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ESTIMATION OF COST ANALYSIS AND INTERNAL TEMPERATURE IN A STRUCTURE WITH AND WITHOUT GREEN ROOF USING BIM SOFTWARE

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Abstract: Although in many countries green roofs still appear to be a novelty, they are in fact a technology that has been known for centuries. During the past decade, urban policies and building regulations in many countries worldwide have led to an increase in the popularity of this technique, mostly due to the belief that green roofs play a key role in environmental restoration in areas where city growth has resulted in significant urban climate deterioration and an increase in the energy consumption of buildings. Until recently, the benefits of green roofs were more qualitative than quantitative in character and they were compared with the benefits of vegetation surfaces. During the past decade, a great number of studies in many different scientific fields have produced important knowledge concerning the actual performance of this green

technology and have managed to quantify its performance through a mathematical or experimental approach. Recently, a number of computer models have been introduced that are expected to contribute more to our existing knowledge. The purpose of this study is to present the recent developments in green roof technology. This chapter focuses mainly on the contribution of green roofs to the energy consumption of buildings, but also reports the results of research relating to most of the other environmental benefits that are reported in literature.

Key Words: - Green Roof, REVIT, HVAC system, rooftops

1. Introduction:-

Green or planted roofs are a type of roof construction which in their simplest form has existed for thousands of years in many different regions of the world. Their role in improving internal comfort conditions was the main advantage in installing such a roof type during times when natural materials were the only available type of building fabric. In cold climates they contributed to thermal insulation of the roof, while in warm climates they protected the roof from overheating due to their increased solar exposure in summer.

Although this climate-dependent behaviour is still one of the reasons for green roof installations, their role as urban ecosystems has been expanded to include other significant characteristics that in many cases seem to be more valuable than the improvement of thermal comfort, such as their environmental benefits. Until recently, the numerous advantages of green roofs had a qualitative rather than quantitative character, since the scientific research in this field was very limited. In most cases, the existence of plants on the top of a building was regarded as an environmentally friendly construction with a generally positive contribution to the building's energy efficiency. For most building scientists, the extra soil layer on the top of the roof was considered to be simply an additional insulation layer which in the worst case could not increase thermal losses in winter and would shade the conventional construction layers in summer, offering protection from overheating due to solar radiation. For environmental scientists, the benefits of such a construction were regarded as being similar to all the benefits that vegetation can offer. During the past few years, a lot of research on green roofs has been done or is still in progress.

2. Review on published Literature :-

Brief literature review on environmental benefits of Greenroofs By Mohammad Mehdi Sadeghian,

Green roofs have numerous environmental benefits and are broadly used around the world. Green roofs can possibly improve the quality of urban runoff, reduce the energy intake of buildings, and enhance visual value to the environment. This review paper focuses on various benefits related with green roofs. This literature review also emphasizes knowledge on the basis of survey with Library, Journals, Internet, Various seminar papers, and reports of research organization. Green roof is an effective energy efficiency measure to reduce the building cooling load in summer and heating load in winter. The most

important green roof Environmental benefits are the ability of rainwater locking up and retaining and reduction in energy ingesting. This paper aims to provide an overview of the effects of the application of the green roof on the environmental benefits such as runoff water, reduction of energy consumption, Thermal benefits, Water quality enhancement, Noise reduction, Air pollution, Enriching biodiversity, Cooling, Carbon fixation, Dust capturing

A comprehensive study of the impact of green roofs on building energy performance By Issa Jaffal, Salah-Eddine Ouldboukhite and Rafik Belarbi,

Green roofs have several environmental benefits, such as improving building energy efficiency. The present paper provides a comprehensive study of the impact of a green roof on building energy performance. A model of green roof thermal behavior was coupled with a building code to allow the evaluation of green roof foliage and soil surface temperatures. Simulations were conducted for a single-family house with conventional and green roofs in a temperate French climate. In the summer, the fluctuation amplitude of the roof slab temperature was found to be reduced by 30°C due to the green roof. The heat flux through the roof was also evaluated. In the summer, the roof passive cooling effect was threetimes more efficient with the green roof. In the winter, the green roof reduced roof heat losses during cold days; however, it increased these losses during sunny days. The impact of the green roof on indoor air temperature and cooling and heating demand was analyzed. With a green roof, the summer indoor air temperature was decreased by 2°C, and the annual energy demand was reduced by 6%. The present study shows that the thermal impact of green roofs is not functionally proportional to the leaf area index parameter. It also shows the high dependency of this impact on the roof insulation. Finally, the simulations suggest that green roofs are thermally beneficial for hot, temperate, and cold European climates.

Cooling the cities – A review of reflective and green roof mitigation technologies to fight heat island and improve comfort in urban environments By M. Santamouris,

The temperature of cities continues to increase because of the heat island phenomenon and the undeniable climatic change. The observed high ambient temperatures intensify the energy problem of cities, deteriorates comfort conditions, put in danger the vulnerable population and amplify the pollution

problems. To counterbalance the phenomenon, important mitigation technologies have been developed and proposed. Among them, technologies aiming to increase the albedo of cities and the use of vegetative – green roofs appear to be very promising, presenting a relatively high heat island mitigation potential. This paper aims to present the state of the art on both the above technologies, when applied in the city scale. Tenth of published studies have been analyzed. Most of the available data are based on simulation studies using mesoscale modeling techniques while important data are available from the existing experimental studies. When a global increase of the city's albedo is considered, the expected mean decrease of the average ambient temperature is close to 0.3 K per 0.1 rise of the albedo, while the corresponding average decrease of the peak ambient temperature is close to 0.9 K.

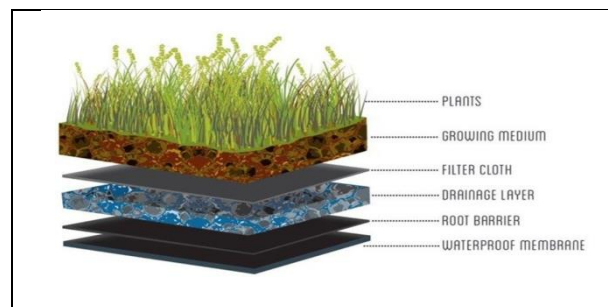


Image 1 :- Anatomy of Green roof



Image 2
LDPE sheet for waterproofing



Image 3 HDPE sheet for Root Barrier

3. Objectives:-

1. To estimate the extent of energy saving on tropical climate following the application of potted plants on rooftop using REVIT.
2. To investigate the influence of potted plants on rooftops on indoor comfort.
3. To reduce the ground surface heating which is caused during the daytime.
4. To estimate the overall cost of green roof & roof with ventilation.
5. To estimate cost of HVAC system required in the structure.

4. Methodology:-

1. **Phase one:** To calculate the energy used by a structure having a bare roof.
2. **Phase two:** To calculate the energy used by a structure having a bare roof and a mechanical ventilation system.
3. **Phase three:** To calculate the energy used by a structure having a bare roof and a air conditioned ventilation system.
4. **Phase four:** To calculate the energy used by a structure having a green roof.

5. Procurement of Materials:-

Following are the materials to be used to reduce the temperature [Anatomy of Green roof]

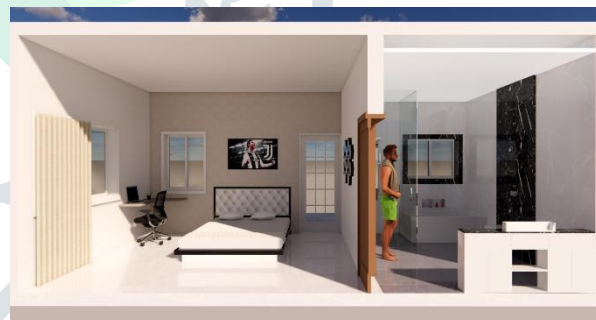


Image- Structure having a bare roof.

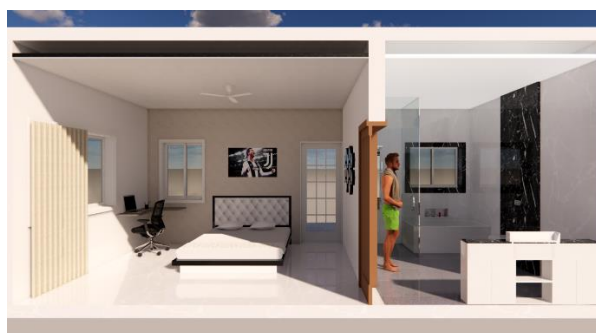


Image-Structure having a bare roof and a mechanical ventilation system i.e. FAN

e can

6. Calculations and results based on above data:-**BARE ROOM 1 Space**

Input Data	
Area (m ²)	17
Volume (m ³)	49.39
Wall Area (m ²)	56
Roof Area (m ²)	18
Door Area (m ²)	8
Partition Area (m ²)	0
Window Area (m ²)	3
Skylight Area (m ²)	0
Lighting Load (W)	0
Power Load (W)	0
Number of People	2
Sensible Heat Gain / Person (W)	73
Latent Heat Gain / Person (W)	45
Infiltration Airflow (L/s)	0.0
Space Type	Dormitory Bedroom
Calculated Results	
Peak Cooling Total Load (W)	0
Peak Cooling Sensible Load (W)	0
Peak Cooling Latent Load (W)	0
Peak Cooling Airflow (L/s)	0.0
Peak Heating Load (W)	1,939
Peak Heating Airflow (L/s)	378.4

BARE ROOM 2 Space

Input Data	
Area (m ²)	7
Volume (m ³)	20.38
Wall Area (m ²)	22
Roof Area (m ²)	7
Door Area (m ²)	2
Partition Area (m ²)	0
Window Area (m ²)	0
Skylight Area (m ²)	0
Lighting Load (W)	0
Power Load (W)	0
Number of People	1
Sensible Heat Gain / Person (W)	73
Latent Heat Gain / Person (W)	45
Infiltration Airflow (L/s)	0.0
Space Type	Dormitory Bedroom
Calculated Results	
Peak Cooling Total Load (W)	0
Peak Cooling Sensible Load (W)	0
Peak Cooling Latent Load (W)	0
Peak Cooling Airflow (L/s)	0.0
Peak Heating Load (W)	336
Peak Heating Airflow (L/s)	65.6

FAN ROOM 1 Space

Input Data	
Area (m ²)	17
Volume (m ³)	46.19
Wall Area (m ²)	54
Roof Area (m ²)	18
Door Area (m ²)	8
Partition Area (m ²)	0
Window Area (m ²)	3
Skylight Area (m ²)	0
Lighting Load (W)	80
Power Load (W)	97
Number of People	2
Sensible Heat Gain / Person (W)	73
Latent Heat Gain / Person (W)	45
Infiltration Airflow (L/s)	0.0
Space Type	Dormitory Bedroom
Calculated Results	
Peak Cooling Total Load (W)	3,673
Peak Cooling Sensible Load (W)	3,635
Peak Cooling Latent Load (W)	38
Peak Cooling Airflow (L/s)	246.4
Peak Heating Load (W)	1,560
Peak Heating Airflow (L/s)	352.5

FAN ROOM 2 Space

Input Data	
Area (m ²)	7
Volume (m ³)	20.38
Wall Area (m ²)	22
Roof Area (m ²)	7
Door Area (m ²)	2
Partition Area (m ²)	0
Window Area (m ²)	0
Skylight Area (m ²)	0
Lighting Load (W)	0
Power Load (W)	0
Number of People	1
Sensible Heat Gain / Person (W)	73
Latent Heat Gain / Person (W)	45
Infiltration Airflow (L/s)	0.0
Space Type	Dormitory Bedroom
Calculated Results	
Peak Cooling Total Load (W)	691
Peak Cooling Sensible Load (W)	674
Peak Cooling Latent Load (W)	17
Peak Cooling Airflow (L/s)	46.3
Peak Heating Load (W)	293
Peak Heating Airflow (L/s)	65.6

Level Summary - Level 1

Inputs	
Area (m ²)	97
Volume (m ³)	276.94
Calculated Results	
Peak Cooling Total Load (W)	17,570
Peak Cooling Month and Hour	May 16:00
Peak Cooling Sensible Load (W)	17,406
Peak Cooling Latent Load (W)	164
Peak Cooling Airflow (L/s)	1,178.7
Peak Heating Load (W)	7,284

Peak Heating Airflow (L/s)	1,704.5
Checksums	
Cooling Load Density (W/m ²)	181.98
Cooling Flow Density (L/(s·m ²))	12.21
Cooling Flow / Load (L/(s·kW))	67.08
Cooling Area / Load (m ² /kW)	5.50
Heating Load Density (W/m ²)	75.44
Heating Flow Density (L/(s·m ²))	17.65

7. Calculations based on above data-

Room with Mechanical Ventilation (FAN) (24 hours)

Energy Calculation

1. Energy generated per Day = 1560 W
2. Energy generated per Month = 1560 W X 30 days
= 46.8 KWh
3. Energy generated per Year = 569.4 KWh

Cost Calculation

1. Rate per KWh in Pune = Rs. 6.58
2. Cost of Fan per Year = 569.4 X 6.58
= Rs. 4260

8. Conclusion :-

Green Roofs are an economical option for cooling of structures over a longer period. Green roofs are attractive option for energy savings in building sector. They reduce building energy demand through improvement of thermal performance of buildings. Green roof reduce indoor temperature. Green roof helps in enhancing the structure aesthetically. Green roofs can be a good option for small scale plantation.

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