

# YI IDS 4-GREENOVATION CHALLENGE PHASE DO PROTOTYPE SUBMISSION

**Title :** CoolEarth A Holistic Approach to Sustainable Urban Cooling

Harnessing Terracotta, Phase Change Materials, And Geothermal Cooling For Urban Environments  
Approach To Sustainable Urban Cooling !

**by:** **TEAM PHOENIX!**

**Challenge :** Low cost cooling solutions for warming cities !



# OVERVIEW OF CONTENTS

A summary of the prototype contents that are being explained further in slides .

<b><u>PRIMARY DESIGN OF IDEA</u></b>	Problem faced succinctly describing the outlines of problems that are need to be solved while prototyping.
<b><u>THE MATERIALS USED</u></b>	Short explanation on materials that are being used in real working system.
<b><u>LATERITTE &amp; CLAY LOUVERS</u></b>	1 <sup>st</sup> Part's technical, designs and working in the system and structure.
<b><u>GEOTHERMAL COOLING SYSTEM</u></b>	2 <sup>st</sup> Part's technical, designs and working in the system and structure.
<b><u>PHASE CHANING MATERIAL</u></b>	3 <sup>st</sup> Part's technical, designs and working in the system and structure.
<b><u>COMPILED DESIGN OF SYSTEM IN STRUCTURE</u></b>	The notion of easily interactable with the environment and the structure & planning and execution of A prototype, into a working system for any space.
<b><u>SYSTEM TECHNICALS AND ITS EFFECTIVNESS</u></b>	The project working details as well as its technical details with its consumption , carbon emissions, sustainability and effectiveness.

# MEET OUR TEAM PHOENIX'S MEMBERS

Our team is a dynamic group of young and enthusiastic individuals who are passionate about solving real-world problems. Let me introduce you to the talented members who make up our powerhouse team

## Lakshya Khare

Team lead lakshya oversees all aspects of our project during this phase. His leadership and vision drive our progress. With a keen eye for detail, he ensures that every piece falls into place seamlessly.

## Janvi Jain

Solution , prototype and its analytical mind and problem-solving skills shine. She tells elegant solutions and translates them into working ideas. Janvi bridges the gap between theory and practical implementation.

## Inshu Jat

Prototyping wizard inshu demonstrates expertise in building prototypes. Her expressing prowers and creativity turn concepts into tangible designs. If you can imagine it, inshu can bring it to life.

## Bivek Kumar Sharma

Research specialist and team glue bivek's research skills are unmatched. He dives deep into data, uncovering insights that guide our decisions. Beyond research, bivek holds the team together, ensuring smooth collaboration.

## Mayuri Bodade

Information compiler and coordinator, mayuri compiled the essential information and coordinated efforts across the team. Her meticulous work keeps us organized and on track.

Our team members are all students at LNCT group of colleges, currently studying in the 1st year of the computer science and data science branch. We believe in continuous learning, adaptability, and pushing boundaries. Our journey is just beginning, and we're excited to make a difference. 🚀🔥



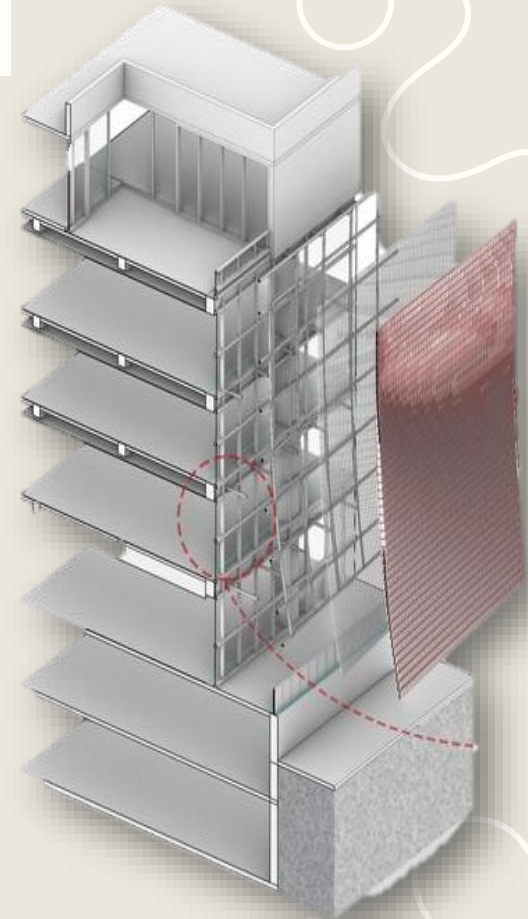
# PRIMARY DESIGN OF IDEA

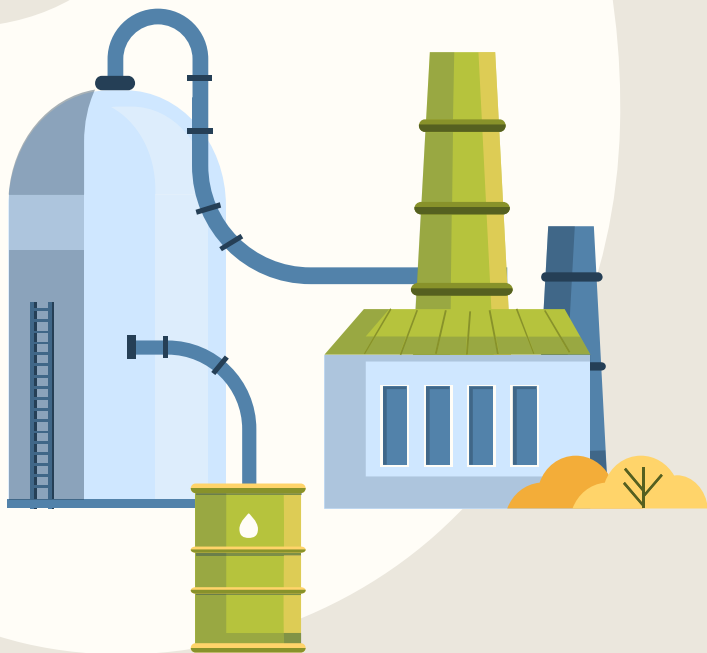
01

The challenge was to integrate this technology and functioning complex thing into one working system that can be organised and worked so systematically that it can solve the provided problem sustainably & Properly in the same structure without changing much in existing infrastructure.

## Problems Encountered In Conducting Research And Selecting The Appropriate Solution:

1. Because India's temperature has been steadily rising, reaching 45-50 degrees Celsius, we must select the **Appropriate Material** for a solution that could offer over time cooling.
2. India has a big low-income category, we needed to select the appropriate material that could be **Easily Outsourced And Made Available** to the entire population.
3. Ordinary cooling devices used an estimated 40-60 gw of power, indicating that the system should be both **Electricity Efficient And Sustainable** for moderate space cooling.
4. The system should be able to sustain and continue to function for an extended length of time **Without Requiring Extensive Maintenance** or replacement.
5. Should be tied to **INDIA'S Soil** and maintain its ethnicity in it.





02

## THE MATERIALS USED:

# THE PRIMARY ELEMENTS INVOLVED IN THIS COOLING SYSTEM

We have successfully extracted the materials that this project team will use to solve the problem. Our team has created and chosen the materials that address the issues and difficulties that have been previously discussed in the project and that are sustainable, affordable, and meet other requirements.



## LATERITTE & CLAY LOUVERS

Water passes through the terracotta & laterite tubes, facilitating evaporative cooling. Air is cooled when it passes through and comes out and stays cool like water in an earthen pot naturally without any chemicals and other toxicants used for cooling.



## GEOTHERMAL COOLING SYSTEM

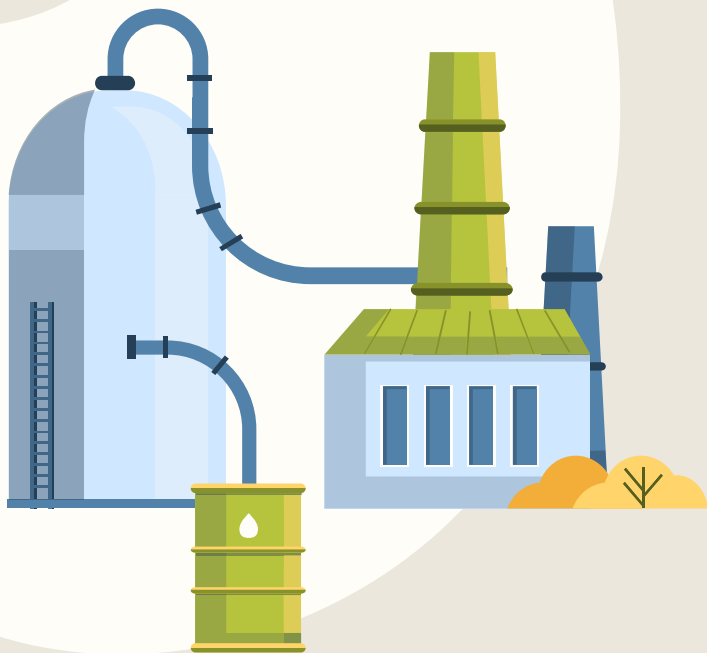
A geothermal cooling system is a type of cooling system for buildings that will use a heat pump to transfer heat to the ground taking advantage of the relative constancy of temperatures of the earth through out the seasons.



## PHASE CHANING MATERIAL

It is a substance which releases/absorbs sufficient energy at phase transition to provide useful heat or cooling. Generally the transition will be from one of the first two fundamental states of matter.





03

## LATERITTE & CLAY LOUVERS

# LATERITE & CLAY LOUVERS TECHNICALS

Laterite has an inherent cooling property that helps to keep homes cool during summer. This is particularly beneficial for buildings located in hot regions.

1. These louvers are made up of **NATURAL COMPOUNDS** in specific ratio then backed at 1200°C.
2. **Low cost easily available and to outsource** form anywhere its an effective solution for exterior walls and window of existing building and structures.
3. It maintain and regulates the air flow and humidity of the structure.
4. Making costs is less the **rs.99** per louver and low cost to install and easily to transportable too.
5. Can reduce up to **15-20 °c** individually (with regulated flow of water at given temperature and conditions)
6. These can be build in 2 forms : **Rods and Single Piece Louvers**



Hollow louvers which are leaf shaped for better transpiration of cool humid air via cold water coming from geothermal pipes



Laterite is a soil and rock type rich in iron and aluminium and is commonly considered to have formed in hot and wet tropical areas to keep them cool.



Combined louvers into a wall creating beautiful as well as sustainable cooling system for spaces.



# LATERITE & CLAY LOUVERS DESIGN

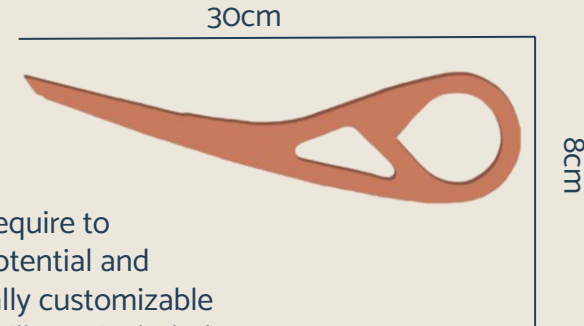


Just like indian water pots it is also made form laterite and clay it is having qualities of cooling its surrounding also the structure of this louver is created in a way that it can transpire water droplet and cool surrounding air.

By using the same science and touch on indian ancient tech these louvers are designed to cool the surrounding efficiently and sustainably we can also modify the shape a bit and create the right use of space according to its design.

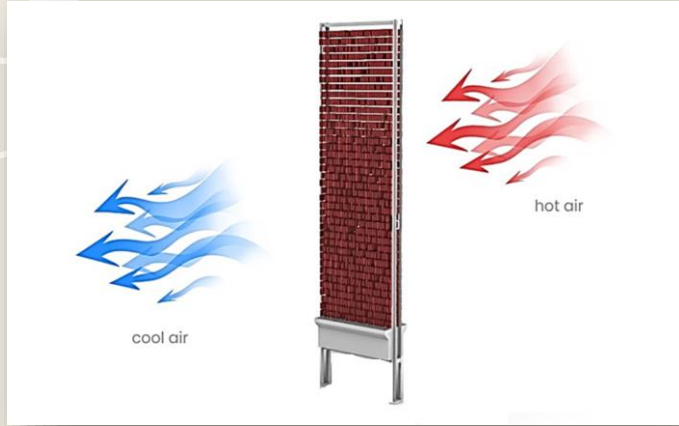


The clamps will hold one louver with another which are made from insulated pipes hollow inside that will supply water from geothermal station to louvers and also keep louver in there place still they can be moved horizontally.



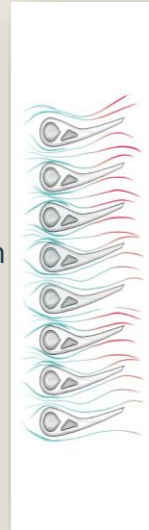
The appropriate size is require to maximize the working potential and cooling how ever its totally customizable and fully made in India (villages included).

# LATERITE & CLAY LOUVERS DESIGN



Red lines (hot air) and blue lines (cool air) flow is shown in picture with the help of multiple louvers The sustainable and efficient cooling will be achieved.

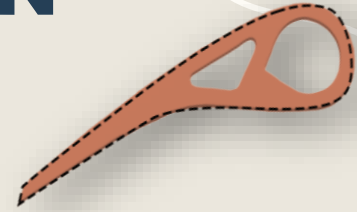
The air flow coming from outside world will get cooler and blown further to maintain the air flow also the hot air will be cooled efficiently taking advantage from natural flow and cooling.



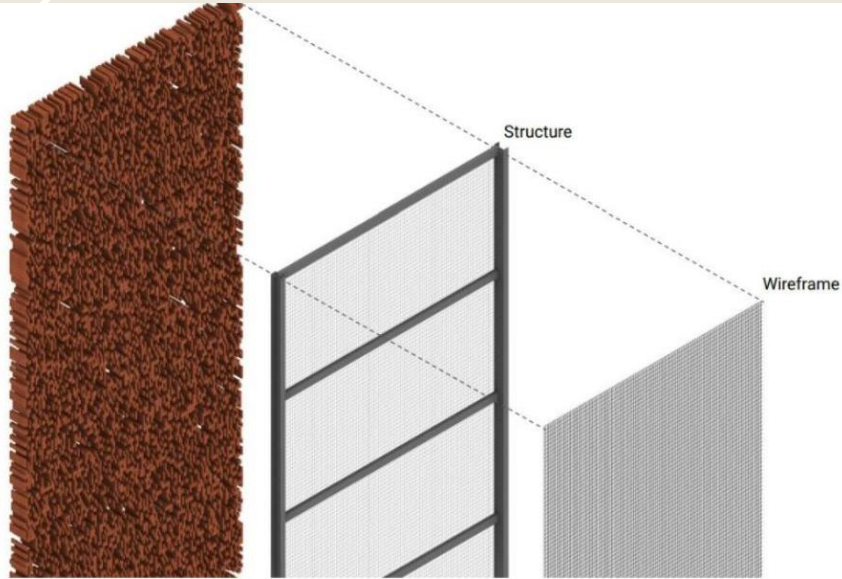
The example picture shows the real example of this system that the sustainable and efficiently Cool the area via laterite Louvers

The material's real image And condition after Installation is shown.

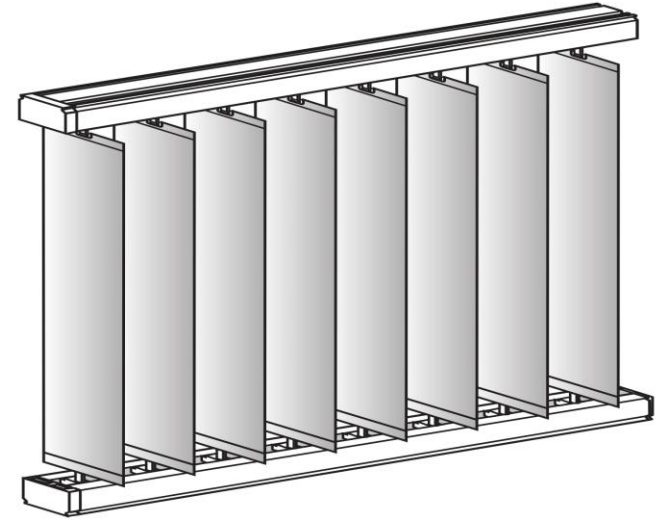
The laterite louvers are Placed on top of each Other and a insulated Pipe is connecting them Together which is hollow And carrying the cooling Solution flowed with help Of geothermal cooling Part.



# LATERITE & CLAY LOUVERS PROTOTYPE



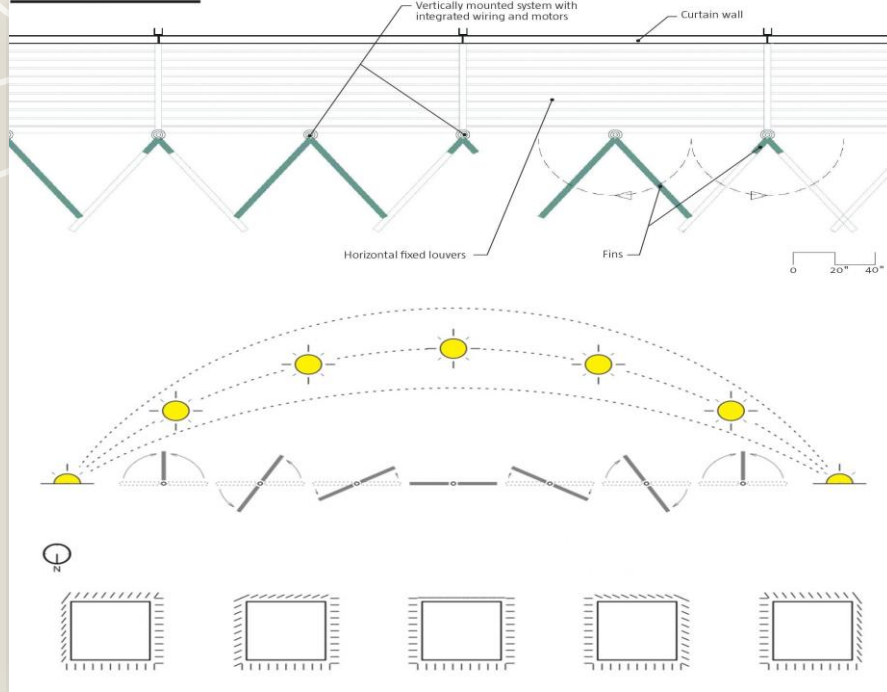
The sketch above shows the prototype of implementation of the louvers into the pre existing structure without needing to change a thing , just require wire frame to hold the parts on its place .



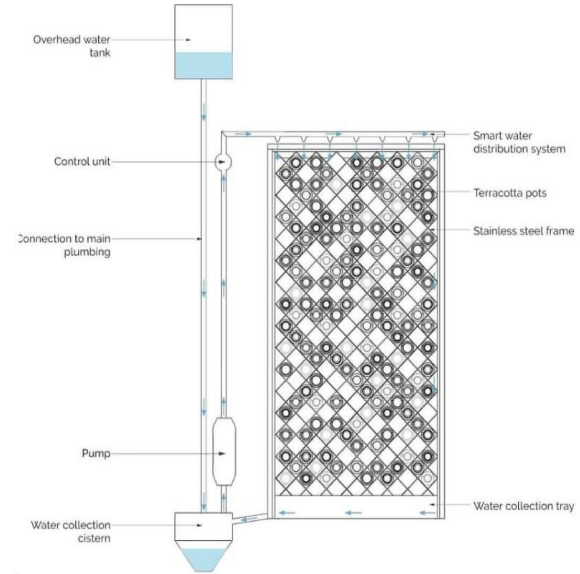
The sketch above shows the prototype of louvers windows design and its final arrangement that is going to get integrated with structure through wires and frame into pre existing structure.

# LATERITE & CLAY LOUVERS PROTOTYPE

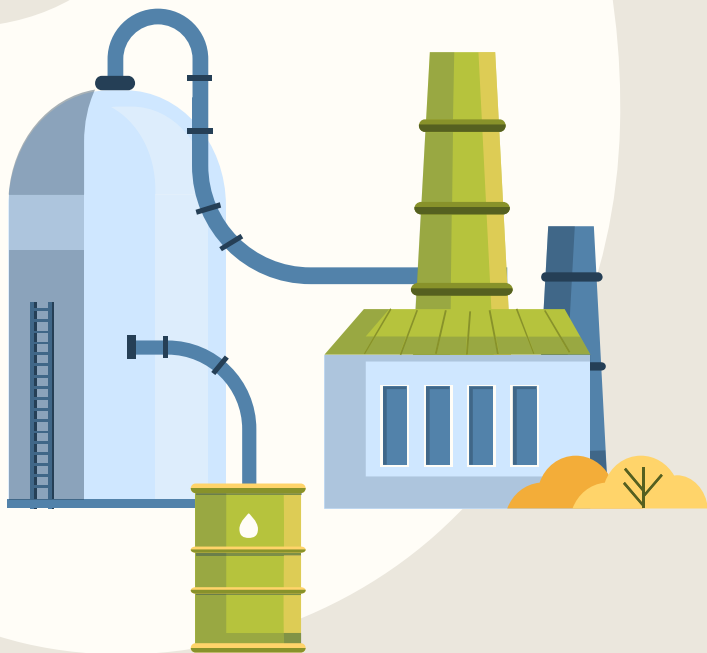
**Sunshading System Section**



**the working - water circulation**



The sketch above shows the prototype of sun shading and moment of the louvers in response to wind flow and sunrays while structure is fixed with wire frame to hold the parts on its place in structure. Other images show the water circulation inside the frame and louvers via geothermal system's pump



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## GEOHERMAL COOLING SYSTEM

# GEOHERMAL COOLING DESIGN

Geothermal cooling uses the earth's stable subsurface temperature to efficiently cool buildings. Heat from indoor air/water is absorbed and transferred to the cooler ground through underground pipes. This cooled fluid then cools indoor air before circulation. Geothermal systems offer consistent performance and lower energy consumption, making them a sustainable cooling choice.

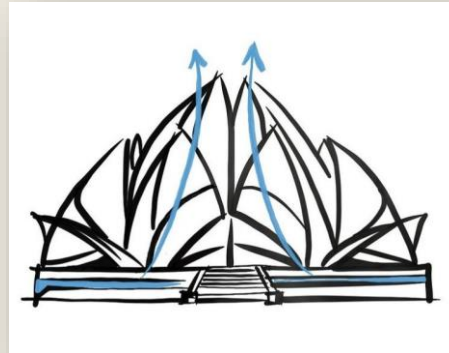
1. This method is used to cool air inside a closed structure via regulating air/water from inside to ground **organically by pumping** system making it an effective solution for providing constant circulation to structures.
2. This method require insulating pipes & **heat transfer pumping system**, ground insulating pipes and initial cost construction under ground.
3. Costs at initial stage the working principal takes 2-5 unit of electricity that can exchange up to **6-8 unit of heat** into structure's outlet.
4. Can reduce up to **5-20 °c** individually (with regulated flow of air/water at different conditions respectively)



A heat and water pump is require in the system that consume minimal electricity the push the flow of water and air in structure through insulated pipes. And also provide the cool water flow to louvers that is automatically controlled via programmed machine and chips.



The image shows that how geothermal pump is pumping the cool air/water into the insulated pipe that has been integrated in column and floor of the house as well as providing cool water to louvers.

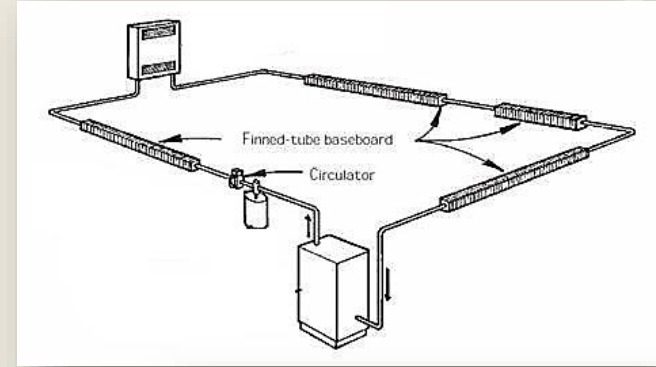


Lotus temple in delhi also cool its inside atmosphere with this same phenomena Of geothermal water flow Underground surface of temple includes water flow that cools the marble used in it.

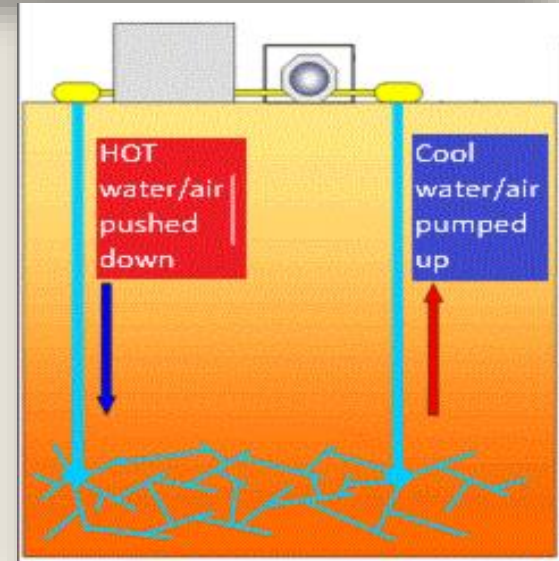
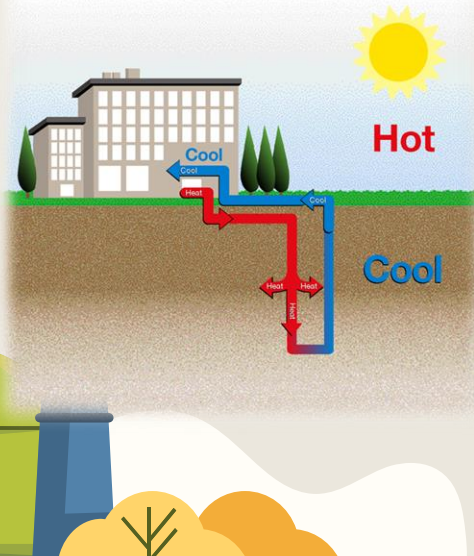


# GEOHERMAL COOLING TECHNICALS

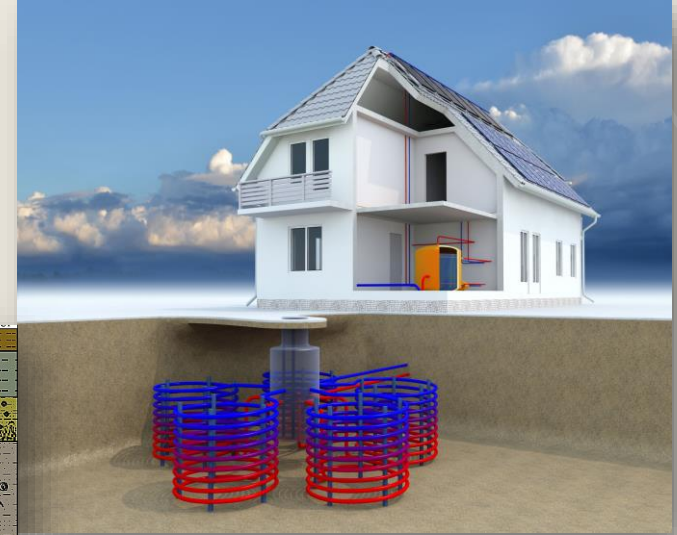
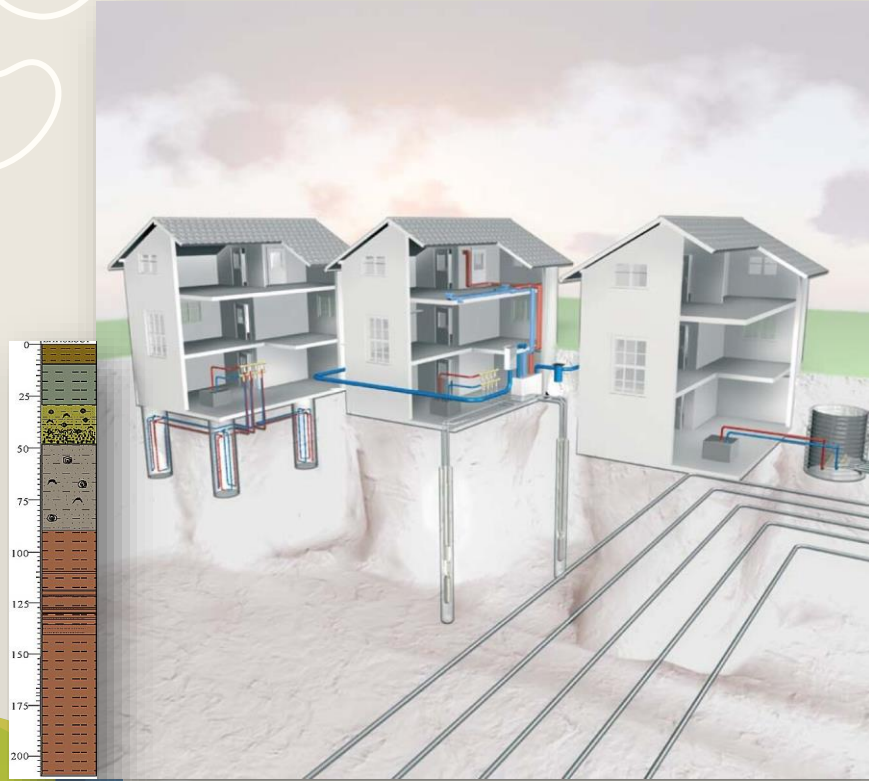
As shown in the image this part of geothermal cooling system shows the upper base working system, in this the insulated pipes flow cool water/air from pump to circulator then pass through pipes creating way to flow in louvers and continuing flow back to pump. The copper or aluminium fins are present in between the way the flow is over seen and controlled automatically via programmed machine that regulates the flow on basis of temperature and time



As shown in the image beside the pump flow hot water and air into the crust and push it down after flowing it into the certain height it get cooled and pumped back to the upper line creating a loop and cool water flow with minimal consumption of electricity , providing air flow that regulate the pressure and humidity of space , and water flow that regulates the coolness in louvers as well as for PCM material in walls that balance the thermal equivalency in structure

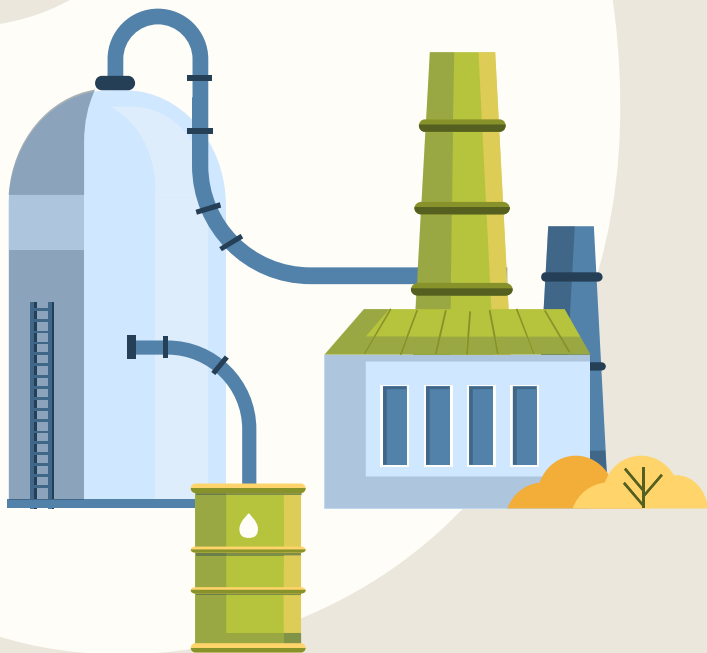


# GEO THERMAL COOLING PROTOTYPE



The image shows that how geothermal pump is pumping the cool air/water into the insulated pipe and the structure of pipes into ground and structure according to the area and base ground of the structure.





05

## PHASE CHANING MATERIAL

# PHASE CHANING MATERIAL TECHNICALS

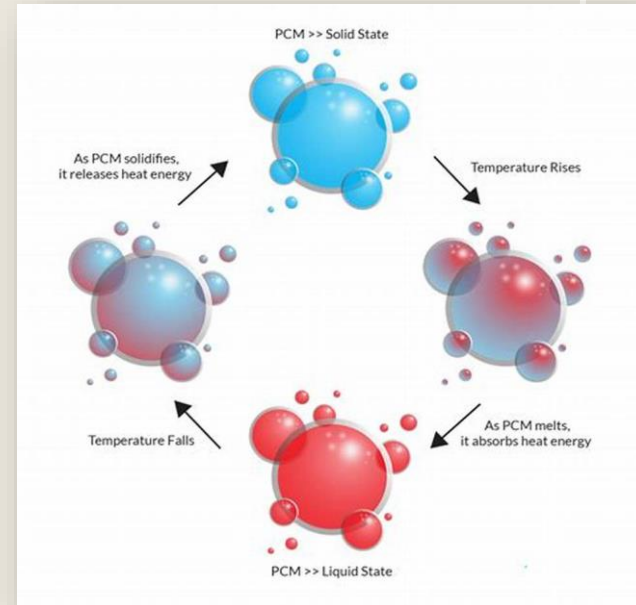
This material is composed of several raw materials that are insulated with PCM inside to allow for continuous absorption of heat during the day to cool the surroundings and release of heat during the night to maintain a temperature balance in nature.

1. These PCM materials are made up of **CHAMICAL COMPOUNDS** in specific ratio then insulated with different metals.
2. Its an effective solution for interior walls and ceilings of existing building and structures.
3. It lower and regulates the temperature of the structure using chemical tech.
4. Initial cost is higher **rs.399** per sq meter and after installation it can work upto 100+ years without decomposition , degradation and maintenances.
5. Can reduce up to **1-10 °c** individually
6. These comes in 2 forms : **sheets and tiles**



The PCM sheets insulated with conducting metal layer by layer converted into tiles and putted on ceiling without changing the existing structure and integrating with preexisting cooling machine helping to reduce more temp and balancing it.

It works on state changing phenomena of chem. Which absorbs heat and reduce surrounding temperature and maintain the balance of energy . at night get back to its phase and state back creating a loop.



# PHASE CHANING MATERIAL DESIGN

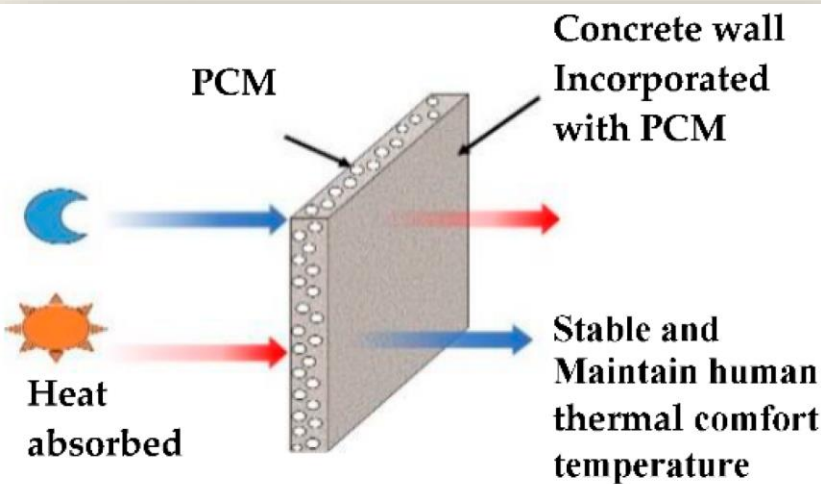


Micro insulated PCM material powder in solid form , that is insulated and packed inside metal sheets layer by layer to form sheets and tiles that are being further used to regulate and balance the temperature via phase changing phenomena , in this case the PCM inside the tile will absorb the heat energy and change its state solid to liquid , and at night it reversed its state to solid by releasing energy.

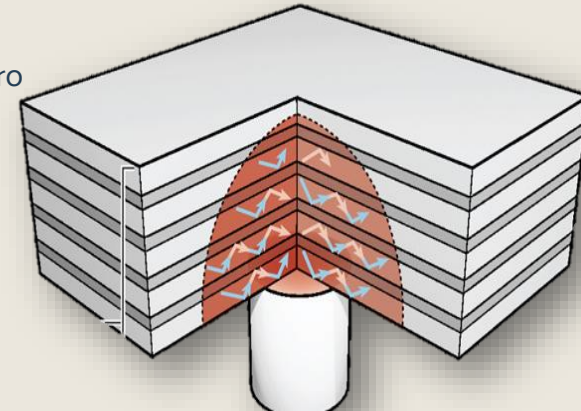
This loop continues without getting degraded for 100s of years and don't require maintenance and replacement .

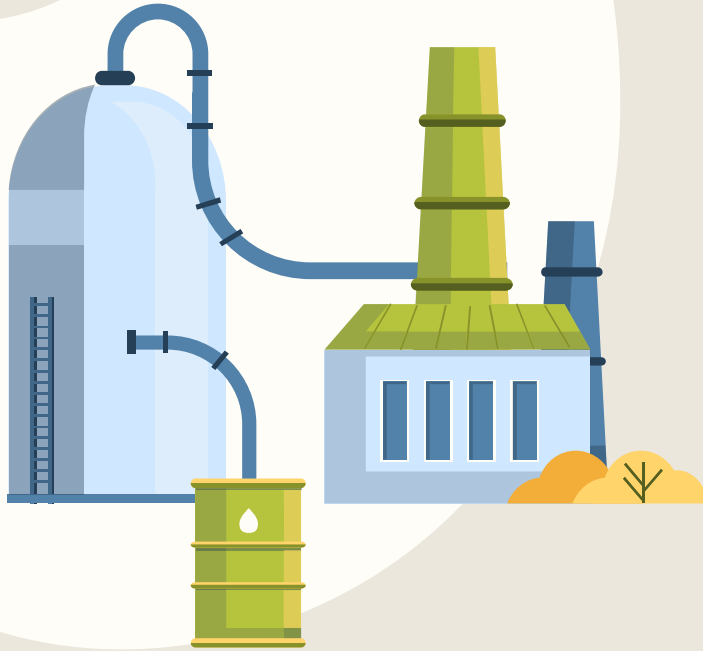


The picture above shows the tile made with insulated wax PCM material in aluminium sheet.



Interlayers combination of micro insulated material and metal sheets with extra cylinder on bottom to increase the area of absorption.





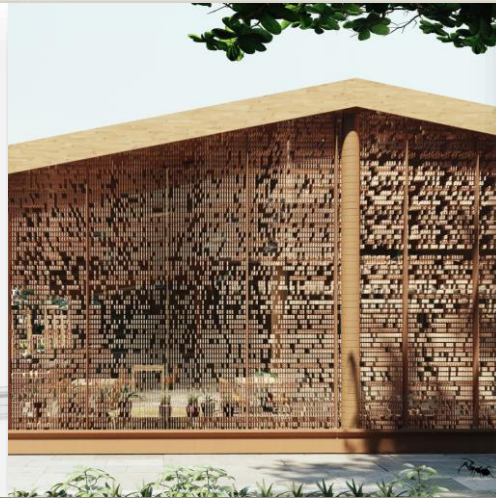
06

## COMPILED DESIGN OF SYSTEM IN STRUCTURE

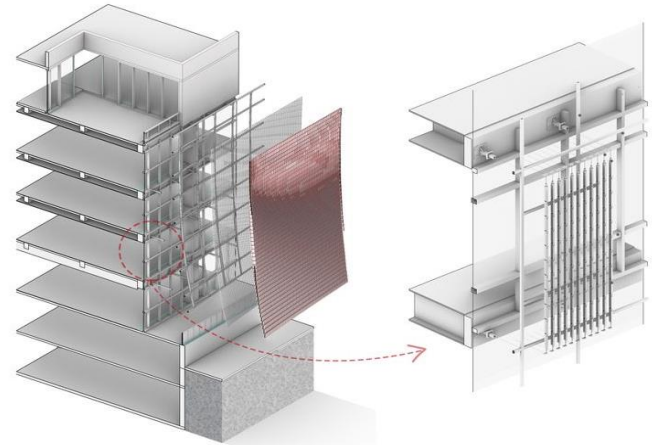
# POTOTYPE OF WORKING SYSTEM AND STRUCTURE



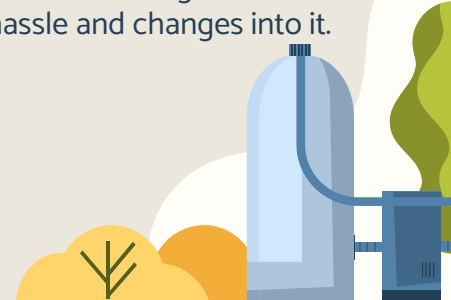
This sketch shows the real structure prototype from out side the real world and that is been integrated with plants to beautify the structure and make it sustainable as well as oxygenated too.



This rendered image shows the real structure implemented with louvers in it with wire frame and insulated pipes in b/w. Creating an effective cooling layer.

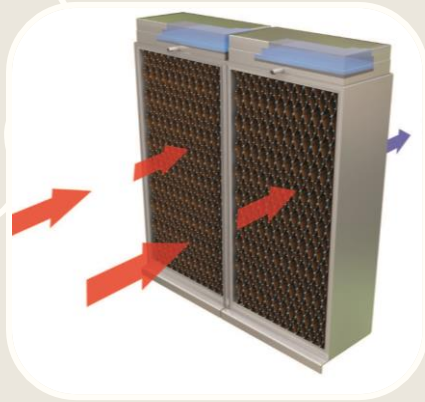


This sketch and prototype shows the geothermal pipes and louvers layer integration in exterior of common building structure Without much hassle and changes into it.

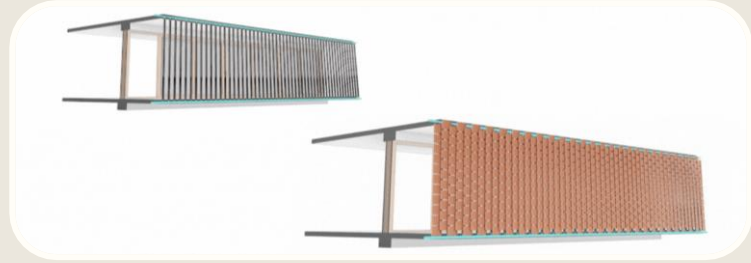




# PHOTOS RELATED PARTS OF WORKING SYSTEM



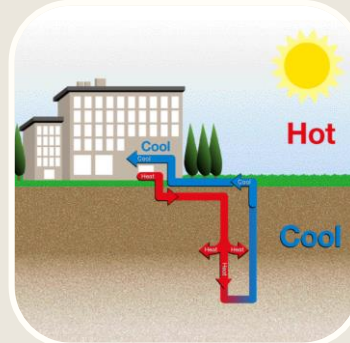
These photos are reference to 1<sup>st</sup> layer and shows the ventilation layer for windows that is been implemented and over the existing structure and the flow and aerodynamic moving design of the hollow louvers. The aerodynamic moment according to sunrays and wind direction shown bellow:

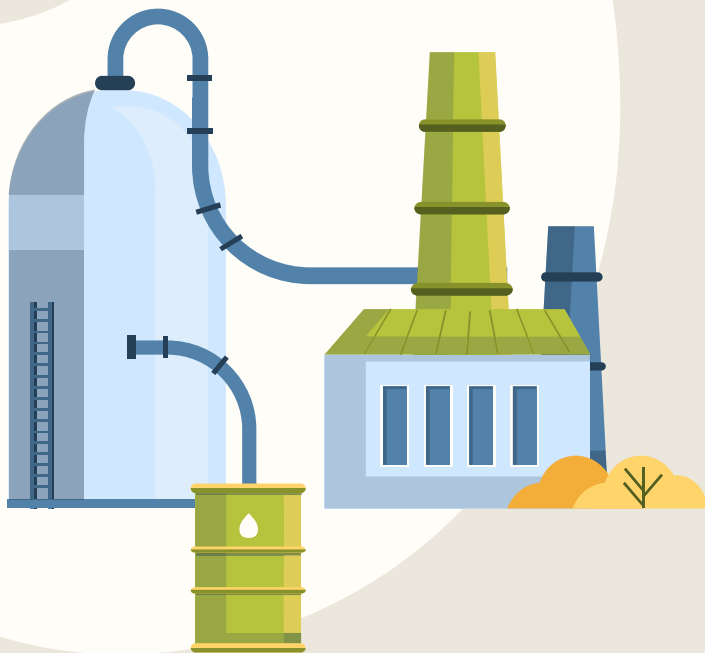


This photo shows the 2<sup>nd</sup> layer and PCM insulated layer for walls and celling that has been implemented to same structure.



These picture shows the 3<sup>rd</sup> layer's phenomena and pump that has been installed in small space without changing much structure.





07

## SYSTEM TECHNICALS AND ITS EFFECTIVNESS

# ENERGY AND CARBON EMISSIONS

By implementing these solutions together we'll get significant reduction in electricity and malicious consumption that were being extensively adds to the buildings running cost and this will reduce it up to approximately:

## 22-30%

Cost is calculated on the basis of data collected by various factchecker and universities.

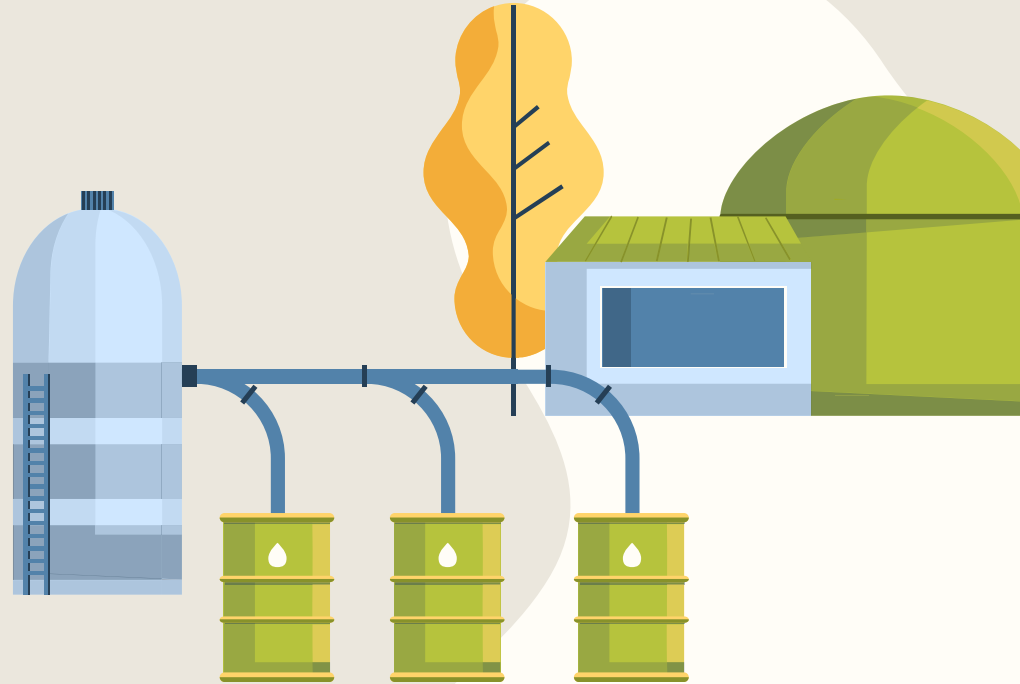
## 50-65 units/day

unit are calculated on the basis of 1x3 ton ac being used 24h daily.

Also can reduce carbon emission and toxicants productions:

## 97.9%

data is calculated on the basis of data collected by various factchecker and universities.





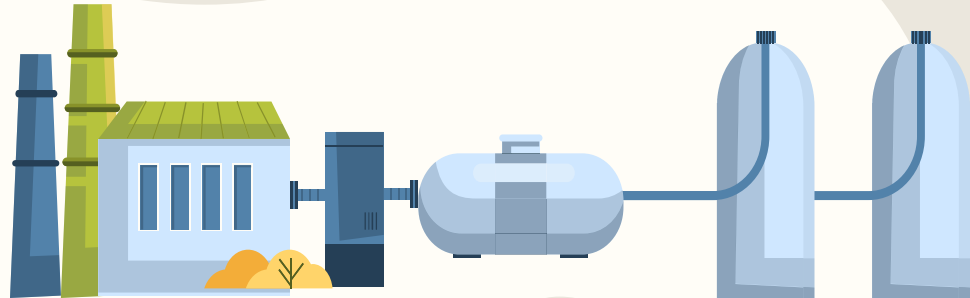
**ONCE AFTER BEARING INITIAL COST AND TIME AT IMPLEMENTATION  
THIS SYSTEM AND SETUP CAN LAST UPTO :**

**100+ years**

Data is been calculated according to material used and also the data given by factcheckers

- This system is self healing and non degradable as well as non decomposable (in open working system) this system setup doesn't need any prior maintenance and technical issue the working and application process doesn't need any extraordinary skill and technical knowledge.
- The sustainability of this setup is better then traditional way and is 40-60x times better then other carbon emitting devices.
- This device setup do not produce or does give very minimal carbon footprint which help in covering up the previous damage.
- This setup is also very minimal and easily producible, and the initial cost can also be brought down after mass producing the raw parts.

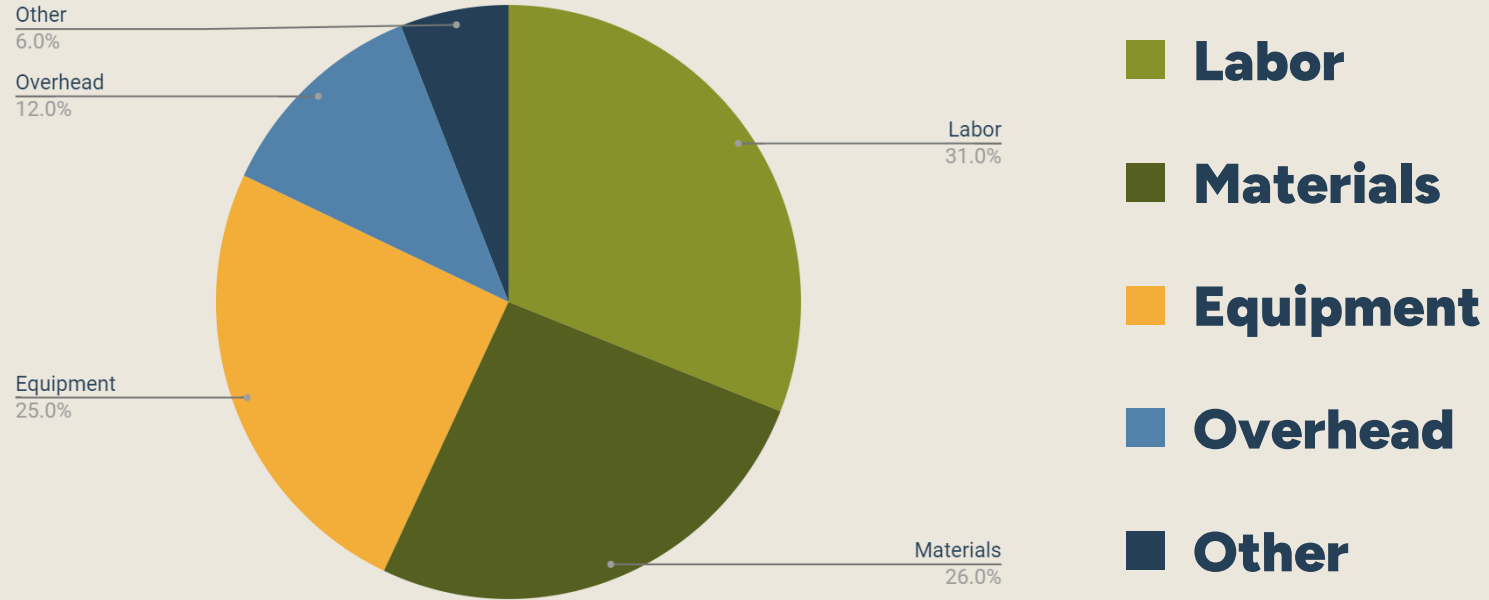
DEVICES	CARBON EMMITION	TEMPRATURE
TRADITIONAL	14-35 Pounds/day	10-30% drop when running
THIS SYSTEM	0.01 Gm/day	20-40% drop constant and significant



# FURHTER BREAKDOWN AND COMPARISIONS

Layers	Intial temp Approx	End temp Approx	Running Resource	Electricity Consunptions	Daily running cost
Terracotta & Laterite:	45-48°C	32-35°C	One time : clay louvers, metal holders and shutters Running time : Water flow	-	-
Phase change material:	32-35°C	26-30°C	One time : PCM and Coveringsheet Running : N/A	-	-
Geothermal Cooling	26-30°C	20-24°C (Constant)	Onetime : Machine & System Running: electricity and ventilation system	2-5 u/day (for 15x15 feet area)	Rs. 40-50/day

# SOLUTION IMPLEMENTATION EXPENSES



❖ Due to production costs, which vary from city to city and based on transportation costs, this data is not set in stone and is subject to change. When seen more broadly, the data is regarded as a mid-sized urban city.

# INITIAL IMPLEMENTATION COSTS BREAKDOWN

Resource	Utilization	Costs (APPROX)
Labor	31%	Rs.18600
Equipment	25%	Rs.15000
Materials	26%	Rs.15600
Energy load	4%	Rs.2400
Overhead	8%	Rs.4800
Other	6%	Rs.3600

**40-60K**

TOTAL INITIAL COST

**UNDER 100h**

TIME OF IMPLEMENTATION

1. This table is consist of the total approx. Initial cost to implement the cooling solution in a 15x15 feet area.
2. Cost effective solution for providing constant cooling to structures in replacement to traditional way of cooling with natural cooling system.
3. This system of cooling require material that need to be out source from various different vendors and places.
4. The cost comparing to traditional way is as low as 8-10% and give solution for cooling 5-15% more effectively also reduce working cost.
5. 80% power saving then classic ac's and other way of cooling.

❖ Due to production costs, which vary from city to city and based on transportation costs, this data is not set in stone and is subject to change When seen more broadly, the data is regarded as a mid-sized urban city.



# THANKS!

This presentation is a part of the prototype submission for the IDS 4-Greenovation Challenge, which is being prepared and submitted by the first year CSE DS Branch students of **TEAM PHOENIX** from LNCT Group of Colleges in Bhopal.

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