Glass Processing Technology
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Lecture – 03
Glass as Building Material

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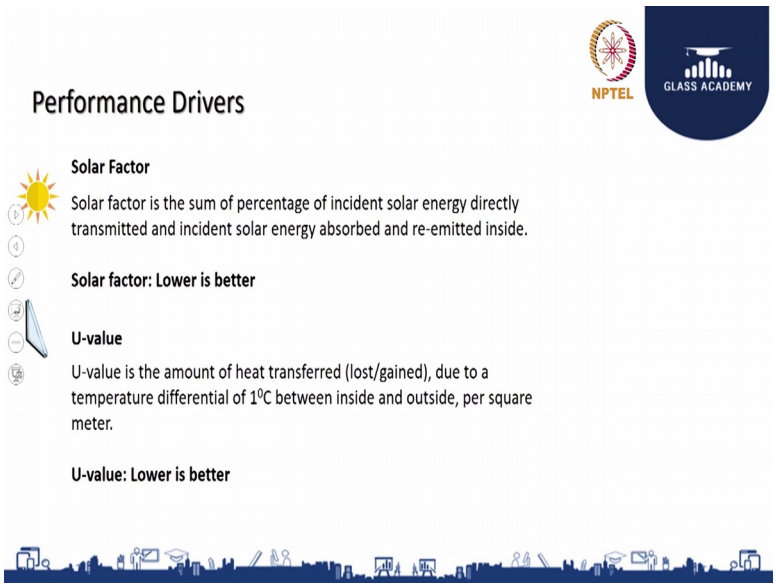

So, how to select a product after day lighting? There are 2 important parameters, one is a solar factor another one is the U-value. So, how a light transformation going to give a discomfort? These 2 parameters also going to have an huge impact on the occupant discomfort.

Say for example, solar factor is nothing but it is a percentage of direct heat transfer that going to happen in (Refer Time: 00:42) U-value is nothing but a happen, it is going to happen because of the differencing their the temperature difference. So, for an example I have a source called sun. And the sun is going to give you me a direct heat which is going to transfer into the building. And the same source is going to heat up my entire environment, which is going to be the ambient temperature the ambient temperature is going to try to enter into my building where I have an set up branch.

So, there are 2 parameters which going to heat the overall heating load in my building, which is the solar factor and the U-value or the direct heat and the indirect heat.

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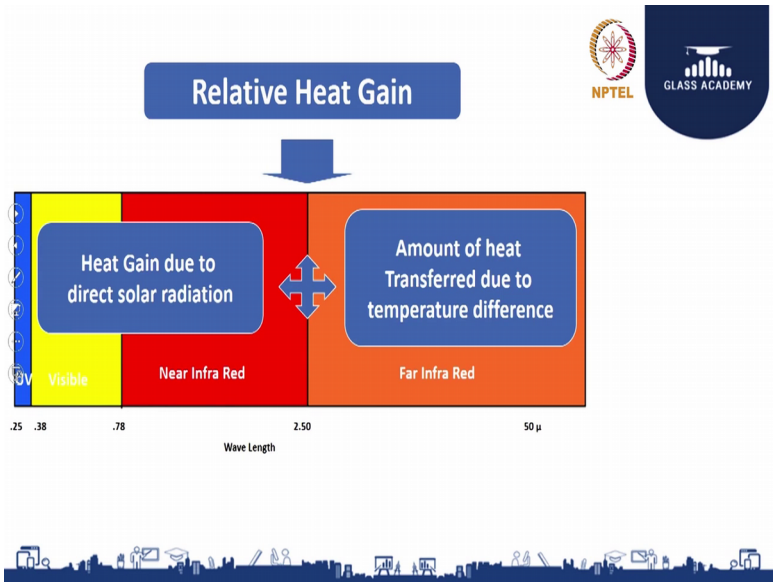

So, to calculate so what is the impact of this heat coming in? Because an any building when we going to do the cooling load capacity, the 2 parameters which we will be calculating one is the envelop heat load another one is the internal heat load.

The envelop heat load is a nothing but the amount of heat that is been getting transferred from the external world to the inside the building through envelop. So, I really when use glass, you have to understand what is the percentage of direct heat coming in and what is the percentage of indirect heat coming in, the sum of heat which is going to impact the overall cooling capacity.

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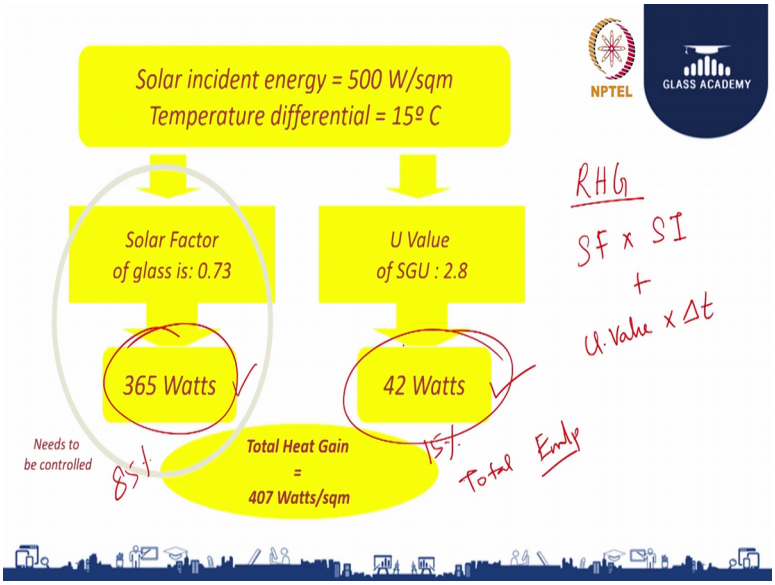

So, to a solve an example, I have a condition here. Say for example, you have a source which is about 500 watts from sun. And you can have a temperature difference which is 15 degrees. So, I have a clear glass in a double glazing format, which is 0.73 solar factor and U-value as 2.8.

So, when I have to calculate the relative heat gain which is called RHG, which is a solar factor in to solar incidents plus U-value into delta t. So, in this case a solar factor is 0.73 and my solar incident is 500 so, 0.73 into 500 which is 365. Similarly, I have a delta t which is 15 and the U-value of the glass which is 2.8 which is 42. Sum of this will become the total envelope heat load.

So, in this case the major thing that we need to understand is what is the contribution or the what is the percentage of heat transfer that happens to direct and indirect. Here the direct heat is about 85 percent, and the indirect heat is about 15 percent. So, when I have a glass, I need to understand what parameter I am going to address in use. If I have a solar control glass, I am going to address this 365 watts, if I going to have a Louie glass I am going to address is 42 percent. So, that is very clearly we need to understand, what is the product that we need for India or for precisely for initial climatic condition. I need a glass which can address the solar factor, because which is 85 percent going to be the contribution due to this.

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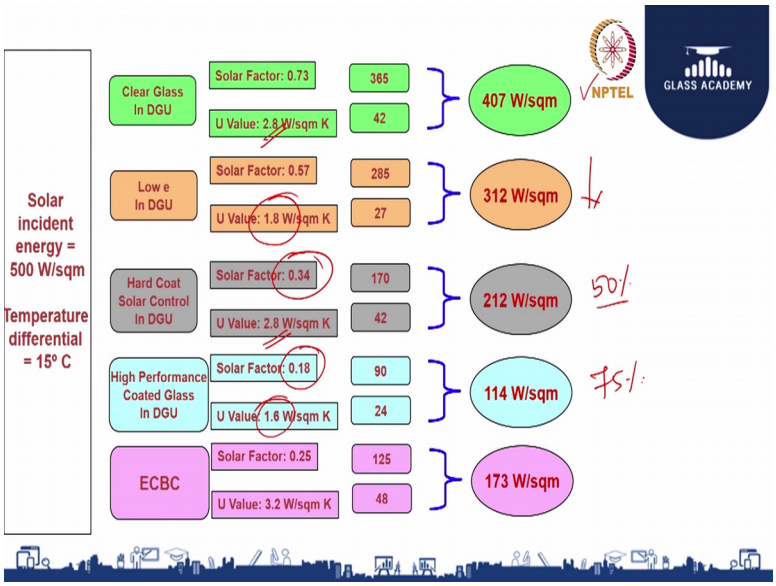

So, you have a detail understanding on this. I have the same typical condition 500 watts and 15 degree Celsius. Same clear glass which is 407 watts. So, when I have a Louie glass or a thermal insulation glass, where you can notice the U-value which is lower than your clear glass.

So, because of that there is an impact in your solar factor. The same formula relatively applied solar factor into solar incidents, U-value into delta t. So, put together the heat coming in it is reduced by 100 watts still there is a scope. So, we have a basic online coated glass which we call hard coated or online coated glass.

Where the coating is done precise to reduce a solar factor, but you can see the U-value still it is same like your clear glass. So, in this case, when I do the RHG it has reduced by 50 percent compared to my base case, and ideally from the base fluid. Then I have an high performance coated glass, where I can address both a solar factor and the U-value. So, the o overall reduction is about by 75 percent. When it is ideally one-fourth of the heat is going to come in. Where it going to impact, yes?

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So, when I have a simple example like this for every 300 3500 watts of heat, we need 1 tons of refrigeration. Means, if I have 5 to 7 square meter of a clear glass in a building in an envelope, ideally I need 1 tons of air conditioning. If the same I wanted to have more facade or more window wall ratio, if I use a same building, with the same one ton of a referenda refrigeration, I can go even up to 12 to 30's square meter of glass. Still I can manage the building with 1 ton of refrigeration. So, this is the impact what a clear glass versus a high performance coated glass can be give.

In a simple term to understand, the capacity of your cooling load can be reduced when the window wall ratio was fixed, weather I am going to use a basic glass or going to be the base using the first generation products or going to use the latest high performance based solid able. We will have a huge impact on your overall capacity of your cooling system.

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So, what are the type of detailed study that we can do? We can do a detailed in depth solar exposure analysis, to understand which direction, during what time and what is the intensity and how long this intensity is going to be on a building. So, based on this you can decide what should be the boundary with boundary of your glass performance backward. Then you can get into the day lighting analysis, which very clearly helps you to understand what is the percentage of light that you need for the particular floor plate or for the particular window wall ratio. This will help you to understand to grave a comfort light transmission into the building.

Third one can be your acoustic analysis, where based on the resource versus volume want to achieve inside, you can clearly understand what is the percentage or what is the d b that you wanted to cut or d b that you wanted to reduce from the outside source to inside comfort levels. Then for the structural analysis, we need to understand for what is the location, and what high it is my building and where is the building, and what should be the wind load as per the IS 875 code I have to do.

Then based on the support condition, whether it is all the force say supports or I going to have a pointed supports or I going to have only top and bottom support. Based on this, I need to understand for the design wind speed for the support condition what should be my glass convention. So, a detailed study has to be done, when we are going to use glass

as a building material to understand the structural requirements to understand the acoustics and do to understand the performance.

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So, how do we achieve all these performance? So called lower solar factor lower U-value lower light transmission assisted there are 2 technology which is called the online technology and the offline technology. As the name indicates you know that online coating is happened going to happened and a glass production process is happened. But this technology has a very limitation on the number of products that I can produce. Because every base I have I can produce only one kind of a product. And it restricts my performance values because the coating, I can do maximum of 2 to 3 layers of coating during this temperature during this process, because the coating has to be done at very high temperature.

That is where the entire industry has moved to offline coating technology, where I have a provision to had n number of layers I would say, based on the kind of product that market wanted to use in the building. The current demand in green buildings, you have a more light higher light transmission with extremely low solar factor and with a different shades the requirements, it is all possible in offline.

This is ideally we can make it made to order kind of products. Because the market will drive you towards the particular performance to requirement which has to be back worked to understand what should be the kind of layers that we should adopted to

achieve the particular performance, which is possible in today's advantage with the modern technology.

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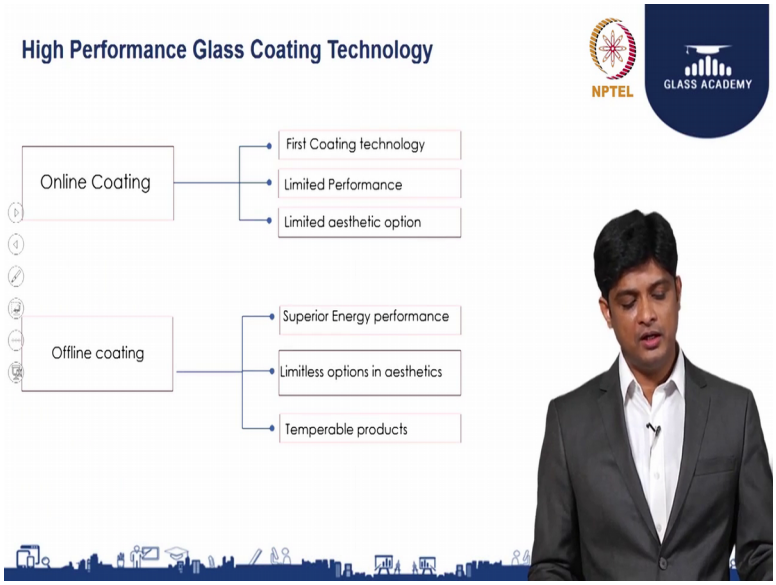

So, as I said online it is a first coating technology it is very endurable coating, but it has it is challenge and it is limitations of the performance or limitation on esthetics. Similarly, when we think about offline, it is excellent I can I can ideally can bring in any kind of a performance requirement. On esthetics you can have n number of option, because with one base you can develop multiple products or multiple shades.

So, you can have about 20, 22, 25 shades of blues and 25 shades of greens and greys. So, it is all possible only in your offline. And all this products whether it is an online or offline this all this products are temparable or process able I would say, it can get many kind of processing whether it can be toughening it can be ease strengthening lamination or double glazing or even bending, or even doing a ceramic fitting on the glass, it is all it is possible in both the technologies.

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So, the third at the last portion I would say; where once you know about the basic structural requirement. We have you have to test it as per the current wind speed then you have to select the product on the performance. And the important one is how to design the building for safety and security. Why it is important because there is a chance of human beings to impact or can be reach out of the glass at any point of time when the current envelops of the glass. So, there are cores like IS 16231 which is launched in 2016.

Which has core part 1 to part 4, which clearly in a very detailed manner helps us to understand based on the critical locations; for example, critical locations like your facade, where you have to check the critical locations like whether the glass is going to be vertical, whether the glass is going to be inclined or glass is going to be overhead or the sky lead. Or whether you are going to use the glass for floors or for connecting bridges.

So, it helps you to understand based on the critical location, what kind of glass is start to be used and ideally it is call safety glass. So, in this a safety glass means so, glass which can be with stand human impact that is what very clearly says in safety glass.

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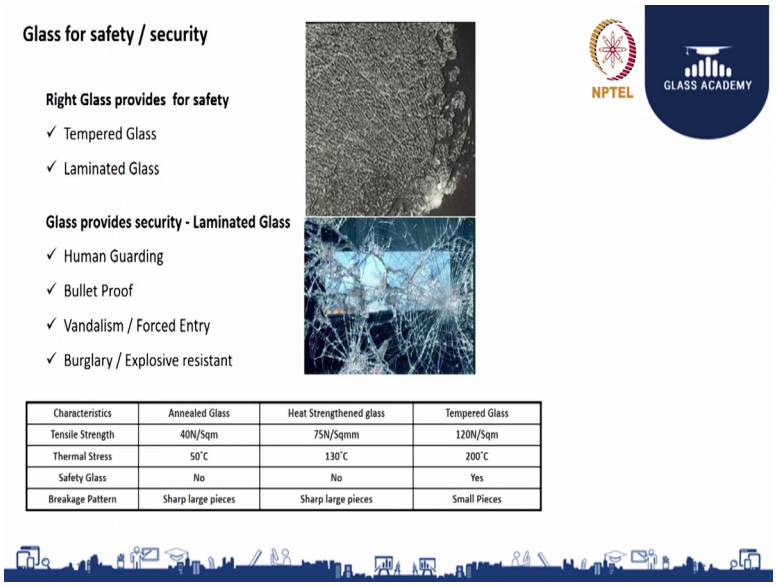

But. it does not mean that this glass going to give you the other safety against your human or bulletproof or it cannot behave like a glass against a vandalism or forced entry.

So, in this chapter in this IS 160 (Refer Time: 10:56) when we say about safety glass, it means only 2 glass or 2 processed types of glass as safety which is ideally the tamper glass or laminated glass. In this lamination, it is option just open whether I can do a toughened lamination or I can do a heat strengthen lamination. So, only the 2 glass has been named as a security or safety glass.

So, in case of security requirement we need to understand what kind of security I am looking forward, whether it is a simple forced entry or it going to be a bulletproof, or it going to be an explosive resistance. So, based on this there are kind of products and the kind of level that I wanted to look forward, and the kind of testing it has to pass through to adjust to the requirement then I have to use the glass. So, there are 2 different things in this one is safety, another one is security. Safety means human impact.

So, ideally it has to be toughened or a laminated glass which can be toughen lamination or heat strengthen lamination. Where it comes to the security, default it has to be laminated, but what is a glass thickness what is a combination, what is a number of how many number of layers it has to be and what kind of material it has to be, it has to be decided based on the kind of security we are looking forward and purpose for it.

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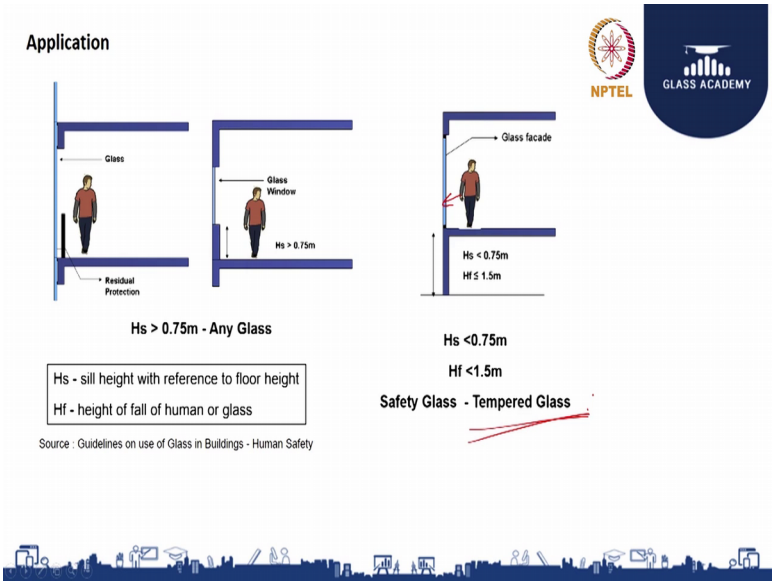

So, these kind of pictorial representations are there in the IS 16231 to understand where the glass is going to be, and what kind of glass has to be used. Say for example, we have an access in the picture where we have an access to touch the glass. In that case it is very clearly says it is safety and tempered glass.

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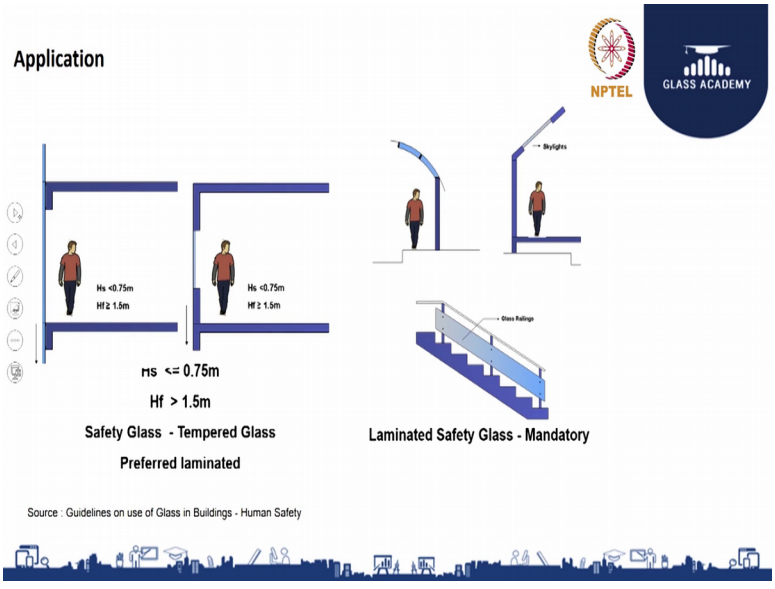

Whereas as an next option when I have a chance that glass is above my head, or it is inclined or even in the handrails, then it very clearly says it has to be laminated safety glass. It cannot be a just simple toughened glass.

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So, to recap it what we have gone through this today's session is; we need to understand how we have to use glass, and how to understand glass. First we need to understand glass by, it is design in the sense what is a purpose, and where I am going to use and how I am going to use. Then we need to do a simple analysis on the energy requirement and the light requirement.

So, that you will be very precise in calculating what is a solar factor U-value or light transmission requirement of the glass. Then what is a need where I am going to use the glass, whether it is going to be an envelope material or patrician, or going to be any other functionality. Then what is a kind of benefit I am going to expect from this material. Whether I am going to use this just an envelope material, or as an security element, or as a material which going to cut the amount of noise coming out which is an acoustic barrier.

So, unless I understand or clearly define the benefit, then it be a challenge later to understand this material. And by function what is the function quality of the glass I am going to be use. Whether it is going to be static or going to be dynamic, or it going to be expressive like dynamic facades. So, unless I have to incorporate all this in the basic design, in my in the basic process of glass selection, starting from the design analysis need benefit and function.

Glass cannot be utilized, or cannot be used as a effective envelop or effective building material.

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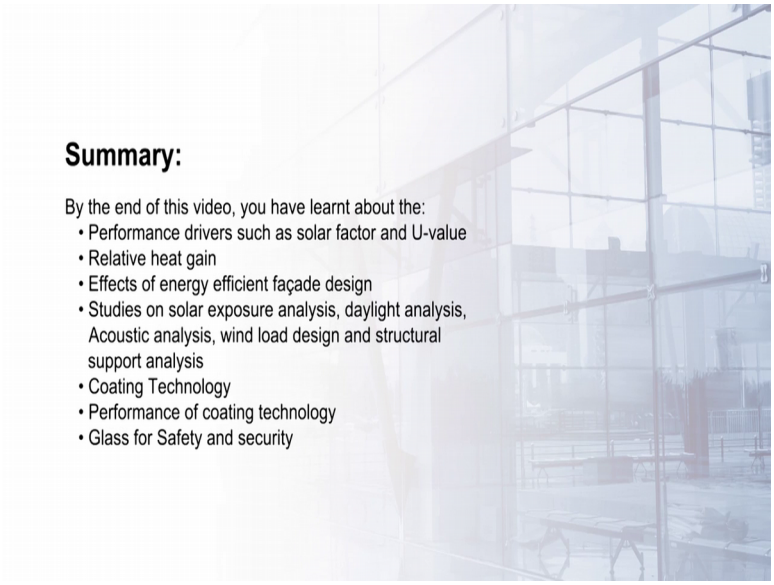

So, with this session we will understand the glass how to use or how to design glass as a building material.