Achieving visual comfort through solatube daylighting devices in office buildings

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ABSTRACT

This project sought to develop commercially available direct/indirect tubular daylighting device diffuser options that significantly reduce direct glare from the diffuser surface. Reducing glare would allow this cost-effective daylighting solution to offer the visual comfort desired by both building occupants and lighting professionals to meet the requirements of many lighting applications. More widespread adoption of tubular daylighting devices would contribute to the larger goal of reducing lighting energy consumption and peak electricity demand.

Keywords — Solatube, Daylighting, Glare, Tubular daylight devices

1. INTRODUCTION

Day lighting has been a part of built form throughout architectural history. Interest in using day lighting as a major design element has varied with the social and economic forces of the time. Now the study of the daylighting has been interesting because the electric lighting is costly. Electric lighting is the major energy consumer. Energy saving can be achieved by the use of daylight and it also translate into energy cost saving from reduced electricity consumption for lighting and cooling as well as from reduced needs during peak demand period in building.

The fundamental challenge remains constant across the projects: how to admit useful levels of daylighting as deeply as possible and deliver a high quality visual environment with no excessive contrast or uncontrolled sun penetration, within budget and acceptable to the aesthetic criteria of architect and client.

The objective of this study is to explain the great importance for daylighting and the role played in design process for the building and the participation in the design form the first step which effects the designers decision for dimensions, positions for the opening and building orientation, use of shading device etc which gives the psychological comfort for the building use. To control the heat transfer through opening there are different simulation and manual techniques are used which gives to the designer a clear image for what will be a situations all the year around.

2. RELEVANCE

The two primary reasons for using daylight to meet the illumination requirements of an architectural space are the psychological benefits and the energy savings benefits Good daylighting has been shown to improve the overall attitude, satisfaction and well-being of building occupants. Research has proven that natural lighting helps people be more productive, happier, healthier and calmer. Natural light has also proven to regulate some disorders including SAD (Seasonal Affective Disorder). Compared to other home lighting methods, natural lighting reduces eye strain and makes it easier for people to see. 47% of the energy used in the Office is for space conditioning (lighting and temperature control).

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Natural light produces energy savings by allowing an employee to use less heat, less air conditioning and eliminates the need to use artificial light. In some cases, adding natural light to the office caused energy costs to decrease by as much as 75%. Compared to other home lighting methods, natural lighting reduces eye strain and makes it easier for people to see. The uses of natural light in a home or business space is cleaner for all inhabitants and also helps preserve the environment. Natural light is also helpful for increasing the aesthetics of a space. Architects use natural light to make spaces appear larger, illuminate an interior structure and increase the beauty of a space. Aside from health and energy saving benefits, a proper daylighting plan can reduce electricity, HVAC (heating, ventilation, and air conditioning) costs and saves energy People with a view and exposure to natural light are less likely to report negative health symptom so providing a daylight system for office building will be beneficial.

3. SOLATUBE
3.1 Solatube Natural Lighting (TDD)
A solatube devices, or TDDS for short, are Affordable, high-performance lighting solutions that bring daylight into interior spaces where traditional skylights and windows simply can’t reach. A daylighting system that avoids the problems of glare and excessive solar heat gains.
Tubular Daylighting Device are tubes that capture sunlight from the rooftops and pipe them to the indoors of the buildings.
The piping of the light is made possible because of the metallic reflections that happen all the way along the tube when the light passes through it.
And the finally diffused light comes out of the pipe to illuminate the indoors after passing through the diffuser.

![Solatube Diagram](image)

3.2 Features (TDD)
**Roof Dome**
- Roof dome are made from Bohemian Crystal and practically don’t age compared to plastic domes.
- Crystal has great capacity for collecting daylight when there is cloud cover.
- Crystal domes don’t distort the natural colors of daylight.
- The surface of crystal is very hard and smooth and smog and dust doesn’t stick to it as on plastic.
- Crystal domes don’t yellow after several years on a roof and continue to emit light for decades.

![Roof Dome](image)

**Diffusers**
- Light way chose sodium potassium glass for the ceiling diffusers of incoming light.
- Other producers make this feature from plastic, which means faster aging and the danger of color distortion in the incoming daylight.
- There is a difference visible to the eye between plastic and glass diffusers.

![Diffuser](image)
Flexible tube
- Amount of light: due to physical laws, it delivers very little light. For this kind, the name “dark pipe” has been created.
- Construction companies like to use it as a substitute for a light pipe because its price is a third of a light pipe which shines.
- It works only in direct sunlight.

3.3 Benefits of solatube system
The major benefits of daylight harvesting are:
- **Energy efficiency**: A lot of energy is wasted and costs for the business increases with inefficient systems. Energy costs accumulate for businesses with 3 main costs
- **HVAC costs**: HVAC refers to Heating, ventilation and air conditioning costs. These are the costs that come along with the air conditioning of the buildings due to build up a lot of heat and much of the energy goes into cooling down these systems. These costs can be saved with proper natural lighting systems.
- **Lighting costs**: Almost 65% of the energy costs that are borne are due to Lighting which can be significantly reduced using natural lighting.
- **Maintenance costs**: Other miscellaneous costs associated with HVAC which included maintenance costs can also
- **Healthier working conditions**: Natural lighting promote better health for the occupants – Research studies has shown that natural light improves health and overall well-being of the occupants of a building. A research at the Cardiff University reported the relationship between natural elements and human productivity and found a 15% increase in the productivity with employees with offices having natural elements compared to employees with offices without having natural elements.

4. CONCLUSION
The use of Solatube daylighting devices in different building typologies is fast becoming a trend in the construction industry. Besides being a source of natural daylight, it provides a form of ‘healthy’ daylight to commercial in a building space. In other words, the glare or heat associated with the sun’s rays is filtered off unlike the traditional skylights which contribute to heat gain and glare and result in eye strain and the fading off of soft furnishings. There are still innovations in the lighting industry which is a positive sign that better solutions will come up. Solatube daylighting devices are cheaper to procure and install compared to traditional skylights even though they deliver equal light output. They help to keep insulation in residential buildings. This is a useful device for residential buildings located in cold climatic regions. The maintenance costs that accrue from usage of Solatube daylighting devices are very low. This is hugely due to the fact that they are designs that come as one piece and have impact properties. Daylight solutions for spaces located deeply within the offices and therefore have to rely on artificial forms of light like the electric lights. Hence, developing tubular daylighting devices for such offices will not only make them sustainable or energy-efficient but also a comfortable place for their occupants to live and work in.

5. ACKNOWLEDGMENT
First and foremost, enormous gratitude is due to principle Mr. Dighe Sir and Mr. R. B Koli Sir who has been there as my supervisor for whole 2 years and has been unstinting in his support and constructive critique. The author wish to thank the department of Architecture in Kolhapur University as they declare no conflict of interests.

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