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The Potency of Waste Paper "Egg Tray" as a Noise-Reduction Material

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Abstract. Noise is one of the problems that often occur in urban areas due to the traffic condition. Noise in a building design depends on the choice of materials as sound absorbers. The type of sound dampening material that already exists is a porous material, a resonator, and a panel. The material often used as an absorber is porous materials, because it is relatively cheaper and lighter, especially to reduce the noise in the narrow spaces such as housing and offices. Various substitutes are made from cheap materials, such as the use of recycled materials of egg tray paper with the size of 40 x 40 centimeters. The objective of this research is to find the ability of this waste paper in reducing noises. The method used in this research is field measurement using a Sound Level Meter in a model. The use of the egg tray paper is able to show an adequate acoustic quality as noise absorbers, with the average value of NR 22-26 dB.

Introduction

Noise is one of the problems that often occur in urban areas. The failure of urban design in some big cities in Indonesia is often being the main cause of the problem. Many citizen break the rules about the buildings. Furthermore the roads full of vehicles that cause traffic jam and often make some noise, whereas many buildings are built near the roads, i.e. housing and office buildings. Those two kinds of building need a quietness to do the activities inside them. Some people might sleep or work there, but the traffic noise makes they can not do their activities well. The traffic noise is the main issue of the community who live in urban area because it may cause an adverse human health and psychological effects [1].

In order to face the problem, many kinds of sound absorber is being developed. It is also needed to create a good acoustic in a building. Some of the materials that are often being used are glasswool and rockwool, but it cost too much so that many substitute materials has been developed, such as stereofoam. Another alternative material is by using the recyled material as the sound absorber. There are some previous research done by another researcher by using recycled material to be a sound absorption. They use palm fibre from arenga pinnata as the sound absorption and the result shows that a comparison palm fibre and artificial material and consequently palm give better quality values because it economic value and friendly environment[2]. Another research used coconut fiber, plywood, and tray [3]. So this research uses another recycled material named egg tray. The main material composes an egg tray is recycled paper. The surface is wavy, the shape is square with the size of 40x40 centimeters. Because of the compose material of the egg tray that is made by recycled paper, the price of it is quite cheaper than the other fabricate acoustic panel. The availability of the egg tray is quite excessive and become waste in some places. The wavy shape and the compose material also become a consideration since the wavy and porous material often become a good sound absorber. The objective of this research is to find the ability of egg trays in reducing noise and being used as a sound absorber.

There are some terms in noises; *background noise, noise*, and *ambient noise*. *Background noise* is a sound around us that appears continually and stable in some level. The comfortable background noise is not more than. Noise is a sound that appears uncontinually and unstable in a level that is more than the background noise. *Ambient noise* is a noise level around us that is combination between *background noise* dan noise [4].

Methodology

This research uses measurement in the field as the strategy by using SLM Rion NL-31 analog as the tool. It also uses a calculation by using the formula of NR (noise criteria). The dependent variable of this researh are the placement of egg tray in the building wall. The independent variable is Noise Reduction (NR) of egg tray.

Building Model

The building model used as the control variable is brick wall construction with egg trays in the layer. This model is 1x1x0,6 m^3. The materials are brick wall plastered, ceramic tiles, asbes ceiling, wood roof.

The Tools and the Procedure of the Measurement

The measurement was done in the condition that all of the opening were closed, to avoid a sound intervention through holes. The sound received by the inside of the model purely the sound through the wall. The tool used for this research is Sound Level Meter (SLM) analog to measure the noise inside the room. The other tool is a speaker to raise the sound outside the room that is assumed as the source of noise. The pink noise sound that represent all of the frequency was raised through the speaker placed in 5 meters away from the measured models. The sound data from outside the measured wall and from the inside room that is bounded by the wall is needed to find out the ability of the wall in decreasing the noise.

The Sound Source is from Outside the Room While the SLM is Placed Inside

1. The sound is from outside the room that one of the wall side is covered by the egg trays.
2. The sound is from outside the room that two sides of the wall are covered by the egg trays.
3. The sound is from outside the room that three sides of the wall are covered by the egg trays.
4. The sound is from outside the room that all of the sides of the wall are covered by the egg trays.
5. The sound is from outside the room that all of the sides of the wall and also the ceiling are covered by the egg trays.

The Sound Source was Inside the Room While the SLM was Outside

1. The SLM is from outside the room that one of the wall side is covered by the egg trays.
2. The SLM is from outside the room that two sides of the wall are covered by the egg trays.
3. The SLM is from outside the room that three sides of the wall are covered by the egg trays.
4. The SLM is from outside the room that all of the sides of the wall are covered by the egg trays.
5. The SLM is from outside the room that all of the sides of the wall and also the ceiling are covered by the egg trays.

The measurement is to find out some sides of the wall that will be the most apropriate placement to reduce noises and to find out the NR.Results and Discussion

Result and Discussion

The sound source is 90 dB, the sound received in the nearest spot is 76 dB, while in the farthest spot is 70 dB. It means that the wall without egg trays is capable to reduce noise for 14-20 dB. So if it were used in housing around the roads that has 70 dB noise in average, it would make 50 dB inside the house. It is still far from the strandard of noise criteria of a house.

a. The sound source is outside while the SLM is inside.

The noise is heard inside the room without egg trays is 70 dB while the sound sorce is 90 dB.

The Use of One Layer of Egg Tray:

1. The sound source is from outside the room that one of the wall side is covered by the egg trays. The result of the measurement is 70 dB
2. The sound source is from outside the room that two sides of the wall are covered by the egg trays. The result of the measurement is 70-2=68 decibell
3. The sound source is from outside the room that three sides of the wall are covered by the egg trays. The result of the measurement is 60+6=66 decibell.
4. The sound source is from outside the room that four sides of the wall are covered by the egg trays. The result of the measurement is 60 decibell.
5. The sound source is from outside the room that all of the sides of the wall and also the plafond are covered by the egg trays. The result of the measurement is 60-6=54decibell.

b. The sound source is from the inside while the SLM is in the outside

The sound source is 90 dB, the sound received in the nearest spot is 70 dB, while in the farthest spot is 60 dB. It means that the wall without egg trays is capable to reduce noise for 20-30 dB. So if it were used in housing around the roads that has 70 dB noise in average, it would make 50 dB inside the house. It is still far from the strandard of noise criteria of a house

The Use of One Layer of Egg Tray:

1. The SLM is from outside the room that one of the wall side is covered by the egg trays. The result of the measurement is 58 decibell.
2. The SLM is from outside the room that two sides of the wall are covered by the egg trays. The result of the measurement is 56 decibell.
3. The SLM is from outside the room that three sides of the wall are covered by the egg trays. The result of the measurement is 55 decibell.
4. The sound source is from outside the room that four sides of the wall are covered by the egg trays. The result of the measurement is 54 decibell.
5. The SLM is from outside the room that all of the sides of the wall and also the plafond are covered by the egg trays. The result of the measurement is 50 decibell.

From the measurement results above, it can be seen that the placement of the egg trays influence the noise reduction inside a room. The placement outside the wall can only reduce the noise outside for about 20-36 dB. It means that if the egg trays were placed in outside of the wall of the house near the road which has 70 dB noise in average, it would have around 50-44 dB of noise inside the room. It is quite silence in housing and office area and suit to the standard of noise criteria.

Moreover, The placement of the egg trays inside the wall can reduce the noise outside for about 32-40 dB. It means that if the egg trays were placed in the inside of the wall of the house near the road which has 70 dB noise in average, it would have around 38-34 dB of noise inside the room. It is quite silence in housing and office area and suit to the standard of noise criteria.

Conclusion

The egg rays can reduce noise for about 20-40 dB from the sound source. It is better that the wall without egg trays layer that can only reduce noise for about 16-20 dB. The placement of the egg trays also influence the ablity of the egg trays in reducing noise. The placement inside the building can reduce more noise than the one outside the building. It is recommended that this material can be used at buildings near the crowded areas, like a main road, train station, etc; as in Indonesian context that there are so many small houses built near those areas.

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