

Abstract:

The last two decades have witnessed a rigorous energy crisis in developing countries, mainly during the summer season, principally due to the cooling requirements of buildings. The consumption of energy in buildings is very high and is predicted to be increased further owing to improved living standards and an increase in the world's population. The excessive use of air conditioning has been clearly increasing in the market over the past few years and significantly contributes to the increase of supreme energy consumption regarding to the Global Watch Institute, buildings consume about 40% of the world's energy production. Energy use in buildings also accounts for 33% of all annual carbon dioxide emissions, contributing significantly to climate changes resulting from the accumulation of thermal combustion gas. Take for example, the case of India, the construction sector accounts for about 33% of electricity consumption, and the commercial sector accounts for 8% and 25%, respectively.

The objective of passive cooling and heating techniques can reduce the peak cooling and heating load in buildings, thus reducing the size of the air conditioning equipment and the period for which it is generally required. Therefore, in this project, passive cooling, heating techniques and energy efficiency measures will be addressed. Moreover, different passive cooling and heating techniques and their role will be discussed in providing thermal comfort and its significance in energy conservation

Acknowledgement:

The aim of the project is to function on both cooling and heating; the various use of this system could affect the overall results. The environmental issues that comes into play is the quality of the fresh air and heating used during the process that may very well affect in reducing inimical greenhouse gas emissions and the rates of carbon dioxide and also without using generated electricity which is very costly.

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Chapter 1:

1.1 Introduction

The last two decades have witnessed a rigorous energy crisis in developing countries, mainly during the summer season, principally due to the cooling requirements of buildings. The consumption of energy in buildings is very high and is predicted to be increased further owing to improved living standards and an increase in the world's population. The excessive use of air conditioning has been clearly increasing in the market over the past few years and significantly contributes to the increase of supreme energy consumption.

Regarding to the Global Watch Institute, buildings consume about 40% of the world's energy production. Energy use in buildings also accounts for 33% of all annual carbon dioxide emissions, contributing significantly to climate changes resulting from the accumulation of thermal combustion gas. Take for example, the case of India, the construction sector accounts for about 33% of electricity consumption, and the commercial sector accounts for 8% and 25%, respectively.

1.2 Problem Statement

The continued rapid growth of the construction industry and energy demand raises a number of questions, persistent problems and a need for a solution. The introduction of mechanical cooling allowed not only the ability to increase full thermal comfort for longer periods, but also a great deal of flexibility in building design, while at the same time leading to changes in lifestyle and work habits. However, the use of "high tech" has significantly led to ignoring natural cooling techniques. Now with the increasing realization of the rapid depletion of non-renewable energy sources and the harmful environmental effects of fossil fuel waste, it is acceptable to state that it is unwise to consume huge quantities of non-renewable fuel for air conditioning from buildings when our ancestors have achieved thermal comfort by natural means.

1.3 Objectives of the Study

Passive cooling and heating techniques can reduce the peak cooling and heating load in buildings, thus reducing the size of the air conditioning equipment and the period for which it is generally required. Therefore, in this project, passive cooling, heating techniques and energy efficiency measures will be addressed. Moreover, different passive cooling and heating techniques and their role will be discussed in providing thermal comfort and its significance in energy conservation.

1.4 Modern passive cooling methods

Passive cooling is done in modern homes in one of two ways:

Shading in plants and trees or umbrellas take into account the angle of the fall of the sun in summer and winter, the shade is very useful in the hot areas where the sun's heat is high and cause harm and distress to the inhabitants of the house and can be shading either by planting trees that block the high majority of the sun from the house or by working windows in a way The sun is less prone to the equator than in the summer, when the sun is perpendicular to the nearest orbit to the geographical area in which the house is located. However, the amount of solar radiation entering the house is higher in winter, which is required. Rotating the internal air in the house to ensure the elimination of excess heat through the upper openings, either by making upper openings to remove hot air and withdraw the air less heat than the windows, or through the work of the internal lobby or open the upper openings so that the air is heated inside and paid Which will ensure that there are active air currents inside the house and cooling it.

Chapter Two

2.1 Literature Review

The "passive" solar design involves the use of natural processes of cooling to get balanced internal conditions. The energy flow in passive design shall be by natural means: radiation, conduction, or convection without the use of any electrical device. The preservation of a comfortable environment within a building in a warm climate depends on reducing the rate of thermal gains in the building and encouraging the removal of excess heat from the building. To prevent heat entering the building or remove it once it enters is the basic principle of cooling in the passive Cooling concepts. This depends on two conditions: the availability of a heat sink that is at a lower temperature than the internal air, and promotes heat transfer towards the aquarium. Passive cooling techniques can reduce the cooling load in buildings, thus reducing the size of the air conditioners and the time required in general.

Passive Cooling Techniques

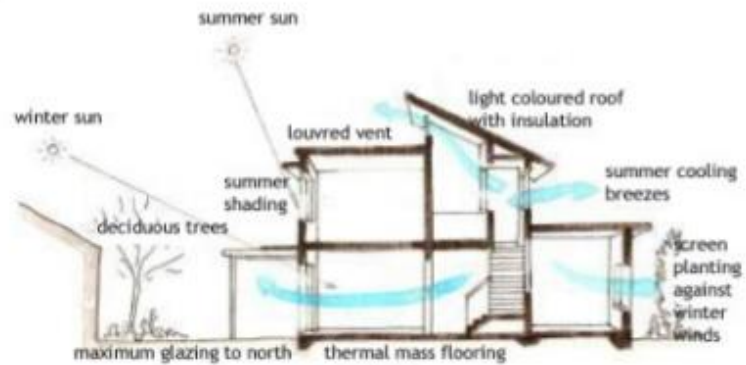


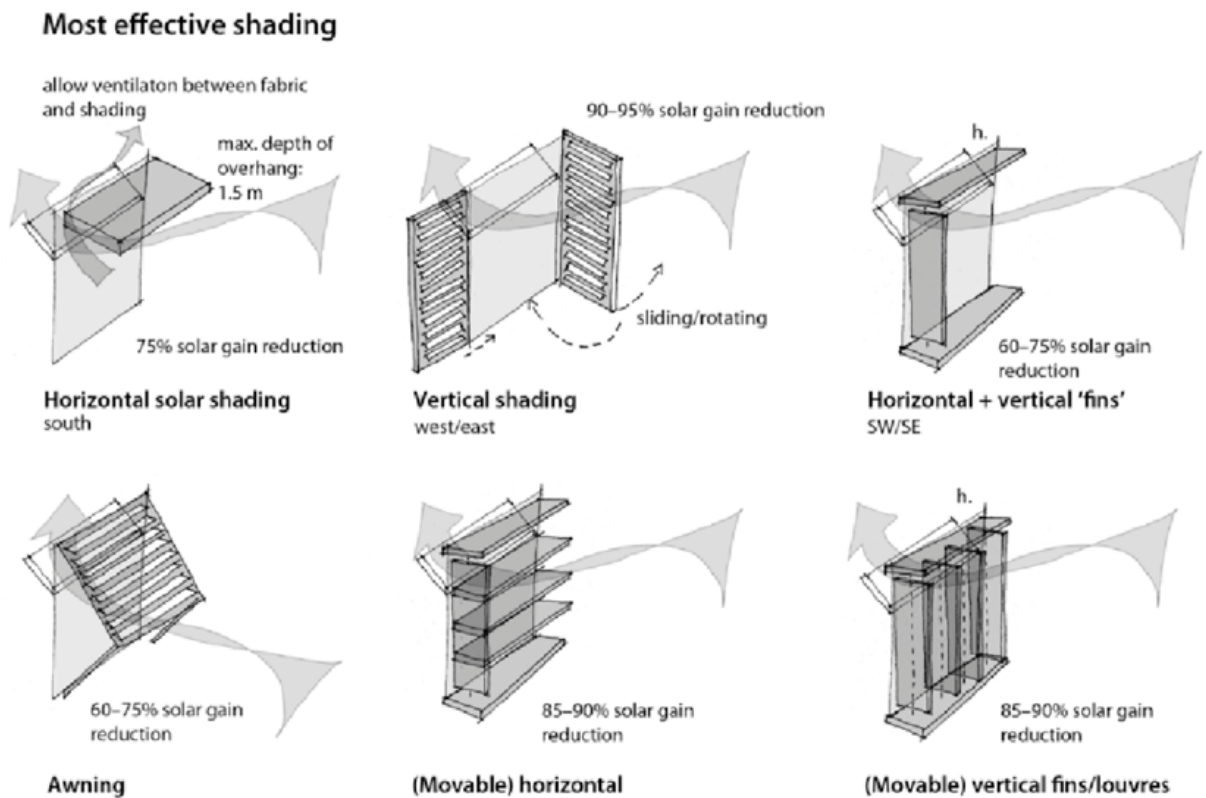
Figure 2.1 3: passive cooling techniques

Important cooling concepts such as shading are discussed in detail:

2.2 Solar shading

Among all other positive solar cooling techniques, solar shading is related to the thermal cooling of buildings especially in a developing country because of their cost-

effectiveness and ease of implementation. Rural areas in India and developing countries in the Middle East have seen a rise in the roof of the RCC. However, the availability of electricity in villages, especially during the summer, is limited. These roofs tend to make the interior temperature very high around 41 ° C: due to the high temperature of the buildings' surface at about 65 ° in arid zones. Solar shading with locally available materials such as terracotta tiles, hay, inverted earth pots, dates palm branches and others can greatly reduce this temperature.



Bottom three shading devices are suitable for all orientations if movable shading fins. They are effective solar shading, but reduce daylighting and winter solar gain so use with care. Design sliding/inward-opening windows, which do not impede natural ventilation. Design top inward-opening 'hopper' windows for night cooling (h.).

Figure 2.1 4 : solar shading

2.3 Insulation

Insulation effect is the reduction of heat gain and heat loss. The greater the insulation in the outside of the building, the lower temperature moved into the building or outside because of the temperature difference between the inside and outside. Insulation is also controlled by the internal temperature of the radiation (MRT) by isolating the internal surfaces from the effect of external conditions, and also reduces the drafts caused by differences in temperature between the walls.

2.4 Methods of passive heating

The house is directed towards the equator so that it gets the largest possible amount of heat from the sun that always shines from the equator. Therefore, the house is designed in some cold areas in a longitudinal manner, where the longer face with large windows towards the equator, which helps to absorb most of the sun. During the day, the windows are preferred to be longitudinal rather than transverse, because the longitudinal windows allow a solar line to reach all the contents of the room, ensuring that part of this energy is stored while the solar radiation does not reach through the wide windows to all the contents of the room.

Ground protection and thermal insulation The ground protection of the buildings aims to preserve the heat absorbed by the house from the sun for the longest part of the night and is often followed in cold areas because the earth's temperature is often

constant and ranges between 15-20 degrees Celsius, In the snowy winter days, where temperatures are low to zero, while the home is equipped with windows directed to the equator to benefit from solar radiation, as for thermal insulation is suitable for almost all environments and is useful in summer and winter and in cases of cooling lazy or It keeps the heat indoors in the winter while the solar heat prevents it from reaching through the walls of the house and thus the interior remains moderate.

It is not possible to design a passive energy building that is suitable for all climates and is suitable for all climates. Each climate needs special design for building according to temperature. Cold climates need passive heating techniques. Hot climates need lazy cooling while cooling and heating are mixed in temperate climates. With a variety of climates from areas rich in architecture that uses heating and passive cooling, and under the high bill that families have to pay to provide heating and cooling, the design of a building saves energy without the need to pay additional amounts to operate is one of the best missions Which must be entrusted to design engineers and constructors.

Chapter 3: System Design

3.1: Design Constraints

There are several forms of passive construction of energy, which have been designed and completed around the world since the human being knew almost permanent housing and all relied on the principle of one basic is to acquire heat from the sun in winter and keep them as large as possible and avoid absorption of this heat in the summer

or loss in the shortest time. However, different constraints were encountered during the process of this study. The most clear on is few studies were conducted in this field as it is a new field.

Although studies have been done on different other applications of it, the fact that this specific application, ironing, is a deviation from the more commercial drying method, the lack of direct information on the topic served as one of the more apparent constraints. This was mediated through combining the logic behind modern ironing and ultrasound drying, and systematically applying them together in order to reach a conclusion on the functionality of the prototype. Passive cooling and heating, sometimes referred to simply as passive solar design, is the process of using specific construction systems to help regulate internal temperature using selective and useful solar energy in an effort to improve energy efficiency. In these systems, the building itself or some of its elements benefit from the natural energy properties of materials when exposed to the sun. In general, these passive systems are simplified with some moving parts, requiring minimal maintenance. These include the engineering necessary to create these systems carefully select the materials for the construction envelope - including building walls, floors, roofs, windows and their glazing materials - and determine their correct orientation. The passive heating and cooling are picked up or strategically stained against solar radiation.

3.1.1 Constraints:

With the device being a new concept in design, there are various different constraints that are present within its design cycle, as well as with varying result types. These constraints range from.

- Environmental
- Economical
- Social

The analysis of each individual constraint will be elaborated on, as well as showing techniques used to mediate the issues these constraints presented.

3.1.1.1. Environmental

The principle aim of the project is to function on both cooling and heating; the various different use of this system could affect the overall results. The environmental issues that comes into play is the quality of the fresh air and heating used during the process that may very well affect in reducing inimical greenhouse gas emissions and the rates of carbon dioxide.

3.1.1.2 Economical

Considering one of the main aims of the project is to be as cost efficient as possible, Technically, PSH is highly efficient. Direct gain systems can use (ie converted into "useful" heat) 65-70% of the energy of the solar radiation that hits the hole or collector. To put this in perspective near to last the energy conversion process, the reduction of theoretical photosynthesis efficiency is about 11%. The solar passive part (PSF) is the percentage of convection required by PSH and thus represents a potential reduction in heating costs. RET Screen International reported PSF of 20-50%. In the area of sustainability, energy conservation is considered even for the order of 15% significant. Other sources report the following PSFs:

5-25% for modest systems

40% for "very large"

Up to 75% for "very intense"

In favorable climates such as the US Southwestern, high-efficiency systems can exceed 75% psf.

3.1.1.3 Social

As this system is new and people are not ware enough, they are still hesitated in adopting this new system. However, utilization of the passive cooling and heating system could preserve lives by reducing indoor pollution which currently kills more than a million people in the world. Moreover, it could reduce fire and fuel injuries, thus ameliorating quality of life in general as people would use natural resources only.

3.1.2 Design Methodology

Passive heating and cooling systems are used to avoid the use of air conditioning or heater. Many more advanced techniques to control household temperature use negative methods to achieve energy efficiency. There are a variety of different techniques that harness or selectively protect against the sun's energy to heat or cool a building without using a heater or air conditioner. These technologies include operable windows, solar chimneys, solar walls, and trombic walls. These techniques are used to regulate internal temperatures by capturing or venting heat from solar radiation. Shading technology can also be used strategically to reduce heating. By creating places where shadows can be increased or reduced, the amount of solar radiation entering the space is reduced, thus keeping the room cool without using air conditioning. These techniques can be used to build a modern structure and can also be integrated into existing structures. Local climate is always the biggest factor when designing and implementing passive solar heating and cooling systems.

3.1.2.1 How does it work?

Passive cooling and heating system benefit from natural processes such as conduction, convection and radiation to heat or cool the building. Because of this, they require little or no external energy to work out and can contribute to energy efficiency at home. When the sun rises, the solar radiation warms the buildings. This solar energy is converted into heat and transported by hot air or water to the building. By capturing or shading this radiation strategically, the temperature of the house can be regulated. In addition, heat gain can be stored from solar solrazation for future use. The capture of solar radiation in the winter helps to warm the area, and the shading of the solar radiation in the summer to cool the space. Thus, the use of insulation and thermal mass is critical to prevent overcooling of space in winter. Similarly, the use of shading techniques with windows and glazing is equally important in preventing overheating of summer space.

3.1.2.2 Components of passive cooling and heating system

1. Relay module 8 ch-1
2. Mega Arduino board
3. LCD 2 pieces
4. On / off switch
5. LM 35 z
6. Terminal legs.
7. FAN 2
8. Resistor 1/4 W.
9. Break bored 102.
10. Heat sink c Germany
11. FM jumper wires
12. Aluminum heat sink
13. DH 11. 5

Table 2: Components of passive cooling and heating system

3.1.2.3 Engineering Standards

One of the first decisions to be taken on heating and cooling for residence is whether the systems will be active or negative in nature. This is the fundamental issue affecting many design decisions - building orientation, descent, envelope, internal organization, and materials. Passive heating and cooling systems are those that do not use purchased energy, and place multiple functional requirements on many components of the building, which are highly integrated with all aspects of building design.

3.1.2. 4 Implementation

While societies of developing countries have many needs, they are also evolving rapidly. Families in these societies are usually very open to changes and opportunities that will help them live better. They struggle, but with hard work many have the opportunity to prosper and improve their quality of life. Since conventional cooling and heating systems are not widely used in developing countries, there is an opportunity to implement a different option that would provide sufficient cooling at a fraction of the expense of conventional systems, while being respectful of the outdoor environment and socially acceptable. Passive cooling systems offer this opportunity. Passive cooling systems have lower initial and operating costs than air conditioners, which are

expensive and out of reach of low income and even many middle income families in less developed countries. Even families that can afford to buy air conditioners, sometimes cannot provide maintenance for them or even turn them on when they need to. Because of their simple design, passive cooling systems can be built at lower costs and using local labor and resources, generating income for local entrepreneurs that stays in the community and contributes to local development. There is also a hepatic quality about the use of Passive Cooling Systems, the dweller knows what part of the house is operating to achieve comfort and can see and feel the effect of the system as it works to harness the natural forces and cool the house. And since passive cooling systems rely on building design and materials to control natural forces, they help to establish a closer connection between the dwellers and the environment through the building, ultimately helping to better connect with nature's rhythms. If passive systems are added in existing buildings as the population wishes to improve their life quality, energy consumption will increase very little, while thermal comfort will improve substantially. If passive cooling systems are well integrated and generally accepted by the population, it would be an important step to create a more sustainable architecture in developing countries.

3.1.2. 4.1 Design of Solar Building

In the design of the solar building, the windows, walls, and floors are made to collect, store and distribute solar energy in the form of heat in winter and reject the heat of the sun in the summer. This is called passive solar design or climate design because unlike the flexible solar heating systems, do not use mechanical and electrical devices. The key to designing a passive solar building is to make the most of the local climate. Which are concerned with elements including window placement, glass type, thermal insulation, thermal mass, and shading? Solar passive design techniques can be applied in most new buildings with ease, but existing buildings can be adapted or "updated and modified".

3.1.2. 4.2 Site considerations during design

1. The latitude and longitude of the site, the path of the sun's movement, and the amount of sunrise (sunrise hours).
2. Seasonal changes associated with solar energy play a major role in the amount of energy gained and influenced by daily temperatures, solar radiation and humidity.
3. Changes in temperature during the day.
4. Precise climatic details associated with breeze, moisture, vegetation, and topography.
5. Obstacles associated with location and heat obtained from the sun and wind movement.
6. Design elements for residential buildings according to local climatic conditions by:

- a. Type of rooms, equipment used, type of walls and interior doors used orient the building towards the equator (or a few degrees east to catch the morning sun the building is located on the east-west axis. - The windows are sufficiently sized to face the sun in the middle of the day in the winter and be shaded in the summer.
- b. Reduce windows in other areas, especially in the west.
- c. Choose the appropriate size of the windows according to the location of the building for the longitude and latitude and according to the elements of shading (used or already existing such as bushes, trees, fences, fences, etc.).
- d. Use appropriate insulation to reduce the heat gained. -
- e. Use the thermal block to store excess solar energy during the day in the winter and then radiate it at night.

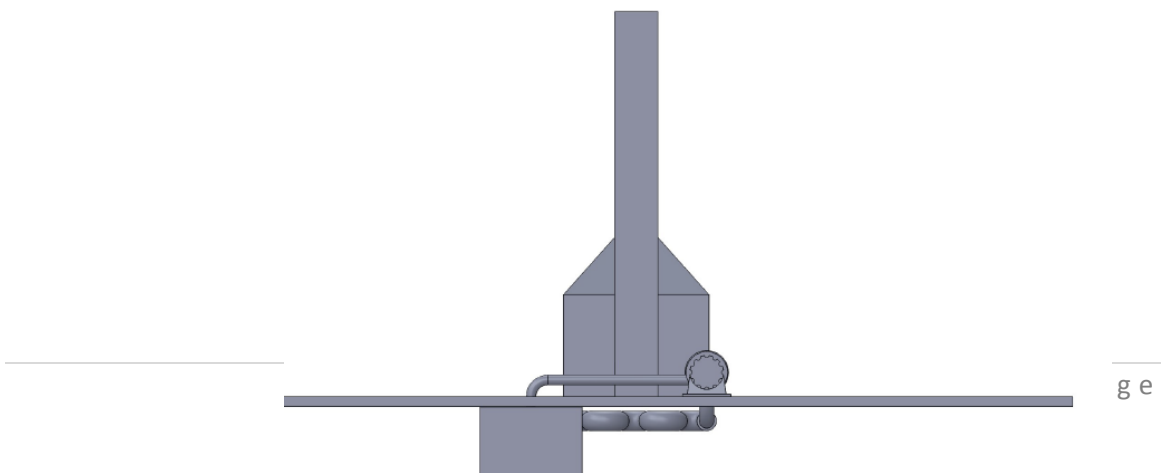


Figure 3.1: cad model water tank under ground

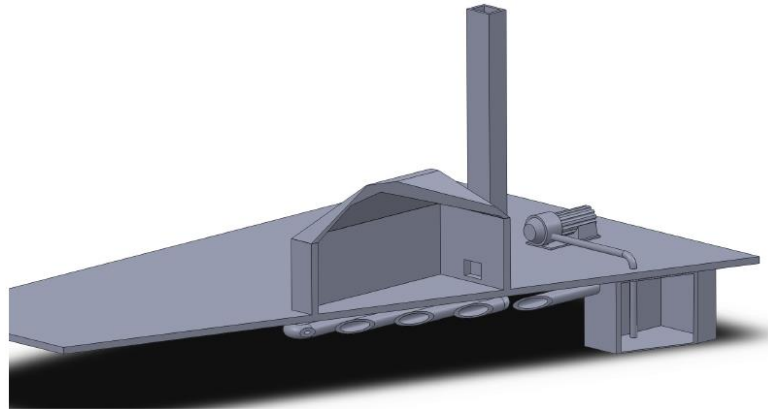


Figure 3.2: inlet cad model design

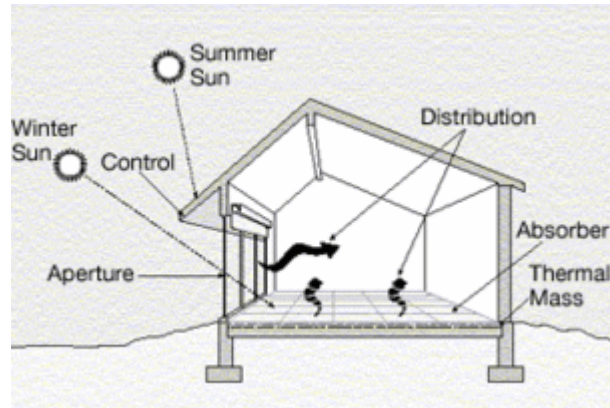


Figure 3.3

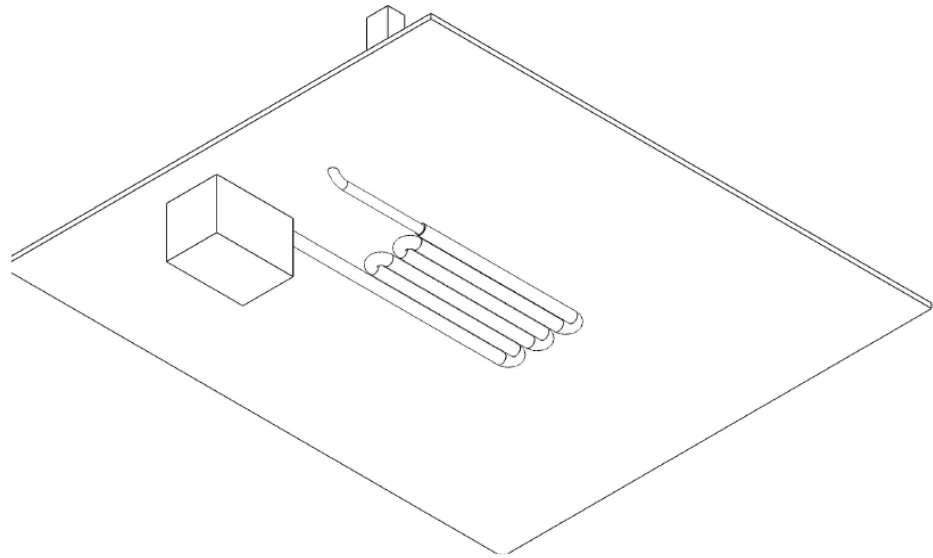


Figure 3.4 under ground cooling coil cad design

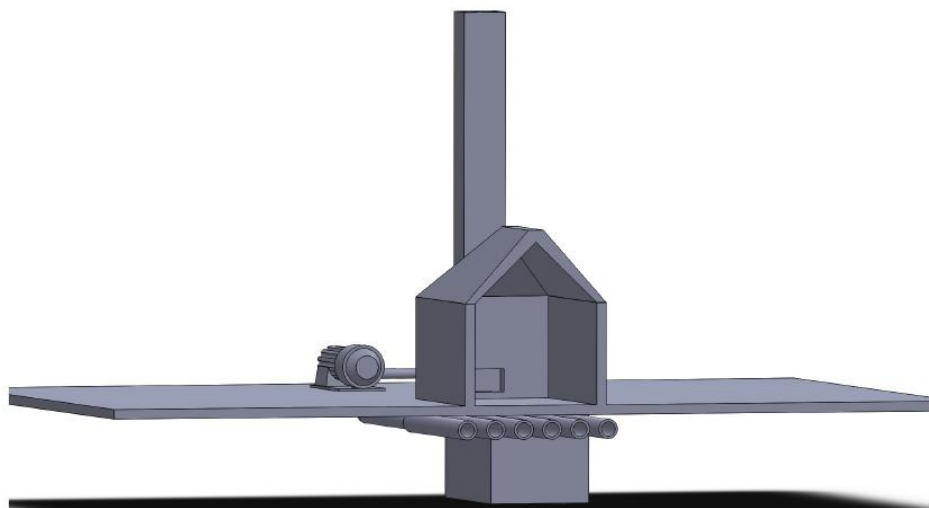


Figure 3.5: full looking cad design

3.1.5 Calculation

$$\dot{Q}_{loss} = \Delta T + U + A$$

$$A=?? \text{ ______ } A = (\text{walls} + \text{flour} + \text{roof})$$

$$\dot{Q}_W = \dot{Q}_a + \dot{Q}_{Loss}$$

$$\dot{m}_w * C_{pw} \Delta T_w = \dot{m}_a \Delta h + U * A * \Delta T_a$$

‘Where: (\dot{m}) mass flow rate, (C_{pw}) specific heat capacity and (ΔT_w) temperature of wall ‘

$$\dot{m}_w C_{pw} \Delta T_w = \dot{m}_a \Delta h + \dot{Q}_{Loss}$$

$$\Delta T_w = T_{w2} - T_{w1} = \text{--- --}$$

$$\Delta T_a = T_o - T_i = 44 - 24 = 20 \text{ } ^\circ\text{C}$$

$$U = 2.2931 \frac{\text{W}}{\text{m}^2\text{C}}$$

$$A = ??$$

$$C_{pw} + 4.186 \text{ KJ/kc}$$

$$T_i = 24 \text{ } \phi_i = 50^\circ\text{C} \text{ } h_i = 47.79 \text{ kJ/kg}$$

$$T_o = 44 \text{ } \phi_o = 70^\circ\text{C} \text{ } h_o = 152.5 \text{ kJ/kg}$$

$$\Delta h = h_o - h_i = 104.26 \text{ kJ/kg}$$

$$\dot{m}_w = \rho_w * \frac{\pi}{4} D_{pipe}^2 * (2\pi n r)$$

$$\rho_w = 10^3 \frac{\text{KG}}{\text{m}^3}$$

$$A_w = A_{pipe} = \frac{\pi}{4} D_{pipe}^2$$

$$M_w = \text{-----} \frac{\text{Kg}}{\text{j}}$$

$$V = w * r = 2\pi n r$$

Where: (**n**) RPM

INSIDE h_i OUTSIDE h_o

Still air	moving air ($v=3.5$)
<i>Material</i>	$R \left(\frac{m^2}{W} \right)$
<i>Inside still air</i>	$R=0.12$
<i>Wood layer</i>	$R_w = 1/6.1 = 0.164$
<i>Insulator layer</i>	$R_{ins} = 4 * 16 / 0.037 = 0.1081$
<i>Moving air</i> $V=3.5 \text{ m/s}$	$R_4 = 0.044$

$$R_{eq} = \sum R_i = 0.12 + 0.164 + 0.1081 + 0.044$$

$$R_{eq} = 0.4361 \text{ } ^\circ\text{C} \cdot \text{m}^2 / \text{W}$$

$$U = \frac{1}{R_{eq}} = \frac{1}{0.4361} = 2.2931 \frac{\text{W}}{\text{m}^2 \text{ } ^\circ\text{C}} \text{ (Overall heat transfer coefficient)}$$

$$\dot{m}_a = \frac{\dot{m}_a * c_{p_w} * \Delta T_w - UA \Delta T_a}{\Delta h} = \dots \text{ kg/s}$$

$$\dot{Q}_{\text{actual cooling}} = A + 0.06 \frac{TR}{m^2} = \dots \text{ TR} * \frac{210}{60} = \text{KW}$$

$$1TR = 210 \frac{KJ}{MR} = \frac{210}{60} KW$$

$$\dot{Q}_a + \dot{Q}_{FAN} + \dot{Q}_{Loss} = Q_{sun}$$

$$\dot{m}_a \Delta h = q_{sun} * A_{chim}^{sun} - I * V - UA * \Delta T_a$$

$$\Delta T_a = T_i - T_o = \text{-----} \text{---}^\circ C$$

$$T_i, Q_i \text{-----} H_i \quad T_o, Q_o \text{-----} H_o$$

$$\Delta h = h_i - h_o = \text{-----} = \frac{KJ}{Kg}$$

$$Q_{sun} = \text{-----} \frac{Kw}{M^2} (given) \quad U = 2.2931 \frac{W}{m^2c}$$

$$A = ?? \quad A_{sun} = \text{-----} (standard)$$

$$\dot{m}_a = \frac{q_{sun} A_{chim}^{sun} - 1 * v - U_A \Delta T}{\Delta h} = kg/s$$

$$\dot{Q}_{het} = \dot{m}_a h_a = q_{sun} A_{chim}^{sun}$$

Chapter 4

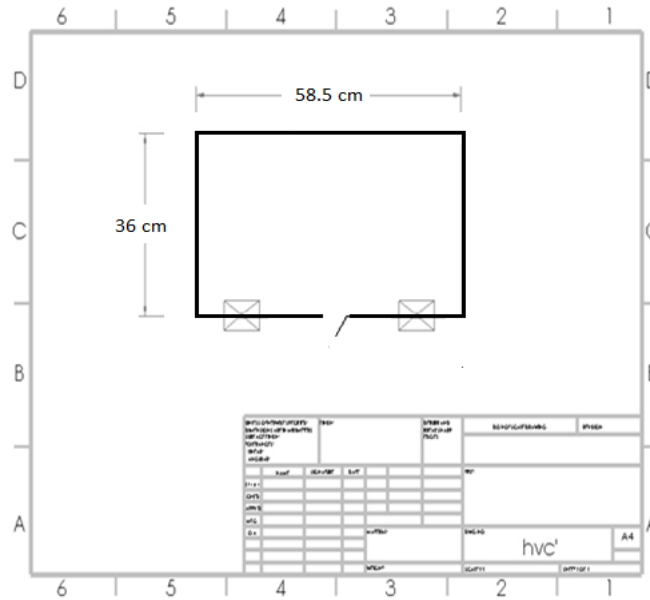
4. System Testing and Analysis

4.1 Introduction:

As we know in Kingdom of Saudi Arabia the outdoor average temperature reach about 45 C in summer, while the indoor temperature required to be less than 25 C, in this project, we aim to design a proper AC unit for an house contains of three rooms one of them store room and the two others for secretary and manger, under Khobar city weather conditions using the skills we learned from principle of heating and ventilation course.

4.2 Procedure:

- House space: The house has area of 36 cm x 58.5cm. And the ceiling height is 21cm. Also, it contains two windows with an area of (4x4) cm, single glazing frame and one wooden door with area of (10x4) cm wood door.
- Ceiling elevation 21cm.
- Inside condition 25 C dBT, 50 % R.H.
- Outside condition 45 C dBT, 60% R.H.
- Lighting we have one light 10W/m².
- DF =1 for glass window and for light.
- In the figure below, we will understand the dimensions of the rooms and the directions also.



North



4.3 Results, Analysis and Discussion:

Our calculations will be based on the following report from Saudi standers metrology and quality organization (SASO), "FOR LOW RISE BULDENGs NOT BULID BY THE GOVREMENT" SASO.

Opaque Elements	U
Ceiling	0.1583
Floor	0.1583
Wall	0.1583
Door	0.1583

Table 4.1: results, analysis and discussion

1- Transmission through Structure and Sun Gain:

Component	Area (cm ²)	For Glass Only		U	ΔT	ΔT _s	Q _t	Q _s
		SC	W/m ²					
Wall: N	(36*21) =756 cm ²	-	-	0.158	20	3	0.239	0.036
Wall: E	(58.5*21) =1228.5 cm ²	-	-	0.158	20	7	0.388	0.136
Wall: S	(36*21) =756 cm ²	-	-	0.158	20	9	0.239	0.080
Wall: W	(58.5*21)-2(4*4) -(10*4) =1156.5 cm ²	-	-	0.158	20	22	0.365	0.402
Celling	(36*58.5) =2106 cm ²	-	-	0.158	20	25	0.665	0.832
Floor	(36*58.5) =2106 cm ²	-	-	0.158	0	-	0	0
Wooden door W	(10*4) =40 cm ²	-	-	0.158	20	-	0.014	0
Two Glass window W	2*(4*4) =32 cm ²	0.55	310	3.2	20	22	0.205	0.546
Sum							2.115	2.032

Table 4.2: diminutions

2- Lighting:

Component	Area (m ²)	W/m ²	DF	Q _t
One light	0.2106	10	1	2.106 W
Sum				2.106 W

Table 4.3:lighting

$$Q = Q_v + Q_t + Q_l = 2.115 + 2.032 + 2.106 = 6.253 W$$



Figure 4.1: solar chimney



Figure 4.2: final look of prototype



Figure 4.3: cooling coil and insulation

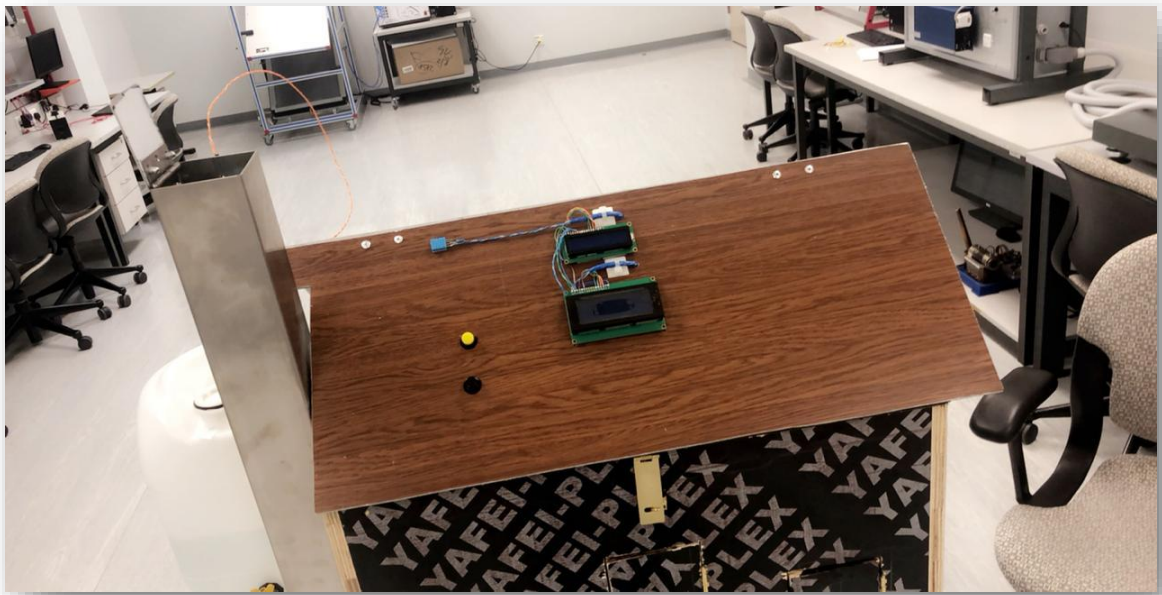


Figure 4.4: information screen



Figure 4.5: DR. Nader Nader (project adviser) and team members.

Chapter 5

5. Project Management

5.1 Project Plan

The plan of this project has been designed in comprehensive method to cover the necessary work task and to implement the specific work solid. It was very imperative to discuss the goals and objective of this project before implementing it. This also includes the responsibilities and the plan action. The given schedule below “Table: 5.1” maintained in full details the number of stages, task, and main description and achieved time.

Number of stages	Task	Description	Time
Stage one	Design and components	Provide materials and build the structure with accurate measurements.	Week 1 to 3
Stage two	Storage and retrieval machine structure	This stage includes transferring loads from storage to another area through using different machines with different components.	Week 3 to 4
Stage three	Storage modules	Provided in one unit that load containers of the stored materials with different parts built for this purpose.	Week 4 to 6
Stage four	Testing	Recording the tests for successful conclusions and to treat with unexpected troubleshooting.	Week 7 to 11
Stage five	Calculation	Calculate the time and the different sizes that help in successful operation Stage	Week 11 to 12
Week six	Data analysis and evaluation	All data collected from tests and after notes recorded will be in analysis and evaluation processes to practice modifications and adjust the required stages in final test for mechanical and electronically evaluation.	Week 12:16

Table 5.1: project plan

Week Plan	Description Progress's	Percent
One	In the first stage, roughly design of the machine with Stating the first bill of material, specification and selecting of the parts and requirements needed.	100%
two	In the second stage, second design draft that resulting from the literature review and come up with final design.	100%
Three	When we visiting workshop, it was important to look at what is available in the market, what part need to be order or manufactures if needed.	100%
Four	In the part of the virtual design, there was concern with the apparatus in solid works.	100%
Five	Purchasing parts depended on manufacturing all the required parts and components according to the system specifications where some parts were under manufacturing operation.	100%
Six	During manufacturing the frame which is considered the main part, all parts were fit in and firmly installed.	
Seven	In the stage of assembly of the manufacturing parts, it should be done after finalizing all relevant parts in the main frame.	100%
Eight	Motors purchasing order	100 %

Table 5.2: project plan

5.2 Contribution of Team Members

IT shows the efficient distribution of tasks among the team members with the main task for each member. It also illustrates the fully participation of each member on the basis of the appropriate order of the plan. It may be indifferent percentages in some parts; however, it is obvious how the rest of the team members were assigned to complete the work tasks according to the responsibilities as one of the main parts in the project action plan. Table (5.3) tasks & Contribution

Task	Member 1 (muflih)	Member 2 (Talal)	Member 3 (Nawaf)	Member 4 (Adel)	Member 5 (Khalid)
Stage 1: Design and components	96%	95%	97%	100%	90%
Stage 2: Storage and retrieval machine structure	96%	94%	97%	93%	93%
Stage 3: Storage modules	93%	96%	100%	95%	98%
Stage 4: Testing	95%	100%	92%	93%	94%
Stage 5: Calculation	97%	97%	96%	98%	92%
Stage 6: Data analysis and evaluation	95%	94%	97%	95%	94%
Stage 7: Design and components	94%	98%	100%	98%	93%

Table 5.3: contribution of team members

5.3 Project Execution Monitoring

Meetings: it was accepted by the team members to meet every Wednesday to distribute the tasks among team members and share ideas. Furthermore, it is very important to review the achieved and finished tasks which include assessment and work evaluation. This could help the members to check their work under the guidance of supervisor and make any required changes to the project. This includes checking the validity of manufacturing parts before we use it and testing the operation system.

5.4 Challenges and Decisions Making

The first bill of the materials showed the importance of using appropriate parts that are in need to start the operation system. This includes some parts like

14. ARDUINO MEGA
15. 20*4 LCD DISPLAY
16. DHT11 –Humidity & Ambient Temperature
17. On / off switch
18. LM 35
19. Terminal legs.
20. FAN
21. Resistor 1/4 W.
22. Break bored 102.
23. Heat sink

The requirements of the projects are always reviewed to get manufacturing parts or in some stages it is necessary to ask for manufacturing new parts and components. Visiting workshops before implementing the implementing the project. It is necessary to check the quality of practical tasks in the plan using the knowledge with wide experience. There were some challenges that we faced during the project as there were some different frames that is not suitable for the project. It took many days to order these parts from Amazon.

Chapter 6

6. Project Analysis

6.1 Life-Long Learning

It was a very good experience for us as students at PMU University who were able to use different mechanical and electrical parts in implementing a necessary project under the name of passive cooling and heating system which benefits from natural processes such as conduction, convection and radiation to heat or cool the building. Because of this, they require little or no external energy to work out and can contribute to energy efficiency at home. When the sun rises, the solar radiation warms the buildings. As we team members, we were able to collect enough information from previous work to get full details related to cooling and heating system.

Each team member had a specific task to be completed through checking some websites like Google to check for similar projects and avoid any failure attempts. Mechanically, it was very important for our project to be successful to check for theoretical and mechanical information about the project as the theoretical information is not suitable enough so that handling with components and mechanical parts should be important.

During our courses we checked the figures and how to make calculations with power supplies and to measure the torques, distances and speed with some equations. Practically the issue had different, but it could not be fair to ignore data in our major courses. As any project had needed practical experiences we had counted many attempts in testing components and the effectiveness of mechanical and electrical parts to get the appropriate design for the project operation.

Before listing the main points in our new knowledge for the project, it is necessary also to point to the importance of practical skills. The first one was the importance of intra and interpersonal communication skills as it was very imperative for the team members to be in contact and review all the achieved tasks. , the second one included work organization as a main part in leadership skills and team work. All the team members were cooperative enough in doing all tasks on time through team meetings and implementing the tasks individually and collecting work in groups. All of the team members were full of motivation. The third one there were some challenges, mistakes which happened unexpectedly. However, the leader was able to overcome all of these barriers and obstacles. This gave the team members the ability to think critically in solving any problems and find solutions. The lesson from this project is that we can solve any problems or obstacles we encounter if we worked together within a team. With enough motivation and fairness, we can critically solve any problems properly.

6.2 Impact of Engineering Solutions

The main idea of the project was to introduce unique services for implementing passive cooling and heating which can reduce the peak cooling and heating load in buildings,

thus reducing the size of the air conditioning equipment and the period for which it is generally required. Therefore, in this project, passive cooling, heating techniques and energy efficiency measures will be addressed. Moreover, different passive cooling and heating techniques and their role will be discussed in providing thermal comfort and its significance in energy conservation.

The advantages of this project lies in the environmental benefit that comes from the quality of the fresh air and heating used during the process that may very well affect in reducing inimical greenhouse gas emissions and the rates of carbon dioxide. On the social basis, utilization of the passive cooling and heating system could preserve lives by reducing indoor pollution which currently kills more than a million people in the world. Moreover, it could reduce fire and fuel injuries, thus ameliorating quality of life in general as people would use natural resources only.

6.3 Conclusion

Passive cooling and heating system benefit from natural processes such as conduction, convection and radiation to heat or cool the building. One of the first decisions was taken

into consideration on heating and cooling for residence was whether the systems is active or negative in nature. Many design decision were taken into account in implementing the project like building orientation, descent, envelope, internal organization, and materials. Passive heating and cooling systems were effective as no use of purchased energy, and place multiple functional requirements on many components of the building, which are highly integrated with all aspects of building design.

6.4 Recommendations

It would be necessary to provide effective passive cooling and heating for heating and cooling both the building and the people in it. Evaporation of perspiration is the most effective physiological cooling process. It is recommended to have other forms of passive and heating systems to include all areas in the country in the summer and winter seasons.