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Review on Various Techniques of Energy Conservation for Thermal comfort

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Abstract - Now day's thermal comfort is key factor for dynamic energy conservation method. The environment of workings into the several firms enhanced using the good and focused lighting levels which is needed for good quality purpose, Energy efficiency was enhanced because of better temperature & its levels of humidity. The enhanced daylight performance in interior making a good effect to reduce artificial lights. It is also providing the heat to interior due to this its making a comfortable zone in working area. As we see the natural climate is always varying regularly during day & night in every season. It isnecessary to keep good conditions and climate into the working area which is making comfort zone for working conditions. It is also needed that individually resources of the every occupant should be there; it is advantage of energy performance of any area.In this paper we discussed comparative study of dynamic methods for energy conservation for thermal comfort; we studied several articles for this study according to subject.

Keywords - Thermal comfort, Energy conservation, Dynamic energy conservation, visual comfort

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INTRODUCTION

One of the Crucial objectives of sustainable design is Energy saving. Along with saving energy, creating the best comfort inside the interior has utmost importance. One of the key strategies to reduce energy consumption is recognized as day lighting, which reduces the usage of artificial lighting inside the building. The introduction of daylight into the interior has positive effects on productivity and health of the occupant. On the other hand, excessive sunlight inside will cause thermal and visual discomfort. Incorporating daylight into a building design has been recommended for green building rating systems and Energy standards [1].The factors which influence the needs of the building energy include sunlight, temperature, and perspiration. These factors vary with season, location as well as orientation of a building and the time of the day.

As the previous studies day lighting is always be great strategies for the excellent and high performance for buildings which are sustainable. It is also providing big advantages for the area environment and good lighting space. It is just not committed to low maintenance only with the small energy consumes but it is making a comfortable zone for working area. In the recent years, the growth in Information Technology is responsible for the rise in Energy uses in office buildings. In an office building, two-third of all the energy consumed is due to lighting, equipment inside the office as well as Heating Ventilation and Air Conditioning (HVAC). In the present age with diminishing natural resources, the energy efficiency can be improved introducing daylight into the interiors. Even in the modern offices, the daylight entry is very important, not only from the energy efficiency but also "for majority of occupants the window remains that vital link with the outside world" [2].Lighting accounts for over a quarter of the total energy usage in commercial buildings. LED is found out to be the best solution, since the heat output from the LED is negligible. The adoption of energy-saving LED lighting technology is one way to reduce the costs, but clearly even greater savings are possible by turning lights OFF when not needed, and optimizing light levels to suit the working environment and the task in hand. Suitable controls are the key to reduce energy consumption for commercial buildings particularly. This requires a baseline of automatic controls. Having established a framework of automatic controls, there will always be a requirement to override default conditions with manual switches/dimmers, remote controls or through access to the programming system [3].

Energy Informatics can be known as "designing, analyzing & developing systems to increase performance of energy need & transmission systems". This means that the energy consumption can be reduced with proper information. i.e. “Energy + Information = Less Energy” [4].The weakest thermal elements in a building are its windows, since they are responsible for excessive heat penetration and hence overheating [5].Energy can be saved by properly selecting window coverings or treatments. The Window treatments can also reduce heat gain in summer and heatless in winter. The Window treatments which can reduce heat loss in summer include Vertical or Horizontal slat type and Window blinds and they can block the direct sunlight into the interiors [6].

The introduction of shading devices can significantly reduce the cooling demand and hence the load on the HVAC. The shading devices, in turn, will protect the façade from direct insulation [7]. Automated shading devices rotate according to the comfort needs and the weather conditions. Temperature and luminance sensors are used to give commands to the shading devices. A carefully positioned shading system will control the entry of daylight and hence substitutes the artificial light with the daylight [8].

“The situationsof mind which shown the need with Thermal environment” is referred to as Thermal Comfort. This varies from person to person both physiologically and psychologically. Hence, it is difficult to describe the thermal environment that would satisfy everyone. However, the conditions are defined where a specified percentage of occupants would feel thermally comfortable. The six initial elements viz., radiant temperature, air temperature, humidity, metabolic rate, clothing insulation & air speed need to be addressed while defining the thermal comfort. All the above factors vary with time [9].The Thermal comfort can be achieved with thermal balance, where the inside heat produced in the body is equal to the heat lost to the environment. If the weather is too hot or too cold it can cause thermal dissatisfaction [10]. In order to maintain the thermal comfort levels of the occupants, most of the energy is greatly utilized to heat, cool & control humidity in space. The energy demands can be reduced by utilizing advanced materials, which improve environmental impact [11].

“The ability of a person to carry out any task comfortably in terms of his/her photo-sensory perception” is known as Visual Comfort. The various factors on which the Visual comfort depends are the direction of light source, the light intensity, the contrast of surfaces, the reflection of surfaces, photo-sensory response of the eye and the nature of the task being undertaken [12]. The minimum level of luminance required to provide visual comfort for various tasks and locations is specified by International recommendations. The Visual comfort can be achieved by maintaining the recommended luminance level avoiding glare. Happiness and productivity of the users of a building can be enhanced by providing the right mixture of air speed, temperature, and humidity. Since everyone has his/her own criteria for comfort, it is usually measured by the percentage of occupants who are satisfied with the prevailing condition [13]. The users can be kept comfortable using solar radiation to keep warm and the fans to move air when it’s too hot. In order to maintain comfort inside a room both thermal as well as visual comfort has to be achieved. The main intention of the intelligent system is to continuously satisfy the occupants in terms of comfort followed by reducing the energy consumption. The earlier studies have proved that the energy performance of any building with lighting controls and automated window blinds is superior to those with the static blind system [14].Movable shading devices prevent the building from overheating as well as provide thermally and visually comfortable environment. The control strategy adopted and the choice of the system are influenced by many parameters. The studies carried out so far, have investigated the influence on energy demand considering either the thermal comfort or the visual comfort at a time. Only a few of them have considered both the visual and the thermal comfort into account [15].

LITERATURE REVIEW

This section present the previous studies which is done by several authors in selected subject, we referred several researches for this study.

In [1] studied the effectiveness of day lighting through simulation of a typical office floor at Dhaka City. The significance of light shelves was highlighted pertaining to daylight entry. It was proved that among the seven alternatives studied, light shelves at a height of 2m above floor level performed better to achieve the required light levels. Energy consumption in an office building can be reduced by integrating artificial lighting with daylight.

In [2] carried out a simulation study for organizational buildings in the tropical climate of Batu Pahat in Malaysia to find the thermal performance. This was followed by validation with measured data. The discrepancy was less than 10% that indicated a good agreement. It was found that direct solar radiation influenced the heat gain in a building.

In [3] an important strategy for thermal as well as visual comfort is the proper use of shading. Some of the shading strategies are overhangs, louvers and vertical fins. These shading strategies can be external or internal as well as fixed or adjustable. While designing these elements, both the thermal and the visual comfort need to be considered simultaneously. The heat and glare of direct sun entering through the windows can be avoided using the shading devices.

In [4] Energy consumption from artificial lighting can be reduced introducing shading system, which in turn improves the visual comfort of the occupant. An automated system which operates by sharing the information will provide the maximum comfort and is energy efficient. The actual occupancy data of the occupant was used in simulation. A comparison of different control strategies was performed based on heating, lighting, energy consumption, visual comfort and electric demand.

In [5] explained the computer based analysis and design techniques to create environmental simulation models on which the thermal comfort ranges and air conditioning loads in a residential house were predicted.

In [6] used Matlab/Simulink to implement normal building HVAC method. This system predicted the temperature change into building & estimated the amount of energy which is wants to achieve comfort level. The location of building, inside properties of the building, gains & heating system as well as weather were considered for estimation. This model has the advantage of its less computational resources and its simplicity.

In [7] showed that human thermal comfort is not reflected adequately by only PMV. In order to reflect human thermal comfort in an interior, the humidity control is very important. The range of humidity for human comfort is between 30 % and 60%.

In [8] specified that for the occupant to be satisfied with the environment, both the thermal and the visual comfort have to be achieved. By reducing cooling loads i.e. avoiding additional energy consuming devices for cooling, the thermal comfort can be achieved. For optimization, the building simulation software tools can be used.

In [9] optimized the design of passive buildings using the simulation through an approach which is comfortable. Solar shading that plays a very important role in Tropical climate has been emphasized. The solar shades are developed depending on the availability of daylight inside the room and the percentage of thermal comfort required.

In [10] focussed on achieving visual comfort and energy saving integrating day-light & artificial light in hot temperature humid climate. The visual performance & energy saving were predicted for three kinds of various glazed windows. A good amount of decrease in cooling & building energy conservation has been analysed for all types of glazing.

RELATED STUDY

Following table shows the related studies of this paper

Table 1: Related work

Ref. No.	Author name	Paper Title	Year	Objectives
[11]	Giarma C., Tsikaloudaki K., & Aravantinos D	Day lightingand Visual Comfort in Buildings' Environmental Performance Assessment Tools: A Critical Review	2017	The arangment of safer & comfortable physical climate is most essential need considered by buildings. Furhter more, The inside climate quality described through main axes point, i.e. thermal, acoustic & visual comfort, Alos the inside air quality considered, it was very deficult situation if considered health problems, also it will it is making affect on productivity of workers.
[12]	Fasi M. A., & Budaiwi I. M	Energy performance of windows in office buildings considering daylight integration and visual comfort in hot climates	2015	Focused on achieving visual comfort and energy saving integrating day-light & artificial light in hottest humid climate change. The visual performance &energy saving were predicted for three various kinds of glazed windows. A good amount of decrease in cooling & building energy reduction has been analsyd for all types of glazing.
[13]	Liang R., Wu Y., & Wilson R	Thermal and visual comfort analysis of an office with thermo chromic smart windows applied	2015	While into the conditions of buildings, the windows has been significant for giving day-light &solar heat gains of the internal environment, they are also responsible for increased energy loss. Author showed that energy reduction in to the building may be decreased by enhancing the performance of windows
[14]	Mainini A. G., Bonato D., Poli T., &Speroni A	Lean strategies for window retrofit of Italian office buildings: impact on energy use, thermal and visual comfort	2015	In order to achieve comfort in an office room along with ambience and good lighting effect, the window coverings play an essential factor. Electrical energy consumption will increase due to overheating of a room, which is caused by the entry of daylight from windows. The heating can be reduced by the introduction of shading devices. The shading device also aids in reducing glare inside the room
[15]	Sharma S., Boddu J., Charan G. S., Sharma S	Home automation through FPGA controller	2015	Author implemented a home automation system using the FPGA as the controller. Communication between the mobile and the controller was established using Global System for Mobile (GSM) network, and Short Messaging Service (SMS) based wireless technology was used.

RESEARCH GAP

An extensive review of the research work was carried out in the area of Energy Conservation for Thermal comfort, energy conservation and adaptive controllers. Although some works have been reported in the area of thermal and visual comfort, it is observed that the Energy Conservation for Thermal comfort has been given priority. Daylight integration into the interior was based on Thermal comfort. While considering energy conservation, the load on the Air Conditioner (AC) due to daylight entry was not explored.

Based on the above observations, the gaps in the earlier research are formulated as follows:

- Collaboration of thermal comfort behind in place along with due known as decrease on air conditioner load which is not explored.
- Energy saving collectedfrom given integrated approach into the area which has not been touched upon.
- Considering optimum quantity of day-light which is basis on thermal comfort need of worker, is one of the areas where next investigations are needed.

CONCLUSION

An effort is made to explore the research undertaken in the areas of day lighting, thermal comfort & energy conservation. A dynamic window blind controller that can significantly lower the energy consumption while providing the ideal living and working circumstances, which, in turn, lead to more well-being of the occupant is the need of the hour. From the survey of the previous work undertaken, the area that has not been analyzedso far is taken up in this research work. The challenge is to lower the energy consumption by increasing the comfort within the building with one integrated solution. Hence, this work concentrates on developing a dynamic method giving the higher priority to thermal comfort energy conservation. Finally, the system developed is proved to be energy efficient.

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