UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Improving of Cool Air Evacuation Process for Home Application

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Process) with Honours.

By

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Process) with Honors. The members of the supervisory committee are as follow:

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ABSTRACT

This report is concentrating on the natural cooling system for a cabin, which will not require much power consumption (electricity). This study is the study of advanced methods for planning a suitable and successful to absorb cold air out and how to maintain the house temperature at a suitable temperature. Process improvement was conducted by modifying the ducting system and fan installed on 4 hole with hole size 120mm diameter and 5820mm deep. Fans are use as medium absorption to attract cold wind out and cool cabin continuously. Fans used should have an ability to attract cool air from deep and small size is the advantages of the fan. The research was starting by monitor situation in the underground; water level and underground temperature are measured. Process monitoring is carried out until a certain lapse of time to get a stable reading and appropriate. After that, it was followed by finding the appropriate ducting system. With this system, wind that have been absorb always cool and able to cool the house within a short time. When all studies run smoothly, sensors will be installed. Sensor serves to detect the temperature inside the house, when temperatures are above the prescribed fan will work to lower the temperature inside the house. If the study is successful, the comfortable temperature will be produced in the cabin.

ABSTRAK

Projek Sarjana Muda I ini membincangkan tentang proses penambahbaikan sistem penyejukan semulajadi untuk sebuah kabin, dimana ia tidak memerlukan tenaga elektrik yang banyak. Kajian ini ialah kajian lanjutan bagi merancang kaedah yang sesuai dan berjaya untuk menyedut udara sejuk keluar dan bagaimana untuk mengekalkan suhu rumah pada suhu yang sesuai. Proses penambahbaikan ini dijalankan dengan mengubah suai system paip dan memasang kipas pada 4 salur angin. Kipas ini berperanan menarik udara sejuk keluar dan seterusnya menyejukkan rumah. Kipas yang digunakan adalah kipas yang mempunyai keupayaan untuk menarik angin dari bawah tanah ke permukaan. Kajian ini dijalankan dimulai dengan memantau keadaan paras air bawah tanah dan suhu bawah tanah. Proses pemanataun ini dijalankan selang masa tertentu sehingga mendapat bacaan yang stabil dan sesuai. Selepas itu, ianya diiukuti dengan mencari sistem penyaluran yang sesuai agar angin yang terhasil sentiasa dalam keadaan sejuk dan mampu menyejukkan rumah dalam jangka masa yang singkat. Apabila semua kajian berjalan lancar, sensor akan dipasang. Sensor berperanan mengesan suhu didalam rumah, apabila suhu berada melebihi paras yang ditetapkan kipas akan berfungsi untuk menurunkan suhu didalam rumah. Sekiranya kajian ini berjaya, suhu yang selesa akan dapat dihasilkan didalam kabin.

DEDICATION

For my beloved Father and Mother who always support and give their love that I really need during accomplish this thesis.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

COP	-	Coefficient of performance
IRH	-	Institute for Reproductive Health
PVC	-	Poly (vinyl chloride)
ANV	-	Advanced naturally ventilated
HVAC	-	Heating, Ventilating, and Air Conditioning
FT	-	Foot
M	-	Meter
CAD	-	Computer-aided design
V	-	Voltage
Mm	-	Millimeter
G	-	Gram
HZ	-	Hertz
^oC	-	Degree Celsius
PTC	-	Positive Temperature Coefficient
NTC	-	Negative Temperature Coefficient

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CHAPTER 1

INTRODUCTION

1.1 Natural Cooling System

This project is concentrating on the natural cooling system for a cabin, which will not require much power consumption (electricity). This project is designated for the development and the demand of an affordable cooling system for a house. The design is using simple piping system to blow the cool air from underground into the cabin. The piping system is buried certain depth into underground and it is hollow type pipe to blow the cool air into cabin. Four blower which have a capability to absorb cool air from underground will installed at four piping hole.

For the controlling of the exhaust fan, a temperature sensor which is used to sense the cabin temperature is installed in the system. In this controlling system, the range of temperature that is considered as suitable temperature (human comfort range) is set. If inside the cabin temperature is within this range, the control system will turn the blower off. So, the cool air from underground will stop entering the cabin. In the other way, if the cabin temperature is increasing (hot), the control system will turn the exhaust fan on and cool air from underground will enter the cabin.

This cabin presents the theoretical design principals of the underground evacuation cooling system, detailed parameter of design, the efficiency and the results of underground cooling evacuation system design.

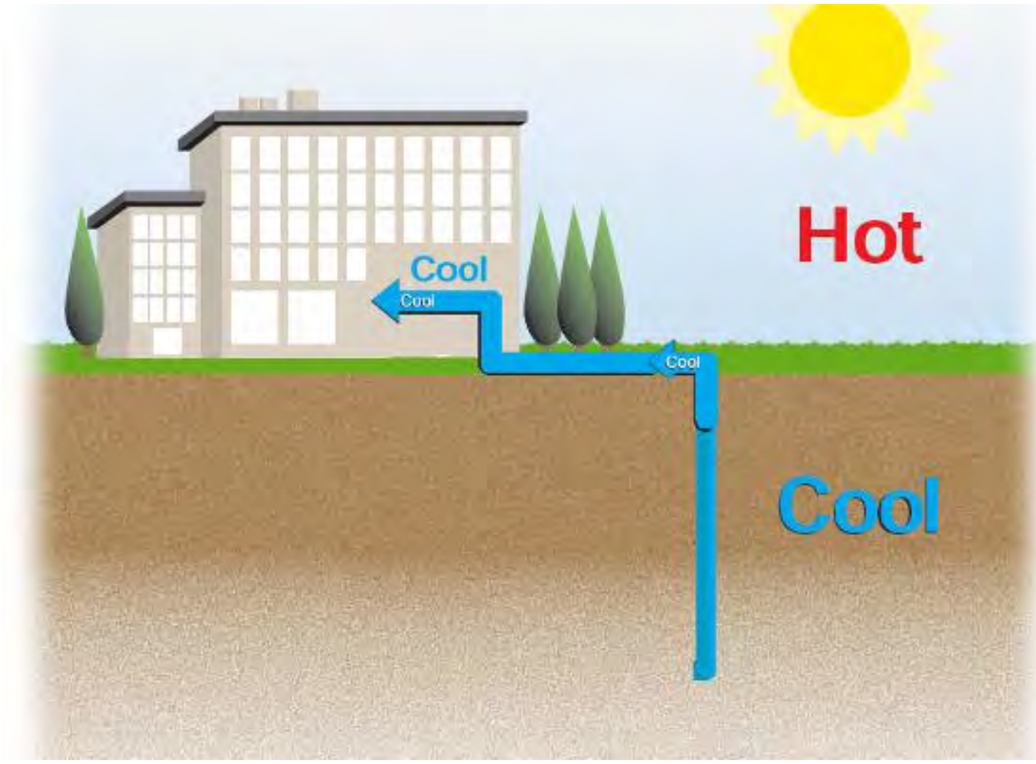

Figure 1.1: Earth Underground Temperature Delay

The main thing in underground evacuation cooling system is the underground properties. If it does not have these natural properties, this underground evacuation cooling system won't be functioning. Below is some information about these underground properties.

Actually, the earth has a built in time delay. During those times of the year when the cooling requirements are highest, the earth's temperature is still relatively cool, allowing easy absorption of excess heat into the ground. The ground temperature actually lags the outside temperature by several months, so that by the time the earth increases, the building's total cooling requirement has been reduced.

As the result, when outside is hot, the underground temperature is actually cool. Oppositely, when outside temperature is cool, the underground temperature is hot. This property is very useful for underground cooling system. The main propose of air conditioning in Malaysia is just for cooling when it is hot. So, when the day is hot, the underground temperature is cool. So, by using these properties, a new type of cooling system can be created or designed to replace air conditioning system. We can figure this out by doing a simple experiment. During hot day, if we open the water tap head, the water that comes out is cool for first few seconds. After that, the water will become warm again. The water pipes are buried inside the ground. So, from this we can know that the underground temperature is cool even though it is a hot day because of time delay of earth.

As a consequence, to continue this budget-saving project, the base of the cabin is built on the project site and followed by the whole physical of the cabin. The piping system which is located behind the wall will flow the cool air to the ceiling of the cabin. In the ceiling, there is a wooden-box to gather the cool air before it is spread through a diffuser which is to spread the cool air into the cabin. This diffuser can blow the cool air into the cabin equally. These are the whole idea of what natural cooling system all about.

1.2 Background Research

1.2.1 Temperature

The temperature of the ground, a few feet beneath the earth's surface, remains relatively constant throughout the year, even though the outdoor temperature may fluctuate greatly with the change of seasons. The underground temperature is 37°F (2.7°C) to 74°F (23°C), are the natural temperature just a few feet underground in many places in the world.

1.2.2 Cooling system

A man would think of a cooling appliance which can decrease the temperature in the house. Cooling system with large volume is widely used in large open area. Such as factories, sports stadium, coffee shop, outdoor place. It combines the natural cooling process of evaporating water and a high velocity air blower to deliver naturally cooled air. Cooling and heating use more energy than any other system in your home.

Much of the cost of cooling your home can be saved by passive cooling techniques which don't require expensive retrofits or professional installations. There are few methods that can be used to have a free or low-cost home cooling system with less impact on the environment and your energy bill. One of them is the concept of whole-house fan.

This project is using the same concept with the whole-house fan. A whole-house fan is a type of fan installed in a building's ceiling, designed to suck hot air out of the building. It is sometimes confused with an attic fan. A whole-house fan sucks hot air out of a building and forces it into the attic. This displaces the very hot air trapped in the attic (which is pushed out the gable-end or soffit vents). Then, with windows and/or doors open to the outside, the whole-house fan draws cooler outside air into the building to replace the hot air (creating a cooling breeze whilst doing so). Attic fans, by comparison, only serve to remove some hot air from the attic; no cooling effect is provided to the actual living space.

A whole-house fan can significantly lower the temperature in a building very quickly, and is much less expensive to operate than air conditioning. Newer whole house fans are extremely environmentally friendly and energy efficient additions to house cooling systems. On temperate days they can be turned on to circulate rising hot air out of the house while pulling cool air in. Also new models are quieter and smaller than their older counterparts. So, this new system which is to be designed is expected to consume less energy as compared to the conventional cooling systems.

1.3 Problem Statement

Malaysia has an equatorial climate, giving it a warm and wet weather due to its proximity to the equator. Temperatures in the lowlands range between 29°C - 35°C during the day and 26°C - 29°C at night, depending on the amount of rainfall and sunlight. On an average, Malaysia receives about 6 hours of sunshine each day with cloud formations occasionally leading to rainfall. However, daytime is usually warm and sunny, with heavy rains only occurring in the evenings onward. So, this kind of weather would increase temperature in a house, which sometimes will cause the uncomfortable environment inside the house.

Air-conditioner is a well-known appliance for cooling systems. However, the cost to produce and to have the appliance is quite expensive. The main culprit in high electricity bills is air conditioner, as cooling is the most expensive cost. Furthermore, if the house have 3 or 4 air conditioner and tend to prefer Western style homes that are ready with bigger window that make house hot and need air conditioner turned on all day. Some 60% of electricity bills are from the usage of air conditioner.

So, this project is very expected to create a new cooling system which consumes less energy to the conventional cooling systems and some more, is a starting point of creating an affordable cooling system for everyone.

1.4 Objectives Of The Research

The main objective of this cooling system research is to consume less energy as compared to the conventional cooling systems. Less energy will decrease the cost, in terms of the production and the cost during application. This investigation is to adjust the temperature from hot to normal temperature. This normal temperature is considered as the human comfort range which is not very hot and not very cool. The objectives of the research in details are to:-

a. Improve cooling system
b. Design the ducting system suiting the cabin.
c. Design the Auto-control blower for the system.
d. Test and continuous improvement.

1.5 Scope

The project is to be tested at UTeM Fasa B rigid ground within the area of the base of the cabin is 3100mm x 2440mm with the temperature is as normal as usual (room temperature=25°C -27°C) during day, and 21°C - 24°C while at night.

1.6 Significance Of The Project

This project is a trial for redesigning of the cooling system of a cabin, which will require less power consumption compared to the conventional existing cooling system. The natural cooling system is expected to be designed with less complicated concept as compared to the existing one. It is expected to form a less costly and more economic cooling system.

This project is persuading people to prevent the global warming that cause by the used of air-condition, indirectly. This project is important because the one of the main objectives is related to human's life and also to the environment. Natural cooling system will consume less power consumption and this will reduce the cost yet improve men's lives.

CHAPTER 2

LITERATURE REVIEW

M. Macias, A. Mateo M. Schuler, and E.M. Mitre discovered the application of night cooling concept to social housing design in dry hot climate. They aim to ensure a certain comfort for the flats during the summer months by applying a passive solar cooling concept. By introducing an accessible high thermal mass in the building construction and activating it during the night with increased ventilation, the concept tries to limit the indoor temperature below an operative temperature of 28 °C, instead of using fan.

In one article at http://www.southface.org/web/resources&services/publications/factsheets/housefan.pdf, a whole house fan can be used as the sole means of cooling or to reduce the need for air conditioning. Outside air temperature and humidity dictate times when the whole house fan would be favorable over air conditioning. If both methods of cooling are present, a seasonal use of the whole house fan (during spring and fall) may yield the optimum combination of comfort and cost. a whole house fan represents a potential energy loss because it is essentially a large, uninsulated hole in the ceiling. Standard fan louvers do not insulate or seal tightly.

Karsten Voss, Sebastian Herkel, Jens Pfafferott, Günter Löhnert and Andreas Wagner (1995) proposed the Energy efficient office buildings with passive cooling. To gain access to information on energy use in office buildings, the German Federal Ministry for Economy launched an intensive research and demonstration programme in 1995. In advance of the 2002 EU energy performance directive a limited primary energy coefficient of about $100\,kW\,h\,m^{-2}\,a^{-1}$ as a goal for the complete building services technology was postulated (HVAC + lighting) for all demonstration buildings to be supported. A further condition was that active cooling be avoided. Techniques such as natural or mechanical night ventilation or heat removal by slab cooling with vertical ground pipes as well as earth-to-air heat exchangers in the ventilation system were applied.

Kevin J. Lomas (1996) find the Architectural design of an advanced naturally ventilated building form. Advanced stack-ventilated buildings have the potential to consume much less energy for space conditioning than typical mechanically ventilated or air-conditioned buildings. He described how environmental design considerations in general, and ventilation considerations in particular, shape the architecture of advanced naturally ventilated (ANV) buildings. The attributes of simple and advanced naturally ventilated buildings are described and a taxonomy of ANV buildings presented. Simple equations for use at the preliminary design stage are presented. As the result, the guidance, simple calculation tools and case study examples will give architects and environmental design consultants confidence to embark on the design of ANV buildings.

D.Y. Goswami and K.M. Biseli (1993) present use of underground air tunnels for heating and cooling agricultural and residential buildings. It describe the soil temperature, at a depth of about 10 feet or more, stays fairly constant throughout the year, and is approximately equal to the average annual ambient air temperature. So, underground temperature can be used as a cooling system. The method of using this concept is to pass air through an underground air tunnel and air is cooled or heated can be used directly for the conditioned space or indirectly with air conditioners or heat pumps. The material of tube use is corrugated plastic or galvanized steel but steel is more costly. The diameter of tube is 12 in with the depth is 6 ft, 9ft and 12 ft.

Rogers, Walter E. and Midgett, Preston C. (1980) describe a method of heating or cooling a structure by utilizing the natural earth as a source of energy to heat and cool, due to the mean temperature lag phenomenon. The heating and cooling system including one or more conduits disposed approximately six feet underground and having opposite and extremities communistically connected to the structure. A fan assembly included