RECYCLE MATERIALS AS INDUSTRIALISED BUILDING SYSTEM (IBS) INTERNAL PARTITION

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ABSTRACT

Partition walls are the walls which divide a building area into number of rooms to provide privacy to the inhabitants of the building from sound and sight. The partition should be able to contain voices inside the room as to not disturb people outside the room. The objective of this research is to produce a partition wall which is better at sound insulation than the commercial gypsum board. In this research, the soundproofing ability of the partition walls is evaluated using the noise effect system trainer, in order find out the sound source in decibel from the three types of frequencies which are low, medium and high. The study also looking at a way of environmental-friendliness by using recyclable materials as the samples of partition walls is made from egg carton and aluminium cans. The result showed that the partition with egg carton and rockwool is better at blocking sound with percentages of 14.42%, 13.01% and 17.71%. This product act as an alternative for IBS internal partition in the near future.

Keywords: Soundproof; Egg Carton; Rockwool; Aluminium Cans; IBS.

Introduction

Industrialised Building System (IBS) is a construction system where components are manufactured at factories on or off site, transported and then assembled into a structure with minimal work (Hamid et al., 2008). This system means that the parts of buildings such as walls, slabs, beams and columns are produced in the factory under quality control and then it is installed on site. Partition walls also can be considered a kind of IBS system.

Tam et al. (2007a), Jaillon et al. (2009) and Jaillon & Poon (2010) made it clear that on-site waste generation can be solved by using prefabrication. Jaillon et al. (2009)'s research on the waste reduction potential of using prefabrication in building construction in Hong Kong proof that construction waste reduction was one of the main advantages when using prefabrication compared to traditional construction. By using prefabrication in the construction system, the waste generated can be reduced by a certain percentage.

There are two types of walls in a house, partition and bearing. Partition walls are thin elements which divide the area into number of compartments to provide privacy to the residents of the building from sound and to provide contentment and security (Broun 2011). Partition walls do not support any weight compared to load bearing wall which carries a certain amount of loading in them such as concrete walls. Bearing walls are walls that withstand a certain amount of loading.

Partition walls have been a common item in the construction industry. There are several types of partition walls which are available in the market. For example, the gypsum board, concrete partition wall, timber partition and many more. There are several criteria of a good partition walls. For example, it must be lightweight and the material used for the wall must be durable. This is some of the criteria that makes it different from the load bearing wall such as concrete wall. Load bearing wall are naturally heavier because it needs to withstand a certain amount of loading.

Besides that, the partition wall designed must also have the soundproofing ability. This is because this research intend to contain the voices inside the room by using a soundproof partition walls. Soundproofing is any means of reducing the sound pressure with respect to a specified sound source and receptor. There are several basic approaches to reducing sound for examples, increasing the distance between source and receiver, using noise barriers to reflect or absorb the energy of the sound waves, using damping structures such as sound baffles, or using active anti-noise sound generators.

Soundproofing has been one of the reasons the partition wall being put up. There are three methods of noise control. The first method is the alteration of the noise and vibration sources. Then, there are modifications along the sound propagation path and last but not least, the sound receiver. Primary method is constrained to economical and technical parameters while third method requires that each receiving person is treated individually. This makes the secondary methods that include vibration isolation, noise barriers, noise absorption and dissipative silencing relatively practical and cost efficient (Kuttruff 1995).

Material used in different structures with soundproofing role is one of the most important factors in noise reduction (Lee and Joo, 2003). For proper application in products, it is important we understand the acoustical properties of porous materials (Cosereanu C.et.al, 2009; Terciu et.al, 2010; Terciu et.al, 2011). The noise control is important in ensuring sound pleasing environments. The elements used in different structures with sound insulation aspect is one of the most important factors in noise reduction. (Jayaraman, 2005)

Experimental set up

Design of Experiment

The main objective of this research is to produce prefabricated partition wall samples from recycled materials (aluminium can, egg tray, etc) and rockwool. Besides that, the research aimed at ensuring the partition walls is soundproof and to produce the final product of IBS partition sampling.

The study of this research focused on the soundproofing ability of the materials selected to make the partition wall. The testing of the samples will be done using the noise effect system trainer. This test is carried out to find out the noise level that pass through the partition wall samples. In the early stages, there will be selection of materials as there are a lot of materials which can be used for soundproofing.

The materials selected will be the rockwool, aluminium cans and egg carton. There will be a combination of rockwool and egg carton and the combination of rockwool and aluminium cans. There will be 3 wall sample in total together with the existing gypsum panel which is the existing partition board. Multipurpose glue will be used to put the materials together in a sandwich panel form.

After putting the material together to form wall sample, the samples of partition walls are tested using the noise effect system trainer. This noise effect system trainer is a rectangular box consisting of a speaker inside the box. The control panel consist of 2 knob which is the frequency knob and the intensity knob. The frequency and intensity knob is both of analog control which means there is no exact value of the frequency and intensity shown.

For the partition walls to be designed in a sandwich panel, this means that for example, for the egg carton and rockwool partition, it will be a layer of rockwool followed by egg carton and then there is egg carton again. For this sample, there will be 3 layer of egg carton with the rockwool in between them. Corrugated board will be used as a finishing layer for both sides. Multipurpose glue will be used to keep the rockwool intact to the egg carton and the corrugated board on the outer layer.

For the aluminium cans partition, the polystyrene board is placed in the middle to hold the cans together in the partition. There will be 16 cans stuck to the polystyrene board on each side. A very thin layer of rock wool is glued to the polystyrene board to make it easier for the cans to be glued to the polystyrene board after this. The cans is crushed into a suitable thickness before it is glued to the polystyrene board. A thick layer of rockwool is then placed on either side of the crushed cans. The corrugated board is then used as the finishing on the outermost layer on each side. Multipurpose glue is used in this research.

The testing of the soundproofing qualities will be by using the noise effect system trainer. First of all, the system trainer is run with low frequency, medium and high frequency without any partition inside to get a control reading. The sound level meter is used to get the reading of sound level at 6cm, 55cm, 105cm, 125cm, 175cm and 225cm.

After that, the rockwool and egg carton partition sample is put at 115cm location. The reading for sound level is measured using the sound level meter at low frequency, medium frequency and high frequency. The readings is then recorded in a table. The steps is then repeated for the rockwool and aluminium cans partition and the gypsum board partition. The completed partitions of aluminium cans, rockwool and gypsum board are then weighed. This step is required to make a comparison on the weight of the partition wall.

Figure 1: Sandwich Panel Partition for Egg Carton

Figure 2: Complete Layered Sandwich panel aluminium cans partition walls

Figure 3: Noise Effect System Trainer

Figure 4: Inside of Noise Effect System Trainer

Result

A combined table will be used to present the result so that it is easier to understand and analyze the reduction in sound passing through the sample of wall panel created. For the control set, there will be no partition sample included so that the original sound level that passes through at the distance of between 105cm and 125cm can be obtained. The table for the weight of partitions is also shown below.

Table 1: Result for Control Set, Egg Carton & Rockwool, Aluminium cans and Rockwool, and Gypsum Board

Frequency Distance(cm)	Sound(Decibel)											
	Low				Medium				High			
	A	B	C	D	A	B	C	D	A	B	C	D
6	73.3	72.3	72.4	74.1	76.8	73.0	76.4	72.7	80.3	71.5	82.9	83.7
55	73.3	72.3	72.8	73.1	78.6	72.4	76.9	73.7	79.3	80.7	84.8	80.6
105	73.3	72.1	72.6	73.6	75.7	70.9	76.4	74.7	79.1	80.1	85.3	74.4
125	72.5	63.8	64.8	67.7	73.6	64.0	68.2	67.3	78.9	63.7	77.5	70.4
175	71.5	62.7	63.8	65.6	73.2	64.9	67.9	66.8	72.6	67.1	73.0	73.4
225	71.5	62.8	63.1	66.6	74.2	62.5	67.6	68.1	79.7	70.7	71.9	71.7

Note:-
A - Control Set (No Partition)
B - Partition with Egg Carton & Rockwool
C - Partition with Aluminium Cans & Rockwool
D - Gypsum Board

Table 2: Weight of the Partitions Tested

Types of partition	Weight(kg)
Partition with Rockwool and Egg Carton	0.71
Partition with Rockwool and Aluminium Cans	0.69
Gypsum Board	1.30

Results and discussion

For the calculation, the average sound level is taken for the 3 readings before and after the partition wall is placed. Then, the percentage of reduction in noise is calculated. For the control set, the percentage for low, medium and high are 2.05%, 4.48% and 3.28% respectively. For the partition with egg carton & rockwool, the percentage of reduction in noise are 14.42%, 13.01% and 15.23% respectively. The percentage in noise reduction for aluminium cans and rockwool are 13.62%, 12.81% and and 13.77% respectively for low, medium and high frequency. Last but not least, for the gypsum board, the percentage in noise reduction is 10.51%, 9.35% and 10.86% respectively for low, medium and high.

From the result obtained, this research prove that the egg carton and rockwool partition is a better partition in terms of sound reduction. This is because the percentage of sound reduction for the three types of frequencies, the egg carton and rockwool partition is the highest compared to gypsum board and the rockwool and aluminium partition. Besides that, this also prove that egg carton and rockwool is also a good sound insulation material.The research prove that the egg carton and rockwool partition is better at blocking sound compared to the other two partition. This is because the percentage for the reduction in noise is the highest compared to the other two partition.

As for the weight of the partition, the partition sample created both are lighter than the gypsum board. This is one of the advantages for the partition wall that are created because lighter weight allows it to be easily movable compared to partition which is heavier. From Table 2, it can be seen that the weight of the partition with rockwool and egg carton is 0.71kg compared to partition with aluminium cans and rockwool which is 0.69kg and the gypsum board which is 1.30kg.

Conclusion

From the result, this research conclude that the percentage in the reduction of sound is the highest for the egg carton and rockwool partition at 14.42% for low frequency, 13.01% for medium frequency and 17.71% for high frequency set. This shows that rockwool and egg carton is good at blocking sound from passing through them. For this, the objectives has been achieved in ensuring that the partition wall is soundproof. This research is important as the future researcher can replace the elements inside the sample of the partition wall and retest it for the soundproofing ability. Samples of partition wall have been made from recycling materials at the initial stage. The two samples produced are using the egg carton and the aluminium cans. So, this research has achieved its objectives of producing prefabricated partition wall samples from recycle materials. This is important for the environment as the waste materials at the landfill site can be reduced if the elements that are at the landfill site can be reuse or recycle.

Based on the result obtained, we can conclude that partition wall made with rockwool and egg carton is a better partition compared to partition with aluminium cans and rockwool, and the available existing partition which is the gypsum board. The with rockwool and egg carton is better at absorbing the sound and reflecting it which explains the sound level is the lowest at 125 cm, 175 cm and 225 cm compared to other sample.

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