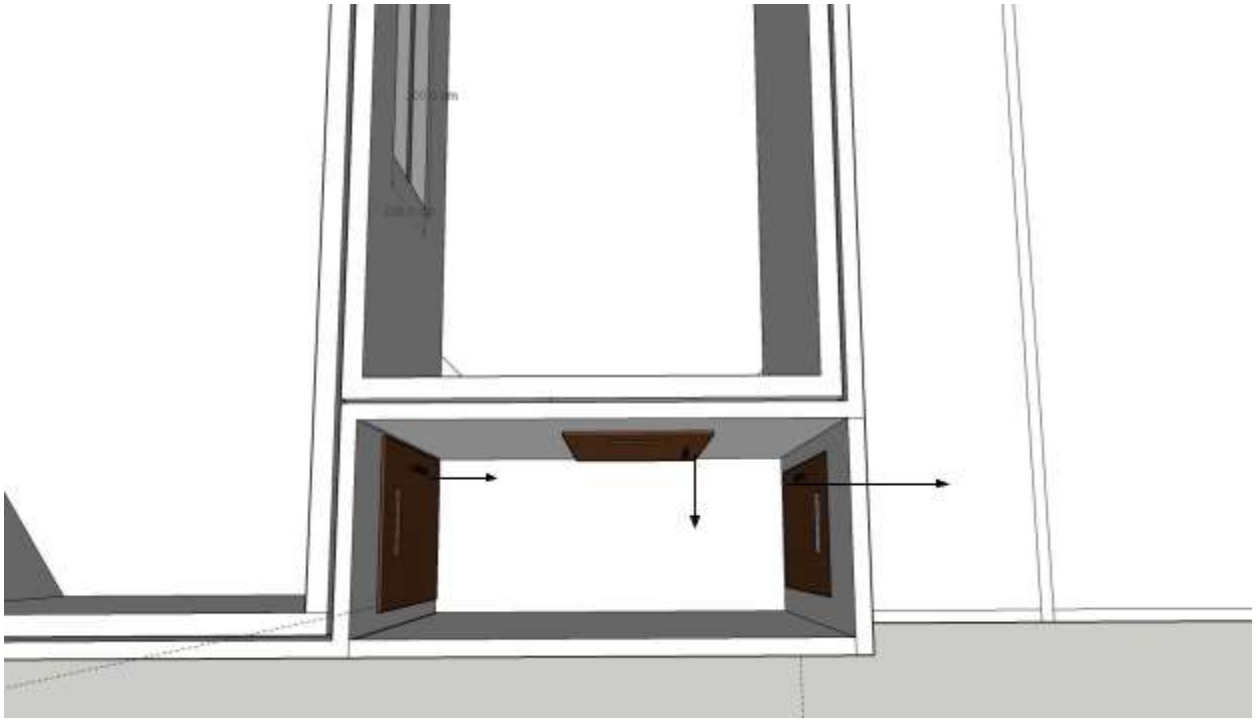


Figure 12 - Door opening directions

Ceiling Design

For the ceiling of both the live room and control room, go for an uneven wooden design to scatter the sound as follows for better results.

Room modes and Low frequency analysis

Control Room

Eigenfrequency (Hz)	Angular frequency (rad/s)	Damping ratio (1)	Quality factor (1)
33.000	207.35	-1.0018E-13	-4.9908E12
63.558	399.34	-8.1985E-16	-6.0986E14
65.002	408.42	-3.9152E-15	-1.2771E14
66.003	414.71	-2.1521E-14	-2.3233E13
71.616	449.97	-6.2311E-15	-8.0242E13
72.901	458.05	-1.5774E-15	-3.1697E14
90.918	571.25	-3.7118E-14	-1.3470E13
91.636	575.77	4.4336E-14	1.1278E13
92.644	582.10	-8.0984E-13	-6.1741E11
96.726	607.74	1.6311E-13	3.0654E12
99.015	622.13	-3.0627E-14	-1.6326E13
112.37	706.02	-2.9122E-12	-1.7169E11

Table 1 - Room modes for the expected control room

The above table is representing the eigenmodes or room modes of the designed control room according to the dimensions. Those frequencies will create some higher and lower pressure zones within the room.

Please check the below diagrams for a better understanding.

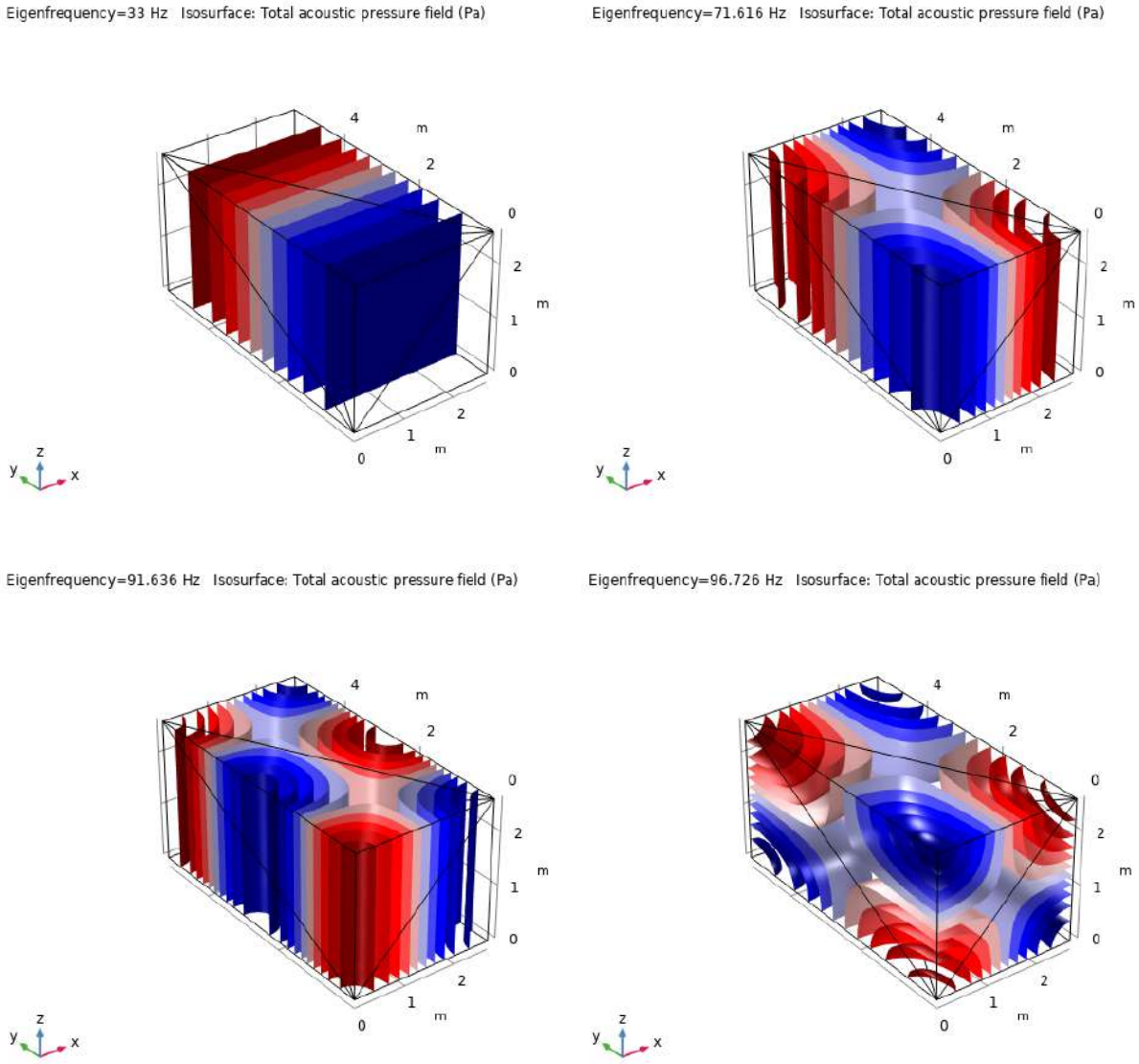


Figure 13 - High pressure zones (Control room) are in Red and Blue for different directions

As you see in Figure 13, there will be high pressure zones at the corners of the room most of the time. Therefore it's required to install corner traps to isolate the energy at each corner.

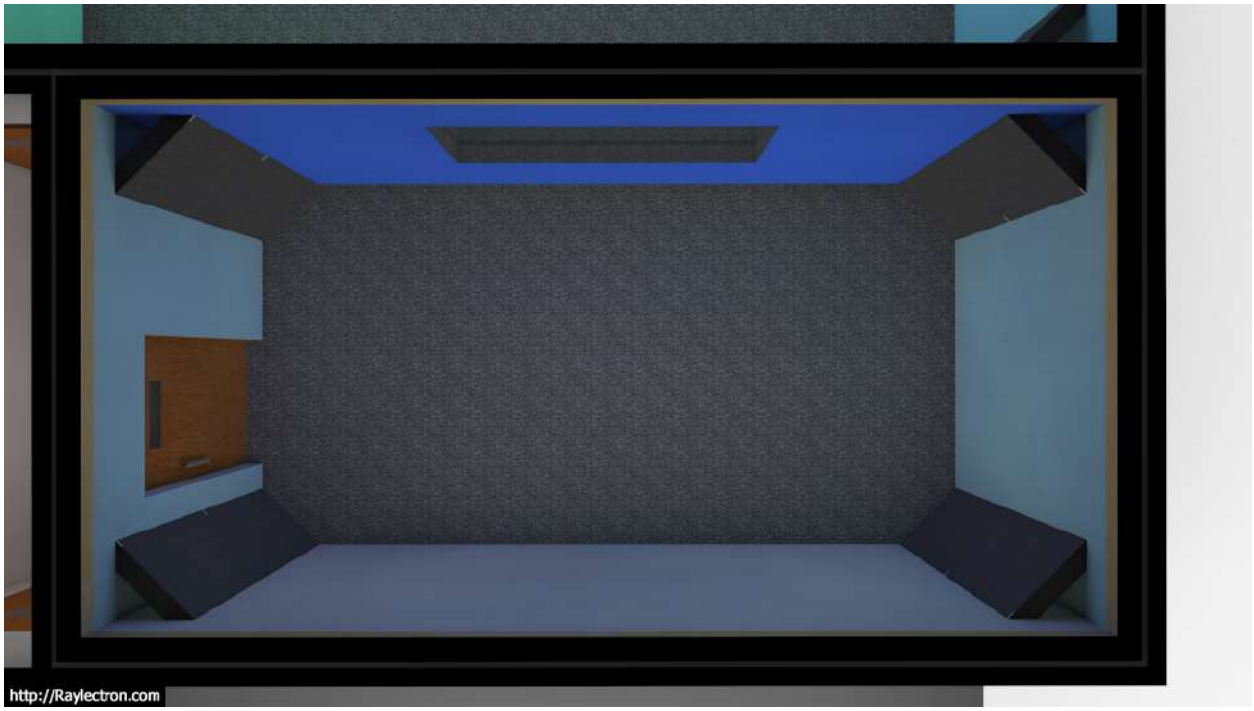


Figure 14 - Bass trap layout of control room

Bass Traps - 8 Corner bass traps of 120cm height each

Live Room

Eigenfrequency (Hz)	Angular frequency (rad/s)	Damping ratio (1)	Quality factor (1)
39.191	246.24	-1.5847E-14	-3.1552E13
49.392	310.34	7.9715E-15	6.2724E13
56.079	352.35	7.9973E-16	6.2521E14
65.005	408.44	5.7631E-16	8.6758E14
67.574	424.58	-8.6238E-16	-5.7979E14
70.447	442.63	3.3022E-16	1.5141E15
75.911	476.96	4.6553E-16	1.0740E15
76.832	482.75	-4.0774E-15	-1.2263E14
78.828	495.29	-2.1551E-14	-2.3201E13
81.650	513.02	-4.1239E-14	-1.2124E13
85.865	539.51	5.6746E-10	8.8111E8
87.452	549.48	-8.3417E-11	-5.9939E9

Table 2 - Room modes for the expected live room

The above table is representing the eigenmodes or room modes of the designed live room according to the dimensions. Those frequencies will create some higher and lower pressure zones within the room as we observed in the control room.

Check the following diagrams.

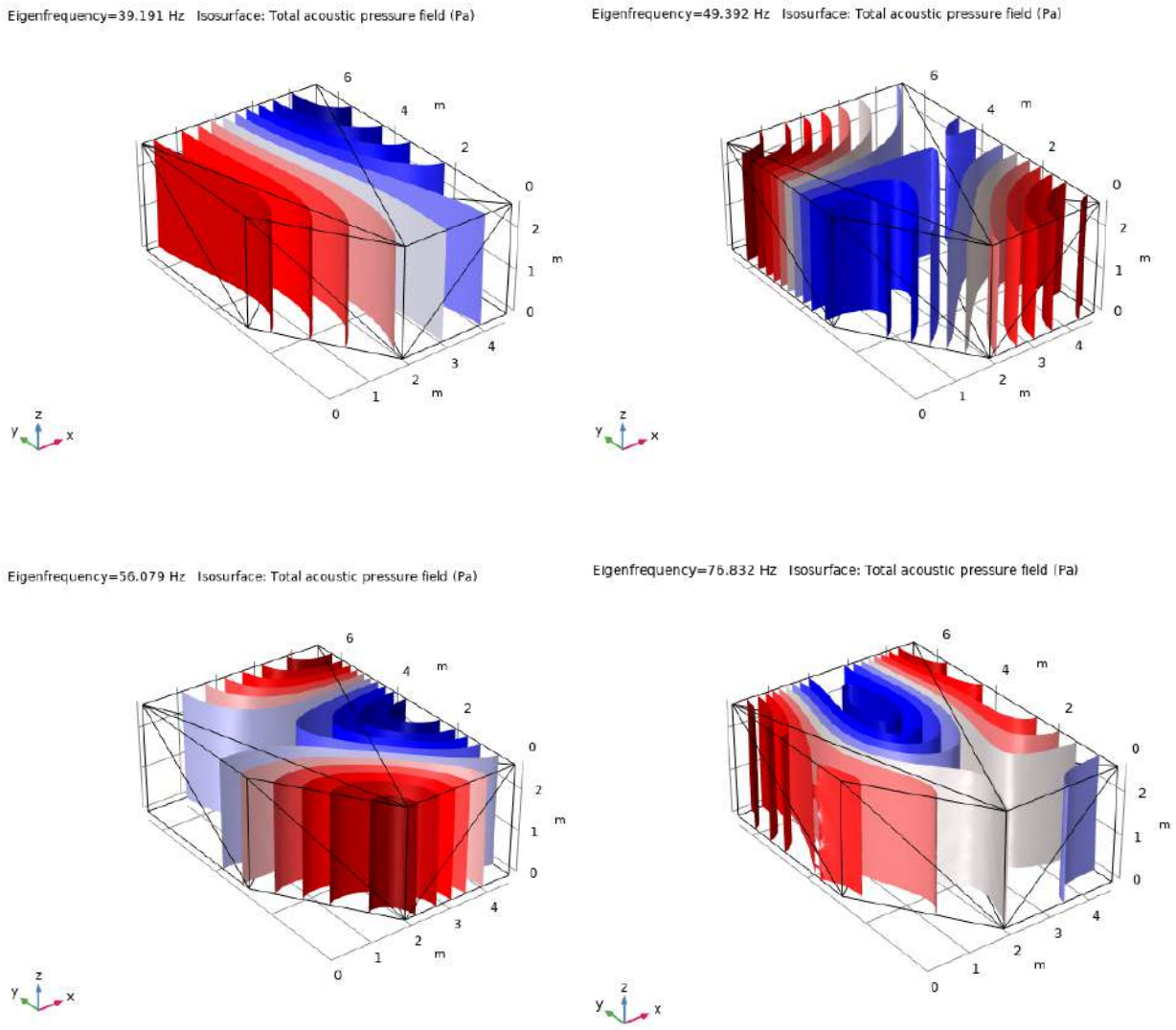


Figure 15 - High pressure zones (Live room) are in Red and Blue for different directions

As you see in Figure 15, there will be high pressure zones at the corners of the room most of the time. Therefore it's required to install corner traps to isolate the energy at each corner as we did in the control room.

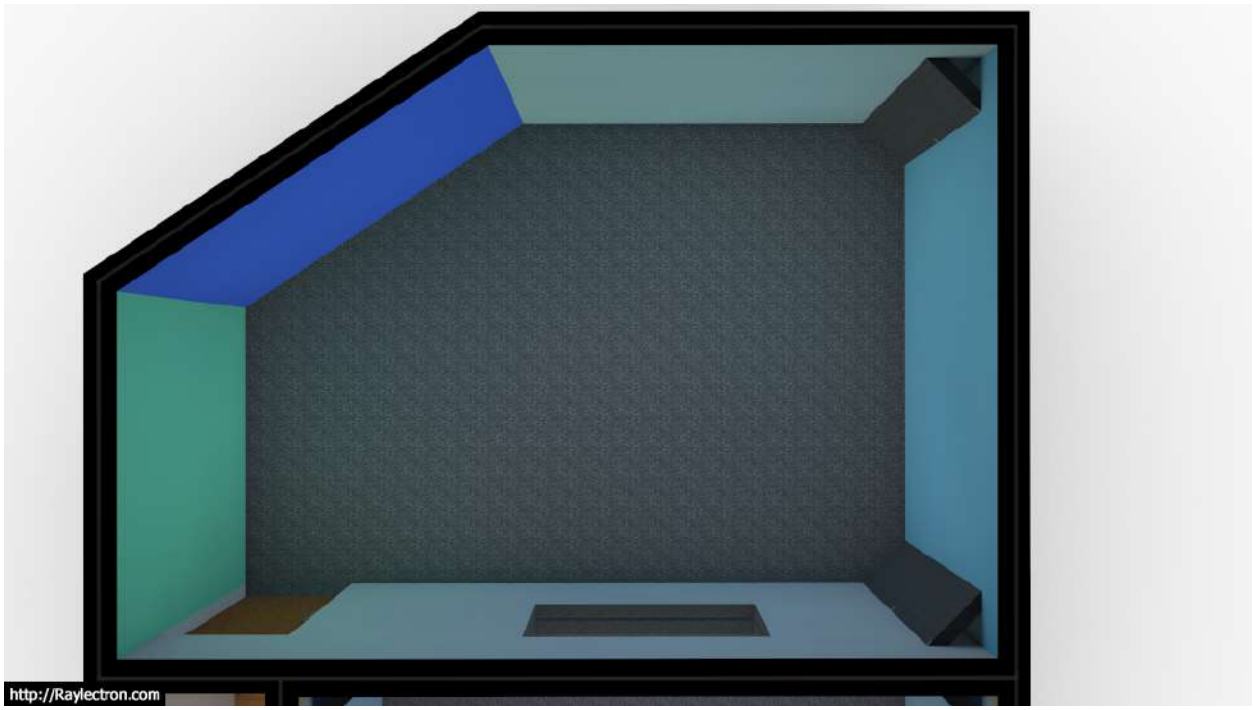


Figure 16 - Bass trap layout of live room

Bass Traps - 4 Corner bass traps of 120cm height each

Reverberation Time (RT60) and acoustic panels

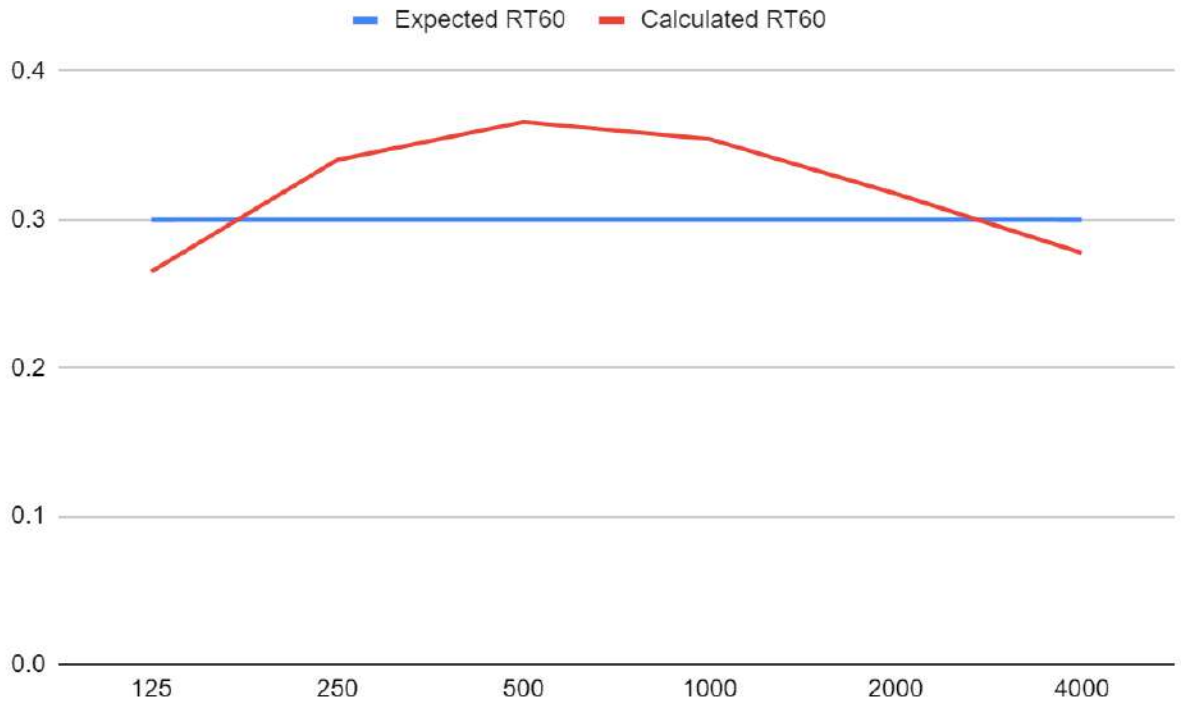
Control room

Let's calculate the Expected Reverberation time of the control room with Acoustics treatment. It's calculated that the control room required the following treatments.

1. 8 Bass traps at corners
2. 4 of ceiling 2" cloud panels of 0.72m^2
3. 6 of 4" acoustic panels of 0.72m^2
4. 2 of QRD 0.72m^2

Reverb Time						
Hz	**125**	**250**	**500**	**1000**	**2000**	**4000**
Expected RT60	0.3	0.3	0.3	0.3	0.3	0.3
Sa	22.53	17.54	16.32	16.85	18.80	21.51
Calculated RT6	0.2648562518	0.3402233626	0.3656847408	0.3542187201	0.3173924254	0.277490793

Table 3 - Calculated RT60 per octave band (Control Room)



Graph 1 - Expected RT60 after the acoustic treatments for the control room

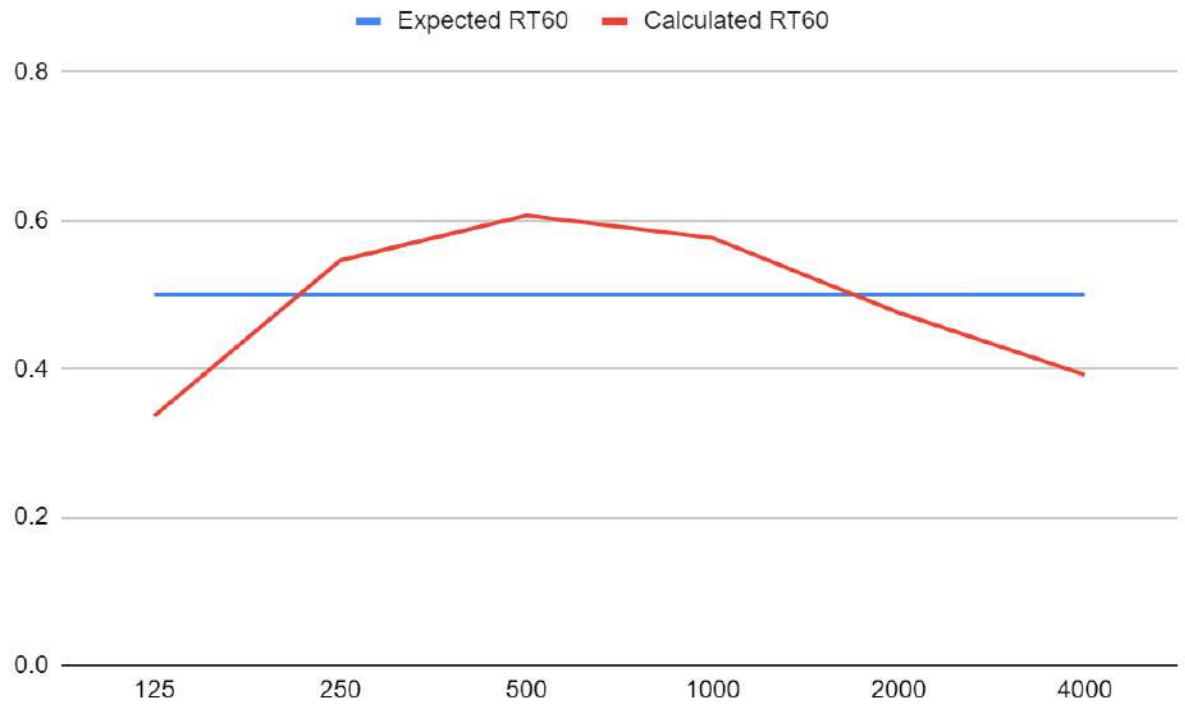
Live room

Similarly calculated the expected Reverberation time of the live room with Acoustics treatment. It's calculated that the control room required the following treatments.

1. 4 Bass traps at corners
2. 4 of ceiling 2" cloud panels of 0.72m^2
3. 10 of 4" acoustic panels of 0.72m^2
4. 5 of QRD 0.72m^2

Reverb Time						
Hz	**125**	**250**	**500**	**1000**	**2000**	**4000**
Expected RT60	0.5	0.5	0.5	0.5	0.5	0.5
Sa	34.80	21.43	19.29	20.30	24.61	29.87
Calculated RT6	0.3364038225	0.5462673077	0.6067901853	0.5765545041	0.4757144738	0.3919142781

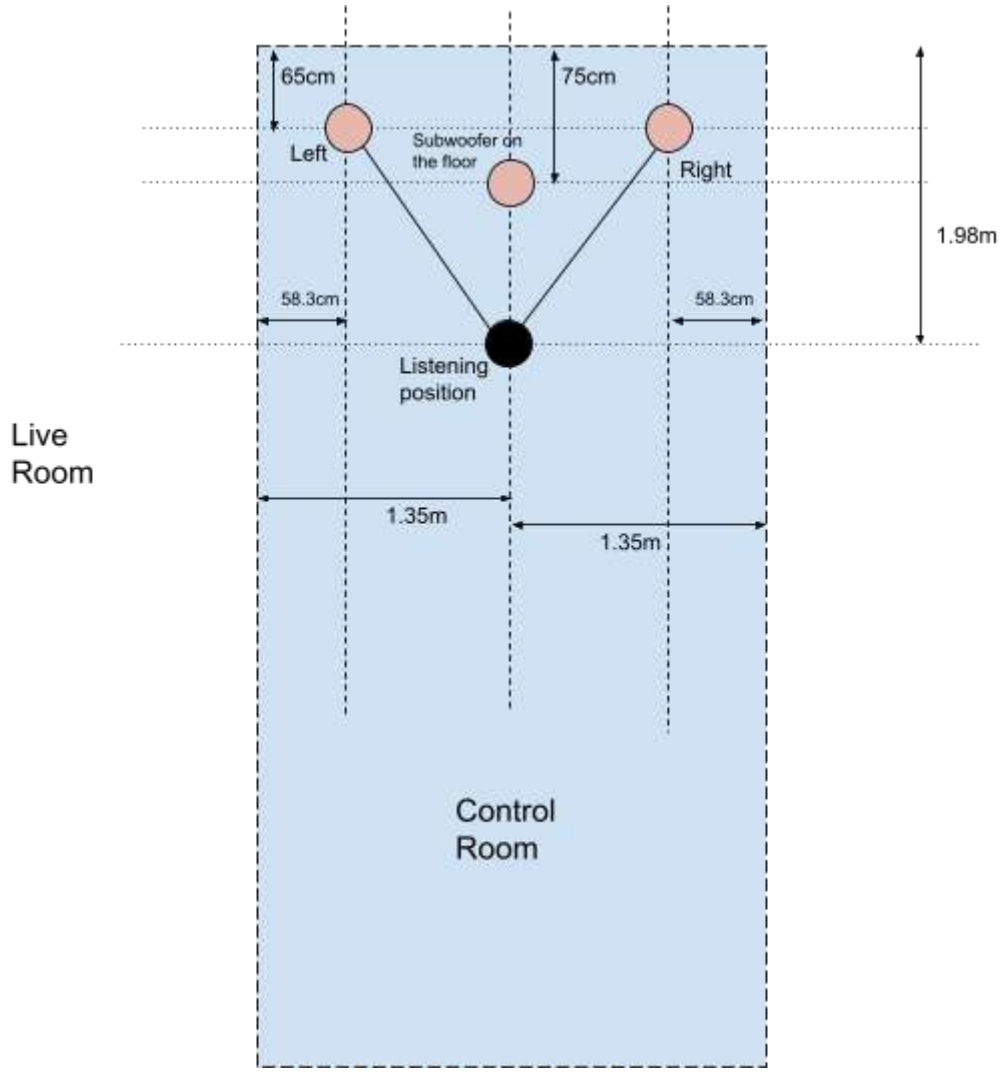
Table 4 - Calculated RT60 per octave band (Live Room)



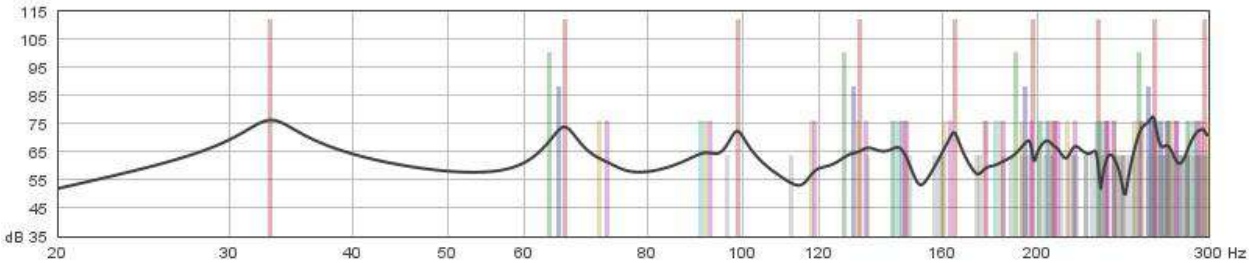
Graph 2 - Expected RT60 after the acoustic treatments for the live room

Identifying the listening position and speaker placement

A sound system of 2.1 is recommended for this room with the dimensions.

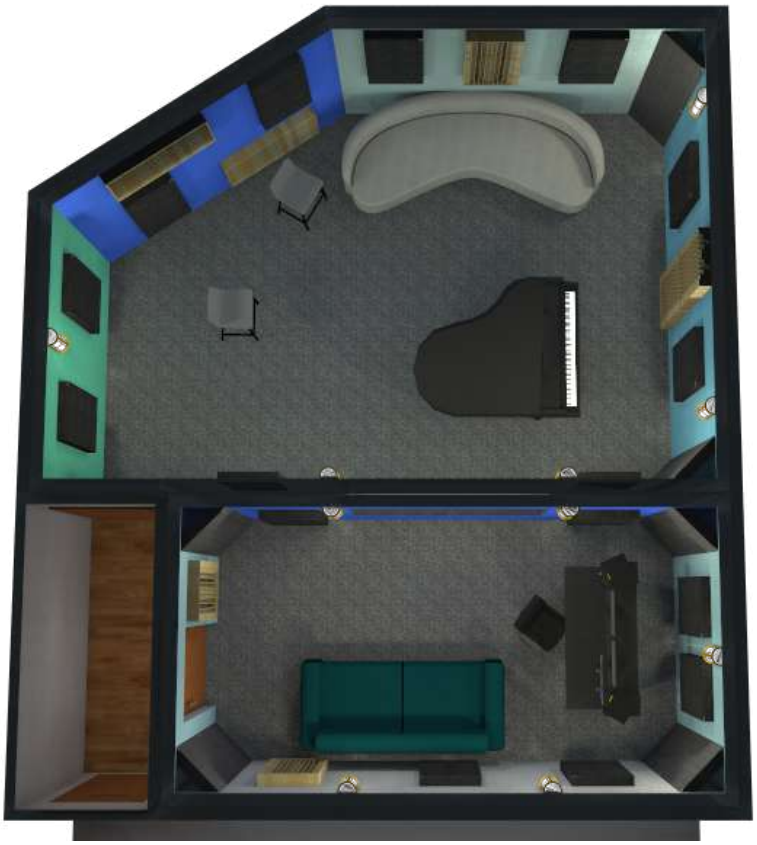


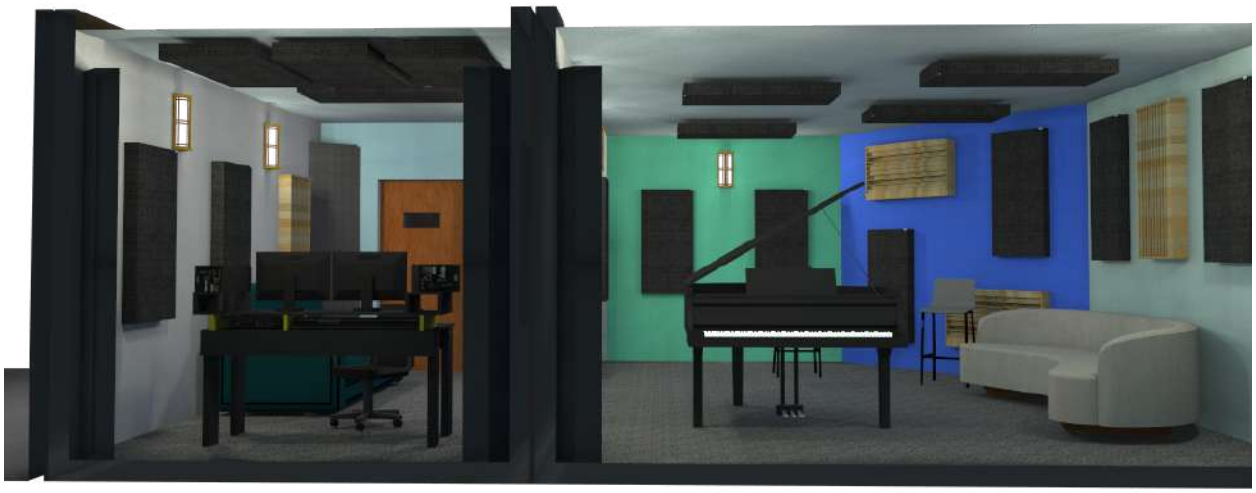
After correct placements and treatment, you'll get a low frequency response at the listening position as follows which will be fine for monitoring.



Final appearance

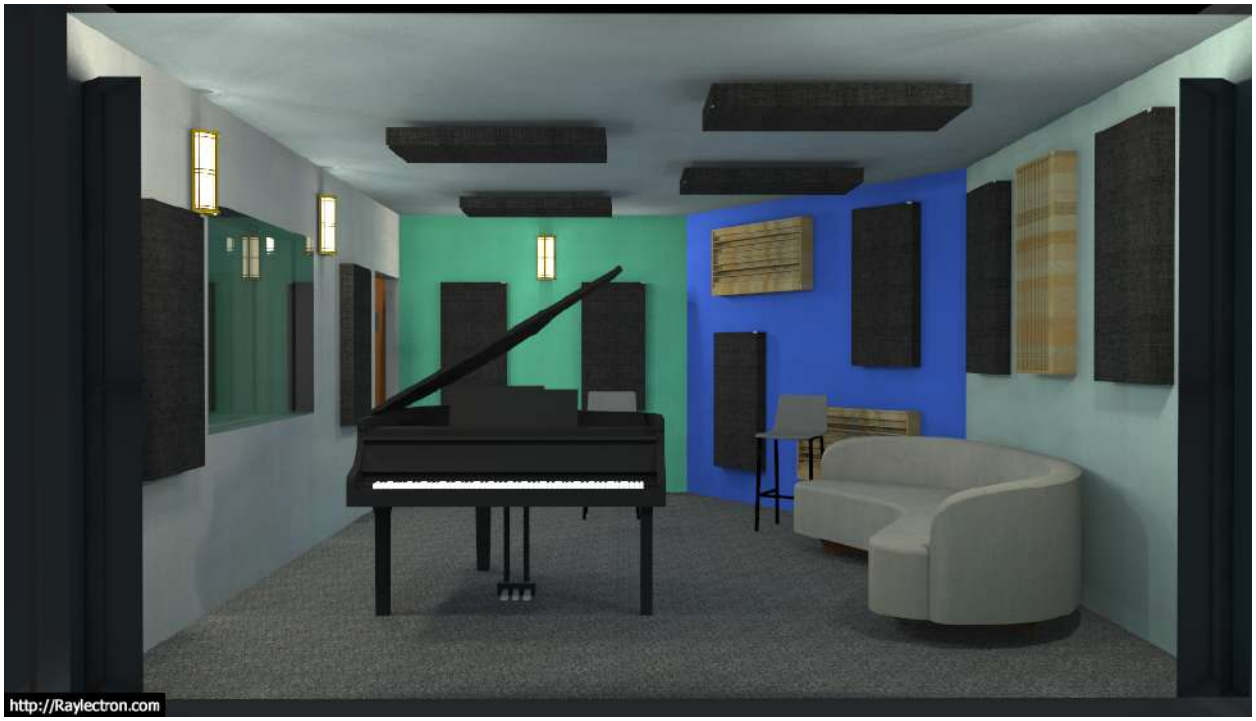
Overall





Control room

Live Room



Suggested equipment and ideas

1. Plan the HVAC system with your requirement with a technician. It will be better if you can install the cooling system outside the studio to avoid noises during recordings.
2. If you need any support in soundproofing the HVAC system, please contact.
3. Get the support of an interior designer if required. Please inform me before adding any additional materials to the space.
4. Decide the power distribution, Audio cable patching and equipment for the studio before the construction. Plan the wiring and cable layout accordingly.

These results are completely based on theories and calculations. Maintain given measurements during the construction and contact me for further assistance.

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