Glass in Buildings - Design and Applications
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Glass Academy

Module No # 11
Lecture No # 51
Introduction

Welcome to the course on Glass in Buildings design and applications. It would be a very interesting course for you because glass has taken its crucial transition for the last 15, 20 years in the buildings, design, and application. So, we need to be very careful in understanding glass, types, how to use it? Where to use it? And what is the benefit of using glass in different formats?

Because we live in a world of imagination, where architects want to imagine and want to make it live, the envelope must be imaginative. So, today's architecture is very clear in looking for. What is aesthetics? How the building has to look? And every building wanted to be standalone. It wants to have its signature design. And they wanted to use this material because the buildings are very flexible in shapes and the robustness's massiveness.

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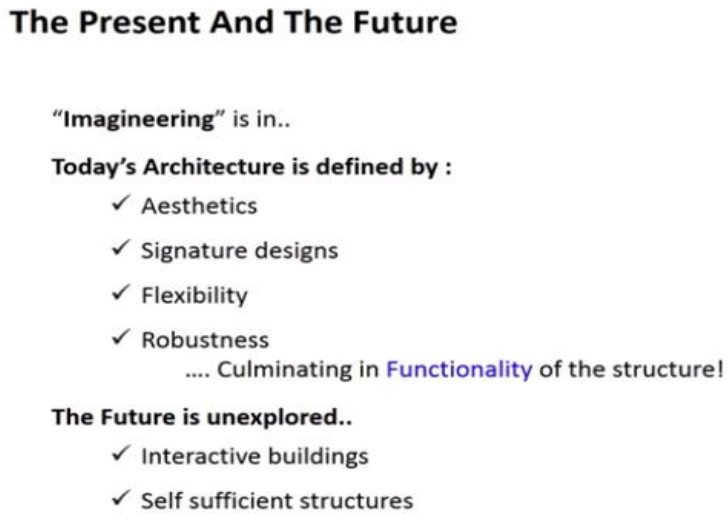

Which; finally, it has to do the overall function of an envelope material also. Whereas the future is still, we have not explored. Because the; future building will be very interactive, you will have a facade that is going to interactive, and you are going to have a self-sufficient building that

means it can be a net-zero building. So, the envelope material glass will speak to the external world, and it will also do something more functional for the application.

So today the modern technology has a provision for us to introduce many glasses, which are very different in their form and shape and its structure or color. You have various color options today. You have various styles and structures that can be created in the form of signature designs. The glass will not be just one envelope material. It will be a multi-functional element in your building. Beyond all glasses of the functional element, what is the benefit of using glass in a building?

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Beyond all, its basic envelope benefits the major impact of glass. Glasses are very lighter materials than any other envelope material or any other traditional material used as an envelope. For example, I can say that about approximately 30 kg per square meter compared to any of its envelope material ranging between 300 to 500 kg per square meter.

It means it is one-tenth to one-fifteenth the lighter material which is part of your envelope. So just an imagination if you look for a building that is about 20 storeys and 30 storeys today, we are working towards tall buildings and high-rise buildings. Where such lighter materials have a huge impact on the overall design; on the basement or the structural design or the foundation design, or the overall execution process involved in it.

Since glass has become a very lighter material again, it is very easy to install, so a faster envelope can be done. Ideally, today modern technologies are available to do about 2 to 3 floors of a building in a day. It means I can do a 30 to 40 storey building within 4 to 5 weeks the complete envelope can be done. And even there are building where you might have been seen; it can be done even parallelly. On the ground floor, the glazing envelope can be closed, and on the top floor, the construction can happen.

Any high-rise building forsake you can take; it has been done like that way. This means the moment you save on the construction time; it will save on the construction cost directly. Then, another important parameter is the dependency of skilled labor at the site. Today, modern technology glass can be a factory-made product and a factory-made solution. You can install glass with very minimal skilled labor with the support of machines and technology.

Another one is the envelope area. The traditional building materials which; are more than 300 mm, which is ideally more than afoot. Now you are bringing it to an inch which is 24 mm, is a basic double-glazing unit. So that is a huge reduction in your envelope thickness means there is a saving in your huge floor plate area because of the cost, the construction cost, the land cost every square feet in a building is going to be more valuable.

So glass, becoming an envelope material not only for its function, because; it brings many other important benefits in the entire construction engineering process. So, how to understand glass then? Since it has various phases, it has a functional role, and it has a structural role, it has a benefit. So, you have to understand glass by design, by analysis, by need. What is the need of your particular building, or what is the need of your particular application?

What is the benefit you are looking forward to? Whether it is fire? Whether it is safety? Whether it is aesthetics? Whether it is any other applications for that sake? By function what you wanted the glass to do.

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What we need to understand glass by.....

- ✓ by Design
- ✓ by Analysis
- ✓ by Need
- ✓ by Benefit
- ✓ by Function

Whether you wanted to be envelope material or wanted to behave your glass to express something or make glass your digital media facade, it all has to be understood. So before getting into the course, we should understand that when you wanted to have a glass building, you need to understand by design, by analysis, by benefit, and by function. So, this course design and applications will cover all these listed topics.

Start with the modern architectural requirement, where first you need to understand India's national building code. Suggest the primary design parameter for any building specific to the envelope, specific to fire, specific to its structural design requirements. So that has to be understood in a very clear and more profound fashion. Then the next step is how to make my building sustainable. So first, we need to understand building physics.

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- ✓ **Modern Architectural requirements**
  - ✓ Requirements as per Standards – NBC – Fire & Structural
- ✓ **How to design Sustainable building**
  - ✓ Building Physics
  - ✓ Green buildings requirements
  - ✓ Codal recommendations – ECBC/IS
  - ✓ Segment based design
- ✓ **Manufacturing of glass**
  - ✓ Types of Glass
  - ✓ Coating technology – High performance glass
  - ✓ Innovative application – Electrochromic & Digital printing
- ✓ **Processing**
  - ✓ Tempering/Double glazing/lamination
  - ✓ Printing on glass

How the heat is going to transfer, how the light is going to come. Whether I am going to the light, I need, or I am going to address the glare issue later. What kind of design aspects I have to integrate, understanding my building physics? There are various green building programs in India. So what; are their requirements specific to envelopes, specific to light, specific to energy? So that has to be understood.

Then, when I go to green building, I am supposed to understand the basic energy conservation building code, or there is an Indian standard called IS 16231, which is called the use of glass in the building. So, we need to understand how to use it and where to use and what kind of glass to be used. And again, it is not one solution for all, and we need to understand based on the different segment or type of usage, the building design or the envelope design or the glass or the facade has to be different.

The moment I understand the basic design criteria, I have to understand glass as a material, glass manufacturing. Because this is very important, once I understand the basic manufacturing, what types of glass are available. There is a basic glass; there are tinted glasses, there is a high-performance coating available today. So based on your application, you need to understand what kind of glass we will use. Because glass has a vital role. Then there are innovative applications are there in the glass.

Whether it can be an electrochromic glass that can tint or understand your building, or it can understand your climatic conditions, it can function on its own. There is digital printing available

today where it can create complete aesthetics and communication in your building. The moment I know about the basics of glass manufacturing, then the next I should be aware is about the processing, which I mean whether what kind of process I have to adapt to improve the structural property of my glass?

Whether it is tempering or toughening, I am going to use a double-glazing unit. Or whether I am going to laminate my glass for the safety aspect. Or whether I will do any other value edition on a glass, like ceramic printing or screen printing, to help me both aesthetics and by the functional board. So, I need to understand that. The moment I understood the basic design, then the basic manufacturing, the processing.

Then I need to understand how I am going to design glass as an envelope material. So what are all the critical glass parameters like solar factor, U value, and your light transmission? What is ideal for Indian climatic conditions? What is my codal recommendation says? So how to design? So overall, I need to understand how I am going to design the façade? Facade here means the glass and the system.

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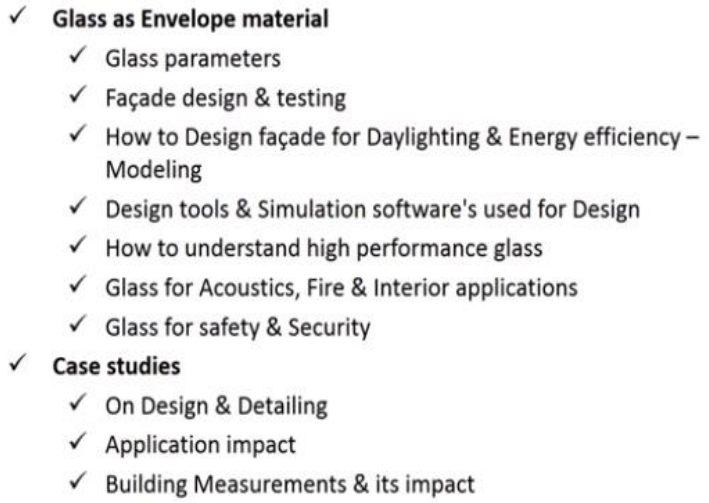

So the moment I do glass and a system, it has to withstand both the basic, it has to behave as an envelope, and it has to behave as a structural element. Then I am supposed to understand what is relevant to facade testing? What are the requirements, and what are the standards? And how to test a facade and what are the pre criteria, it has to address. The design has to be addressed. Then

how to design my building or how to design my facade against the requirement and energy efficiency?

So, I have to model it. So, what are the design tools and simulation software today used in the design? To; understand the impact of various envelope materials, precisely the glass. So, since there are many varieties of glass, I need to be able to understand what it is going to impact my light and heat, which is energy. Then that is where you have to understand, what are the various kinds of high-performance glass available?

From starting from the basic generation, which is online quoted glass, until the offline quoted glass, you have multiple generations: silver-based, single silver, double silver, and triple silver-based glasses. The moment I understand the glasses, I have simulation software to understand the impact on the overall envelope. Then is the glass going to function against the acoustics? Is it the glass going to design against the fire requirement, fire safety norms.

Or I am going to use glass for any interior applications. So based on that, then there are local codes available that help you understand the safety and security applications. What kind of processed glass has to be used for what kind of applications? The moment I know the product, the process, and the design, I need to understand how it has been implemented, how it has been used.

So, there will be many case studies you will be going through on how to design or completely detail the design process. Different applications and what the impact is for various applications, there will be many case studies. Then whatever I do, whatever I design, whatever I stimulate it, is it performing? So, I need to understand how the measurements are done in a building and how the impacts are recorded against my design?

Which is going to be the final case study? So, this session will, the complete session on glass design and applications, will help you understand glass as a building material.