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The comparison of thermal resistance between clay brick wall and sand brick wall for Malaysian climate

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Abstract: Clay bricks and sand bricks are the most common material in Malaysia's construction sector. Wall, as a weather resistance provides a protection to prevent outside temperature affect the room temperature directly. The study intends to study on the temperature effect on different type of walls and insulation material, expanded polystyrene so that the wall suit to the increasing temperature. The approach of the study was based on experimental research. The study reports the results of the thermal resistance for clay brick wall and sand brick wall that applying and without applying polystyrene on the external surface of the wall. The results show that heat flow rate for the clay brick wall was lower than sand brick wall. In addition, the thermal resistance of the wall that applied polystyrene is higher than the wall that did not applied polystyrene. Thus, the clay brick wall that applied polystyrene had the highest thermal resistance.

Key words: Heat; Polystyrene; Wall; Clay brick and sand brick

1. Introduction

In the past, the material that used to build a wall is bricks. Until today, the bricks are still the most common material in Malaysia's construction sector. Clay brick and sand brick are the common brick that can found in market.

Malaysia is a country that have tropical rainforest climate but it never had any extreme high temperature. However, year to year the atmospheric temperature is increasing in Malaysia.

Wall, as a weather resistance provides a protection to prevent outside temperature affect the room temperature directly. However, the insulation of heat on different type of materials is different. In addition, the thickness effects on how many percent heat energy transfer into the room and affect the room temperature. The study focuses on the temperature effect on different type of walls and insulation material, expanded polystyrene so that the wall suit to the increasing temperature.

The study also will look into temperature inside and outside the room as an indicator to check the heat transmission of the wall. This is to know the real effect of heat inside and outside the room.

2. Methodology

The research did in clay brick wall model and sand brick wall model with polystyrene and without polystyrene on the external surface of the wall. The site is beside the futsal field in UPNM.

2.1. Procedure

The sample was produced as procedure below:-

- The clay bricks are laid 2 by 2 for 3 layers in a square box shape.
- The flat roof that produced is laid on top of the brick wall.
- Step 1 and 2 are repeated for the other samples.
- One of the clay brick and sand brick samples are lay a layer of polystyrene and bond it by chicken wire mesh.
- All the samples are plastered it by mortar.

The sample testing and data analysis was conducted as procedure below:-

- The data loggers are putted at the inside and outside of the sample which are the interior and exterior surface of the wall.
- Data are collected at the same time for both data loggers every 10 seconds for 24 hours.
- The data that get from the test are putted into EasyLog to stop and export the data from data logger and do the comparison between the temperature in the building and outside the sample.
- The procedures 1-3 are repeated for 2 times.
- The procedures 1-4 are repeated for the other samples.

The sample testing for comparison between two samples was conducted as stated below:-

- The data loggers are putted in the two samples with and without polystyrene.
- Data are collected at the same time for both data loggers every 10 seconds for 24 hours.
- The data that get from the test are putted into EasyLog to stop and export the data from data

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logger and do the comparison between the samples.
- The procedures 1-3 are repeated for 2 times.
- The procedures 1-4 are repeated for the other samples.

3. Results

The results for this project only covered the effect of the material to the heat flow rate through the material. The data of the temperature were collected for clay brick wall and sand brick wall which apply the polystyrene at the external surface of the walls and without apply polystyrene.

Fig. 1: All brick wall sample

Fig. 2: Clay brick wall that apply polystyrene before plastering

Fig. 3: Sand brick wall that apply polystyrene before plastering

3.1. Comparison the sample that applies and without applies polystyrene

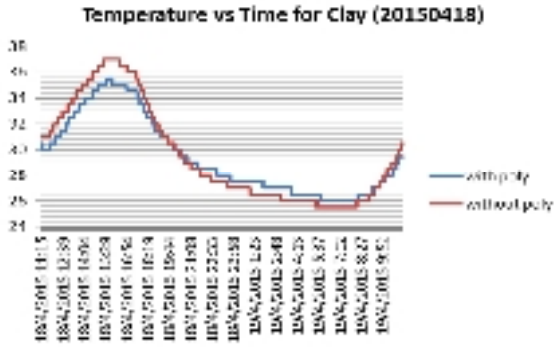

Fig. 4: Temperature versus Time for Clay Brick Wall Sample

Table 1: Maximum temperature of clay brick wall sample

Sample	Max. Temperature (°C)		
Polystyrene	With	Without	Difference
1	35.5	37	1.5
2	32.5	35.5	3
3	33	35.5	2.5
4	33	35	2
Mean	33.5	35.75	

Table 2: Minimum temperature of clay brick wall sample

Sample	Min. Temperature (°C)		
Polystyrene	With	Without	Difference
1	26	25.5	0.5
2	24.5	24.5	0
3	25.5	25.5	0
4	25	24.5	0.5
Mean	25.25	25	

Table 3: Maximum and minimum of the difference in temperature for clay brick wall sample

Sample	Difference in Temperature (°C)	
	Maximum	Minimum
1	2	-1
2	3	-0.5
3	3	-0.5
4	2.5	-1

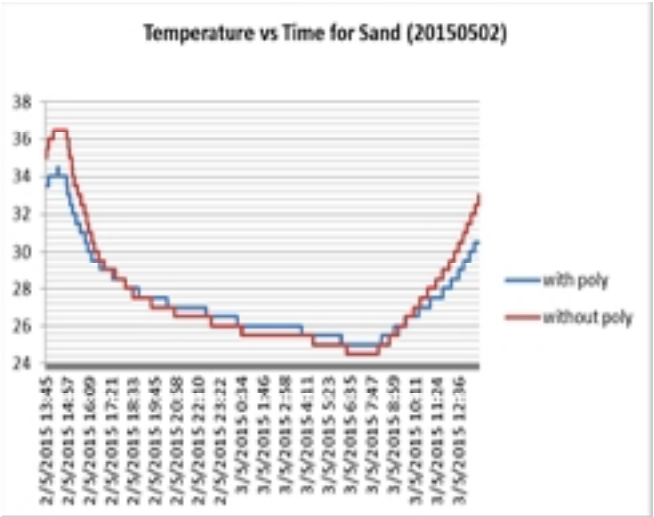

Fig. 5: Temperature versus time for sand brick wall sample

Table 4: Maximum temperature of sand brick wall sample

Sample	Max. Temperature (°C)		
Polystyrene	With	Without	Difference
1	34.5	36.5	2
2	33.5	36	2.5
3	34	37	3
4	34	35.5	1.5
Mean	34	36	

Table 5: Minimum temperature of sand brick wall sample

Sample	Min. Temperature (°C)		
Polystyrene	With	Without	Difference
1	25	24.5	0.5
2	24.5	24	0.5
3	25	24.5	0.5
4	26	26.5	-0.5
Mean	25.125	24.875	

Table 6: Maximum and minimum of the difference in temperature for sand brick wall sample

Sample	Difference in Temperature (°C)	
	Maximum	Minimum
1	3	-0.5
2	3	-1
3	3	-0.5
4	2	-1

3.2. Clay brick wall sample that apply polystyrene

By getting the difference of temperature from data, thermal resistance can be calculated by using formula and the q is get from the calculation of clay brick wall sample that did not apply polystyrene.

$$R = \frac{\Delta T}{q} \qquad (1)$$

Table 7: Thermal resistance for the clay brick wall that apply polystyrene sample

Sample	Maximum (m^2K/W)	Minimum (m^2K/W)
1	0.4909	0.2727
2	0.6	0.1364
3	0.5454	0.2727
Mean	0.5454	0.2273

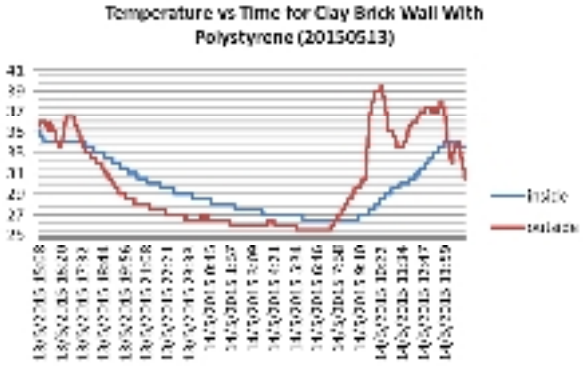

Fig. 6: Temperature versus time for clay brick wall with polystyrene sample

Table 8: Maximum temperature clay brick wall with polystyrene sample

Sample	Max. Temperature (°C)		
Polystyrene	Inside	Outside	Difference
1	35	39.5	4.5
2	35	40.5	5.5
3	34.5	39.5	5
Mean	34.8333	39.8333	

Table 9: Minimum temperature of clay brick wall with polystyrene sample

Sample	Min. Temperature (°C)		
Polystyrene	Inside	Outside	Difference
1	26.5	25.5	1
2	25.5	25	0.5
3	26	25	1
Mean	26	25.1667	

3.3. Clay brick wall sample that not apply polystyrene

Thermal resistance for clay brick counted from formula and furthermore the heat flow rate are determined.

$$R = \frac{L}{K} \qquad (2)$$

Where,

L = Thickness of the specimen (m)

K = K-value

Table 10: Heat flow rate for the clay brick wall that not apply polystyrene sample

Sample	Maximum	Minimum
1	0	5.5
2	11	5.5
3	16.5	0
Mean	9.167	3.667

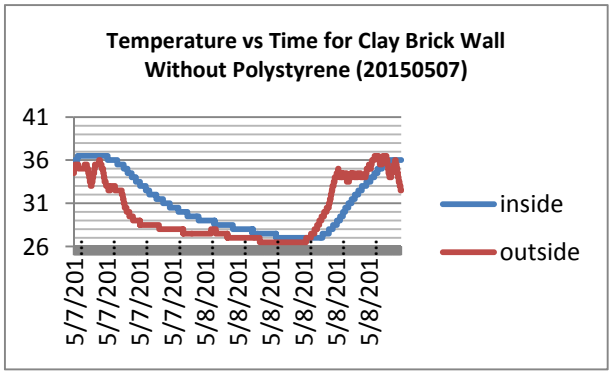

Fig. 7: Temperature versus time for clay brick wall without polystyrene sample

Table 11: Maximum temperature clay brick wall without polystyrene sample

Sample	Max. Temperature (°C)		
Polystyrene	Inside	Outside	Difference
1	36.5	36.5	0
2	37	38	1
3	36.5	38	1.5
Mean	36.6667	37.5	

Table 12: Minimum temperature of clay brick wall without polystyrene sample

Sample	Min. Temperature (°C)		
Polystyrene	Inside	Outside	Difference
1	27	26.5	0.5
2	26	25.5	0.5
3	25	25	0
Mean	26	25.6667	

3.4. Sand brick wall sample that apply polystyrene

Table 13: Thermal resistance for the sand brick wall that apply polystyrene sample

Sample	Maximum	Minimum
1	0.1244	0.1327
2	0.1741	0.199
3	0.1990	0.0663
Mean	0.1658	0.1327

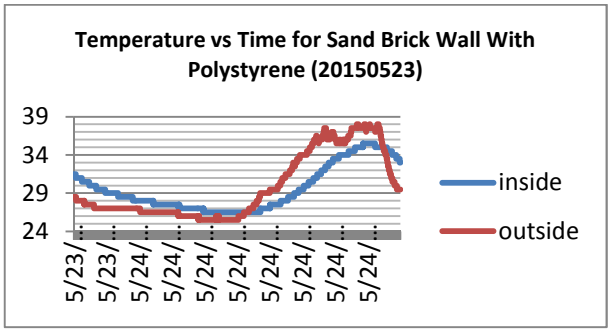

Fig. 8: Temperature versus time for sand brick wall with polystyrene sample

Table 14: Maximum temperature sand brick wall with polystyrene sample

Sample	Max. Temperature (°C)		
Polystyrene	Inside	Outside	Difference
1	35.5	38	2.5
2	34	37.5	3.5
3	35	39	4
Mean	34.8333	38.1667	

Table 15: Minimum temperature of sand brick wall with polystyrene sample

Sample	Min. Temperature (°C)		
Polystyrene	Inside	Outside	Difference
1	26.5	25.5	1
2	26	24.5	1.5
3	24.5	24	0.5
Mean	25.6667	24.6667	

3.5. Sand Brick Wall Sample That Not Apply Polystyrene

Table 16: Thermal resistance for the sand brick wall that not apply polystyrene sample

Sample	Maximum	Minimum
1	0	7.5385
2	37.6923	7.5385
3	22.6154	7.5385
Mean	20.1026	7.5385

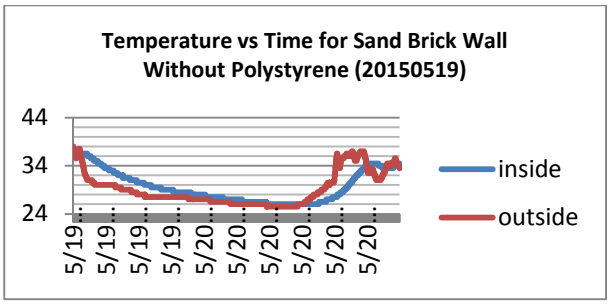

Fig. 9: Temperature versus time for sand brick wall without polystyrene Sample

Table 17: Maximum temperature sand brick wall without polystyrene sample

Sample	Max. Temperature (°C)		
Polystyrene	Inside	Outside	Difference
1	38	38	0
2	36	38.5	2.5
3	38.5	37	-1.5
Mean	37.5	37.8333	

Table 18: Minimum temperature of sand brick wall without polystyrene sample

Sample	Min. Temperature (°C)		
Polystyrene	Inside	Outside	Difference
1	26	25.5	0.5
2	26	25.5	0.5
3	25	24.5	0.5
Mean	25.6667	25.1667	

4. Discussion

In conclusion, according to the research, it showed the rate of the heat flow into wall sample was reduced by the polystyrene for both clay brick wall and sand brick wall. The range of reducing was similar for both types of walls which was 1.5 °C to 3 °C.

However, when the surrounding is cold the range that increases the internal temperature of the wall sample is varying. For the clay brick wall sample, the difference between the sample that have polystyrene and without polystyrene was 0 °C to 0.5°C when the surrounding temperature was low. While in the sand brick wall sample, the difference between the samples that have polystyrene and without polystyrene was -0.5 °C to 0.5 °C.

From the data, the research showed that the heat that can be transmitted into or out the sample walls that have polystyrene was less than the sample walls that was without polystyrene. This is due to the temperature for the wall sample that have polystyrene have lower when the data collected in both of the samples.

Besides that, thermal resistance for the samples that have polystyrene is higher than the samples without polystyrene. For the clay brick wall sample that did not apply polystyrene at the external surface, the thermal resistance was 13/196 or 0.066327m^2K/W. While the sand brick wall sample that did not apply polystyrene, the thermal resistance was 1/11 or 0.0909 m^2K/W.

The thermal resistance for the heat enters the clay brick wall that have polystyrene sample was 0.5454 m^2K/W while emitted from wall sample was 0.2273m^2K/W. For the sand brick wall sample with polystyrene, there were 0.1658 m^2K/W and 0.1327m^2K/W for heat transfer into and out from the wall sample.

For all the thermal resistance no matter in clay brick or sand brick wall samples, the thermal resistance of the wall sample that have polystyrene is higher and it really reduced the heat flow into the wall samples.

As a conclusion, the polystyrene is the material that can reduce the heat transmission into the wall samples and the clay brick wall had better thermal resistance compare to sand brick wall.

5. Conclusion

In conclusion, according to the objective of this project is to investigate the temperature effect between clay brick wall and sand brick wall and to study the temperature effect in insulation material when applied to the walls in Malaysia building. As a result, there are 4 samples that conducted in the research which were clay brick wall without applying polystyrene, clay brick wall with polystyrene, sand brick wall without polystyrene and sand brick wall with polystyrene.

The conclusion that can be made from this project was, the clay brick wall is better than sand brick wall in term of heat retarder. The maximum temperature for clay brick wall is lower than sand brick wall.

It also can be concluded that the polystyrene is a good insulation material to apply on wall for increasing thermal resistance. The temperature in wall sample decrease significantly when apply the polystyrene on the outside surface of the wall.

Thus, the clay brick wall that applied polystyrene is the best thermal resistance wall in this research samples

References

Cultrone, G. et al. (2004) Influence Of Mineralogy And Firing Temperature On The Porosity Of Bricks. Journal of the European Ceramic Society. Vol. 24, pp. 547-564.

Eurocode 2, en.1992.1.1.2004

Fanger, P.O., Thermal Comfort – Analysis and Applications in Environmental Engineering, McGraw Hill, 1972.

Kamaruddin, K., & Hamzah, S. (1998). Investigation on the Physical Properties of Bricks as Load Bearing Wall - phase 1. Retrieved November 10, 2014, from http://eprints.uitm.edu.my/7361/1/LP_KARTINI KAMARUDDIN 98_24.PDF

Kossecka, E. 1992. Heat Transfer Through Building Wall Elements Of Complex Structure. Arch. Civ. Engn. Vol 38 No 1-2, 117-126

Parr, S., & Ernest, T. (1912). A Study of Sand-Lime Brick. Illinois State Journal, State Printers Springfield, III.