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Design of Natural Cooling System Using Well Water

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Abstract: The advent of technology would make human life more convenient, easier, and meaningful. Lots of new inventions and solutions are developed with the combination of technologies in several fields. Natural cooling system related systems are undergoing major development periodically as it becomes a big part of our life. A building with a large number of occupants requires many facilities. Furthermore, a cooling system is an important system for a building while cooling system that have been use nowadays requires more energy consumption and pollution. Thus, this can be controlled by using a natural cooling system using well water. Meanwhile, the idea of this cooling system is to install a well nearby the building and use the well water to cool down a building using a simple mechanical system. Most importantly, the cooling system is illustrated using a conceptual design house.

Keywords: Natural Cooling System, Well Water, Conceptual Design House

1. Introduction

The trends of all countries in the world move to the most reputed and renowned countries throughout the whole world are unfolding in the age of globalisation. This is the path of time the technology displays today is also one of the key reasons why people all believe in creating them. Nowadays, in every building we have a cooling system such as air conditioning which is the main cause of global warming. Global warming issue occurs in worldwide has a central factor in recent years. The demand of the cooling system has grown rapidly over the past few years and will certainly be increasing over the decades. Although the present cooling system has well-tried to satisfy the request by out and away, this chemical based cooling system has to be diminished for the sake of global warming.[1]. Not only that, it can also resolve the impact of climatic change and economy development. Therefore, the efficiency of cooling system is needed to fulfil the requirement. Meanwhile, it can cause harm to humanity if the cooling system management cannot perform properly for the house and building. Thus, the natural cooling system utilising well water can be conceded as one of the next most cost-effective practises in the implementation plan for the building cooling system.

The method, which will be used in the structure because of its prospective advantages and uses, could become very popular from the research on the natural cooling system strategy. The relative

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efficacy of the natural cooling system clearly depends on the native environment, but the natural cooling system is the best suited to all the problems of our global warming in such a way[2].

2. Materials and Methods

The main focus of this research is to investigate the cooling system performance. The conceptual design is made in a small ratio and act as a prototype that represent the real natural cooling system using well water. The methods a clearly elaborated below with the help of diagrams[3].

2.1 Material and Sample

. There are few materials have been used to construct the conceptual design such as plywood, wood, zinc roof, screws, submersible pump, water tube, PVC materials. The materials are selected based on the ability to absorb heat to test the cooling system in the experiment. All these materials are available in hardware shops with a reasonable price.

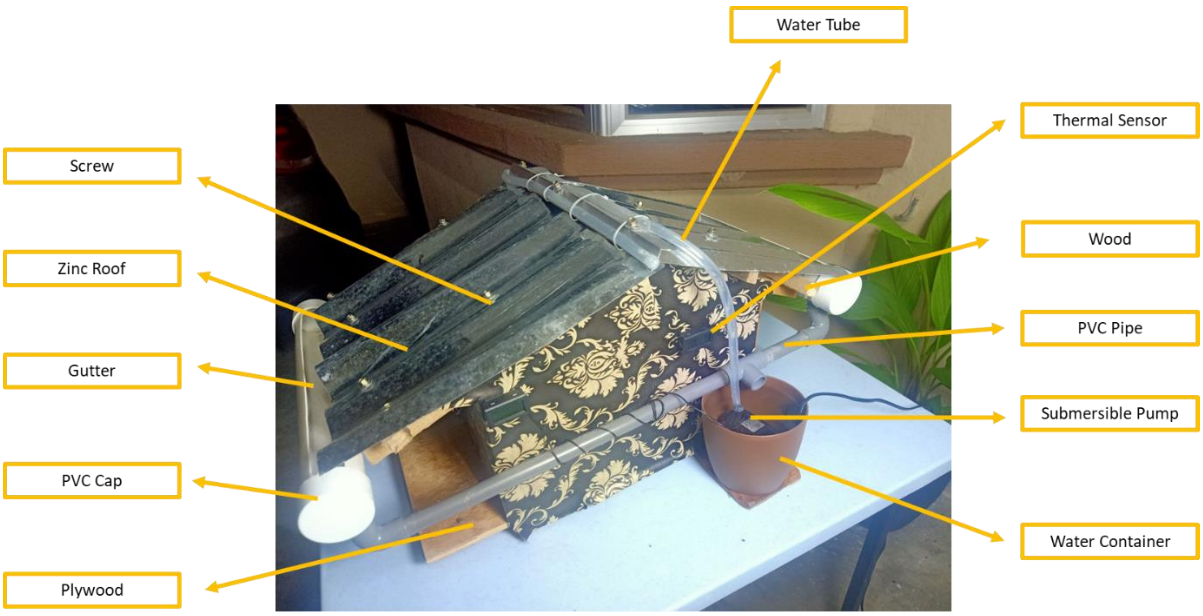

Figure 1: Material used

2.2 Experimental Methods

First of all, the water tank is filled with water and extra water is prepared to add when the pump is on. Besides that, extension wire is necessary to carry out the experiment. Not only that, a submersible pump with 220-240V, 600L/H and 1M H.MAX is used to converts rotary energy into kinetic energy and then into pressure energy to push water to the roof surface. Initial temperature was taken from the water tank and the house after the conceptual design is exposed to atmosphere/surrounding for 15 minutes to obtain the equilibrium temperature. The water tank is filled with water and the power supply is switched on to generate the pump. The submersible pump will suck out the water from the water tank to the roof through a small colourless tube. Next, the water will flow to the zinc roof through small tube. Then, the water will flow to the gutter from the zinc roof. The water from the gutter will then flow through the piping system and back to the water tank. The process will be repeated for 15 minutes. After 15 minutes the temperature will be taken and recorded to a table. The procedure of cooling system will be tested on four different parts of the day[4].

Figure 2: conceptual design

2.3 Formula to calculate

2.3.1 Average

The sum of a set of numbers is divided by the total number of values in the set to get the average. We utilise averages because they're a great method to summarise a lot of information. Instead of having to sift through hundreds or thousands of pieces of information, we now have a single number that summarises everything. While averages have some drawbacks, such as outliers causing an erroneous average, they are useful for quickly comparing data. The statistics average termed Mean is a concept we used to hear in statistics and mathematicians[5].

Average is a highly significant concept in statistics if you want to get the centre value from a set of data, you may use the average function. An average is a statistical concept that can be defined as a single number taken as typical of the given list. Many researchers utilise averages when conducting research, but technical analysts use averages the most since they must compute the average price of the stock in which they are conducting research, hence averages are more important in their area. An average is a number that falls in the middle of a set of data.

Formula to calculate average,

$$\text{Average} = \frac{Total\ sum\ of\ all\ numbers}{Number\ of\ Item\ In\ The\ Set} \qquad \text{Eq.1}$$

2.3.2 Pressure

The force applied perpendicular to the surface of the object per area over which the force is spread is known as pressure. Water pressure, on the other hand, is a word used to describe the force of water flowing through a channel or pipe. It is also possible to calculate the decrease of water pressure[6]. As a result, the force applied over a given area is also the pressure in a liquid. The gauge pressure is the pressure in relation to the surrounding atmosphere. Pressure is expressed using a variety of units. Some of it comes from a force per unit area unit. Pascal is the SI unit of pressure (Pa). Where,

P = water pressure in Pa

ρ = density of water in kg.m-3

g = gravitational force in 9.81 m.s-2

h = height in m

$$p = \rho g h \qquad \text{Eq.2}$$

3. Results and Discussion

In the results of the experiment and profoundly discuss the effect of the cooling system on the conceptual design house. The results from four part of the day is tabulated into a table together with the average calculation. Furthermore, the result of input and output temperature of the water and house is shown in a bar chart separately.

3.1: Results

3.1.1 Table of temperature (morning)

The table below shows the average temperature (°C) that is calculated in the morning of the experiment.

Table 1: Input and output of house temperature

House	°C	T1	T2	T3	Average
	Input	29.1	29.0	28.9	$\frac{29.1+29.0+28.9}{3} = \mathbf{29.0}$
	Output	28.3	28.5	28.4	$\frac{28.3+28.5+28.4}{3} = \mathbf{28.4}$

Table 2: Input and output of water temperature

Water Temperature	°C	T1	T2	T3	Average
	Input	26.9	26.5	26.4	$\frac{26.9+26.5+26.4}{3} = \mathbf{26.6}$
	Output	27.0	27.5	27.3	$\frac{27.0+27.5+27.3}{3} = \mathbf{27.3}$

3.1.2 Table of temperature (afternoon)

The table below shows the average temperature (°C) that is calculated in the afternoon of the experiment.

Table 3: Input and output of house temperature

House	°C	T1	T2	T3	Average
	Input	35.8	35.7	35.6	$\frac{35.8+35.7+35.6}{3} = \mathbf{35.7}$
	Output	33.5	32.1	31.6	$\frac{33.5+32.1+31.6}{3} = \mathbf{32.4}$

Table 4: Input and output of water temperature

	°C	T1	T2	T3	Average
Water Temperature	**Input**	27.8	27.7	27.5	$\frac{27.8+27.7+27.5}{3} = \mathbf{27.7}$
	Output	28.0	28.0	28.0	$\frac{28.0+28.0+28.0}{3} = \mathbf{28.0}$

3.1.3 Table of temperature (evening)

The table below shows the average temperature (°C) that is calculated in the evening of the experiment.

Table 5: Input and output of house temperature

	°C	T1	T2	T3	Average
House	**Input**	31.0	31.1	31.2	$\frac{31.0+31.1+31.2}{3} = \mathbf{31.1}$
	Output	29.5	29.1	29.0	$\frac{29.5+29.1+29.0}{3} = \mathbf{29.2}$

Table 6: Input and output of water temperature

	°C	T1	T2	T3	Average
Water Temperature	**Input**	29.0	29.1	29.2	$\frac{29.0+29.1+29.2}{3} = \mathbf{29.1}$
	Output	27.0	26.9	26.8	$\frac{27.0+26.9+26.8}{3} = \mathbf{26.9}$

3.1.4 Table of temperature (night)

The table below shows the average temperature (°C) that is calculated in the night of the experiment.

Table 7: Input and output of house temperature

	°C	T1	T2	T3	Average
House	**Input**	**27.2**	**27.1**	**26.9**	$\frac{27.2+27.1+26.9}{3} = \mathbf{27.1}$
	Output	**26.5**	**26.0**	**26.2**	$\frac{26.5+26.0+26.2}{3} = \mathbf{26.2}$

Table 8: Input and output of water temperature

	°C	T1	T2	T3	Average
Water Temperature	**Input**	**25.9**	**26.0**	**25.8**	$\frac{25.9+26.0+25.8}{3} = \mathbf{25.9}$
	Output	**25.4**	**25.3**	**25.2**	$\frac{25.4+25.3+25.2}{3} = \mathbf{25.3}$

3.2 Percentage difference between input and output temperature

Table 9: Percentage of difference between input and output temperature

Time	Conceptual Design	Percentage
Morning	House	$\frac{29.0-28.4}{29.0} \times 100\%$ = 0.021%
	Water Temperature	$\frac{27.3-26.6}{26.6} \times 100\%$ = 0.026%
Afternoon	House	$\frac{35.7-32.4}{35.7} \times 100\%$ = 0.092%
	Water Temperature	$\frac{28.0-27.7}{27.7} \times 100\%$ = 0.011%
Evening	House	$\frac{31.1-29.2}{31.1} \times 100\%$ = 0.061%
	Water Temperature	$\frac{29.1-26.9}{29.1} \times 100\%$ = -0.076%
Night	House	$\frac{27.1-26.2}{27.1} \times 100\%$ = 0.033%
	Water Temperature	$\frac{25.9-25.3}{25.9} \times 100\%$

		= 0.023%

3.3: Graph

3.3.1: Morning

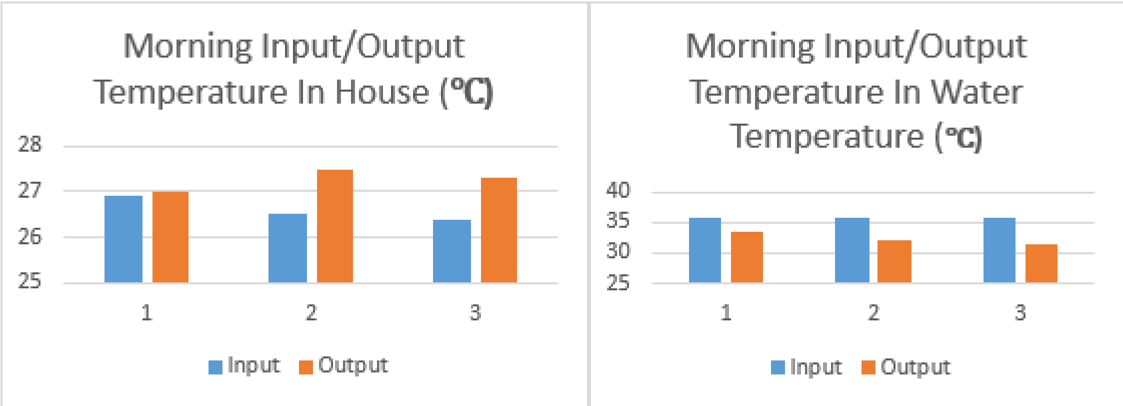

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Figure 3: Morning temperature result; a house b water

3.3.2: Afternoon

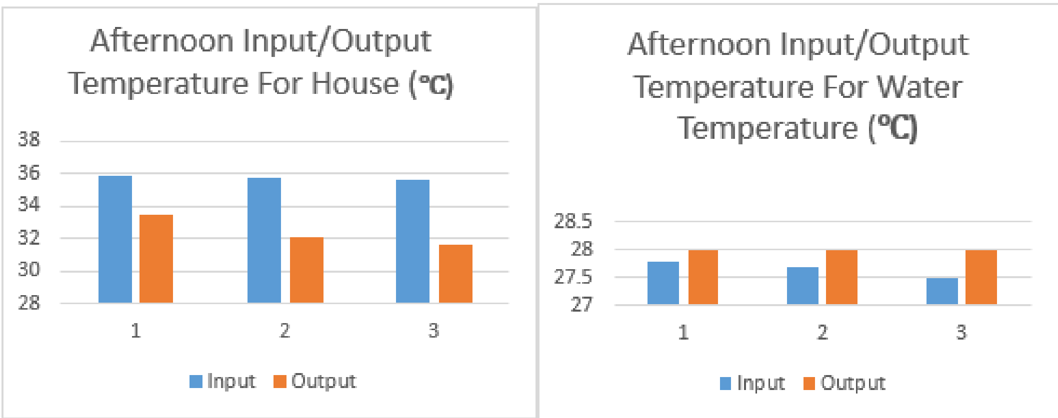

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Figure 4: Afternoon temperature result; a house b water

3.3.3 Evening

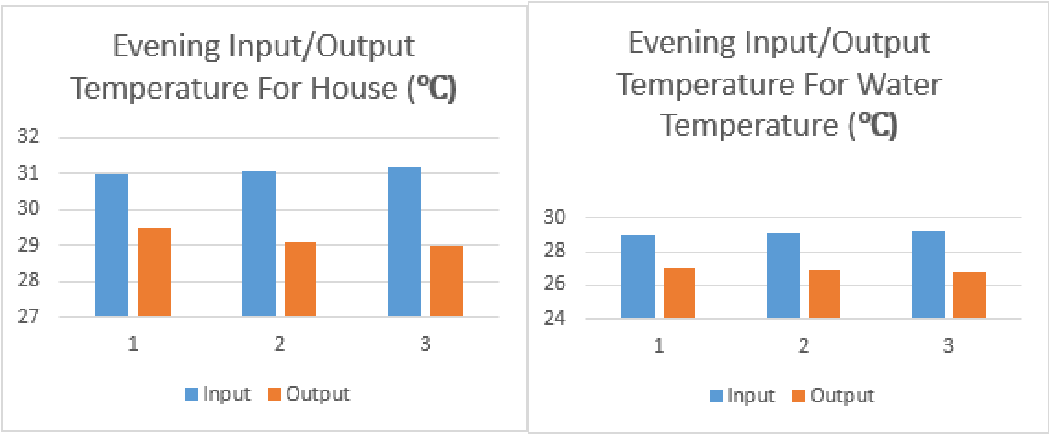

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Figure 5: Evening temperature result; a house b water

3.3.4: Night

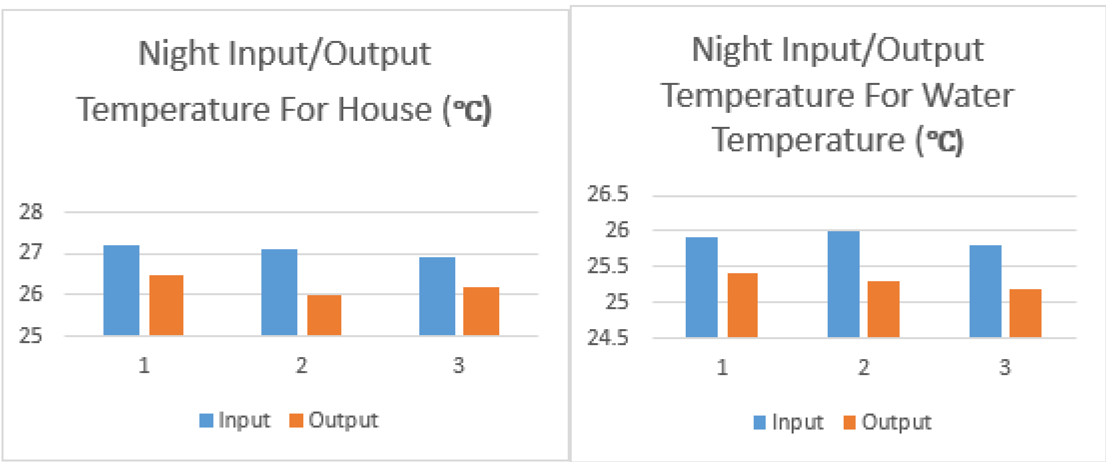

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Figure 6: Evening temperature result; a house b water

4.3: Discussion

From the results that is obtained in this experiment, the water temperature in the house is quite high in the morning where the average temperature is 29.0℃. This is due to the light sunlight during the daytime. The water shows the highest temperature reading in the afternoon because the the sun is at its highest point at approximately noon. The sun's highest point is when it gives the Earth the most direct sunlight, also called solar noon. The sun's radiation is the strongest at this point. So, the average temperature of the house in the afternoon is 35.7℃.

As for evening, the temperature slightly decreases because the radiation of the sunlight decreases which only show an average temperature of 31.1℃. Lastly, the water temperature is low during the night because there is no sunlight during the nigh time and the surrounding is slightly cooler. This can be shown by the average temperature that is measured which is 27.1℃. In short, when the input temperature increases, the ratio of output temperature also increases when it is tested after 15 minutes. In order to calculate the pressure of water, the formula of water pressure is used which is $p = \rho g h$ where p is pressure, ρ for density of water which is 100, g for gravitational field strength which is fixed that is 9.81 and h for depth of water.

From the calculation that is derived, we can get to know that the pressure of water is 2.9 kilopascal. Besides that, from the results that is taken we can get to know whether the cooling system is effective or not. The changes that occurs in the water temperature can be shown in the form of graph from the results taken. The house is set up using different types of materials that has its own function and characteristics. The materials are wood, zinc roof, thermal sensor, PVC connectors, PVC pipe, plywood, submersible pump and water storage pot. The conceptual design of the house is covered with black colour sheet as it is a good absorber of heat. Black colour is always known fot the best heat absorption.

Zinc roof is used as the top layer to cover the house as zinc is a good reflector of heat radiation and can last longer. Zinc has a higher durability, resistant to corrosion, self-healing and also has lower maintenance cost. So, zinc is the best material that can be used to build up this house. Plywood is long, robust and stronger to build this conceptual design. Submersible pump is fixed to pump water in a building from a basement. PVC pipes and PVC connectors are made up of metal piping which can be obtained with a low cost, high strength, and can be fixed easily.

4. Conclusion and recommendation

The design of the approach presented in this paper is appropriate according to modern technology. The temperature of the conceptual design house has been controlled using plain water with an effective cooling system. Although, the experiment was held on a small ratio in the open space, it gives a good outcome on the temperature to cool down the conceptual design. The bar chart shows clearly the difference of the input and output temperature. As a conclusion, the conceptual design for the natural cooling system from well water has been successfully designed hereby it can be concluded that the objective of the study was achieved. This cooling system can be implemented everywhere because of its simple and effective design. Moreover, can safe and prevent wastage of water since the water is recycled throughout the system. Most importantly, the installation of the system is very easy and also provide a long-term internal comfort for the inhabitants. There are few recommendations for the future work for this project. First of all, the system can be improvised by installing a solar panel while solar offers big saving over the monthly bills and also prevent from wasting energy. Besides that, the system can be improvised when the switch is linked wirelessly to a master control panel where the switch can be monitored and controlled in a single place. Finally, is to apply an automatic power cancellation on the submersible pump when the required temperature of the house is reached.

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