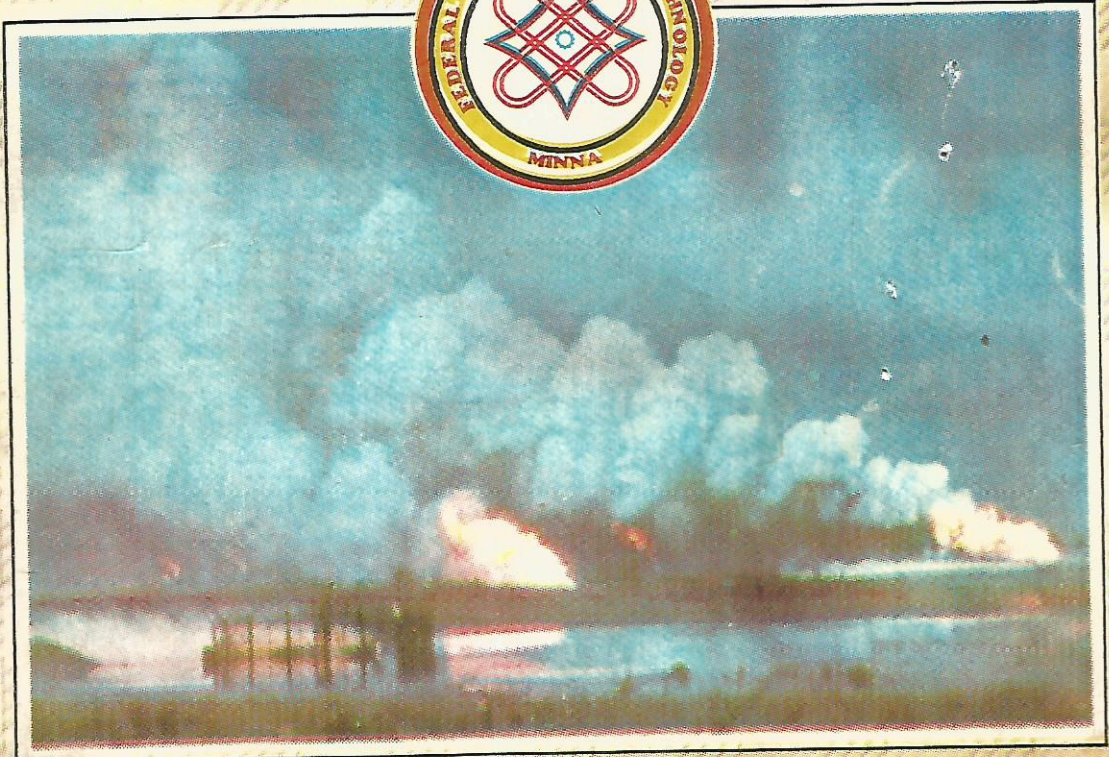


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REDUCING EFFECTS OF SUNSHINE ON A BUILDING FOR AN EFFECTIVE CONTROL OF URBAN HEAT ISLAND

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Abstract.

Building is essential to human beings for living and host of other activities. In order for a building to fulfill its primary function of providing shelter from the adverse environmental condition, its comfort in the thermal environment is of utmost importance: but a building consumes energy and other resources due to solar radiation from the Sun which creates a soft of discomfort for its occupants thereby raising their body temperature beyond normal. The heat when accumulated in a building structure induces thermal Stress and accelerates quite a number of deteriorating chemical processes of some materials that make up the building.

This paper therefore, addresses the problem of environmental management in a building by reducing the effect of sunshine in it. The research throws light into the appropriate selection of materials by assessing their comparative performance in terms of their thermal properties, insulation capacity and surface characteristics that can reasonably control solar radiation in order to maintain the thermal comfort of the occupants and improving their comfort level in the environment. It also emphasizes on the application of shading devices and explains how important is vegetative element such as trees, shrubs, flowers and ground cover help in environmental management.

Introduction

Radiation is a process of thermal energy transfer in the form of heat from one location to another without any intermediate medium. In radiation, heat transfer takes place between two bodies when there is no solid or fluid connection between them. In this case, energy is transmitted through a space by electromagnetic waves or by photons.

Radiation takes place through a change in energy form: from internal energy at the source to electromagnetic energy for transmission, then back to Internal energy at the receiver. This form of heat transfer is distinguished from conduction and convection because it does not depend on the presence of an intermediate material as a carrier. [Meyer, 1983].

The primary radiation sources with which a designer must put into serious consideration is the sun's radiation called solar radiation. The heat flow rate of solar radiation is measured, in watts (W) that is joules per seconds (J/S). It is this solar radiation that brings about change in temperature of a building. The temperature of an external surface affects the internal thermal condition and also has an important influence on the thermal expansion and contraction of the building element, and consequently on its durability and weathering capacity. [Meyer, 1983].

In order to fully appreciate the effects of solar radiation on a building and how heat is transferred within it, it is important to understanding the most essential parts of a building structure that are seriously affected and which are to be protected. These parts are.

(1) **Roof:** It is the most building component exposed to the climatic element. The Impact of solar radiation during the clear days and the loss of heat by long wave radiation

during the night, both affect the roof more than any other part of the structure. In other words, the roof is the nearest component to solar radiation hence; it absorbs and reflects heat to the surrounding structure.

- (2) The wall: - It is also affected by the transmission of solar radiation. During the day, heat absorbed by the roof is transmitted to the walls which in turn re-radiate same to the occupants of the building. At times, walls receive their direct solar radiation from the sun during the day before they transmit heat during the night to the occupants.
- (3) Openings - The major components in a building that constitute what we call openings are the windows, doors and screens. The composing materials of these openings are affected by solar radiation. When doors and windows of a building are opened, there is a flow of solar radiation, but even when they are closed, they offer a very low resistance of heat flow, solar radiation penetrates through glazed doors and windows and heat the interior walls of a building.

The adverse effects of solar radiation of a building and its components discussed above manifest itself in the following ways.

- (a) The heat generated in a building structure due to transmission of solar radiation creates a sort of discomfort on the part of the occupants raising their body temperature beyond normal.
- (b) Solar radiation accelerates quite a number of chemical processes such as the oxidation of paints and the sublimation of volatile fractions from asphalt and bitumen. This process adversely affects the original thermal properties of a building materials and finishes rendering a building incapable to withstand intense thermal exposure condition.
- (c) High temperature due to solar radiation induces thermal stress in structures, accompanied by deformations which may spoil the air tightness or leak proofness of joint between wall panels. The situation is further aggravated by the wall pronounced instability of the temperature pattern.
- (d) Building gains heat by conduction of heat through the walls and by insulation through windows. The total heat gained by the building must be lost in order to maintain a thermal balance. An excess gain will result in a constant rise in temperature of the affected building components.

Aims and Objecties of this Paper:

This paper investigates into the adverse effects of solar radiation on a building and how these can be effectively controlled or minimized:

- (a) To satisfactorily modify the thermal comfort of a building environment through good choice of shading devices and solar radiation preventive methods.
- (b) To provide an effective environmental management techniques that will considerably control the effects of solar radiation on a building.

Ways of Reducing Effects of Sunshine on a Buiding:

Effective solar radiation prevention and thermal control in a building can be achieved through the following ways.

- (a) Form of a building: - The shape of a building plays a big role in the determination of how a building will gain and lose heat, the ability of a building to store heat that is its thermal capacity increases with the volume of the building, its ability to lose what is related to the surface area, the volume of surface area ratio is therefore an important indicator of how a building will heat up by day and cool down by night.

- (b) Orientation - The primary radiant heat radiation consideration in the siting of a building is orientation. The strategy behind the general idea about orientating a building away from sun is to place windows on the side where there is minimum exposure to sun. The orientation of glazing is very important when designing a building, because it is possible to reduce heat gain through glazing, particularly by reduction or avoiding the placement of windows on the east and west façade, also the longer sides of a building should be orientated on the North-South axis.
- (c) Ceiling height: Great ceiling height reduces the internal heat gain in a building, this improves environmental conditions by permitting warm air to rise and allowing fresh air to come in cooling the internal of the building.

Floor to ceiling height is determined by physiological comfort, height of light fixtures for proper light distribution and height of windows necessary for ventilation and lighting. It is important to take into consideration the Insulation value of the materials of which a building is constructed, and also the thermal capacity of the materials to absorb heat in order to provide comfort by ensuring an adequate surface temperature for walls, floors and ceilings.

- (d) Internal heat control: Heat gain are normally produced within a building by lighting bodies, solar radiation, conduction through walls, insulation through windows, internally from occupants, heating equipments, heating rays from the sun and by natural ventilation provided that the thermostatic temperature control is located within the vicinity of the heat gain by means of insulation or weather stripping. Attention must be paid to the type of temperature controls (fans or air conditions) installed to reduce overheating and discomfort.
- (e) The use of building materials: In order to prevent or control the thermal effects of solar radiation on building and its occupants to effectively manage our environment, it is essential to have some knowledge of properties of building materials, particularly in relation to temperature variation and heat flow. The properties of materials determine the characteristics of wall and roof elements and the way they will modify the environment. Hence, the good choice of building materials is of great importance. An appropriate selection of materials which is made possible by assessing the comparative performance of the various materials in terms of their insulation value, thermal transmittance, thermal capacity and air-to-air heat transmission. The lower the air-to-air heat transmission coefficient of a material, the better the insulation effect.
- (f) Shading devices: Shading devices shield a building surface and internal spaces from solar radiation. Their effectiveness depend on the location, orientation and form. Exterior shading devices are more efficient such as that located within a building wall since they intercept the sun's radiation before reaching building surface. The orientation, form, materials and construction of shading devices many vary to suit specific situation. Below are some basic types of solar shading devices.
 - (1) The use of sun breaker which can be horizontal, vertical or a combination of them.
 - (2) The use of adjustable window louvers
 - (3) The use of vertical screen and sun blinds
- (g) Landscaping -Landscaping can be used to reduce the effect of sunshine on a building, landscaping features are used to break sunlight from entering a building, the type of trees used, be it deciduous or coniferous matters. Their distance from the structure should also be considered. Shade trees can seasonally control or direct radiation from the sun, ground surfaces can control reflected radiation, planted ground cover commemorate air temperature and wind breaks can diminish the force of wind over the site and determine the amount of shade provided.

Conclusion

From the above study, it is seen that buildings are actually not managed and needlessly consuming too much scarce resources in our environment as a result of exposure to solar radiation. Therefore, I recommend that:

- (1) Trees should be planted strategically around each building for shading and micro-climatic effects.
- (2) Openings should always be protected from direct radiation by use of effective sun control devices
- (3) External walls should be of dense/ heavy weight materials and reflective colours
- (4) Roof materials should be of reflective surfaces and colours.
- (5) External environment and courtyard should be well-landscaped with shrubs/ ground covers, use of water fountain to control reflected radiation to effectively manage a building..

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