Course Name: Building Materials as a Cornerstone to Sustainability

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Lecture 04

LCD- liquid crystal display

Hello dear students, in the last class we saw how smart windows as a technology and smart windows by using smart building materials can effectively save a lot of energy even up to 36 percent of energy which is very substantial considering the usage of smart windows on energy intensive buildings. Today we will look at yet another alternate technology and material which is the LCD or liquid crystal display. So, in today's class we will look at liquid crystal display for solar radiation control. Is it possible? We will have a look at the introduction, the installation of LCDs, what are its characteristics, and how it benefits us. Does LCD have limitations? What are its plausible applications, especially in buildings? So, what is liquid crystal display for solar radiation control? So, LCDs for solar radiation control are like smart windows for buildings. They use a special technology to manage sunlight and heat.

Imagine a sandwich with a layer of liquid crystals between two clear layers. When we apply electricity, these crystals change how they are positioned. This change, just like magic, lets the LCD decide if it wants to allow sunlight or block sunlight. It is like having a window that can adjust its tint depending on how sunny it is.

This makes it super cool for controlling the heat and light that comes into buildings giving us a smart and flexible solution for solar radiation in architecture. Let us look at the installation of LCDs. To install LCDs, We need to follow these steps. First, preparation of the area. This begins by cleaning the glass surface thoroughly to remove any dirt, dust, or debris, as all of these can affect the adhesion on LCDs.

The second step is to apply the adhesive. Apply a specialized adhesive or film to the glass surface. This adhesive is crucial for bonding the LCD to the glass. Third is LCD placement. Careful positioning of the LCD on the glass becomes important, as does ensuring it aligns correctly with the designated area.

One must take care to avoid air bubbles between the LCD and the glass. The electrical connections must be proper. Connect the LCD to the necessary electrical supply. This typically involves wiring the electrodes to a power source. Next is to test.

Conduct a thorough functionality test to ensure the LCD is responding appropriately to electrical stimuli. Verify its ability to change orientation and control the transmission of light. And last is to seal. Sealing the edges of the LCD to prevent any moisture or contaminant to enter inside. Proper sealing is crucial for maintaining the longevity and effectiveness of LCD.

So, these steps ensure the proper installation of LCDs, making them effective for managing light and heat in buildings. Let us now look at the characteristics of LCD. Liquid crystal displays, or LCDs, have unique traits that are important for solar control. Optically, they can adjust transparency dynamically, managing solar heat and glare effectively. Specific designs control solar heat while ensuring enough visible light passes through it.

Certain LCDs naturally block harmful UV radiation protecting furniture and fabrics. Material-wise, their response time varies, crucial for quick adjustment to sunlight changes. LCDs designed for windows resist environmental factors with specific polymers enhancing stability. Minimizing electricity use is vital. Ongoing research explores optimization for both environmental impact and cost efficiency.

These characteristics make LCD a smart and versatile choice for managing light and heat in various settings. Hence, adjustable transparency As LCDs regulate light dynamically for solar heat and glare management, it is an important characteristic. The next characteristic is the spectral selectivity. Specific LCD designs control solar heat while ensuring sufficient visible light transmission. The third characteristic is its UV protection.

Certain LCDs inherently block harmful UV radiation, safeguarding furniture and fabrics. Their specific material characteristics include their response time as LCDs vary in transitioning speed crucial for rapid adjustment to sunlight changes. Their durability, LCDs designed for enduring windows resist environmental factors with specific polymers enhancing stability. When it comes to their power consumption, minimizing electricity use is crucial. There are certain research papers which expose optimization for environment and cost efficiency.

So, what are the benefits of LCDs? LCDs bring several benefits. First, they reduce energy usage by preventing overheating in summer and minimizing heat loss in winter, resulting in significant savings on heating and cooling. Additionally, LCDs also enhance comfort by playing a very crucial role in establishing a more comfortable indoor atmosphere by shielding against glare and excessive heat, especially in both office and residential settings. These displays also provide enhanced privacy. by obstructing views beneficial for places in busy areas.

They have diminished fading. So, LCDs help protect furniture and fabrics from fading by blocking harmful ultraviolet rays. In essence, LCDs offer a smart and efficient solution for

managing energy, comfort, privacy, and safeguarding belongings. What are the limitations of LCDs? LCDs also come with limitations while they offer benefits. They can be pricier than other solar control options, affecting cost effectiveness.

LCDs need electricity to function, potentially increasing energy consumption and ongoing costs. Their maintenance requirements for LCD may be higher than alternative methods impacting long-term use and efficiency. Over time, wear and tear could affect their durability and effectiveness in controlling solar radiation. Some LCDs may also have limited transparency impacting visual aesthetics and the ability to maintain natural light. It is important to weigh these factors when considering LCDs for solar control in different applications.

So, let us look at the applications of LCDs. Liquid crystal displays, LCDs designed for managing sunlight find diverse applications. They are commonly used in various places like offices, homes, schools, and hospitals. So, LCDs engineered for solar radiation controls find a broad spectrum of uses. They are very commonly employed in setups such as office buildings, residences, schools, hospitals, etc.

And these LCDs contribute to diminishing energy consumption, enhancing comfort, and augmenting privacy. In the automotive sector, they find applications in cars and trucks to mitigate glare, regulate heat, and shield the occupants from UV rays. Similarly, in marine environments like boats and yachts, LCDs are utilized to manage glare control heat and provide adequate protection against harmful UV rays. Overall, as the cost of this technology decreases, LCDs are poised to become an increasingly popular choice for effective solar radiation control in both residential and commercial domains. A small case study of applications of LCDs in buildings.

Let us explore how LCDs were useful in two exciting building projects. One is the Capital One Headquarters at Virginia, US. Here they installed special windows called sage glass electrochromic windows on the outside. Now what happened as a result of this? Just due to this one factor, there was a 20% drop in cooling energy use making the inside more comfortable by controlling glare and improving the temperature. These windows also protected the inside furniture from harmful ultraviolet rays.

Then there is this second example of Grimshaw Architects Headquarters in Melbourne, Australia. In this project, there was a conscious integration of smart windows with chromic interlayers in the building's double glazing system. What was the outcome? Due to this, there was improved thermal comfort for occupants as it minimized glare and solar heat gain, reduced reliance on mechanical cooling, and all of this also contributed to it earning a LEED Gold certification for being environmentally friendly. So, here we have seen in today's class how LCD is very crucial and important as an energy saving smart material contraption. There have been instances as we have seen in the case study where just use of LCD has resulted in better indoor thermal comfort, reduced glare and reduced use of energy.

With this, we stop today's class and in the next class, we will move on to understanding yet another smart material. Thank you.