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NOISE CONTROL FOR A BETTER ENVIRONMENT

Changing your statement with exposure within environments with and without acoustic treatment with cork

Costa, Miriany [1]
University Ceuma Turu
Av. São Luís King of France, 50 - Turu, São Luís - Ma, 65065-470

Sousa, João Victor[2]
University Ceuma Turu
Av. São Luís King of France, 50 - Turu, São Luís - Ma, 65065-470

Silva, Sergio Fernando Saraiva[3]
University Ceuma Turu
Av. São Luís King of France, 50 - Turu, São Luís - Ma, 65065-470

ABSTRACT

This work aimed to show a comparison of the behavior of the students in the classroom with the acoustic treatment in the use of cork and its changes of customs in environments without this type of quality of life and learning. The classroom for being a place for learning, to use very orally as the main teaching instrument. This is not to dissatisfaction with the students in the external risk, in the students of insight of students internacy, stress and lack of attention. Initially, a bibliographical survey was made of the acceptable quantities within NBR 10152 for acoustic comfort. Periodicated in the last time of an error occurred in the last time of an times have been built in or frequentability of the b / K 2270 during 5 days of the week between two rooms in quality, one of rooms includes your easual provided with relation to non-acoustic treatment other room. Finally, an analysis of student behavior after the exposure in the one week period was done.

Keywords: Acoustic treatment with cork, behavioral principles, noise levels.

[1] mirianyengenharia@gmail.com
[2] eng.victorfsousa@outlook.com
[3] sergio.silva@ceuma.br

1. INTRODUCTION

The Acoustic, at the beginning of the eighteenth century, was understood as the science that studies the theory of interconnected sounds the origin of musical instruments and the empirical research to find solutions of good idealization in spaces of worship or spectacles. However, over the years, there has been an evolution and it has also been seen as an area connected to the way of life of individuals, as in their dwelling, in their work, rest and leisure environment (ROCHA, 2012).

In 1992, studies were carried out on Portuguese multifamily constructions, where comfort problems related to noise and noise insulation were highlighted, one of the predominant factors being the lack of convenience among neighbors in buildings, which leads to the appearance of physical- psychic, social and economic.

However, due to socioeconomic development, society has become more judicious regarding comfort, leading to the search for new, more accessible solutions that improve individuals privacy with sound insulation (ROCHA, 2012) .

Over the decades, humans are often and still not perceiving receiving high amounts of noise. These noises can cause various health complications when exposed to excessive and high intensity. The science that studies noise and its intensities is acoustics, and it is with these principles that this article was made (SILVA, 2013).

In the higher education centers it is evidenced the presence of noises of students talking in the corridors, the knocking of doors, the dragging of chairs, the noise of equipment when it is done maintenance in the premises of the institution, among many other functions that occur due to the actions institutions. However, a classroom is a place where all students would need acoustically specific conditions, that is, a quiet environment in which students would be able to absorb the knowledge passed on without noise that would take their level of concentration.

However, it is not only external noise that detracts from the acoustic quality of classrooms. The main acoustic aspect is the clarity of the word in its entirety, that is, the quality of the words heard can be affected by the external and internal noises and acoustically expropriated conditions in the rooms (SILVA, 2013).

The study is one of the obviously most important stages of individuals, from elementary schools to universities, learning consists of transferring information from the teacher to the student. Currently, this information up to now is orally, which leads to information errors at the time of receipt without quality.

The main dilemma of information being received with failures is the acoustic conditions of the room. Making students not understand the word in its fullness. And when this occurs, students are left with incomplete or misinformed information, causing a learning impairment, and discouraging their academic success. Thus, it is necessary that the classrooms have appropriate acoustic qualities for teaching (SILVA, 2013).

In observing the conditions of acoustic comfort in a scenario, it is essential to have an understanding of the presence of two activities, the internal quality of the classrooms and the influence of the external environment. This internal quality of the school environment is generally related to the geometric form of the areas, the sound absorption corresponding to the places and spaces, the power and position of the sources that transmit the sounds. The performance of the external environment is related to the presence of external noisy sources and the quality of the insulation of the surfaces associated with this noise (BERTOLI, 2001).

There are already acoustic surveys that indicate that the classrooms have classifications of problems to the external and internal environment with their respective noises. Internals are associated with voices, reverberation, and impact. External noise comes from traffic, movement in the corridors, multiple conversations in the adjacent rooms, among other noises that occur in the academic scope, both result in the difficulty of verbal communication in classrooms.

With acoustic analysis of the environments, several approaches are taken as measures of sound pressure levels both internal and external of the construction, verification of sources of noise and their specifications (levels, spectrum, duration time). However, the evaluation of acoustic comfort comes from the comparison of the standards evaluated with recommended precepts. The solutions for acoustic repair and adaptation of the areas in some events generate disagreements between ideal situations of thermal and acoustic comfort. (BERTOLI, 2001).

Sound when it reaches a surface, part of the sound energy is absorbed by the material, the other is reflected back reinforcing the sound in the environment that transmits the sound, and the rest of the energy is propagated to another environment. In the internal acoustic treatment, the reflected and absorbed energies are taken into account (SILVA, 2013).

The elements for reflection are intended to intensify the sound produced in order to make the environment more alive. Thus, reverberation time is prolonged with sound

waves filling the environment. Typically surfaces already have reflections due to street stiffness and hardness, such as masonry walls or ceramic floors, causing most of the energy to be reflected.

It is already common in construction to control reverberation time using acoustic absolution materials. The absorption materials have the opposite effect to that of reflection, having the function of reducing the sound activity of the environment. As the absorption materials are mostly porous and fibrous, they are usually flexible, in their interior space they contain air, causing when the sound enters these porous surfaces, it gets lost.

For the implantation of acoustic materials it is necessary to have a good project, since each material has its particularity for the sound control, reflecting or diffusing the sound energy. So depending on the model of the environment this occurrence being well managed is that it promotes sound quality.

Cork as well as acoustic foam and absorption liner is used for acoustic treatment. Unlike other materials, cork is 100% natural, ecological and recyclable, and not only for acoustic treatment, but it also provides good thermal insulation. In civil construction this material is used in wall coverings, flooring in sheet form (Gil, 1998).

The agglomerated cork is able to reduce considerably the noise of impact, making an acoustic correction, in addition to saving energy. When dealing with the special properties of cork, we can highlight its small density, low resistance to deformation, high capacity to absorb energy, and dissipate very well this energy are the vibrations.

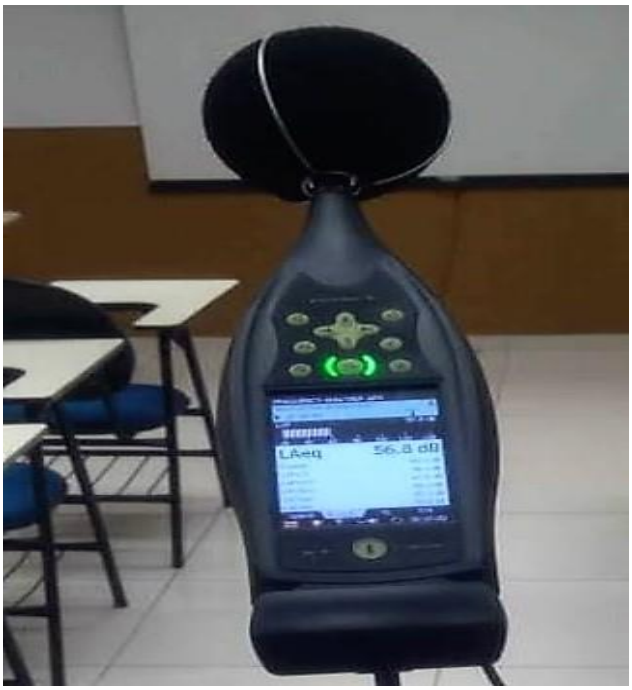
This material has low absorption of water and other liquids, this due to the presence of the suberina and cerina in its constitution. Within its structure, cork has hollow cells, that is spacing, since it is a material that has many pores, in a regular and organized way, capable of giving lightness and homogeneity. And it is precisely these characteristics that make it an excellent absorber of sound energy, making when used as acoustic treatment in classroom masonry to provide an improvement in the intelligibility of the word (Gil, 2012).

2. METHODOLOGY

The case study was carried out at CEUMA University at Av. São Luís King of France, 50 - Turu, São Luís - Ma, 65065-470, inside two classrooms, where one of them is covered with three - millimeter cork plates of thickness in all its internal masonry, in

contrast the other one has coating of pva latex ink, that is used in the other rooms of the institution.

Data collection was carried out in the two rooms, between 09.10,11,19 and 22 October 2018, during the afternoon between the hours of 14:00 and 17:30. During the five days, the B & K 2270 noise analyzer shown in figure 1 was used. This equipment is able to measure vibrations and noises without the use of a computer to assist it, besides counting an upgrade system for measurement of vibration and protection (IP44), has 1/1 and 1/3 octave spectrum with NC - NR - RC curvatures present in the equipment itself. In addition to other advantages that makes it a reference in the acoustic industry.



[Source: author]

First it was necessary to follow some steps so that the analysis and data collection took place correctly. Inside the room, the equipment was placed in the center of the room, then the analyzer was established at the location of the room by the GPS, after that, the recordings of the frequencies determined by the device were started and at the end of each measurement was produced sound pressure level - Laeq.

For analysis of the frequencies, five measurements were carried out with a duration of 5 minutes and 15 minutes. As shown in figure 2, frequency measurements were made in the class with the cork flooring under ambient conditions (without the air conditioning on) which corresponds to the first evaluation of 5 minutes and the others of 15 minutes

with the air conditioning in operation. In figure 3 it is possible to observe the room without the sound insulation, the procedure of the measurements and durations was the same for both, but in the room without the cork lining, was attended by the students and teachers, to be made a comparative of the noise internal and external of the classes that have the same area dimensions.

Figure 2 - Room with cork lining [Source: author]

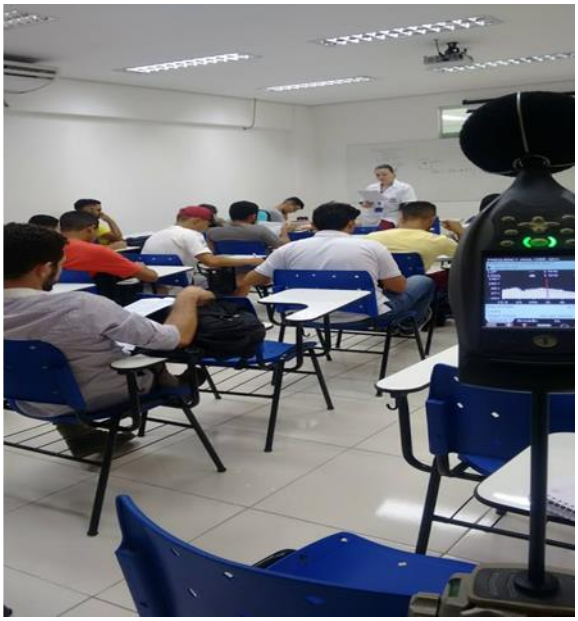


Figure 3 - Room without cork lining [Source: author]

In the two classroom settings it is possible to see some differences mainly in hearing, sight and touch. In the room with the internal covering of the walls with cork boards, referring to the view, it is noticed that the internal environment presents an innovative characteristic, that when a comparison is made with the traditional room, it is not perceptible to perceive the thermoacoustic difference. When entering the room, the person feels a change of pressure on the outside for the internal that is acoustically treated, which occurs through the senses of touch. And finally, through hearing, it is possible to notice that the sound arrives with more pleasant and comfortable intensity to the receiver.

Another important point of this work is to show the behavioral change of the people exposed to the acoustic treatment. For this purpose, a questionnaire to compare the changes that were possible to be noticed in the two environments with and without acoustic treatment was passed to the 20 students of the traditional coating room. As stress, noise, lack of attention and understanding of the lecture given, to show the potential of

cork for the improvement of acoustic conditions and also in academic teaching, allowing the word to be understood in its entirety

3. RESULT AND DISCUSSION

In order to show the effectiveness of cork in the thermoacoustic environment, tables with the values of the frequency measurements performed in the two rooms under study are shown below.

In the room with internal covering of cork, the recordings with the use of the noise analyzer occurred in the classes schedules in the afternoon period in the institution. The first measurements in this room were executed without the operation of the air conditioning, and the other measurements the air conditioning was on, which is exactly what differs the values obtained in the analysis.

Nº of measurements	LAeq. (dBA) Monday	LAeq. (dBA) Tuesday	LAeq. (dBA) Wednesday	LAeq. (dBA) Thursday	LAeq. (dBA) Friday
1	**46.0**	**43.3**	**46.0**	**43.2**	**48.8**
2	**58.4**	**57.0**	**60.8**	**61.1**	**58.3**
3	**56.5**	**56.8**	**61.0**	**61.4**	**57.9**
4	**56.4**	**-**	**61.2**	**61.7**	**58.1**
5	**56.4**	**-**	**61.3**	**61.7**	**58.1**

Table 1 - Room data with cork treatment

Source: author

On the other hand, table 2 shows the average frequency (LAeq) of the room with traditional coating, so only a 15-minute measurement with the connected air conditioning already satisfies the needs for analysis, since this measurement is only for a comparative between the two rooms.

Nº of measurements	LAeq. (dBA) Tuesday
01	69,9

Table 2 - Room data without cork treatment

Source: Author

Table 3 and 4 show the sound pressure levels for internal and external environments within the parameters established by NBR 10.151 and 10.152 (ABNT, 2000, 1987).

Types of Areas	Daytime	Nocturnal
Strictly residential urban area, hospitals or schools.	50	60

Table 3 - Level of assessment of noise in inhabited areas

Source: NBR 10,151

Places	dB(A)
Libraries, music rooms and drawing	35 – 45
Classrooms, laboratories	40 – 50
Circulation	45 – 55

Table 4 - Acoustic comfort levels values dB (A)

Source: NBR 10,152

According to NBR 10.151 (ABNT, 2000) the evaluation criterion for school area is 50 dB (A) this for daytime period, which is precisely the time that the measurements occurred. Comparing with the values of the norm and the values of the measurements of the rooms with and without treatment, it is observed that the frequency levels obtained in the room with cork lining is satisfactory, however the room without the cork, the levels are well above than allowed by the standard. This is due to the interference of the internal noise of the room, for example, the dialogues between the students and the teacher, and the noise outside the room, the noises of the corridors, interference from the noise of opening and closing doors, to the institution. In spite of all these external interventions

that the room with cork lining was exposed, as well as the uncovered room, it was evidenced the effectiveness of the use of cork for the acoustic treatment in classrooms.

Also obtaining the parameter in NBR 10.152 that defines the maximum and minimum levels to obtain acoustic comfort by means of the sound pressure level, in decibels (dBA), it is noticeable that the analysis of the room with its internal cork lining, is shown in performance of the standard in its sound insulation. However, the room with traditional flooring did not show a satisfactory acoustic performance, since the measurements passed the limit of the standard in 40% (BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS, 2017).

All of these comparisons between room frequencies and the norm are needed to understand how these values obtained from field research cause a change in student behavior within the classroom environment.

To the 20 students present in the room with traditional dressing, some questions were asked regarding the main favors that hamper the understanding of the class taught by the teacher and what made the students' focus within the room. About 80% of the students complained about the echo in the room.

The present teacher reported that these noises both internal and external to the classroom environment, hurt his voice, because teachers make vocal effort, and as the noise in many moments of the class increased, this forced to increase the tone of the voice, which causes discomforts during and after work.

The students mentioned that noise leads to irritation and lack of concentration, which increases the students' stress level. There were reports of difficulties, such as understanding what the teacher explained, this placement interfered negatively in the teaching-learning process. As described by Medeiros (1999), high noise generates communication disorders, as is the case of voice masking, which affects the understanding of speech. That was just one of the biggest complaints of the students of the room without coating of cork.

Thus, with the intention of making a comparative, the students were exposed to the room with acoustic treatment with cork. Most students about 60% described that they felt difference from the moment they entered the room due to the aesthetics, the smell of the room that was different due to the cork plates and the internal pressure that was more noticeable than in the room conventional.

Other assignments made by the students were related to the echo that was smaller, that the teacher's speech arrived in a softer way, making the subject passed was absorbed

and understood with better performance. The teacher reported that the class became less noisy, where the internal noise subsided and what external noise no longer bothered so much. This is because cork has the capacity of acoustic absorption and the reduction of reverberation time in certain environments. (Gil, 2012)

According to Costa (1989-90) for a performance of intellectual or physical activities, it is recommended that the noise remain about 55 dBA, which was justly observed in the room with inner cork lining. This demonstrates that a properly treated environment enhances the ability to acquire knowledge, as well as promoting good conditions for the teacher to teach without having to put his health and voice at risk, making attending the lectures more enjoyable and motivating to the students.

4. CONCLUSIONS

Cork presented itself as an exceptional material for thermoacoustic insulation performance. After all the comparative analyzes between the two study rooms, with the standards established by the current norms, the room with internal cork lining proved to be superior in acoustic insulation compared to another room with traditional lining. This confirms that its use has a beneficial impact on people's quality of life, causing the risk to the health of those involved and decreasing life expectancy.

The students themselves indicate the noisy classroom environment, because often the students themselves are the main source of noise, which in unfavorable intensities ends up hampering teaching-learning. In addition to the changes, which can generate inattention, irritation, increased difficulty concentrating and decrease the intelligibility of words.

For this reason it is necessary to incorporate bold coating materials to change the noisy environment of the university environment. The cork is this material, which makes the room more modern visibly besides making the conditions of NBR 10.151 and 10.152 be met. It was found that the use of traditional coatings does not meet the requirements of the Performance Standards, making it indispensable for the change by innovative materials, as is the case of cork boards.

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