What material can block ♫ sound ♫ the best?

Introduction

Abstract

In this project I am studying potential sound barrier materials by comparing five different materials (fabric, wood, styrofoam, tile, and carpet made from artificial grass) to see which one can block sound the best.

In the end, carpet made from artificial grass proved to be the most effective sound barrier while fabric was the least effective.

Category

Energy and Change (ENR)

Purpose of Experiment

We were studying energy in my class and did a short module on sound. However, we did not do a dive deep into it. So I decided to go deeper into studying sound for this project by trying to measure sound travelling through fabric, wood, styrofoam, tile, and carpet made from artificial grass.

The reason I chose these materials was because typically I see fabric curtains and wooden walls used to stop sound but other items that are used in house improvement projects don’t really consider sound like putting in new tile or carpet (like artificial grass) for your floor. So that’s why I’m using materials like tile, carpet and styrofoam to give me a new perspective.

Research on materials to use

From the internet, I found 22 different materials that were used best to block sound. After I collected that information, I started crossing off items that were not easy to get or were not at my disposal. However, I encountered a problem, the final materials were still too many. So, I asked AI what materials are best for blocking sound. Here is what I got.

With this list, I looked for materials that were easy to get, some of which I decided to use for this project.

🏆 **Best Materials for Blocking Sound**

Material	How Well It Blocks Sound
Concrete/Brick	Excellent – very heavy and dense
Thick Wood	Good – blocks most sound
Mass-Loaded Vinyl	Excellent – designed just for soundproofing
Foam/Carpet	Fair – absorbs echoes but doesn't block much
Curtains/Blankets	Some – better than nothing, but not perfect

Source : Microsoft Co-Pilot

Final materials

1. Fabric.
2. Wood.
3. Tile.
4. Styrofoam.
5. Artificial grass.

Hypothesis

*With the five materials I'm using, I think the material that can block sound the best will be **'Wood'**.*

Setup – Option 1

Initially, I thought of having a linear setup with a sound producing device, the material to be tested and the sound meter. Please see the adjacent figure for my proposed setup.

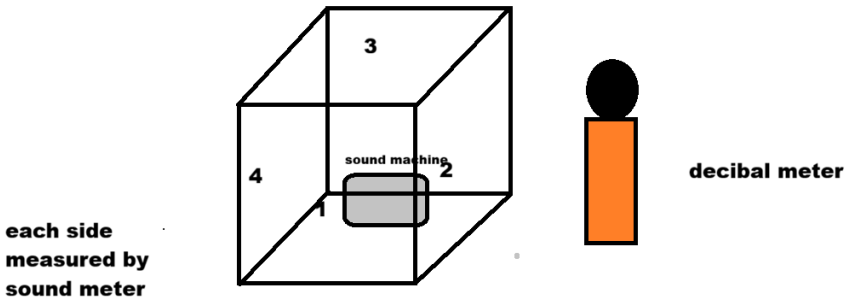
While this is a very simple setup, I realized that having this kind of a setup will cause sound to escape from all sides.

Setup – Option 2

The cube represents the material we will use.

The upgrade from setup 1 is that the material covers the speaker on all sides preventing sound from escaping.

Also, instead of having to build a cube of each material, I decided to use a cube shaped fabric hamper as a frame which I would use for testing the material.



Procedure

1. Used five materials from the store/ easily available at home – fabric, wood, styrofoam, artificial grass carpet and tile.
2. Bought a bluetooth speaker and one audio meter to measure sound in decibels.
3. Conducted the experiment in my room, where the temperature was about 75 deg F.
4. Setup one (base) material “fabric” for a cube shaped hamper and covered the top with the material too. The hamper measured 12” x 12” x 12”.
5. Placed a bluetooth speaker at the bottom center of the cube.
6. Used three types of sound – **rain** on lake, **crickets** chirping (natural sounds) and air conditioner **A/C** (mechanical sound). I ensured that I played each sound at volume level 35 on my computer.

Procedure - Continued

7. Using a decibel meter, I measured the sound level at the center of four faces of the cube for 30 seconds and noted the minimum and maximum sound (dB) levels,

8. Similarly, the other four materials were tested, as follows:

    - Wood – A wooden storage cube was used with the fabric cube placed inside it.
    - Carpet – Artificial grass carpet pieces were used to cover the fabric cube.
    - Styrofoam – Styrofoam pieces were used to cover the fabric cube.
    - Tile – Pieces of tile were held together enclosing the fabric cube.

9. I noted all these readings in my journal and then, I entered all raw data in an excel sheet.

10. In excel, I calculated averages and prepared a graph for my experiment.

Pictures of the setup with each material

Figure 1. Fabric Test

Figure 2. Wood Test

Figure 3. Styrofoam Test

Figure 4. Tile Test

Figure 5. Art. Grass Test

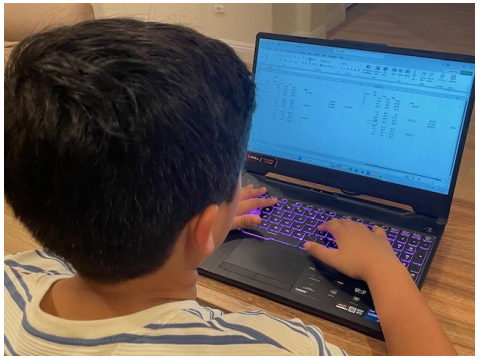
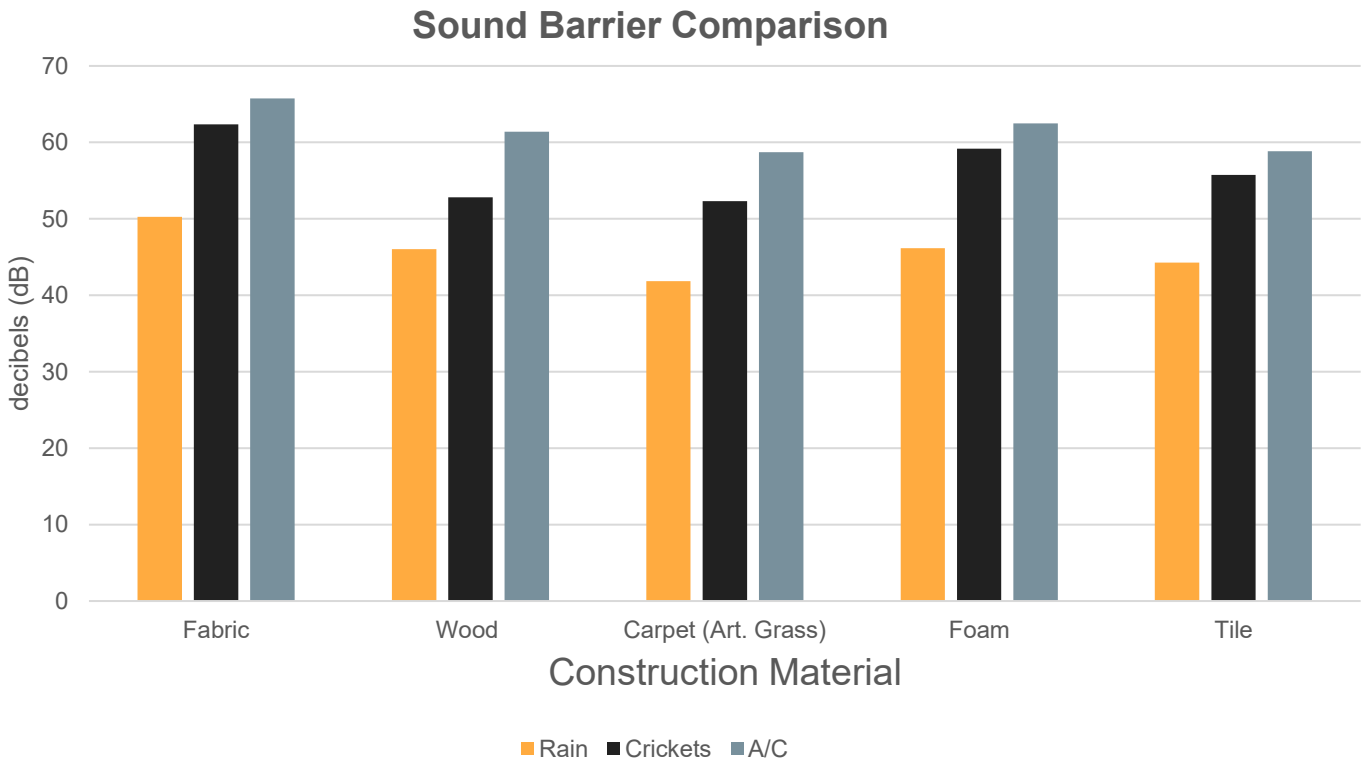


Figure 6. Recording data in Excel

Chart

I used a bar graph to compare the sound (dB) averages for the three sounds against all five materials



Results

As seen in the graph, the natural noises are less noisy than mechanical noise. From the raw data (collected in the journal), the mechanical noise was almost steady, but the natural noise seemed to go high and low and hence, minimum and maximum values were collected and then averaged to determine a more accurate value.

The typical materials like fabric and wood were inefficient sound barriers compared to the other materials like styrofoam, tile and carpet (artificial grass). The carpet material seemed to be the most efficient sound barrier.

Conclusion

- Sound can travel through solid, liquid, and gaseous objects in the form of vibrations. These vibrations when come in contact with an object, results in energy either passing through or reflects (like an echo) or is absorbed (gets converted into some other energy like heat).
- All materials used in this experiment were solid and different in strength, construction and shape. Depending on type of material, amount of energy that passed through was measured.
- The fabric cube was least effective in blocking sound. This was expected since it was the least thick of all materials.
- Wood and styrofoam were the next least effective in blocking sound. Wood is commonly used for building, so my assumption that wood will be the most effective was incorrect. Styrofoam is used for crafts and is effective as wood for stopping sound.
- Tile was effective in blocking sound, more effective against mechanical sounds than natural sounds. It is typically used for flooring.
- Carpet made from artificial grass was most effective in blocking sound. It is typically used for flooring but could also be used for wall decorations and hence help in blocking sound. This means sound was absorbed and converted into another form of energy (maybe heat).

Discussion/future ideas

If I were to repeat this project, I would include other mechanical sounds and other materials for comparison of stopping sound. Also, I would try to do the experiment outdoor to check if different temperatures would affect the travelling of sound. I assume hot temperatures may make the artificial grass warmer, compared to other materials, and so could result in sound escaping the grass, and cold weather could make artificial grass better in blocking sound. In time I shall test this theory!

I hope my project will help to understand benefits of sound reduction and how it can help with energy conservation.

References

1. Sources of sound:
    - Rain: Rain Sounds + Gentle Stream | Sleep, Study, Focus | White Noise 10 Hours
    - Crickets: Cricket Sleep Nature Sounds | Also Use for Studying, Homework, Writing | 10 Hours White Noise
    - A/C: Air Conditioner - 10 hours of relaxing ambient sounds asmr
2. Microsoft CoPilot