

URBAN ISLAND EFFECT & MITIGATION MEASURES

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Abstract -As the global rate of urbanization is increasing, the cumulative effect of all the negative impacts of urbanization leads to the modification of the physical and chemical properties of the atmosphere, the soil surface, and the air quality, etc. The experience of higher temperature in the Urban areas compared to the rural areas as a result of the heat stored in the built structures from incident solar radiation and also due to the heat released from human activities (alterations of surface area, improper urban planning, infrastructure by replacing open land and vegetation), emissions from vehicles, machinery and equipment, this phenomena leads to the formation of heat pockets that are called as the “Urban Heat Island” (UHI), which are mostly the city centers. High temperature in the city centers (urban areas) than its surroundings (suburban areas) cause discomfort to the dwellers in the summer time is alarming and requires much attention around the globe to overcome the advances in technology and its effects. An attempt has been made to list the various measures to mitigate UHI effect and the processes by which the mentioned strategies work.

Key Words: Urban Heat Island, microclimate, solar reflectance, thermal emissivity, absorbed energy.

1. INTRODUCTION

In most of metropolitan cities, the temperature at the heart or the center of the city (central business district CBD) is recorded to be higher than its surrounding suburban area. The phenomenon is called Urban Heat Island (UHI) effect. This results in a temperature difference between the urban and the rural areas which lead to the discomfort in the dwellers in urban areas. When large areas of natural land get replaced by artificial/manmade built surface which absorb the incident solar radiation or heat and re-radiate it at night (when the atmosphere is cooler).

This issue exists in almost every big city and numerous factors are held to cause this effect, including anthropogenic heat release, surface cover, climatic conditions, air pollutants, etc.

Depending on the the ways they of formation, the techniques used to identify and measure, and impacts, and the methods available to mitigate the urban heat island it can be divided into two categories :

1. Surface Urban Heat Island.
2. Atmospheric Urban Heat Island.

A. Surface Urban Heat Island:

This is caused to the artificial or manmade factors like alterations of surface area, improper urban planning, infrastructure by replacing open land and vegetation, increased emissions. This type of effect is present throughout the day and night its usually more intense in the days of summer.

B . Atmospheric Urban Heat Island :

This type of UHI is caused due to the natural factors and sudden atmospheric changes due to the deviation in climate, rainfall, intensity of sun radiation. The effect may be weak or even non-existent during day but becomes more evident during the sunset (Predawn – radiations of the setting sun are hotter), as there is a slow release of heat stored in the manmade elements. The peak of the effect depends on the properties of urban and the rural surfaces, the season, and the climatic conditions.

2. CAUSES of UHI

There are many factors that contribute to the Urban Heat Island formation, some of the significant factors are :

- A. Properties of the urban surfaces
- B. Reduction of vegetation
- C. Human Activities
- D. Natural Factors

A. Urban Surfaces :

The materials that are used in the construction form the urban surfaces, particularly properties like solar reflectance, thermal emissivity, and heat storing capacity determine the amount of suns radiations stored, emitted and reflected. These have a direct on the formation of microclimate of an area.



Figure -1: The heat exchange between urban surfaces

B. Reduction of Vegetation :

In the rural there is dominance of vegetation and open spaces for cultivation which provide shade and hence reduce the

temperature by the process of evapotranspiration. Where as in Urban areas the surfaces of the sidewalks, roads, playgrounds, parking plazas are hardscape dry and impervious and increase the surface runoff of water. As the cities evolve there is stress on natural resources. Trees are cut down to infuse infrastructure, the water bodies are polluted, soil is contaminated these factors results in less shade and moisture in urban area which contributes to the increased air temperatures.

C. Human Activities:

The release of heat into the atmosphere by human activities is called as anthropogenic heat. It can be due to numerous sources like the running appliances, transportation, heating and cooling towers, industrial processes.

D. Natural Factors :

Weather and Location strongly influence the UHI formation.

i . Weather : Wind and Cloud Cover affect the formation of the UHI. Calm winds and clear sky lead to formation of the effect because these conditions increase the solar energy reaching the urban surfaces and minimize the reflected heat. On the other hand the strong winds and cloudy sky suppresses the effect.

ii . Location : Geographic area, climate, topography influence the formation of the effect. The terrain, water bodies moderate the temperature and generated heat to radiate the heat away. If the area is surrounded by mountains then it blocks the wind from entering the city which leads to the formation of the effect in the city.

3. MEASURE TO MITIGATE UHI

A . Planning :

A good urban planning can play a vital role in mitigating the urban heat effect. For instance if the buildings are placed in a angle say 45° wind will get channelized and not flow in only one direction which helps in cooling whereas in a perpendicular layout the air flow is blocked. The ratio of built vs open space also affect the wind circulation and minimize the effect on the urban microclimate.

B . Green Roofs :

It is popularly known as rooftop garden, it's a vegetation layer grown on a rooftop. It provides shade and removes heat from the air by the process of evapotranspiration thereby reducing the temperature of the roof and the surrounding air. It also decreases the run off duration and keeps city cooler for a longer period.



Figure -2 : Green Roof Terrace

C . Pervious pavements :

If the pavements are impervious then it does not allow water to infiltrate and prevents evapotranspiration. Hence making the sidewalks pavements pervious will help in reduction of temperature at a considerable rate and it also helps in ground water recharge. (case: Church St Bangalore)



Figure -3 : Pavements that allow ground water recharge

D . Water Bodies :

By increasing the number of water bodies the temperature falls down due to the evaporative action and enhanced wind flow. The absorption capacity of water is more and it helps in reduction of urban temperature. Case : Brigade Gateway Apartments, Bangalore : The manmade pond gives a evaporative cooling effect.



Figure -4 : Water Bodies – Evaporative Cooling

E . Solar Reflectance :

It's also termed as the albedo of the surfaces, like the pavements, roofs, cars, so that these urban surfaces absorb less heat and transmits less heat into atmosphere. This results in the cooling of the environment and reducing the amount of the greenhouse gases.

3. CONCLUSION

Green vegetation is the most effective measure to avoid the urban heat island effect. Hence its important to be aware of the importance of the greenery in cities they are the lung spaces. In cases of city where the planting of trees in more numbers is difficult the albedo materials, pervious pavements and green roofs may be followed. At a smaller scale considerations have to be made so that the house yard had enough place for trees so that they provide shade. Measures have to be taken to preserve the water bodies as they play a vital role in the mitigation strategy. Urban Heat Island is an alarm to the people to control the activities and *save the environment and in turn save our lives*.

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