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State of Art on Daylight and Energy Analysis on Residential Building

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Abstract: *Site planning and orientation of the building plays an important factor at the early stage of any construction of a building. To find the best position of windows, size and shape of openings and the materials to enhance the comfort to the occupants and reduce the energy consumption. The orientation of a building decides the amount of day light and natural ventilation which can enter the building. Daylight of any region decides wall window ratio which can be analysed using daylight analysis. Daylight Analysis also represents the concept of Green Building. By using varied material for any building, energy usage can be minimized which is need for today's society. Daylight and Energy Analysis is conducted in various software's such as 3DS Max, Relux, VELUX Daylight Visualizer and Revit. Thus, the aim of this study represents the managing of natural light to minimize the use of artificial lighting, reduce carbon emissions, and positively affect the performance, mood and wellbeing of occupants of any space. It also presents a review of literature of previous research conducted on daylight and energy analysis.*

I. Introduction:

Buildings are constructed for residential, office and commercial purposes all over the world. They are major contributes tosocio-economic development of a nation and also utilize a largeproportion of energy and available natural resources. Worldwide, 30-40% of all primary energy is used for buildings and they are held responsible for 40-50% of greenhouse gas emission. It is therefore essential for the building construction industry to achieve sustainable development in the society. Sustainable development is viewed as development with low environmental impact, and high economical and social gains. To achieve the goals of sustainability it is required to adopt a multi-disciplinary approach covering a number of features such as energy saving, improved use of materials including water, reuse and recycling of materials and emissions control. Life cycle energy analysis of buildings assumes greater significance for formulating strategies to achieve reduction in primary energy use of the buildings and control emissions.

Daylighting is the practice of placing windows, skylights, other openings, and reflective surfaces so that sunlight (direct or indirect) can provide effective internal lighting. Particular attention is given to daylighting while designing a building when the aim is to maximize visual comfort or to reduce energy use. Energy savings can be achieved from the reduced use of artificial (electric) lighting or from passivesolar heating. Artificial lighting energy use can be reduced by simply installing fewer electric lights where daylight is present or by automatically switching off electric lights in response to the presence of daylight a process known as daylight harvesting.

Fig: Daylight Analysis for Revit on Autodesk Labs

The importance of energy analysis performance in building design is growing because of the increasing consciousness of it's role in building life cycle costs and environmental impacts. Energy efficient building is becoming more and more vital as energy emerges as critical economic issue due to high demand for energy unsustainable supplies of energy.

II. Literature Review:

A Review of Daylighting Strategies in Schools: State of the Art and Expected Future Trend [1](Youehong Su) (2017)

In this paper they study the daylight condition of the educational building this topic is interest since 19th century in western and European countries. In this study the positions of doors and windows are provided as according to the day light direction so that easily lights are provided to all classrooms so that students are comfortable to the light in the room to measure the daylight suitability of visual comfort current trends in terms of technology and designs approaches.

Day-lighting estimation and analysis in residential apartment building: GIS based approach [2](Mahesh B Sonawane and Sumedh Y Mhaske) (2016)

In this paper the openings in the building envelope have a great influence on daylighting in the internal area of the building spaces. The amount of opening area, its orientation, outside obstruction & positioning of building affects the inside illumination. Most of the energy consumption occurs during theheating, cooling & lighting purposes. This paper aims to provide a simplified analytical and GIS based approach to evaluate the potential of daylight inside the room under clear sky conditions. The work evaluates the intensity of internal illumination in residential apartment building from available outside external illumination.

Evaluating Day-lighting Analysis of Complex Parametric Facades [3](Mohamed Gomaa, WassimJabi) (2016)

This study aims to evaluate and compare the performance of daylighting analysis in two industry standard software (Autodesk Revit and 3ds Max) when analyzing the daylighting of complex parametric façade patterns. The study has shown that generally, both Revit and 3d Max underestimate illuminance values when compared to physical scaled models. 3dsMaxwas found to outperform Revit when simulating complex parametric patterns, while Revit was found to outperform 3d Max when simulating simple fenestration geometries. As a general conclusion, the rapid progress of parametric modelling, integrated with fabrication technologies, has made day lighting analysis of complex geometries more challenging. There is a need for more sophisticated algorithms that can hand le the increased level of complexity as well as further verification studies to evaluate the accuracy claims made by software vendors.

A Vision of Daylight Technologies for High-Rise Residential Building in Tropic [4]
(R A Achsani, S Wonorahardjo and F X N Soelami) (2018)

This paper discusses the daylighting technologies for high-rise residential buildings in tropical area with literature review method. Some factors such function of systems, location, ability to change and transparency the view outside will be the factors that must consider in selecting daylight technologies for high-rise residential building in tropic. The diffuse lightguiding system is a practical daylight technologies for deep floor plan building in tropics. The studies shows that potential daylight technology is diffuse light-guiding system that composed from light shelf, fish system and anidolic system. The performance of light shelf influenced by direct sunlight. Its increasing illuminance near window area and causes uneven distribution of illumination in the room.

Architectural form, orientation, and energy for residential design [5](LudwingVaca) (2015)

This paper discuss a systematic investigation and analysis was taken to study the effects of five building forms and different orientation along the cardinal points using the software. To connect the study to real world circumstances, a residential development in the Las Vegas region was modified using the information found in this study to see how residential developers can design these communities and their buildings with optimized orientation for potential energy savings. The cooling study gave the most diverse results for the different shapes analyzed, with some of the shapes out performing others in different orientations. Even though the rectangular and square shapes have less surface areas, the L, U and courtyard shapes seemed to have benefited from self-shading to reduce the cooling loads.

Daylighting, Space, and Architecture [6](Dalia Ha iz) (2015)

This paper aims to represent different visual comfort elevation methods that can help decision-makers make better informed decisions. Different definitions and structures associated with daylight and glare are examined. It also presents a review of the literature of previous research conducted on daylighting, visual comfort analysis and glare studies. The main goal of this paper was to provide guidance to the designers to make better design decision through the understanding of visual comfort evaluation method. From the examination of the different daylighting and glare evaluation metrics it was concluded that there are no special metrics for visual comfort evaluation.

The Effects of Orientation, Ventilation, and Varied WWR on the Thermal Performance of Residential Rooms in the Tropics [7](Nedhal Ahmed M. Al-Tamimi) (2010)

This paper describes an investigation into the effect of building orientation in view of solar radiation absorptance of exterior wall, varied area ratio of glazed window to wall and the effect of natural ventilation on the thermal performance for residential building in tropical region. The method used in this study is experimental, technical and quantitative in nature. It focuses to study influences of orientation, natural ventilation and varied WWR to the indoor environmental performance. Appropriate selection for windows orientation, optimal size of the glass and applying natural ventilation system, can reduce the negative effect of solar radiation in increasing indoor air temperature.

Effect of daylight saving time on lighting energy use: Aliterature review[11]
(Myriam B.C. Aries) (2008)

This paper presents a literature review concerning the effect of DST on energy use. The principal reason for introducing (and extending) daylight saving time (DST) was, and still is, projected energy savings, particularly for electric lighting. Simple estimates suggest a reduction in national electricity use of around 0.5%, as a result of residential lighting reduction.

State of the art in lighting simulation for building science: a literature review [12]
(Carlos E. Ochoa)(2012)

This paper examines the current state of the art in lighting simulation related to building science research. Lighting simulation currently focuses on representing accurately a large number of common situations encountered by building designers and researchers. Elaborate building components require separate analysis through complex simulation aids. Few tools support the early architectural design process. Simplification applies when integrating lighting simulation to whole-building simulation.

Prospective techniques of effective daylight harvesting in commercial buildings by employing window glazing, dynamic shading devices and dimming control: A literature review [13](Sheryl G. Colaco) (2008)

Daylighting has been perceived to possess good potential for energy conservation. In this perspective, there have been significant advances in research methodologies and technologies for optimizing energy consumption through daylight harvesting in commercial buildings. The objective of this paper is to examine the status of published research on three key building parameters: window glazing area, dynamic shading devices, and daylighting controls playing a rule on energy conservation.

Comparative analysis of simplified daylight glare methods and proposal of a new method based on the cylindrical illuminance[14](Santiago Torres) (2015)

This paper analyzed the accuracy of simplified glare analysis methods compared to the Daylight Glare Probability (DGP) through a parametric study. The study was carried out to analyze the reliability of some simplified glare predicting methods with respect to DGP.Itconsisted of glare calculations in a sample office room, with varying façade layout and orientation. For office buildings, this latter is the most accurate metric to quantify the potential discomfort glare for occupants, but it implies long simulation times to calculate the necessary view positions and directions for each time-step throughout a year, even when the simplified DGPs is used.

Benefits of Building Information Models in Energy Analysis [15](AnttiKarola) (2007)

The results show potential benefits of utilising BIM based concept in energy analysis moreefficient data input and more reuse for the existing data, possibility to use dynamic energysimulation instead of traditionally used static methods, support to use whole building spatial simulation instead of traditionally used zone based approach. However from the wholebuilding process perspective, the biggest benefit is that by using BIM it is possible to bringcontinuous verification of energy performance for the whole building life cycle.

3D Modeling and Energy Analysis of a Residential Building using BIM Tools[16]
(A. S. Shivsharan) (2017)

The paper is based on the Autodesk BIM capabilities to perform an Energy analysis of a G+9 Residential building. The paper seeks to find and help integrate the use of BIM energy analysis results in the predicting the energy consumption of the building. This will further help in keeping track and study the energy consumption of the building in the future maintenance.The paper shown that BIM-based design and documentation system is suited for delivering the kind of information that can be used to improve design and building performance. Much of the data needed for supporting green design is captured naturally during the design process and is extracted from the building information model as needed.

III. Conclusion:

In above literature reviews most of the daylight studies are focus in office building or school building for the productivity and learning sensitivity. Also, we come to know that they did Day-light and energy analysisof buildings using various software such as 3d max, BE optGIS, data logger BABUC, Revit, BIM, and Revit etc. Revit is best for architecture designing as compare to other softwares, but other softwares are highly recommended for rendering. Revit software can generate excellent result for concept modelling, construction documentation, bills of quantities. By means of applying anidolic system in tropical area improving illuminance ratio and also reduce glare by 14% under overcast sky condition. From another literature we studied that EAST direction is always hotter than WEST direction by considering two parameters WWR and Nature ventilation. From studying all the literatures we finally conclude that REVIT software is a upgraded software where we can make plans into any 3D models and also we can perform Daylight and Energy analysis which saves our overall cost and increase comfort of living.

References:

[1]. Yuehong Su“ ARiview of Daylighting Strategies in Schools: of the Art and expected Future Trends” Building 2017,7,41; doi:10.3390/buildings7020041
[2]. Mahesh B Sonawane and Sumedh Y Mhaske “Day-lighting estimation and analysis in residential apartment building: GIS based approach” 2016 IOP Conf. ser.: Earth Environ. Sci 37 012024
[3]. Mohamed Gomaa, WassimJabi “Evaluating Day-lighting Analysis of Complex Parametric Facades” Evalution – Volume 2 – eCAADe34 2016
[4]. R A Achsani, S Wonorahardjo and F X N Soelami “A Vision of Daylight Technologies for High-Rise Residential Building in Tropic**”** HABITechno 3 International Conference 2018
[5]. LudwingVaca“ Architectural form, orientation, and energy for residential design” University of Nevada, Las Vegas December 2015
[6]. Dalia Ha Iz “Daylighting , Space, and Architecture” an open access journal for architectural research 2015 volume 12 | issue 1
[7]. Nedhal Ahmed M. Al-Tamimi, SharifahFairuz Syed Fadzil, Wan Mariah Wan Harun “The Effects of Orientation, Ventilation, and Varied WWR on the Thermal Performance of Residential Rooms in the Tropics ” journal of Sustainable Development 2010
[8]. AgnieszkaLesniak, EdytaPlebankiewicz“ Cost Calculation of Building Structure” 2012
[9]. LalakiyaBiraj, Patel Harsh “A critical literature review on benefits due to passive solar energy system in educational building” IJCRCE Volume 2, Issue 5, 2016 ISSN 2454-8693
[10]. Ian Edmonds “Daylight in building-A source book on daylighting systems and components” research gate 2000
[11]. Myriam B.C. Aries**“**Effect of daylight saving time on lighting energy use: A literature review” science direct Volume 36, Issue 6,2008
[12]. Carlos E. Ochoa “State of the art in lighting simulation for building science: a literature review” Journal of building performance simulation Volume 5, Issue 4, 2012
[13]. Sheryl G. Colaco “Prospective techniques of effective daylight harvesting in commercial buildings by employing window glazing, dynamic shading devices and dimming control: A literature review**”** 2008
[14]. Santiago Torres “Comparative analysis of simplified daylight glare methods and proposal of a new method based on the cylindrical illuminance” Energy Procedia 78 (2015) 699-704
[15]. AnttiKarola **“**Benefits of Building Information Models in Energy Analysis” Proceedings of clima (2007)
[16]. A. S. Shivsharan **“**3D Modeling and Energy Analysis of a Residential Building using BIM Tools”IRJET Volume 4, Issue 72017, ISSN 2395-0056