

Acoustics - 5008MAPA 2019/2020

A “KWL” Studio design

Student name: Silviu Stefan Nitu

Student no: 8343174

1.INTRODUCTION AND OVERVIEW

Acoustics are everywhere, all around us, in the music we hear, in our voices, in the cars, in our rooms. As an acoustician, you have to use your expertise to make all kind of designs, from a recording studio to a smartphone audio application, or workplace noise measurement and control. It means high-level education and practice, and it can help us to develop in other careers, due to knowledge gained in science, engineering, or even construction.

Acoustic treatment in a recording studio is very important. In the first instance it helps the microphones in getting a correct and natural sound from instruments or voices in the live room, without any unwanted noise, giving quality to the sound from the very beginning. In the second instance, it helps the sound engineer to mix and master correctly and creative in the control room. A good room acoustics does not have to be perfect, without any reverberation, it has to give the sound life and colour, in a good stereo image, elements which are really important in the making of a good sound. Also, we have to take in consideration the fact that each room is built for a different purpose, so, in conclusion, we have to use different acoustic treatment for each of them, in order to obtain a good frequency balance.

In order to obtain a good sound we have to use different types of absorbers to reduce the natural reverb of the room, but it might kill all the life of the room, that is why the absorbers work very well with diffusers, which are scattering all the reflections, in order to make nothing getting trapped, so the natural tone is preserved.

For my design, I have choose to keep things simple. My studio purpose is mainly hiP-hop production and post-production. When it comes to this genre, the vibe in the studio is very important, but the look is usually quite simple, colourful and lively.

I have been looking for some good looking designs on the internet, and I found some nice ones:



FIGURE 1 – STUDIO DESIGN FOR INSPIRATION



FIGURE 2 – NAS CUTTING-EDGE STUDIO – DESIGN FOR INSPIRATION

The design will have a main dominant colour, red, which is one of my favourites. The design will have to create a nice underground vibe in the studio. The control room has to have enough space for at least 6 or 7 people, so I decided to bring in a sofa and some armchairs. The engineer will have the mixing desk in the front of the room, and he will have a second chair next to him for the artist or an assistant. The live room is big enough to have some instrument inside, but I decided to build a separate box inside for the vocal microphone, the rest of the room being used only for repetition or live sessions. I decided to build this separate “mini live room” because the hip-hop vocals do not really need reverberation when recording, so this will be full of absorbers, eliminating most of the natural reverb inside of it.

My main source of inspiration is represented by a number of studios that I have visited during my career, studios where I have recorded songs and sometimes mixed and mastered. The first professional studio that I have visited was called “AMAVI”, and it is a local studio based in Bucharest, around the city centre, which is mainly focused on hip-hop production. The studio was placed at the basement level of the house, it was quite small but with good acoustics inside. The interior was all black, full of absorbers and 3 diffusers on the back wall in the control room. The live room was small, it could take only 3 people in it, without instruments, but the control room was big enough to keep over 10 people. The size of the live room was not a problem, because of the main purpose of the studio was only voice recording, having absorbers mounted on every wall, including the ceiling, the result being a clear voice without any reverberation. The control room was the perfect environment

for the artists and the sound engineer, being spacious and good looking, with “AMAVI” banners on the walls and RGB lights placed in some places.

My ideal is to keep things simple and efficient, in a good looking and acoustic treated environment, with enough space for people in the control room, and a live room which allows diversity for both recording and repetitions.

2. THE STUDIO DESIGN

Before starting doing my design, I have done some research on how a room should be treated. At first, I have considered using a room correction software, but I have concluded that it will not help when I have strong long reverberation times. I have decided to go for a design good for mixing and critical listening, which is using broadband bass absorption systems that are built into the walls. In order to keep the liveliness of the space, I will mount a rear diffuser.

At first, I have calculated the reverberation times of the rooms before the acoustic treatment. The material used for the floor is parquet fixed in asphalt, on concrete, while the ceiling is covered with a 10 mm thick plasterboard, with 25 mm bitumen. The walls are covered by a 100 mm plastic board. I have calculated the times for both rooms separately, the results being:

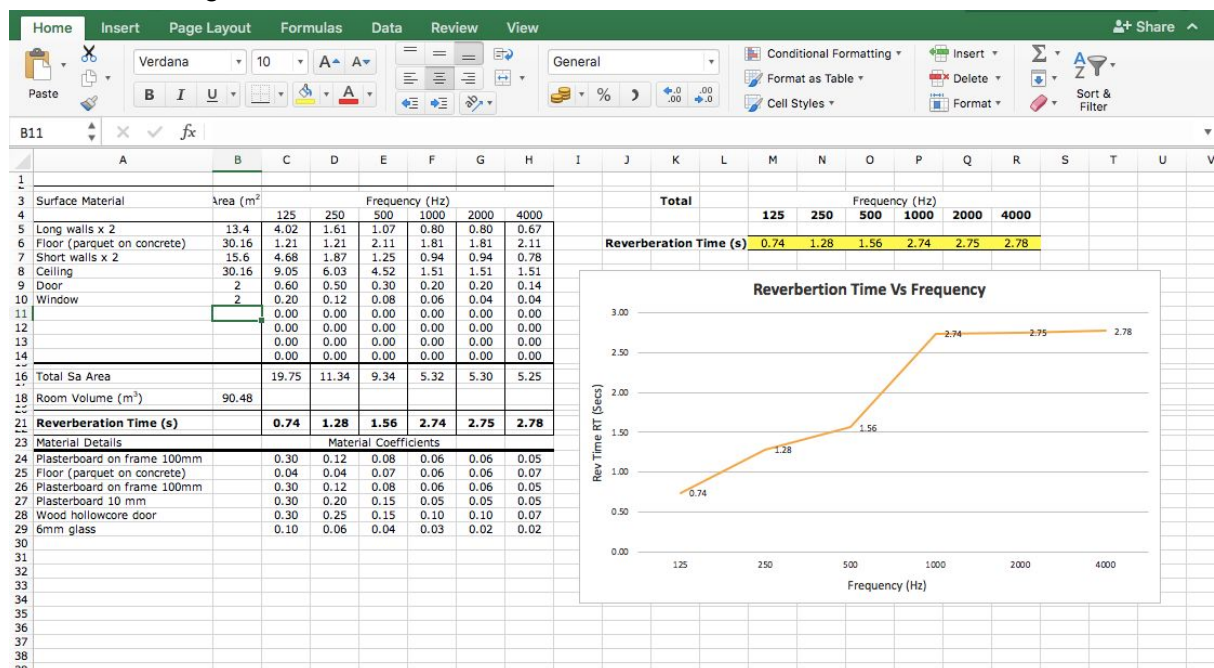


FIGURE 3 – REVERBERATION TIMES IN THE CONTROL ROOM BEFORE TREATMENT

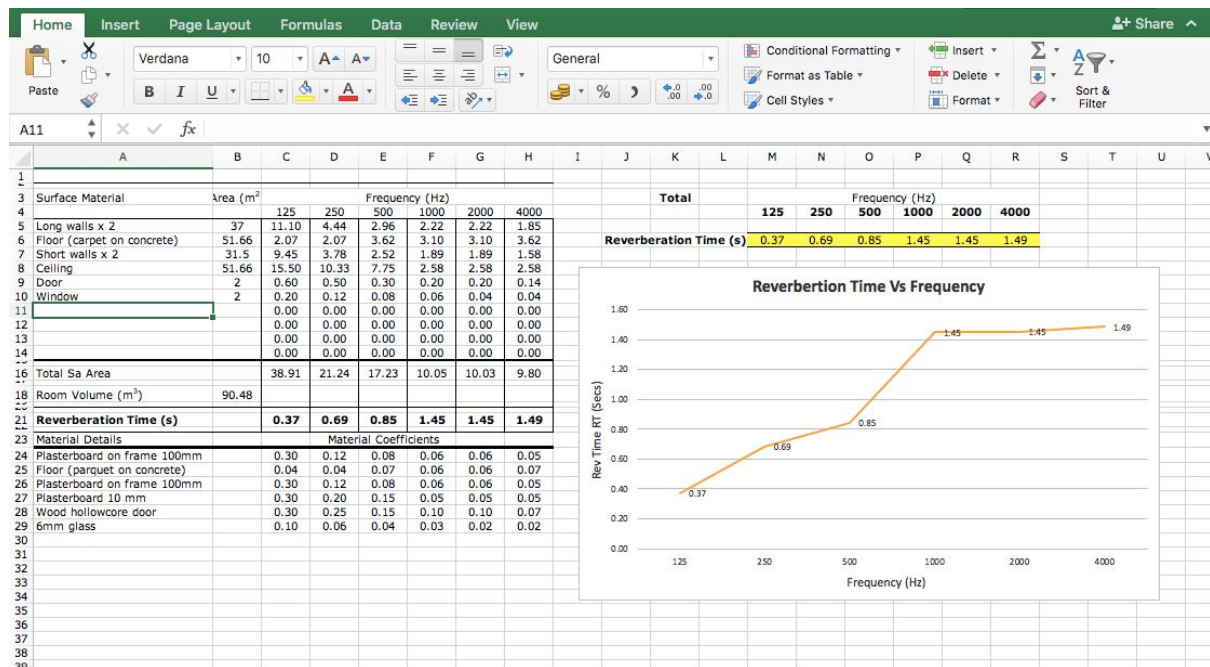


FIGURE 4 – REVERBERATION TIMES IN THE LIVE ROOM BEFORE TREATMENT

Considering these calculations, I have decided to treat the rooms in a way to obtain an average reverberation time of between 0.3 and 0.7 seconds for both control room and live room, so I can keep the life of the sound, without any problems in hearing, recording or mixing.

2.1 ACOUSTIC TREATMENT – CONTROL ROOM

I have started with the control room, where I have put the biggest effort, trying to obtain a good environment for the ears. The first thing in the treatment process is represented by the bass traps. At first, I have considered to use porous absorbers to catch the low frequencies. When using porous absorbers we have to leave a gap between the absorber and the wall, because they absorb most efficiently where the wave is at its maximum velocity. In our case, a sound waves reaches its maximum speed at $\frac{1}{4}$ the wavelength from a boundary, so, in consequence, the absorber should be placed at $\frac{1}{4}$ the wavelength from the wall.

As an concrete example, I have used the quarter wavelength rule to calculate the required distance for 40 Hz and 70 Hz.

For a 40 Hz wave, the wavelength is 28.125, from which a quarter is 7.03 feet = 2.14 meters.

For a 70 Hz wave, the wavelength is 16.07, from which a quarter is 4.01 feet = 1.22 meters.

I have realised that this solution is not an option, due to the big gap which is required to attenuate the low frequencies. I found out a quite good way to mount efficient bass traps, using edge absorbers, by mounting a thick piece of fibrous material (like Roxul Rockboard 60/40 or OC 703/705), which is creating an air gap. The sound speed is reaching the

minimum value when hitting the corner, but it will raise dramatically when travelling in the space in front of it.



FIGURE 5 – OC 703

Normally, the places where the bass is building up more strongly are the corners, especially the trihedral ones, formed at the intersection of 2 walls and the floor or ceiling. I have mounted 3 bass traps, 2 on the back corners, starting from the ceiling, going to the floor (covering 2 dihedral corners and 4 trihedral corners, 3m x 0.7m) and one on the upper front corner, right on the top of the mixing desk, going from the left wall to the right one (covering 1 dihedral corner and 2 trihedral corners, 5.8m x 0.7m).

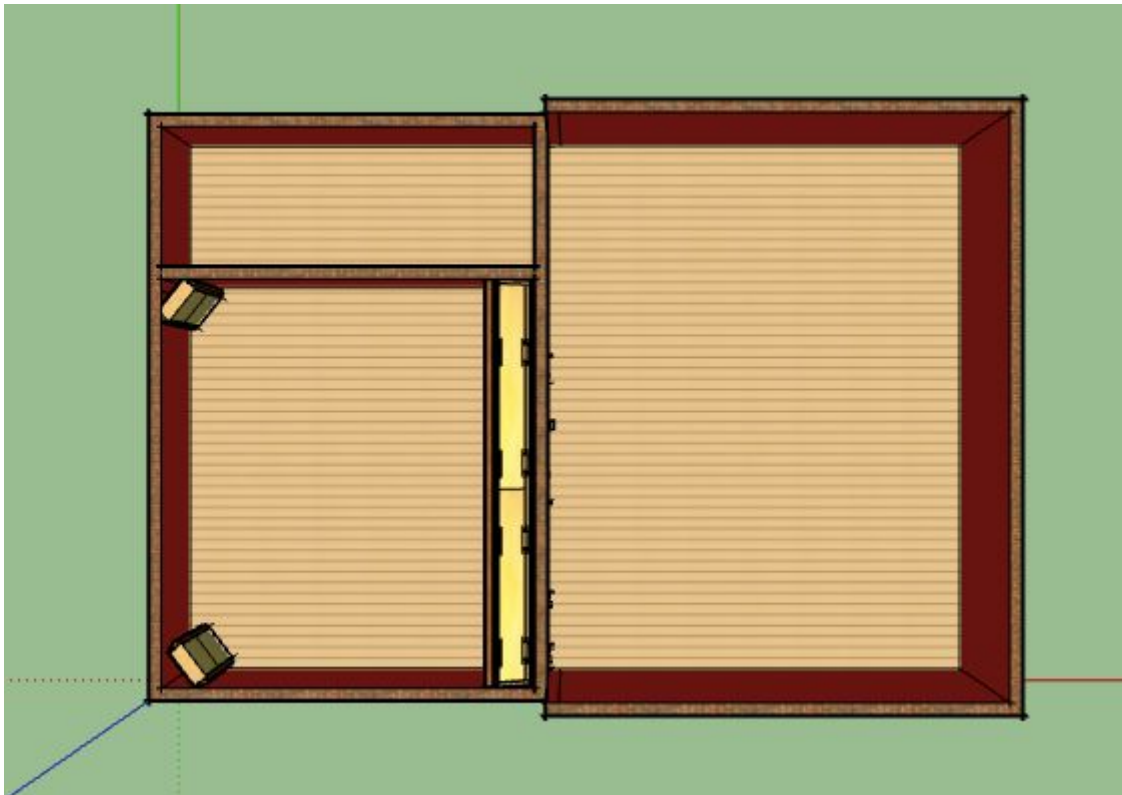


FIGURE 6 – BASS TRAPS MOUNTED – TOP VIEW

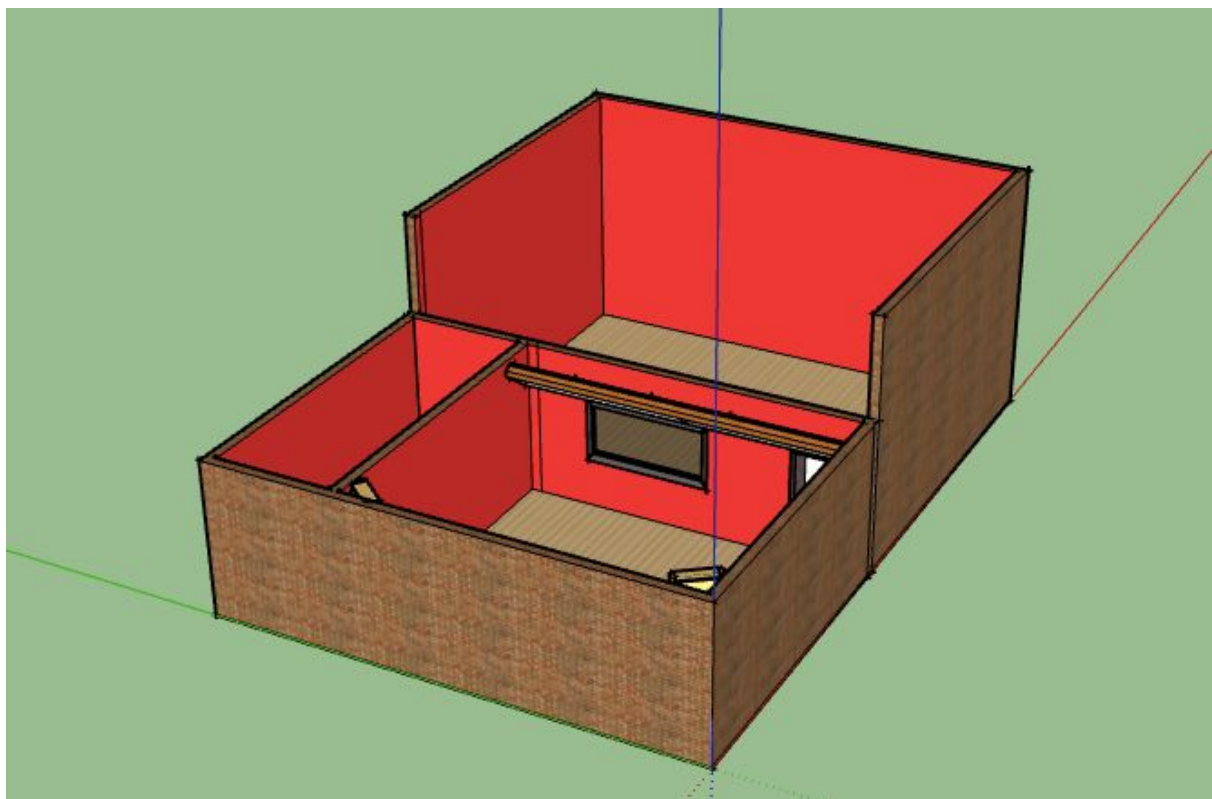


FIGURE 7 – BASS TRAP MOUNTED – SIDE VIEW

The next step was to adjust the position of the mixing desk and the listening position. I have placed the desk, together with the monitors, a little bit far from the front wall, at a distance of 0.8 meters, so the sound will have enough space to develop.

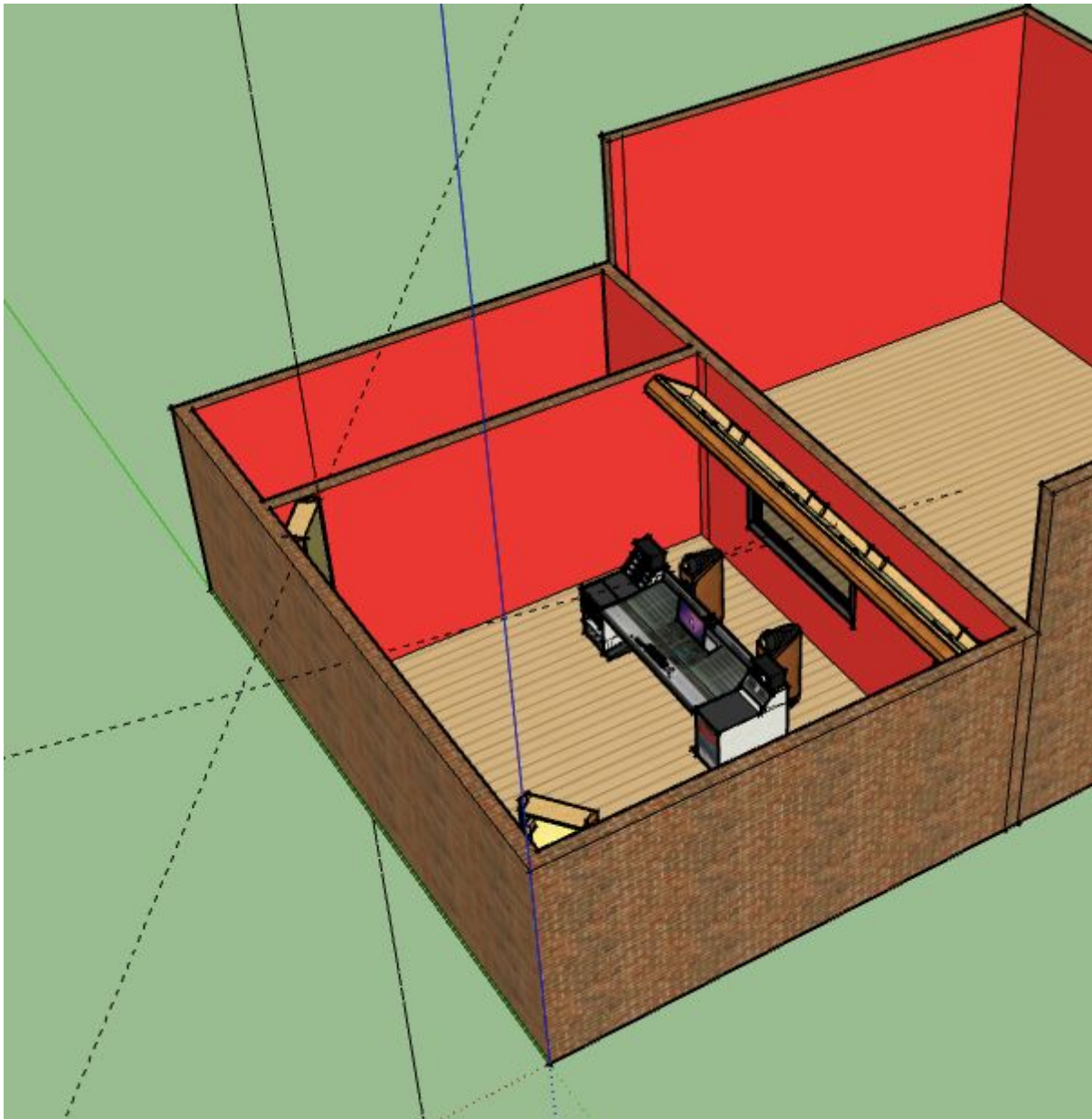


FIGURE 8 – MIXING DESK PLACEMENT

After this, I have started to treat the side-walls. After placing the mixing desk, I was able to identify the first reflection points, which are very important for the aspect of the sound. If they are left untreated, the sound from the speakers will be combined with the reflections, making comb filtering, which is a sort of an acoustic distortion, masking details in the media and causing coloration.

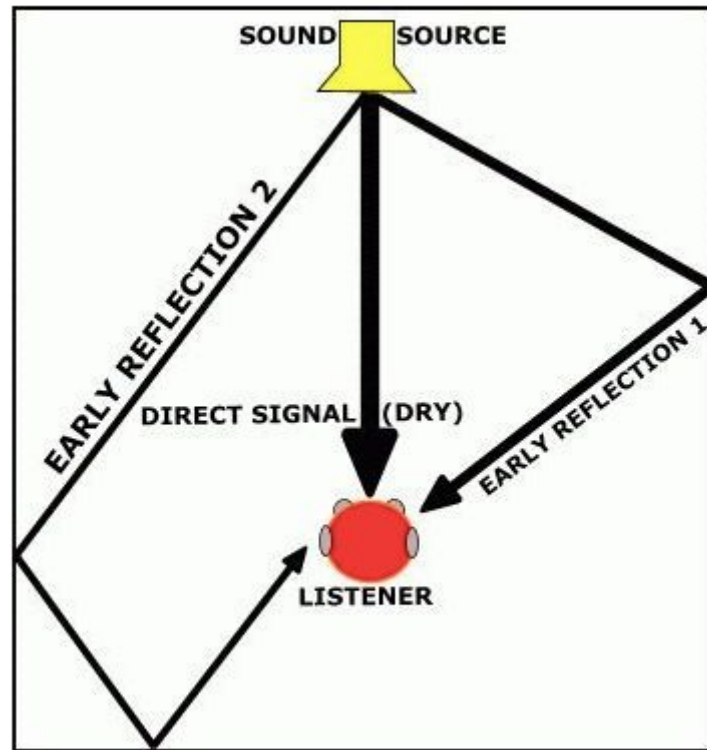


FIGURE 9 – EARLY REFLECTIONS

In order to make the early reflections lower, I have mounted 4 broadband absorption tiles, 2 on the left side and 2 on the right side, on the same line with the mixing desk, so they will cover enough surface to catch the early reflections.



FIGURE 10 – AURALEX ABSORPTION TILES



FIGURE 11 – SIDE ABSORPTION TILES

After the first row of side absorbers, I have decided to add 2 more panels on the front wall, behind the speaker, so they can reduce the reverberation more. The material is the same with the side ones, but these ones are smaller. Also, due to the high reverberation at higher frequencies, I have decided to add 2 more panels on the sides, but bigger, made of a 9 mm acoustic plaster, on the wall, with bigger absorption coefficients on higher frequencies.

The last absorber mounted in the control room is the one on the ceiling. We will be mounting one cloud panel, hanging over the mixing desk and leaving 75mm airspace.

The last thing in the treatment process is the diffuser. I do not want to get rid of all of the reflections, but I need a part of them to create a realistic stereo image and make the sound natural. The diffuser will be mounted on the back wall, having the role to scatter the sound and making it return to your ears at many different intervals.

And, as a slight note of treatment, I decided to change the door with an acoustic one, with steel frame, double seals and absorbant in airspace.

The results obtained after the acoustic treatment are shown below:

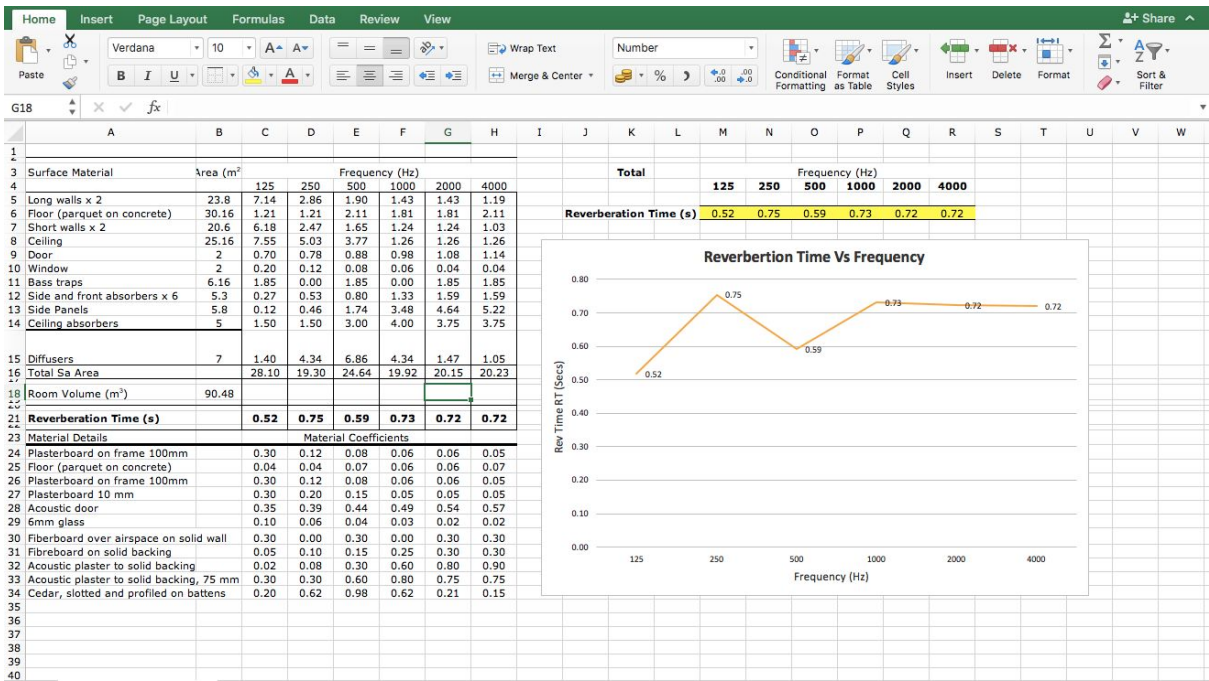


FIGURE 13 – REVERBERATION TIMES AFTER ACOUSTIC TREATMENT

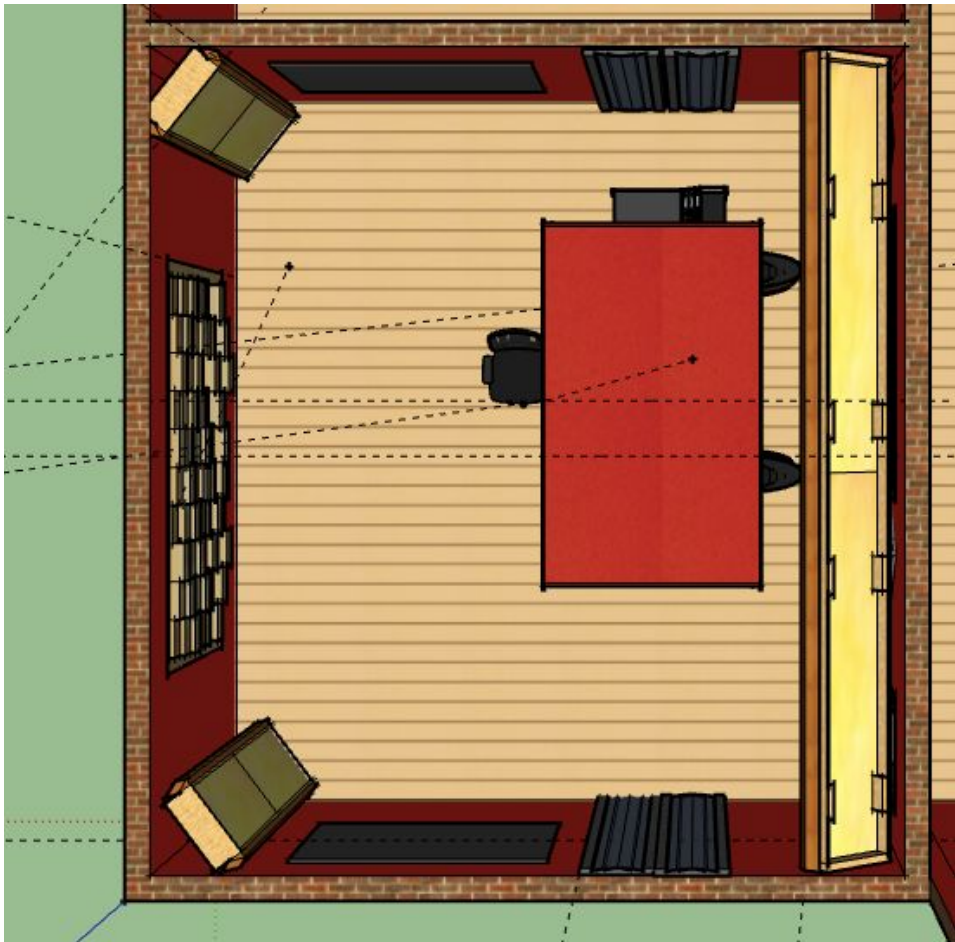


FIGURE 13 – CONTROL ROOM AFTER ACOUSTIC TREATMENT – TOP VIEW



FIGURE 14 - CONTROL ROOM AFTER ACOUSTIC TREATMENT – SIDE VIEW 1

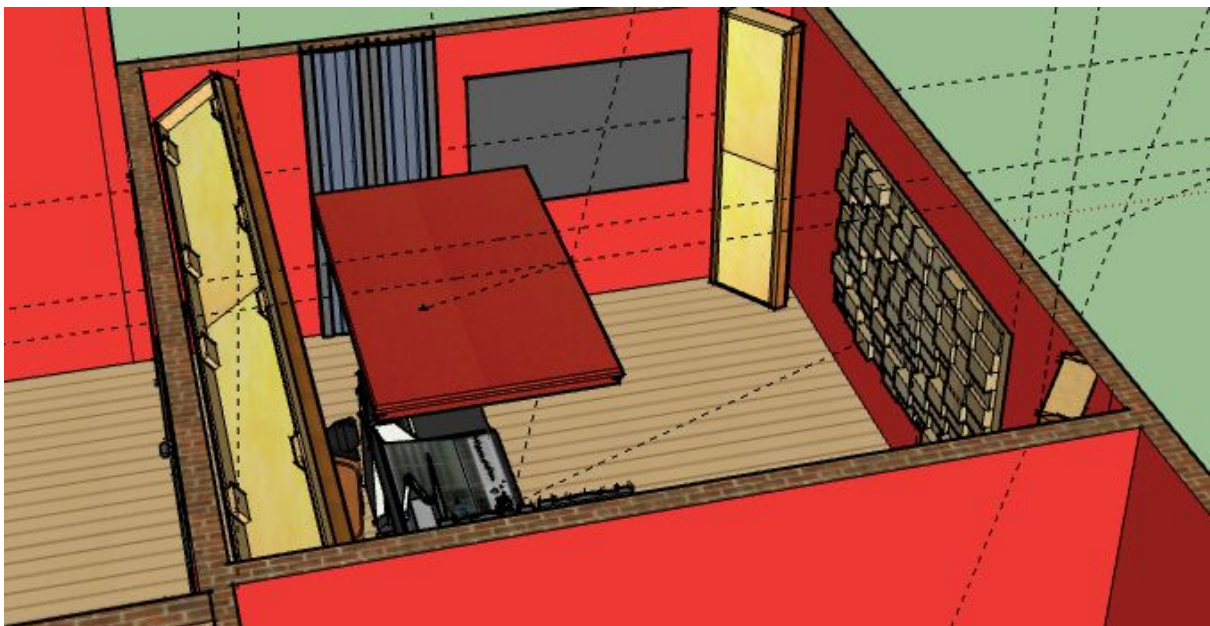


FIGURE 15 – CONTROL ROOM AFTER ACOUSTIC TREATMENT – SIDE VIEW 2

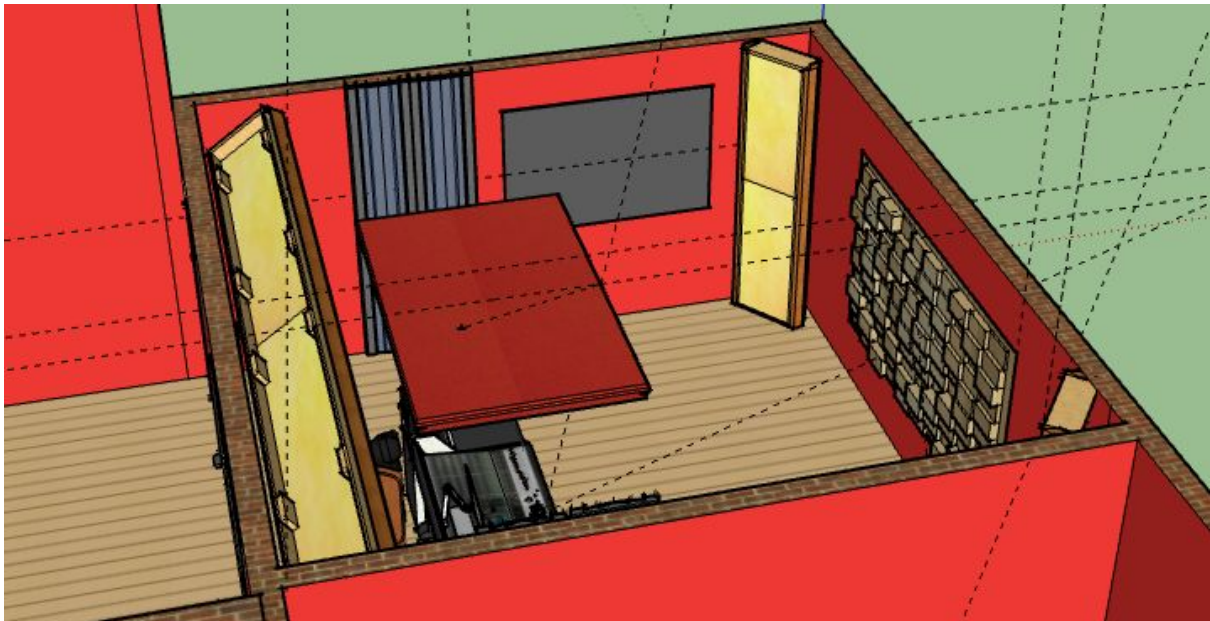


FIGURE 16 – CONTROL ROOM AFTER ACOUSTIC TREATMENT – SIDE VIEW 3

2.2 ACOUSTIC TREATMENT – LIVE ROOM

When I started the live room I wanted to try to keep the same range of used materials. The room is much bigger, so the reverberations are bigger as well.

The first thing that I have done was to create a separate recording room, which is much smaller than the whole live room (L=2.1 meters, W=2.1 meters, H=5 meters), which has a balanced and relatively low reverb time on high frequencies. However, on the low end frequencies the reverb time is bigger than the high end ones, but still acceptable.

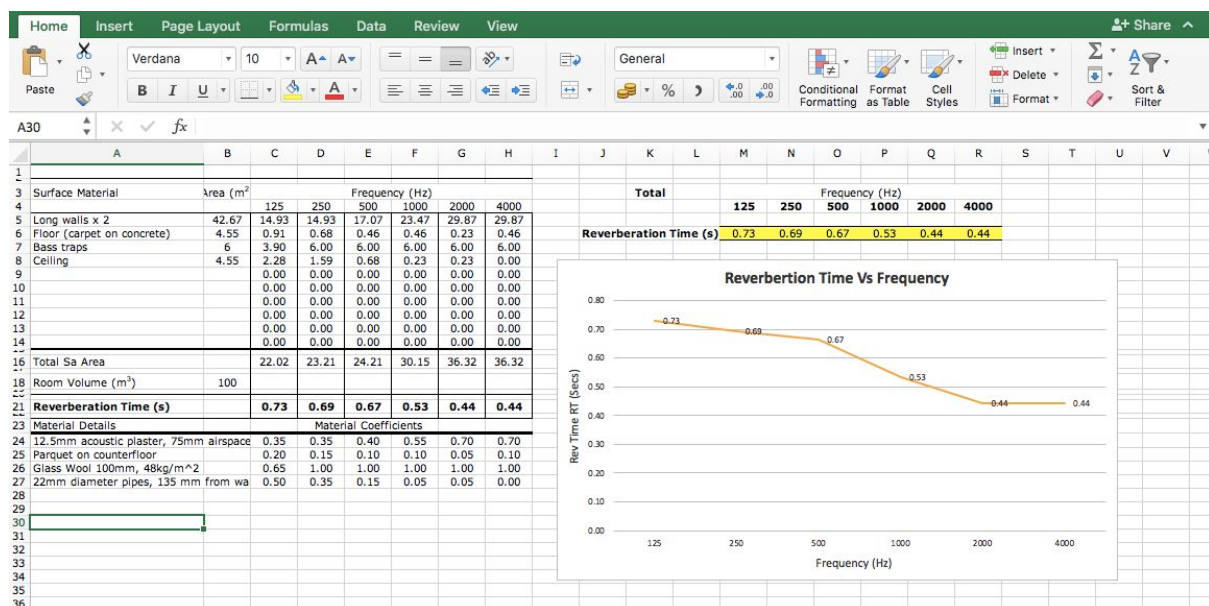


FIGURE 17 - REVERBERATION TIMES FOR THE SMALL ROOM INTO THE LIVE ROOM,
AFTER TREATMENT

Due to the new room inside the live room, the total surface of the walls has become much bigger, so I had to do separate calculations for those ones.

The bass traps are much lighter this time, just some curtains. Being a large room, controlling the low frequencies is easier, so I had no problems with reducing the low reverb time.

I have used big absorbers on the sides, summing almost 27 square meters, which have done a lot of hard work. I have designed the live room more for instrument recording, even considering the low reverb times obtained in the end. The main challenge was to keep the life in the room. I have thought that instruments usually need a touch of reverb, so that is why I have mounted 2 big diffusers on the rear wall, next to the small room.

I have also mounted a small ceiling absorber, in the middle of the room, in order to catch some of the first reflections coming from different sides on the room.

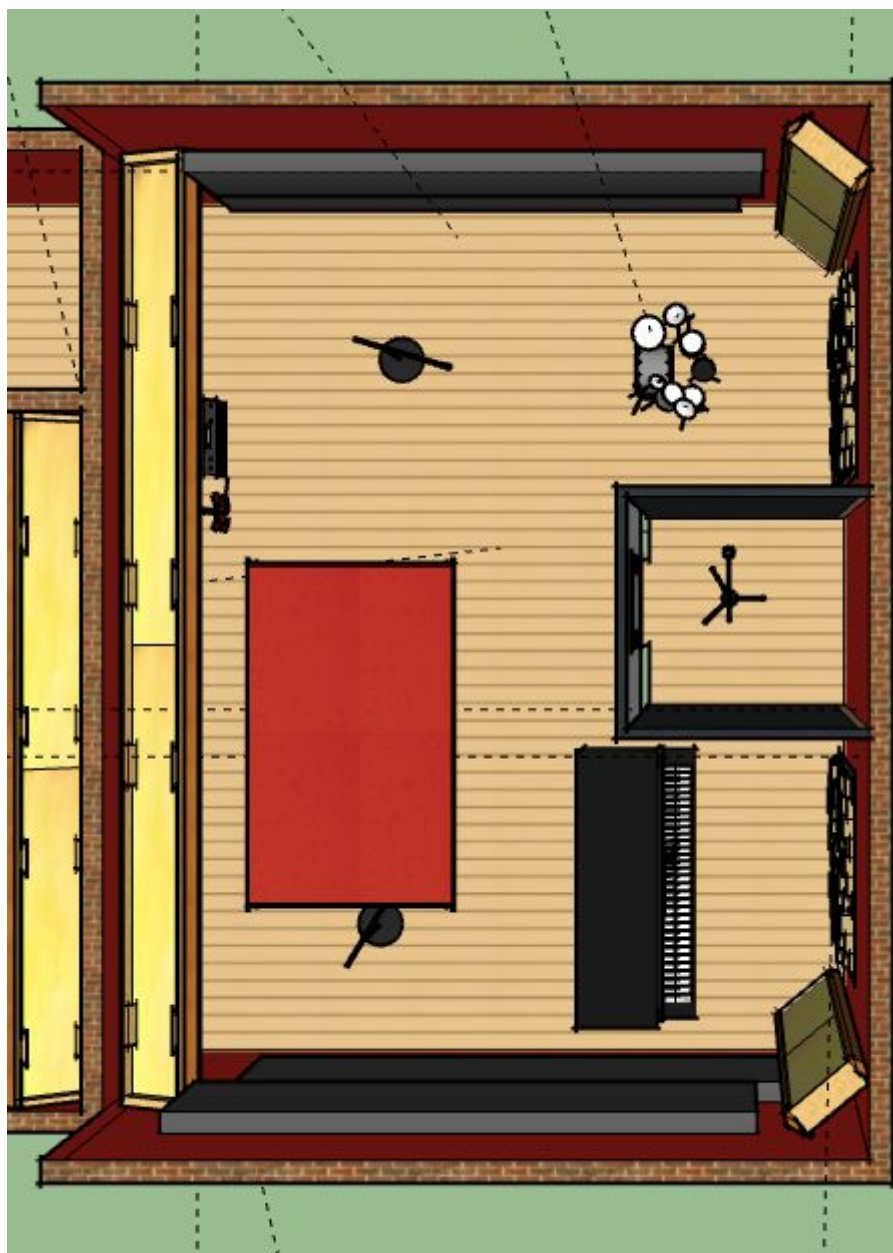


FIGURE 18 - LIVE ROOM AFTER TREATMENT – TOP VIEW

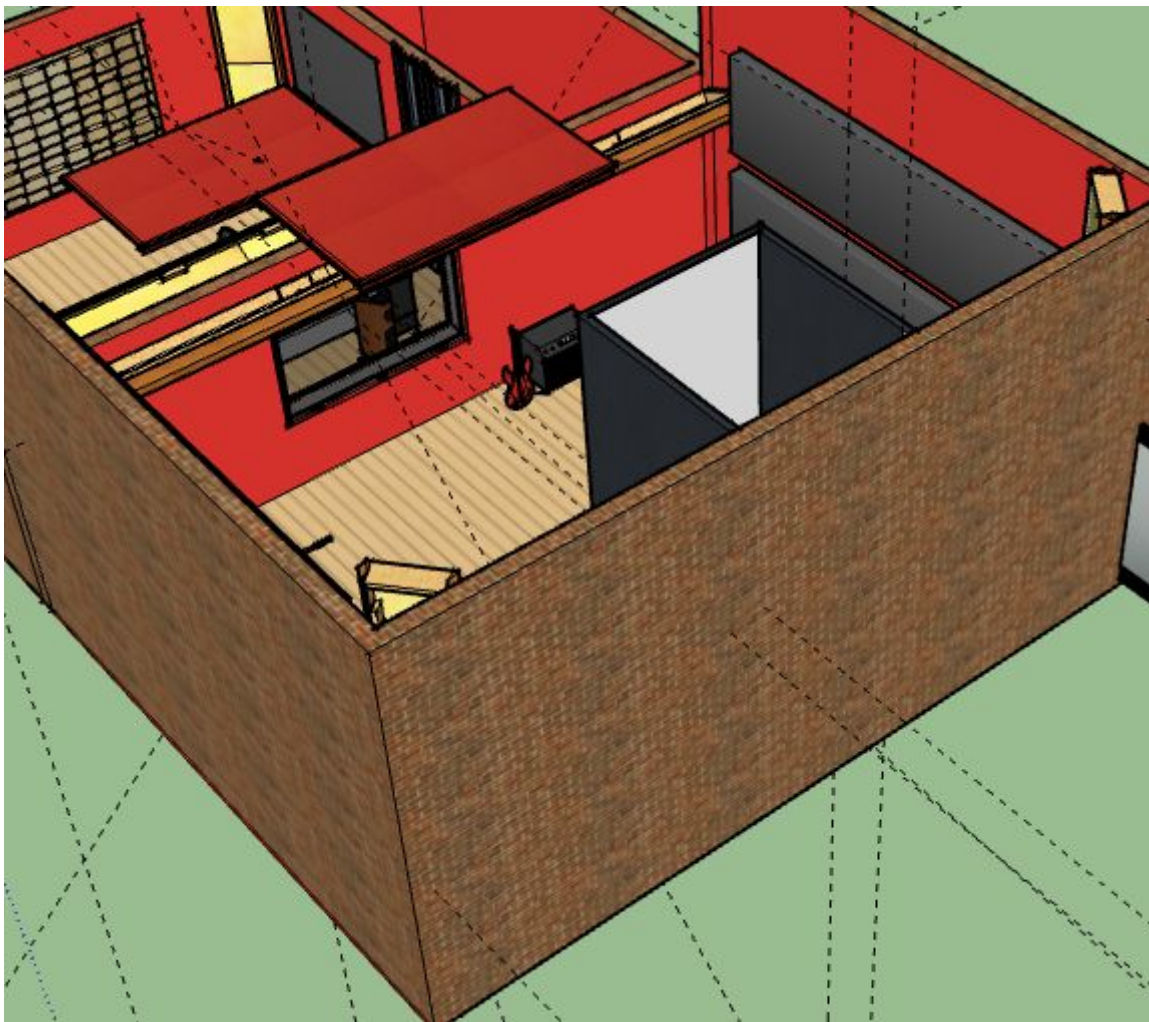


FIGURE 19 – LIVE ROOM AFTER TREATMENT, SIDE VIEW 1

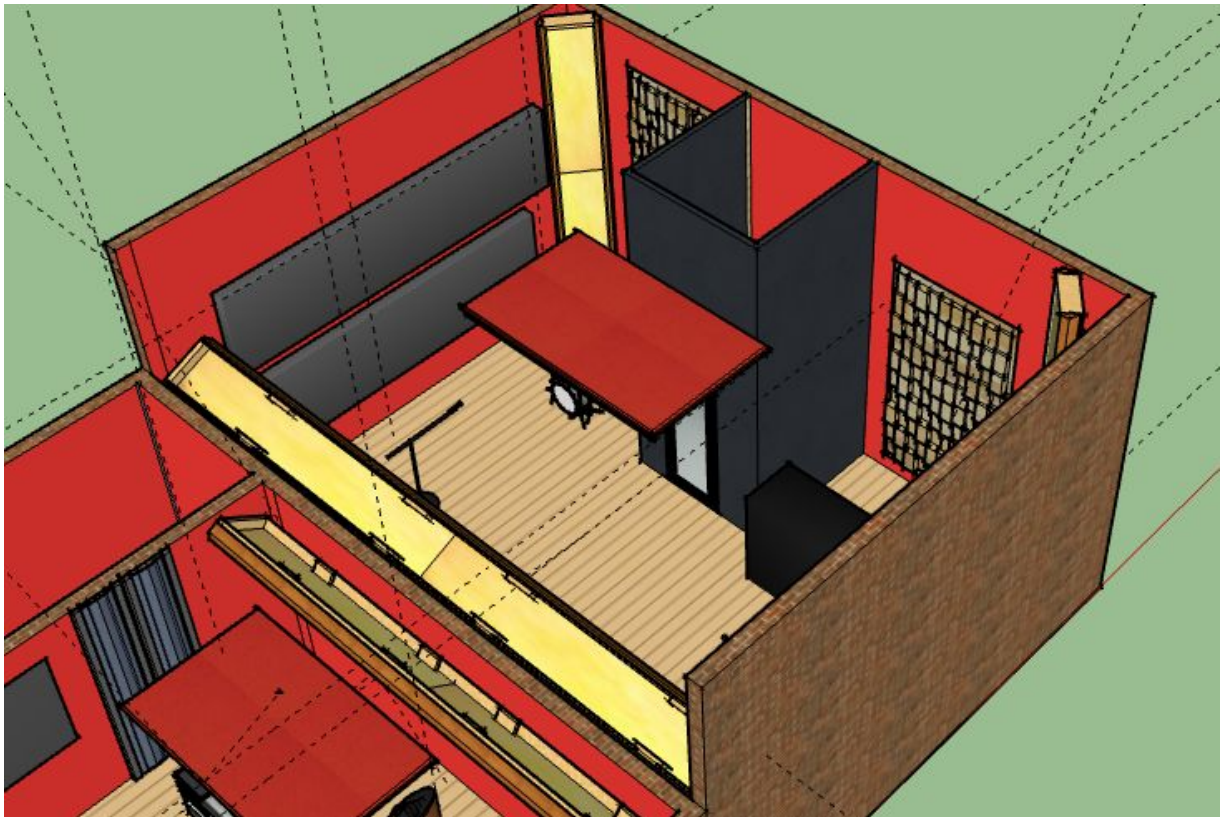


FIGURE 20 – LIVE ROOM AFTER TREATMENT, SIDE VIEW 2

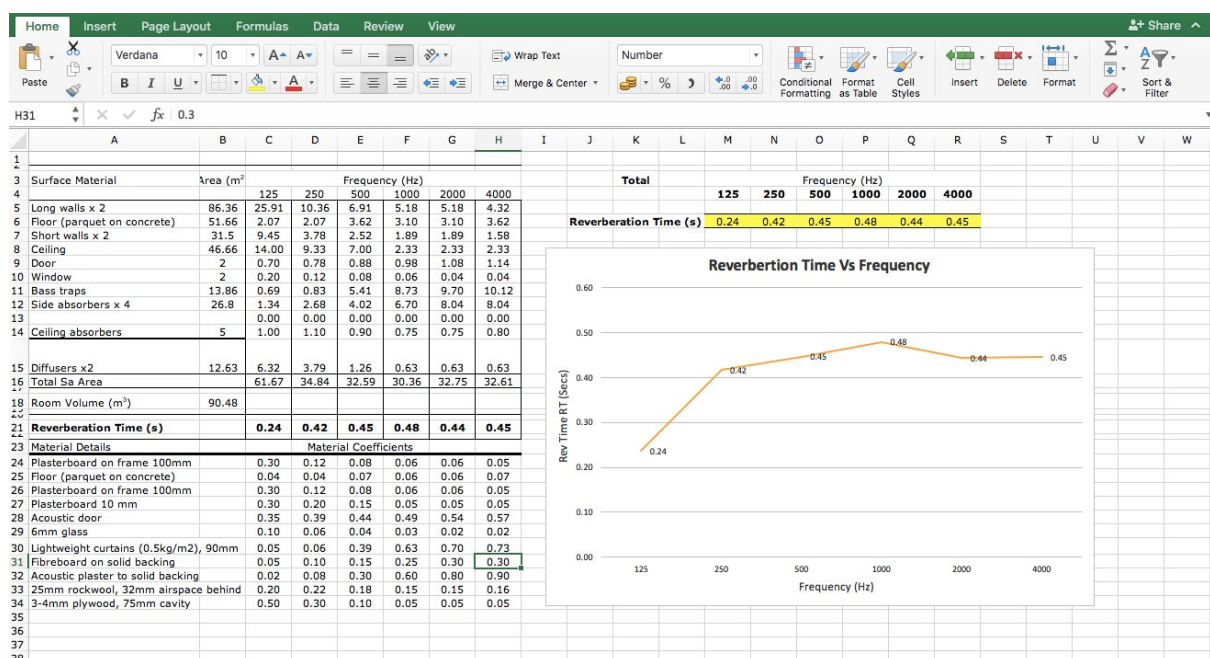


FIGURE 21 – REVERBERATION TIMES IN THE LIVE ROOM AFTER TREATMENT

The big challenge with the live room was represented by the size of the room, especially the separated room. I had designed the small room only for vocals, trying to keep them away from instruments and bleeding. The rest of the room is designated to specific instruments recording and live session, being big enough and well treated for a good sound.

I have tried to create a less reverberant medium for the recording part, where the natural reflections can be your worst enemy. That is why I have spent more time on the control room.

My research has been mainly based on the internet, looking for website that can be trusted, such as www.argen.com, where I could find a lot useful content well explained, and with concrete examples. Another source for my research is even my experience, I have been working with loads of sound engineers in my country, and I have visited their studios, which are not the best when it comes about acoustic treatment, so I have tried to combine their ideas with my knowledge and create a decent studio with the main purpose of recording hip-hop.

I have also looked for designed by simply just searching on engines like Google, where I could find a lot of inspiration. My design is quite simple, but I prefer efficiency, with a decent aspect.

3.CONCLUSION

During this assessment I had the opportunity to understand a really important principle in the music industry, the acoustics, and why they are crucial when it comes about creating music. Now, based on the learning outcomes I can develop my own studio and think the design by myself. One of the things that I have found interesting is the use of the diffusers. In any place that I have been in, I could not see any of them, and I had no opportunity to hear the sound in a room with diffusers. I think it is one of the most important parts in the treating process and it looks really beautiful, having a lot of aspects.

Another interesting things is the fact that the low frequencies are really hard to stop in a normal room. I have seen that in the live room they went off quite fast, because of the size, but in the small room and the control room they have been really "stubborn". I have used the most powerful material that I could find on the list, and I still could not find a way to bring the low frequency reverb time under 0.5 in the small room.

During making this assignment I have encountered many problems, which have left big signs on the project itself. The first one, and probably the biggest, was the program. In my opinion, Sketchup does not have a smooth and fast workflow, not even decent one. A lot of tools are hidden, I had no option to use commands on the keyboard to activate a tool or a function (Or I have not been able to see one), and I had to click every tool every time when switching between them, which represented a big waste of time.

If I would have to implement this in real life, I would probably take a lot of time, because I did not take in consideration the red walls, only when doing some calculations, but I think that putting this in reality is a lot harder than it seems, I would prefer to wait until I have enough knowledge and experience. If I would start it tomorrow, I would probably begin with the first layer on the walls, and I would make sure that I am using quality materials. I would also try to make my own diffusers, in the way that I want them to look, and I would also pay a lot of attention at the bass traps, I still do not know how to deal with them properly.

The acoustic treatment will probably remain relevant a lot of time from now. People are trying to correct the acoustics in a room by buying expensive hardware or software, which, for the moment, do not offer the quality and the feeling of a proper studio. I think that

we will have acousticians a lot of time from now, because they are usually learning more than simple acoustics. They are learning physics, or mathematics, sciences which will help them in many other careers.

LIST OF REFERENCES:

1. Tim Perry (2016). [ONLINE] Available at:
<http://arqen.com/acoustics-101/room-setup-acoustic-treatment/>. [Last Accessed 25 apr 2020].
2. Lee Glynn (2009). . [ONLINE] Available at:
<https://www.pmtonline.co.uk/blog/2009/04/07/a-basic-guide-to-acoustic-treatment/>. [Last Accessed 25 apr 2020].
3. Auralex (). . [ONLINE] Available at:
<https://www.pmtonline.co.uk/auralex-wedgies-studio-foam-box-of-24-charcoal> . [Last Accessed 28 apr 2020].
4. Tim Perry (2016). . [ONLINE] Available at:
<http://arqen.com/bass-traps-101/placement-guide/>. [Last Accessed 25 apr 2020]
5. E-Home Recording Studio (). . [ONLINE] Available at:
<https://ehomerecordingstudio.com/acoustic-treatment-101/> . [Last Accessed 20 apr 2020].
6. Undercaste Studios (2020). . [ONLINE] Available at:
<http://www.adsinusa.com/adphotos.htm?id=3889w4739>. [Last Accessed 12 apr 2020].
7. Mark Sullivan (2017). . [ONLINE] Available at:
<https://www.wework.com/ideas/growth-innovation/hip-hop-trailblazer-opens-cutting-edge-studio>. [Last Accessed 12 apr 2020].
8. Institute of Acoustics (2019). . [ONLINE] Available at: <https://www.ioa.org.uk/node/15>. [Last Accessed 2 may 2020].
9. Leor Galil (2017). *Private Stock is a one-stop hip-hop shop* . [ONLINE] Available at:
<https://www.chicagoreader.com/chicago/private-stock-hip-hop-valcarcel-chinza-fly-vangogh-escobar-cuevas/Content?oid=25694791>. [Last Accessed 12 apr 2020].
10. Richard E. Berg (1998). *Acoustics*. [ONLINE] Available at:
<https://www.britannica.com/science/acoustics>. [Last Accessed 28 mar 2020].
11. Chalmers University of Technology (). *e.g. Training and certification*. [ONLINE] Available at: <http://www.ta.chalmers.se/education/master-sound-vibration/role-of-acoustics/>. [Last Accessed 28 mar 2020].