

Smart Glass Technology in Workplace An Approach to Create a Healthy Closed Office Planning

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Abstract— The pandemic has accentuated the importance of physical aspects of the workplace. As the world has started slowly returning back to the offices, it has become a necessity to make the workplaces flexible, hygienic and safe, without compromising on the productivity of the jobs. Innovation in technology and materials have escalated to make the workplace design suitable for present or any future unprecedented and unfortunate pandemics. There have been speculations on whether the open office planning is still conducive for work, considering the social distancing norms for health safety. On the other hand, a closed office planning that provides the necessary safety, security and privacy, may undeniably in some cases, lead to the feeling of social alienation among workers. The methodology adopted for research is literature review of Smart Glass technology, survey on awareness of the technology among architects, interior designers and engineers and lastly, proposing a model office design of closed office planning combined with Smart glass technology application designed in Sketchup software. This research paper aims to propose the idea that a closed office planning with the application of Smart Glass partitions can serve as an intermediate solution for workplaces in future, thereby offering flexibility, safety, privacy and healthy working environments, without compromising on communication and collaboration among the employees. The paper also stresses on the importance of creating awareness of Smart Glass technology among the designers.

Keywords—Smart glass; switchable glass; anti bacterial; closed office; smart materials; sustainable architecture

I. INTRODUCTION

As the world braces itself to enter into a dynamic future full of uncertainties amid the pandemic, the technological revolution has escalated its pace in almost every sector we know of. One such technology innovation is the Smart glass or the Switchable Smart glass which has numerous applications in every field. As the workforce returns back to the offices, every other person would want to feel safe and assured that they are working in a completely hygienic and healthy environment. The Smart glass technology when applied in offices, ensures the same. Also, when we consider the open office planning vs the closed office planning, the cons outweigh the pros for open office planning, considering the current pandemic situation where it is desirable to have enclosed and hygienic spaces of work for every individual rather than open areas where the infections may easily spread. Therefore, the closed office planning when combined with Smart Glass technology would prove to be one of the most efficient solutions for offices of the

future in terms of energy savings, privacy, hygiene and health safety.

II. SMART GLASS TECHNOLOGY

Smart Glass, also sometimes called as Switchable Glass is a type of glass that can change from transparent to translucent or opaque with the help of a simple switch. This type of glass technology has many applications in almost every industry and can be used in the construction industry for windows of buildings, room partitions, skylights, electric curtains, advertising screens and many more areas.

A. Types of Smart Glass Technology

Smart glass can be classified into three broad types such as electrochromic, photochromic and thermochromic glass. Sometimes, a combination of photochromic and thermochromic glass is also used which is called TPG i.e., Thermochromic Photochromic glass.

1.

1) *Electrochromic Smart Glass*: This type of glass changes its transmittance when it is stimulated by an electric signal. It utilizes an electrochromic film with an ion storage layer and ion conductor placed between two transparent plates. The electrochromic film is usually made of tungsten oxide, owing to the electrochromic nature of transition metals. An electric potential initiates a redox reaction of the electrochromic film transitioning the color and the transparency of the smart glass. The PDLC smart glass i.e., 'Polymer Dispersed Liquid Crystal' can be considered a sub type of electrochromic glass as this glass also requires supply of electric current to alter its light transmittance properties. In PDLC glass, the central layer is a liquid crystal placed within a polymer matrix between electrodes. In the off position, the liquid crystals are randomly dispersed and have low transmittance. With the application of a voltage, the liquid crystals orient themselves, thereby allowing for the transmittance of light. PDLC films are self adhesive that can be easily applied to either new or already existing ordinary glass and glazing panels.

2) *Photochromic Smart Glass*: This type of glass changes its transmittance when exposed to radiation. It is also known as 'Solar Smart Glass' as it changes its light transmittance based on the amount of incident UV light. It is one of the best applications for windows, skylights in buildings for energy savings as it does not require electrical stimulation for changing optical properties. It is often made by

embedding silver chloride (AgCl) or another silver halide in microcrystalline form into some glass. When the silver chloride is exposed to ultraviolet light in the UV A spectral region, it forms tiny silver particles which absorb light. Photochromic glass use can help build sustainable architecture and score credits points for Green Building Certification of standards such as LEED from the US Green Building Council (USGBC) and BREEAM from the UK. It helps to meet the minimum daylighting requirements of 300 lux across 50% of building interiors, without the increase in HVAC Load, thereby, leading to substantial cost savings [1].

3) *Thermochromic Smart Glass*: This type of glass changes its transmittance when exposed to radiation. It changes its light transmittance based on the amount of incident UV light. It is one of the best applications for windows and skylights in buildings for energy savings, as it does not require electrical stimulation for changing optical properties.

2.

3. B. Properties and Advantages of Switchable Smart Glass

Smart Glass panels are available in the market in various shapes such as trapezoidal, parallelogram, triangle, circle, curved and many other irregular shapes as per requirements as shown below in Fig.1 and 2. They are also available in a variety of colors such as blue, grey, red, green and clear as shown in fig.3.. Due to the many characteristics of materials used to manufacture the Smart Glass, there are several advantages.

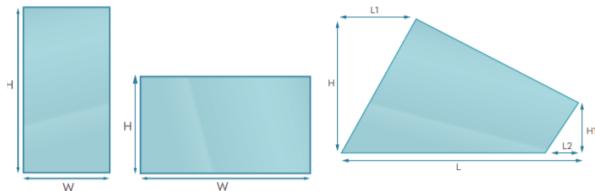


Fig. 1. Examples of rectangular and quadrilateral shapes of smart glass [2]

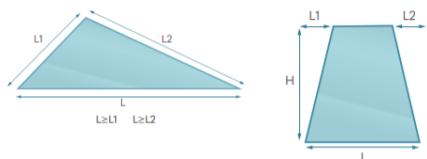


Fig. 2. Examples of triangular and trapezoidal shapes of smart glass [2]



Fig. 3. Examples of colours available in smart glass (PDLC) [3]

Use of photochromic smart glass provides temperature control in interior areas, and thus, leads to energy savings. The major advantages of using Smart glass instead of ordinary glass are the long-term cost savings, increased life cycle span of glass due to its durability, reduction in energy loads by 20-26% of the peak energy demand [2]. The simple switch property of glass of transitioning from transparent to translucent provides

the necessary privacy as per requirement as shown below in fig.4.



Fig. 4. Transition from clear to frost glass [4]

Smart glass also has antibacterial properties. It has silver ions inside the glass whose antimicrobial action destroys 99.9% of all bacteria that form on its surface at the same time also preventing the spread of fungi [5]. When Smart Glass is laminated with a thin layer of PVB (polyvinyl butyral) sandwiched between two or more layers of glass panes, it helps improve the noise insulation property. Thus, smart glass has numerous applications in offices, hospitals, restaurants, health spa, canteen, toilets, shower rooms, pharmacies, laboratories etc.

III. CLOSED OFFICE PLANNING

In a closed office planning, there are walls, cubicles or high partitions that are used to create a series of individual working spaces for each employee. Studies have shown that such type of office planning provides enhanced levels of productivity with increased levels of concentration, focus and privacy. On the other hand, it also causes a high level of dissatisfaction with respect to social interaction within the office with their co-workers [6]. This may lead to the feeling of isolation among the workers. Therefore, there needs to be an intermediate solution to integrate the pros of closed office planning concept along with the smart glass technology.

IV. SMART GLASS TECHNOLOGY IN CLOSED OFFICE

When Smart Glass Technology is applied in a closed office layout, the pros of both the technology and the closed office layout, creates a space which is healthy, hygienic, safe, flexible. It enables increased concentration, focus and privacy for the employees while working, thereby, increasing the work productivity. Also, the hindrance of dissatisfaction with respect to social interaction can be reduced with a flip of switch.

A model of a closed office has been depicted in figure no.5 where the partitions are constructed of Thermochromic Smart glass. The thermochromic smart glass, when used for

partitions, enables the workers to change its light transmittance with the help of a switch, depending on his/her requirement. The glass can be switched to frosted i.e. translucent glass enabling low light transmittance while working, to maintain required privacy and focus, as shown in fig.7 and fig.8.

One of the many advantages of using this type of glass partition is the flexibility to convert the entire room into a single Audio Visual room with the flip of a simple switch as shown in fig. 5. In this type of setup, every worker will be at his/her own desk, while easily viewing the common projecting screen panel, when all the glass partitions are made transparent. This kind of setup can easily allow meetings, seminars, workshops, with minimum physical contact between the employees and yet, achieving full vision and communication across the room as shown in fig.6. For enhanced audio communication, centrally operated microphones and speakers may be provided at every desk which can be used for communicating with each other across the room without leaving your desk.

Also, the antibacterial properties of Smart glass partitions, reduces the dangers of infection spreading via bacteria or virus through surfaces.



Fig. 5. Closed Office with Smart glass in Transparent mode for AV room



Fig. 6. View from farthest desk towards the AV Screen in Closed Office with Smart glass in Transparent mode



Fig. 7. Closed Office with Smart glass in Translucent mode for working for enhanced privacy,focus,concentration



Fig. 8. Closed Office with Smart glass in Translucent mode for working for enhanced privacy,focus,concentration

V. CONCLUSION

Smart Glass technology, therefore, when used appropriately in a closed office layout, can be a boon to the future offices and workplaces, especially in scenarios of pandemics like COVID 19 which led to economic recession across the world. One of the many reasons for the recession was that the people could not attend offices due to lockdowns imposed to control the spread of infections. However, one of the major challenges of using this technology is awareness about the technology.

A survey was done to find out the awareness level of this technology among the designers, architects, interior designers and engineers. It was found that 96.2% of the targeted sample was unaware of this type of glass. Therefore, awareness needs to be increased through rigorous marketing and other such strategies.

Are you aware of Smart Glass/Switchable glass and its technology?

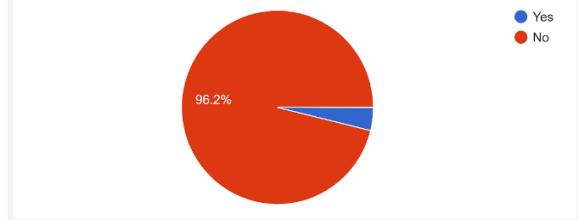


Fig. 9. Survey results-Awareness of Smart glass technology

Further research needs to be conducted on the areas on how the smart glass technology can be used in a beneficial way in the construction industry. Utilising the smart glass technology in closed offices can, thus, help us prepare flexible, hygienic, safe office spaces with adequate social interaction among the workers. This would help us to prepare model office spaces that will persevere successfully in the uncertain future where we need to be prepared for inevitable and unprecedented pandemics that are inevitable with the advancement of biotechnology and allied fields.

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