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Ultra Energy Efficient Building' For Housing Sector

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Abstract: Day by day the demand for electricity is increasing. With increasing population and industrialization, electricity consumption has been abruptly increased. The main source of today's electricity generation is fossil fuel. Electricity is generated by burning these invaluable natural resources and polluting the environment. If the same persists, there will be no sustainability for the future. Also Ultra Energy Efficient Building uses INSULLA tiles on roof for energy efficiency. Insulla tiles are made from phase change materials (PCM) technology which reduces the surface temperature by 20? and indoor temperature by 10? Thus eliminating the need for use of air conditioners in day time resulting in less electricity consumption.
By implementing this method, there will be no need to depend on nonrenewable energy or government provided electricity. No electricity bills forever. This method can be implemented to all Existing and new buildings.
Keywords: Energy Efficiency, Green Energy, Renewable Energy, Energy Generation, Energy Audit.

I. INTRODUCTION

A. General

As the population is increasing day by day at a rapid pace, the demand for electricity is also getting increased every day. Today electricity has become a necessity for all. Be it a business or a regular job, without electricity it is nearly impossible in this competitive world.

Another important factor is that a country's growth is also indirectly related to its strong energy infrastructure. Imagine India without power supply!! What will happen to the share market!! What about the media, social life, corporate life, luxury, comfort, innovation, etc?? Everything will come to a halt. Luckily with the innovations of many scientists and their invaluable contribution towards scientific research, we have electricity lighting up our houses today.

But the demand is increasing abruptly which led to a demand-supply gap in electricity distribution in the country. Also electricity is being generated by burning fossil fuels which results in polluting the atmosphere to the extreme.

Large amount of CO2 and other harmful gases are being released into atmosphere by burning these fossil fuels which is resulting in poor air quality, global warming and depletion of valuable natural resources.

II. SCOPE & OBJECTIVE

A. Scope

The need for this project arises due to the following concerns,

1) Increasing demand for electricity in our country.
2) Use of fossil fuels for conventional energy is resulting in depletion of natural resources.
3) Energy infrastructure is week in our country to meet the energy demand.
4) There must be a permanent innovative green solution to self power buildings and meet today's energy demand.

B. Objective

1) To generate more energy than the building will consume using innovative renewable energy methods.
2) To reduce heat inside the building.
3) To provide a definite solution as an alternative to the use of conventional energy.
4) To use only renewable energy sources to light up the building.
5) To eliminate usage of fossil fuels.
6) To eliminate carbon emission.
7) To promote green energy.

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III. LITERATURE REVIEW

A. *Literature Overview*

1) Zero Energy Building: A. J. Marszal, P. Heiselberg, J. S. Bourrelle, E. Musall, K. Voss, I. Sartori, A. Napolitano
The concept of Zero Energy Building (ZEB) has gained wide international attention during last few years and is now seen as the future target for the design of buildings. However, before being fully implemented in the national building codes and international standards, the ZEB concept requires clear and consistent definition and a commonly agreed energy calculation methodology. The most important issues that should be given special attention before developing a new ZEB definition are: (1) the metric of the balance, (2) the balancing period, (3) the type of energy use included in the balance, (4) the type of energy balance, (5) the accepted renewable energy supply options, (6) the connection to the energy infrastructure and (7) the requirements for the energy efficiency, the indoor climate and in case of gird connected ZEB for the building– grid interaction. This paper focuses on the review of the most of the existing ZEB definitions and the various approaches towards possible ZEB calculation methodologies. It presents and discusses possible answers to the abovementioned issues in order to facilitate the development of a consistent ZEB definition and a robust energy calculation methodology.

2) Zero Net Energy Building by J .Lautsen: J. Lautsen concluded Zero Net Energy Buildings are buildings that over a year are neutral and they deliver as much energy to the supply grids as they use from the grids. Seen in these terms they do not need any fossil fuel for heating, cooling, lighting or other energy uses although they sometimes draw energy from the grid.

3) Overview of Possible Renewable Supply Options: Marszal et al

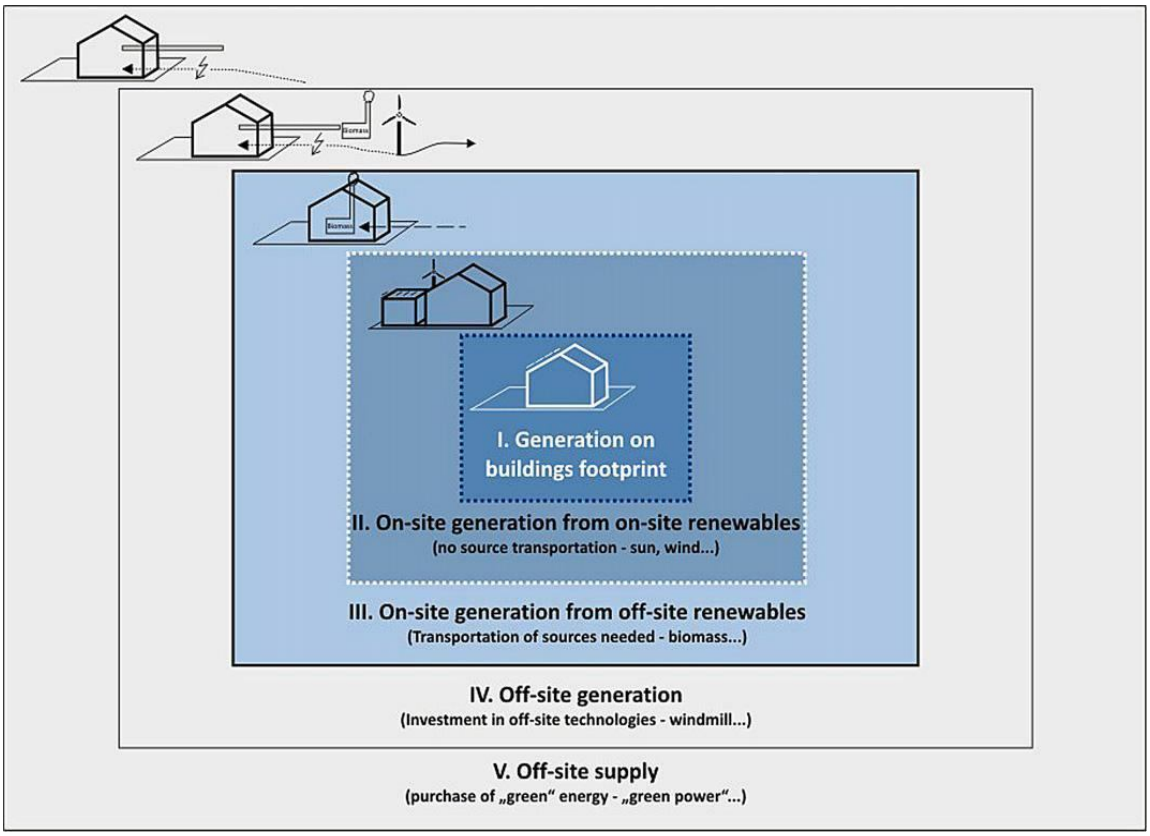


FIG 2.1 : Renewable supply options

4) Connection with the Energy Infrastructure by Mertz et al: The literature focuses either on off-grid or on-grid zero energy buildings. In both approaches the building is the energy consumer as well as the energy producer from renewable energy sources. The main difference is the connection to the energy infrastructure.
It has been concluded that off-grid zero energy buildings are autonomous and do not depend on grid electricity

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IV. RESEARCH METHODOLOGY

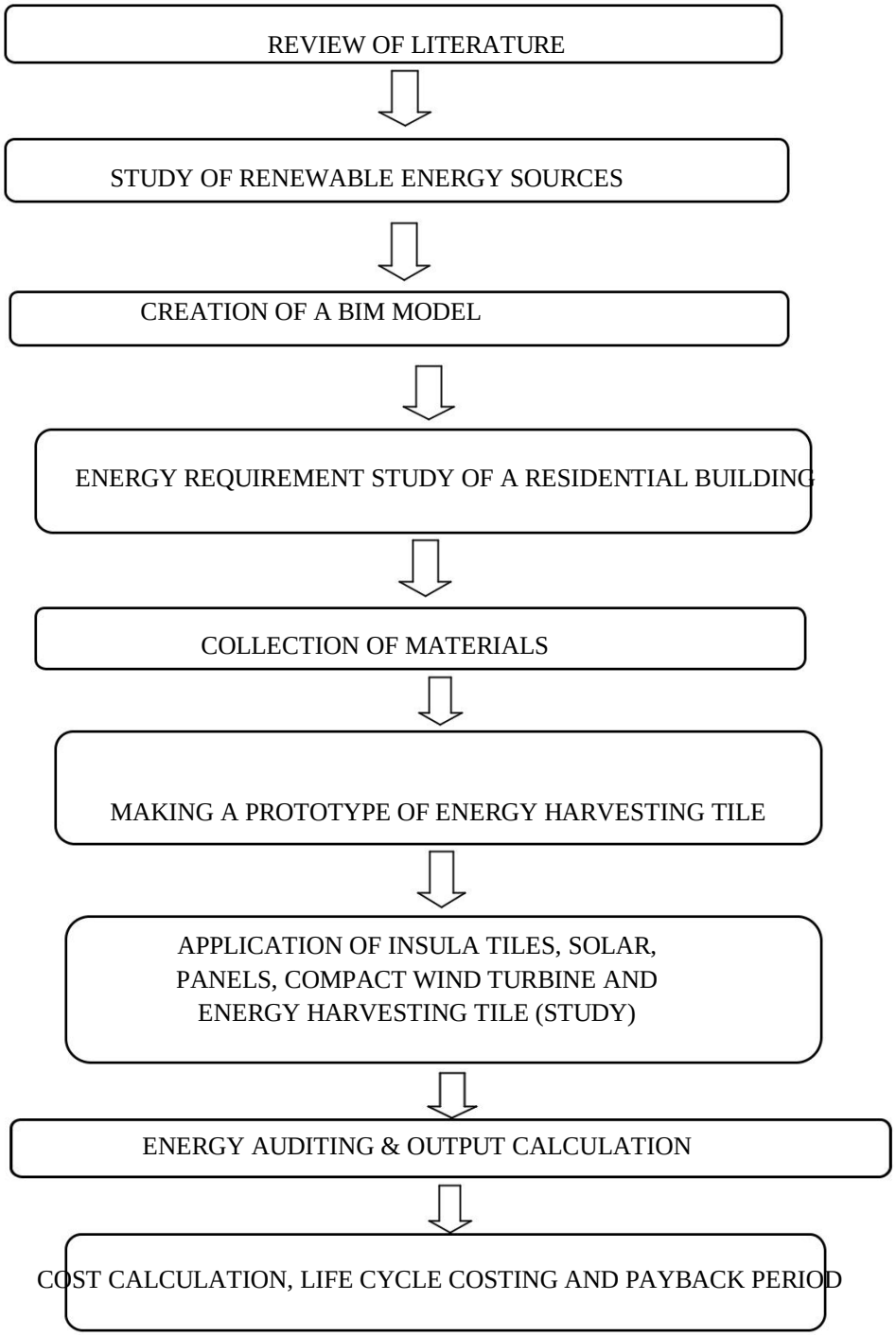


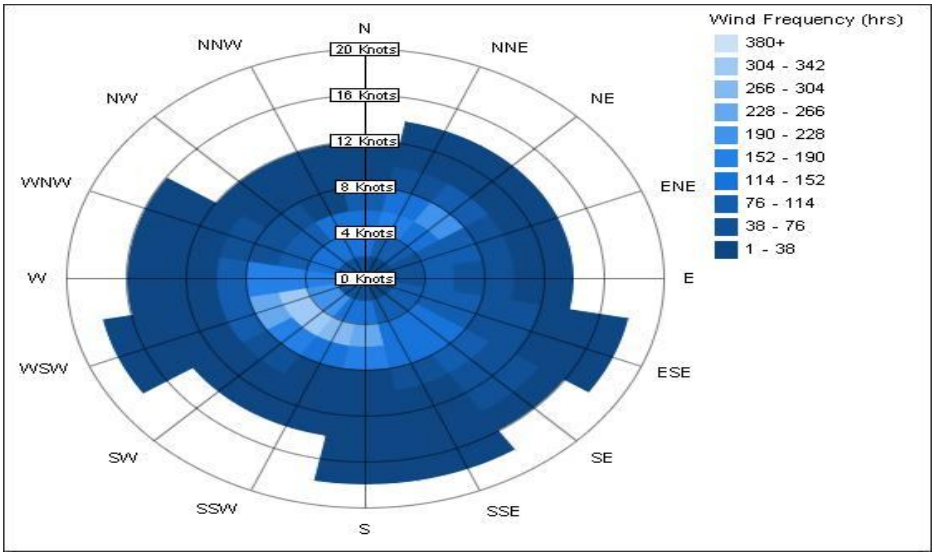
FIGURE 4.1 METHODOLOGIES

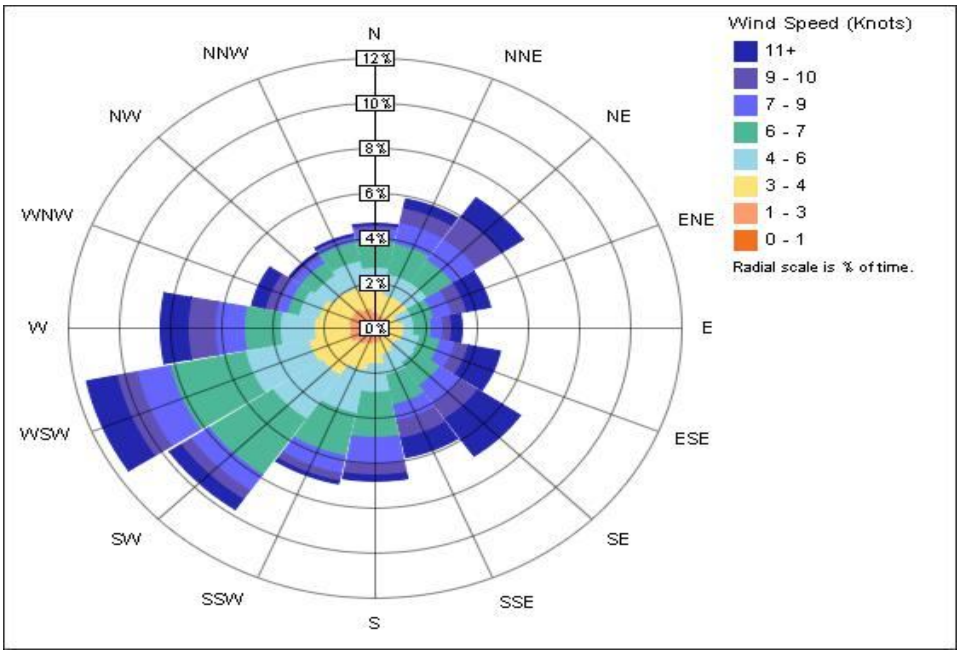
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V. RESEARCH ANALYSIS

FIG 5.4: ANNUAL WIND FREQUENCY





VI. BIM MODEL

A. General

A BIM model of the building was created using revit architecture software.

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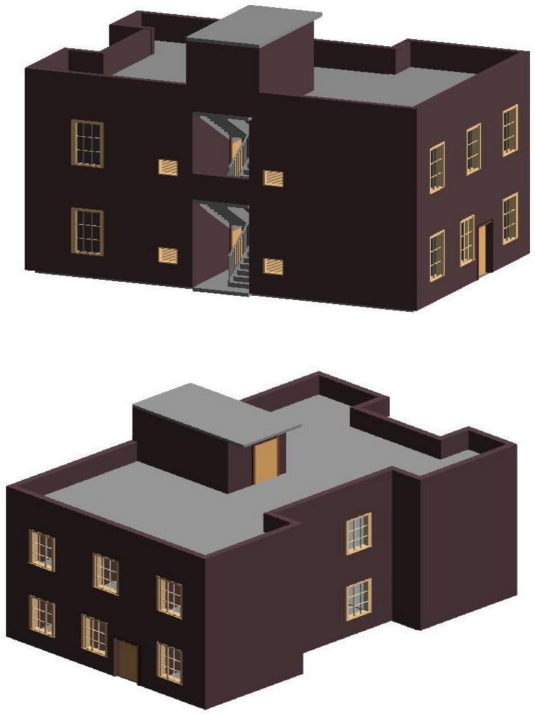
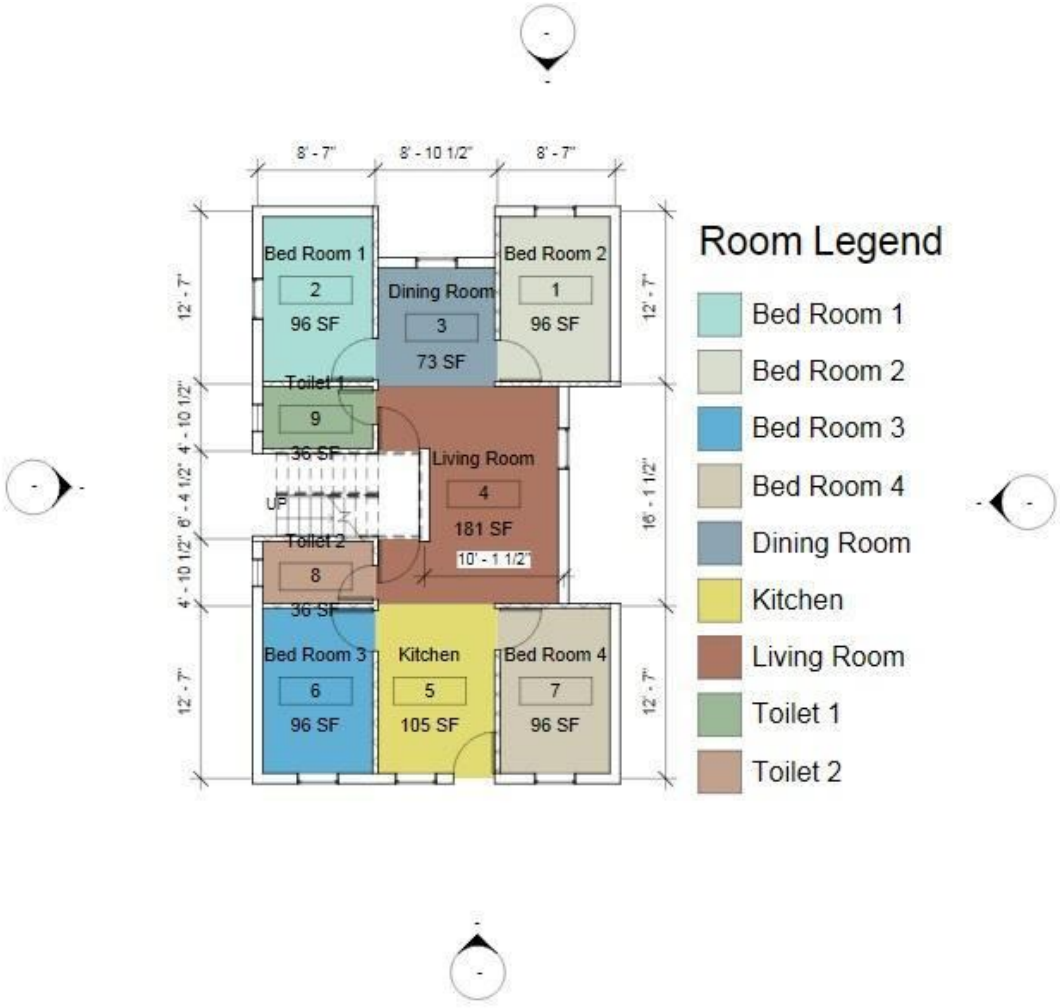


FIG 6.1: Model of the actual building using Revit Architecture



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VII. SITE FOR IMPLEMENTATION

Have taken an existing residential building in Velachery as he appropriate site for the implementation of this project.
The reason why I have took an existing building is because we know the monthly energy requirements of the building.
Also this will prove that all existing buildings can be converted to ultra energy efficient buildings in the future.



FIG 7.1 : Actual building for implementation

VIII. ENERGY ANALYSIS

A. General

Energy analysis is done to determine the annual energy consumption of the building under study based on the type of materials and equipment used in the building. It also gives us the areas of the building where we can make necessary changes to further reduce the energy consumed.

A comparison of annual carbon emissions, Electricity end uses, Monthly cooling loads and Potential energy savings between conventional material and insulla tiles has been displayed from fig.9.3 to fig.9.10.

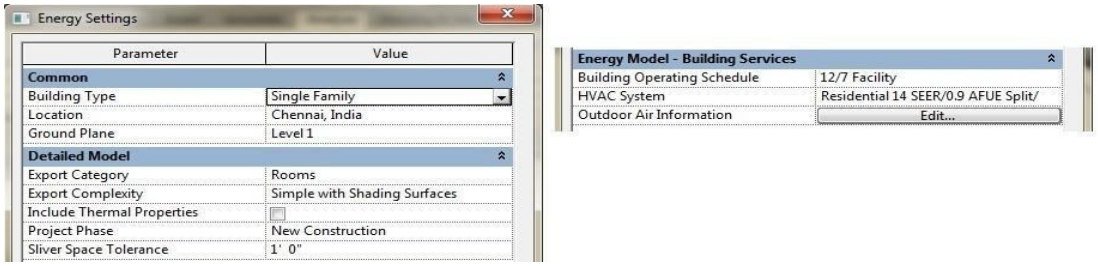


Fig 9.1: Energy Settings

Location:	MAS, TN
Weather Station:	726146
Outdoor Temperature:	Max: 105°F/Min: 61°F
Floor Area:	1,737 sf
Exterior Wall Area:	2,376 sf
Average Lighting Power:	0.45 W / ft²
People:	2 people
Exterior Window Ratio:	0.08
Electrical Cost:	$0.05 / kWh
Fuel Cost:	$0.14 / Therm

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Fig 9.2: Site Properties

FIG 9.3: Annual carbon emissions using conventional materials

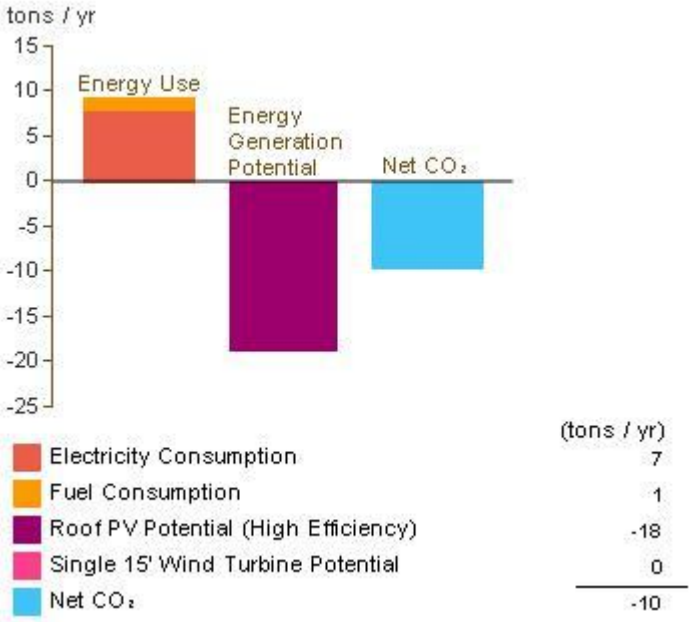


FIG 9.4 : Annual Carbon Emissions with Insulla Tiles

FIG 9.5 : Electricity end uses using conventional materials

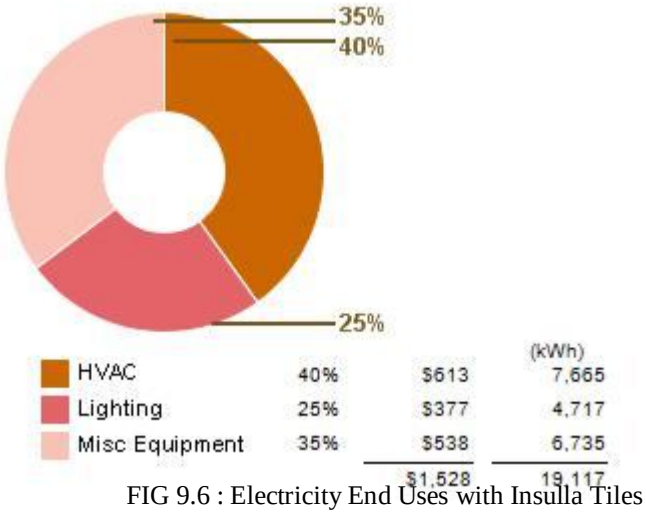
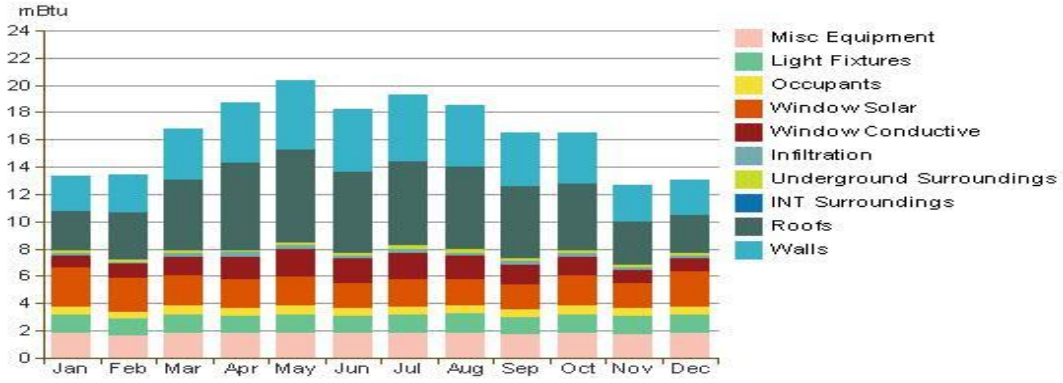


FIG 9.6 : Electricity End Uses with Insulla Tiles



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FIG 9.7 : Monthly cooling loads with conventional materials

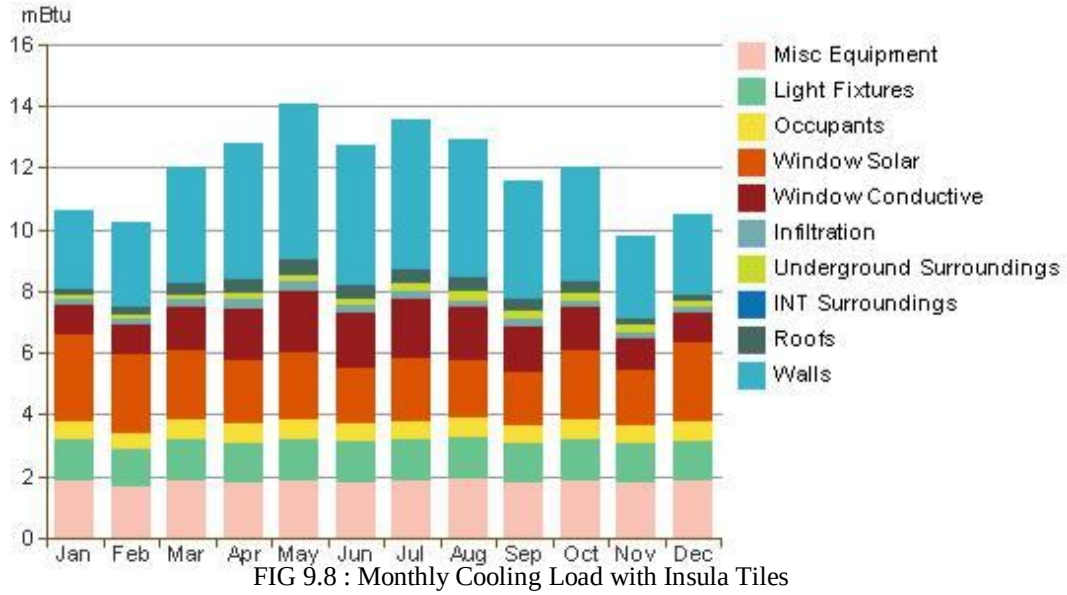
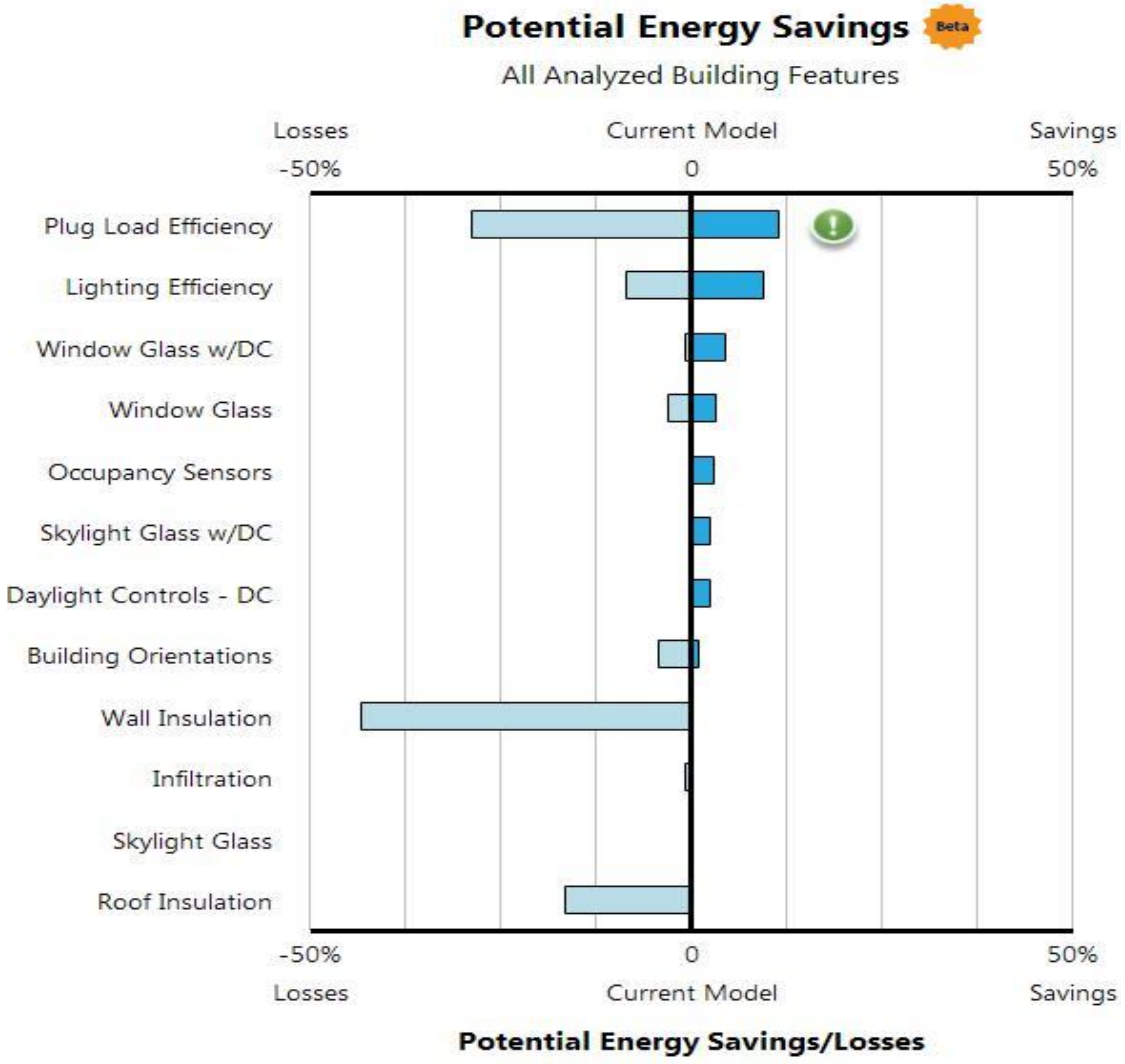


FIG 9.8 : Monthly Cooling Load with Insula Tiles



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IX. RESULTS & DISCUSSIONS

A. Results

By installing solar panels in a residential building of 1050sq.ft. The yearly electricity requirement is met and Rs.98,866 is saved on annual electricity bill.

By installing wind turbine, around Rs.5000 is saved every year on electricity bill.

By installing energy harvesting tiles, Rs.44,333 is saved on yearly electricity bill.

By installing insulla tiles in roof, the surface temperature is reduced upto 20℃ and room temperature by 10℃ thus cooling the surroundings without using air-conditioning thereby reducing electricity usage.

B. Discussions

The initial cost of ultra energy efficient building is high compared to normal buildings. But in long term basis, the savings in electricity bills will overcome the initial cost spent for installation of solar panels, wind turbine and energy harvesting tiles in few years. Thus it is feasible.

By using insulla tiles on roof, we are eliminating the use of air conditioners which consume most of the electricity. Thus cutting our electricity bills by half.

X. CONCLUSION

The energy requirement of a residential building can be fulfilled by applying the concept of ultra energy efficient building with clean and green renewable energy by means of solar panels, compact wind turbine, insulla tiles and energy harvesting tiles.

Harmful CO2 emission and release of harmful gases into atmosphere is reduced and burning of fossil fuels is prevented.

Excess energy produced is stored in grid and used for other purposes.

The building's heat is considerably reduced by the use of insulla tiles. It reduces the surface temperature up to 20℃ which not only keeps the heat out of our homes, but also brings down the use of air conditioners and electricity consumption.

Insulla tiles also reduce the room temperature up to 10℃ making the building cool and energy efficient.

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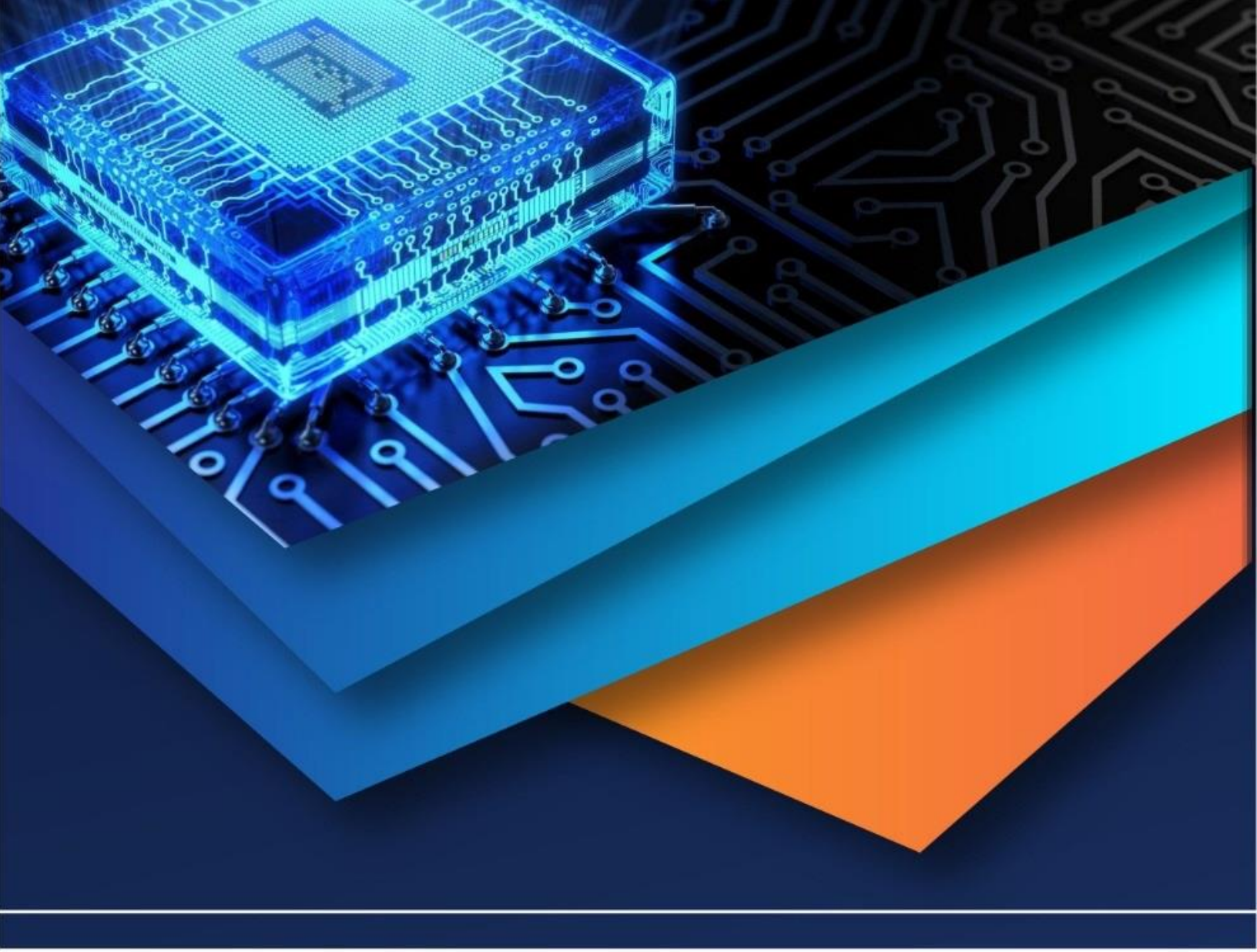
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