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The mixture material of dried straw and kapok for acoustic treatment for UTeM mosque.

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Abstract. The acoustical requirements in terms of intelligibility and liveliness are dissimilar for both of sounds-recitation and speech on religious subjects at UTeM mosque. To attain an overall satisfactory acoustical performance, it is significant to find an optimum Reverberation Time (RT) and the best directivity, which is the major factors affecting intelligibility and liveliness. This experiment is conduct to gauge the effect of RT by making it a variable, while keeping other factors as non-variable and fulfilling ideal conditions for maximum intelligibility. Bearing in mind, the acoustical problems always occurred in any communication building. To improve the problem, this paper presents the new idea of improvement by using biodegradable sound absorber materials which is the mixture of dried rice straw and kapok.

1 Introduction

The concept idea of the acoustic treatment and speech intelligibility quality analysis in different dimension rooms in Masjid UTeM are an eminence of sound distribution. The important of loudspeaker reverberation time and absorption coefficient in respect of speech intelligibility will observed. In order to get an efficient learning and communication process, the room's clarity is one of the important factors [1-8]. It became more important when listeners need to understand every single word. In certain condition such as a well-built mosque, without electronic aid system, the ability to perceive information is limited. The purpose of this experiment is to study the effect of absorption coefficient and its reverberation time (RT) on speech intelligibility with respect to different room sizes and loudspeaker configurations.

There are several numbers of acoustical parameters that can gauge the quality of sound [9-12]. In a very limited budget, one of the parameter where practically used is loudspeaker. Different arrangements of loudspeaker affect the sound distribution. The other way to get a

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good sound production is sound absorber. In this experiments, the dried rice straw (*jerami padi*) & kapok (*Kekabu*) are used to observed either both materials are a good sound absorber or not.

1.1 Relationship between Reverberation Time (RT) and absorption coefficients (α)

Reverberation time (RT) can be classified as one of major factors that affect the transmission of the speech sound from speakers to listeners. It is functioning to amplify the sound in an enclosed spaced and may help the system maintain the sound pressure level from seat to seat. In open spaces, Reverberation Time can be ignoring since there is no sound reflection required. In this project the researcher chooses RT60 which represent the sound is decreased by 60 dB.

$$RT60 = (0.16V)/ (S\alpha) \qquad (1)$$

Where:

V= Volume of the room, m^3

S = Total surface area of the room, m^2

α = absorption coefficient of the surface of absorber material

2 Methodology

This experiment was conducted in the Masjid Sayyidina Abu Bakar, UTeM. The plan drawing for the Masjid given from the Development of UTeM. **Fig. 1.** Shows the sample of plan layout of the mosque and the placement of loudspeaker. The sound source is placed at three different areas to observe the sound distribution. First loudspeaker was placed at the centre of the room. The loudspeaker spreads a sound wave in a spherical surface form. The spherical distribution will give the directivity of sound at various places unidirectional. The second loudspeaker was positioned at the flat surface area as shown at the back area of the mosque will produce the hemispherical surface of sound wave. While, the third loudspeaker was set at the edge of the mosque, the loudspeaker will produce the quarter of spherical forms of sound propagation.

Fig. 2. shows the steps of implementation the sound absorber. In this experiment, the anechoic chamber is used to carry out because the material of the chamber is acrylic which helps sound reflection. Thus, the sound produced by the loudspeaker is only distributed and travel in the box which slightly same with an enclosed space. Before dried rice straw used as sound absorber, it need to be rendered under the sundried about two weeks. The implementation of the mixture of dried rice straw and kapok in the modified anechoic chamber will yield the value of the RT60. All the data were collected by using NTI AL1 acoustilyzer meter.

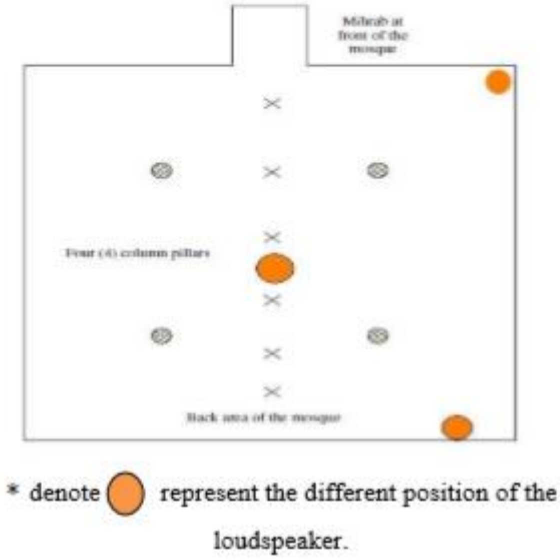

Fig. 1. Plan layout and loudspeaker placement of UTeM mosque.

Fig. 2. The process flow for implantation sound absorber using mixture material (kekabu and kapok).

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3 Result and discussion

In this section, the parameters and components that used in this experiment were described in detail. This project separated in two major parts, first, the quality analysis of speech intelligibility and second, the implementation of new sound absorber.

The two rooms in the mosque are used as an experiment area. The first floor, which is the main praying area and the second floor, refers to the muslimah praying room area. Different room's design will give a different reverberation time calculation. It is due to the size of the room space and amount of the absorptive surfaces within the space that give effect to the reverberation time. The value of absorption coefficient for each material was taken at 2 kHz frequency. During this experiment, the speech predictor used is %Alcon's and the maximum frequency required for this speech predictor is only 2 kHz. Material density gives effect on sound dispersion; hence, it also affects the total of the absorbed sound liveliness. By referring **equation (1)** the reverberation time can be calculated by using the above parameters values shows in **Table 1**. The effectiveness on rice straw mixed kapok as acoustic materials can be shown in the higher value of the absorption coefficient. Sound absorption coefficients of the 0.25 and 0.6 specific gravity rice-straw mixed kapok were higher and significant than the others bio gradable-based materials.

Table 1: The parameters for calculation reverberation time (RT).

Surface	Material	Area, S, (m^2)	Absorption coefficient, (α)	$A = S\alpha$
Ceiling	Lime, ciement, plaster	409	0.07	29
Floor	Tufted pile, Carpet on felt	409	0.25	102.25
Walls	Painted concrete	210	0.09	18.9
Kiblah Niche	Plaster	57	0.04	2.28
Door	Plywood	30 in 9 units	0.10	2.0
Ceiling design	Underplayed perforated	43	0.9	38.7
			Total	194
			Volume (m^3)	1178m^3

4 Conclusion

From the results, it can be concluded that the loud speaker arrangement for each room effects the perception of the signal at each transmits point. The closer listeners to the loudspeaker, the better perception and reception of the signal. This is due to excessive reverberation time, the correlation between SPL and RT60 was explored. The higher quality of sound, Q, covers the larger region of perception in each classroom. In this experiment, it is also proved that the sound absorber which is the mixture of dried rice straw and kapok are one of the best acoustical treatment solution. This is due to higher value of the absorption coefficient in between 0.25 to 0.6.

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