Glass in buildings: Design and Application
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Lecture – 71
FAQs About Usage of Glass in Buildings

Good everyone. So, I am Eshwar. I am from Saint Gobain Glass. And, in this module I will be taking you through a frequently asked questions, which I usually come across and which may also be of very good use to you when you make the right glass option. So, thanks to glass academy for this opportunity. So, this is the topic for today FAQ is a what usage of Glass in Buildings.

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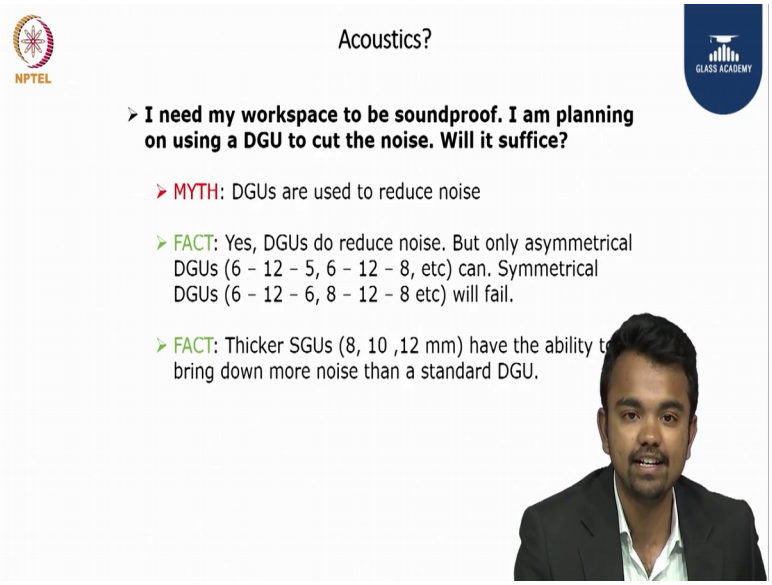

So, I am starting off with acoustics because this is a primary concern and one of the more sensitive verticals of comfort which people look for these days. Now of course, we know that the extent to which acoustics bother us glass allows in a certain amount of noise and so do walls.

So, how can I choose the right glass option? So, I need my workspace to be sound proof and I am planning on using a DGU is what I hear from many architects these days. So, will it suffice? So, one myth which is a commonly out there in the market these days is DGUs double glazed units are used to reduce noise, but it is a myth. So, what are the facts? The fact that yes DGUs do reduce noise, but only asymmetrical DGUs. The outer

light and the inner light should have different thicknesses only those are good in reducing noise.

Commonly these days the standard DGU thickness which is used is 6 12 6 or a 8 12 8, such DGUs do not actually perform well, if I have to talk about acoustics. The performance of a asymmetrical DGU is way better and the higher the thickness difference the ability to reduce noise is even more. So, each thickness of glass acts as a separate filter cutting out certain frequencies, which helps us to attain a better indoor ambient. Having said that thicker SGU s when I say it can be a 8 mm or a 10 mm or a 12 mm thick single gazed unit.

These bring down more noise than a standard DGU standard 24 mm DGU. The reason is simple thicker it is the theory of mass more heavy the object the more higher the ability to bring down the noise.

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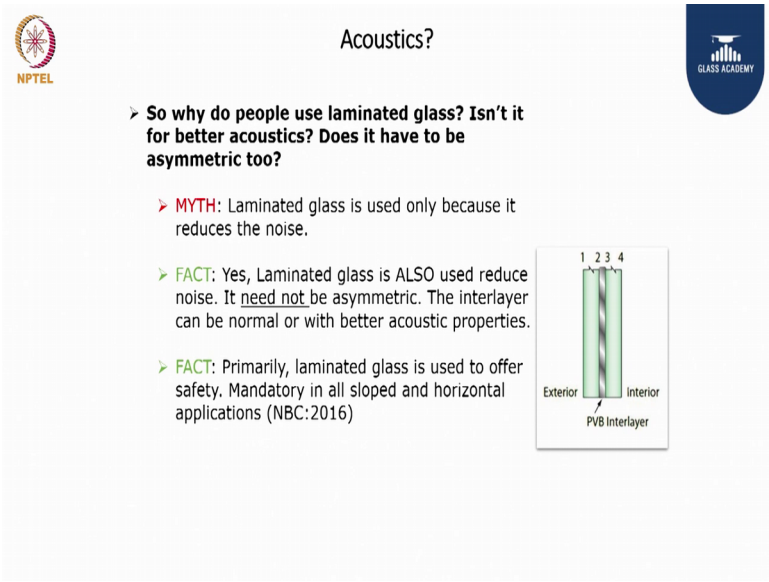

Now, going further on the same topic so, people when I state these opinions these facts people usually ask. So, why do people use laminated glass is not it better for acoustics or let us say it is better does it have to be asymmetric too.

So, the myth is laminated glass is used only because it reduces the noise. So, this is a very highly this is a misconception, which is there it is not just used to reduce the noise yes noise reduction is one of the benefits of laminated glass. So, it is also used to reduce

the noise and it need not be asymmetric like a DGU. A, DGU needs to be asymmetric to cut down the noise 6 and 5 6 and 8 and so on.

But, a laminated glass need not be a symmetric it can be 6 and 6 it can be 8 and 8 it can be 6 and 5 depending upon your design. Now, when a glass is laminated there are many inter layers which you may be aware of one is pvb polyvinyl butyral there is also a acoustic pvb. So, the same pvb which is used to laminate glass comes with certain additional acoustic properties.

So, these acoustic properties enhance the glass to bring down the noise which comes indore ambient now of course, is one more interlayer called centric glass which also behaves in a certain different way. So, while if at all we are going for a laminated glass as an option to reduce the acoustic care should be taken to ensure, whether it if it can be achieved with a SGU itself or if it can be achieved with the DGU itself.

If the only purpose is acoustics may be only a SGU or only a DGU can help you to achieve the required noise cut off. Of course, lamination is important we will see why it is important in for these lights. Now, primarily laminated glass is used to offer safety this is one thing which we need to definitely keep in mind. Now yes, it offers the benefit of acoustics no doubt about it, but laminated glass is primary used to offer safety. And if there is any noise cut off which cannot be achieved by a single glazed unit or a double gazed unit.

Then it makes more sense to go for a laminated glass. Now, what the latest national building code 20 16 revised one says is that, for any sloped application of glass or a horizontal application of glass, it is mandatory to use a laminated glass.

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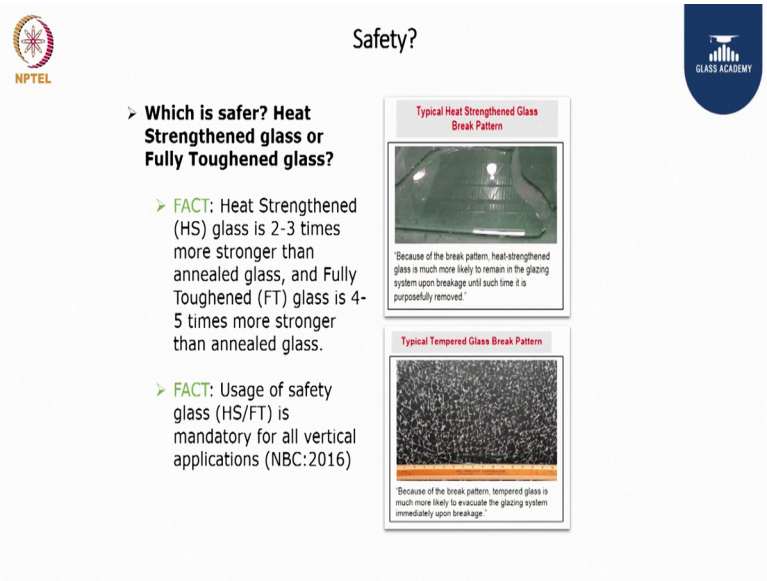

So, going forward again revolving around safety a few more questions which I get is which is safer is heat strengthened glass safer or a fully toughened glass safer. Of course, by now you would be aware of the different fragmentation patterns of heat strengthened glass; and fully toughened glass as of heat strengthened glass breaks into chunks and fully toughened glass breaks into very small fragments which will not actually cause a lot of damage or harm.

Now, the fact is that heat strengthened glass is 2 to 3 times more stronger than the normal annealed glass the float glass. And, the fully toughened glass is about 4 to 5 times more stronger than annealed glass.

So, if we are designing for resistance against impact, the ideal choice would be to go for fully toughened glass. Now, having said that the usage of heat strengthened glass or fully toughened glass, which is labelled as safety glass is mandatory for all vertical applications of glass. This is as per the national building code the latest revision 20 16.

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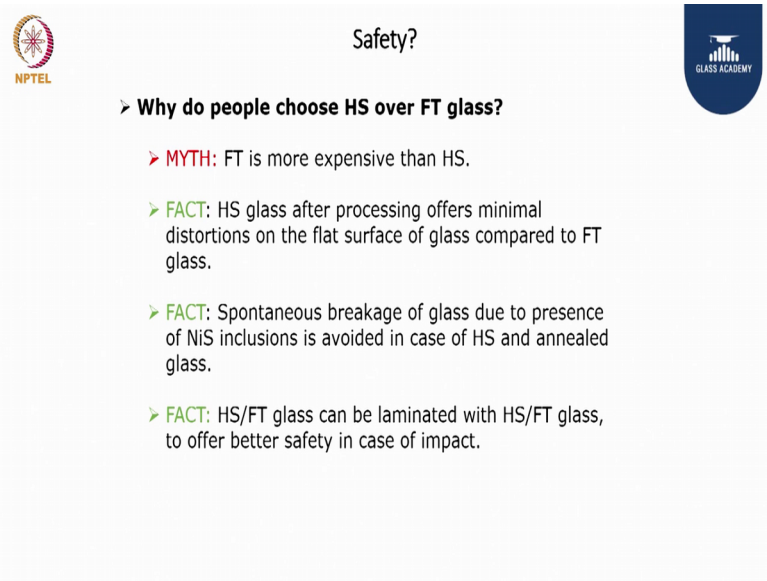

So, if fully toughened glass is indeed better in terms of resistance against impact again over when compared to heat strengthened glass. Why do some architects or why do some designs actually have heat strengthened glass? Why do not they go for a fully toughened glass? So, one more myth which many people are not aware of is the fact is that fully toughened glass is more expensive than heat strengthened glass which is not at all true.

Now, the fact is that heat strengthened glass after processing offers a minimal distortions on the flat surface of glass compared to fully toughened glass. Now, glass of course, whenever it is subjected to any heat treatment; there are some distortions which are created. Now, heat strengthened glass which is the slightly inferior in terms of a resistance against impact amongst these 2 will have minimal waviness and minimal distortions on the flat surface of glass compared to a fully toughened glass.

So, this is probably why one of the reasons why heat strengthened glass is chosen over fully toughened glass. One more fact is that spontaneous breakage of glass due to the presence of nickel sulphate inclusions is avoided in case of heat strengthened glass and annealed glasses. One more reason why architecture or consultant prefer to go the heat strengthened glass over a fully toughened glass is this.

Because spontaneous breakage is something which cannot be estimated or which cannot be certainly said that this is when it is going to happen. It may happen after a day of installation onto your building, it may happen even after 10 years after installation on to

your building. And, whenever it is going to happen it will cause a very small explosion of salts, which will create a lot of noise. And it may be difficult for people and the end user to replace it also. Having so, this is one of the reasons why heat strengthened glass is preferred over fully toughened glass despite fully toughened glass being stronger than heat strengthened glass.

Now, can we laminate tempered glass is one other question which few people ask yes; the answer is yes, annealed glass can be laminated with annealed or heat strengthened or fully toughened, heat strengthened glass can also be laminated with annealed or heat strengthened or fully toughened, and same goes for a fully toughened glass that can also. So, you can actually play with the permutations and combinations of these 2 and design a laminated glass of your depending on the kind of impacts you expect.

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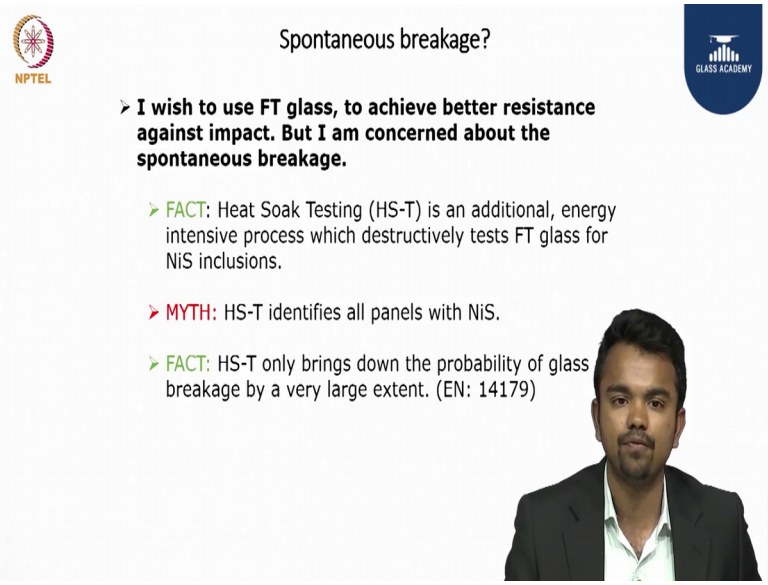

So, coming to spontaneous breakage because it touched upon it people one frequently asked question is people intend to use a fully toughened glass, because it has a better resistance against impact, but there is a very high concern about the spontaneous breakage. So, how can I eliminate it should I go back to heat strengthened glass and compromise on my design or should I stick with the fully toughened glass and run the risk of glass spontaneously breaking?

So, to avoid this there is a separate test called as a heat soak text. This is an additional process and a energy intensive process which tests the glass destructively. So, the glass

panels after being cut and after being process as per your design, after let us say it is fully toughened this will be subjected to high temperature and high pressure in a in a oven of it is own. So, what happens is the nickel inclusions which are may be there in the fully toughened glass are activated in this oven itself.

So, that they do not come outside what happens is these nickel this nickel sulphite inclusions in the panel, it activates the glass so, that it breaks within the oven and so, that it does not even (Refer Time: 09:15) So, this is the process of destructive testing which involves considerable amount of energy and time on the same panel which was fully toughened, but the fact is that there is an additional test which can be done on fully toughened glass to minimise the possibilities of nickel sulphite breakage. So, one more myth is that when heat soaking testing is done. All the panels with nickel sulphite are identified and they are eliminated right away.

So, even when I say that heat soak test is something which is going to benefit you to go with a fully toughened glass, it may not eliminate all the nickel sulphide included panels completely. So, it only brings down the probability of glass breakage. Of course, it is by a very large extent the probability of glass breakage due to nickel sulphide after heat soaking reduces by more than 80 percent, or close to 90 percent, but it is not nil this is also as per a European standard 1 4 1 7 9 1 processing standard which tells the procedure to be followed during the process of heat soaking.

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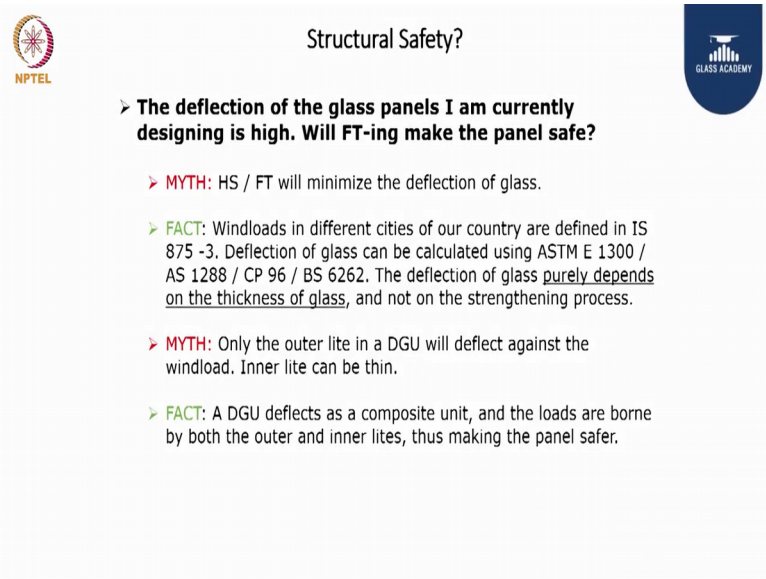

Now, coming to structural safety and structural stability; now, the deflection of glass panels which you may design is something which you will be very keen to know. There are may be cases where the deflection of a glass panels are very high, it maybe exceeding the allowable deflection limits. So, people usually have this assumption that fully toughening a glass or heat sensing a glass from the anneal state will make the panel safe.

So, the myth is that the heat strengthened glass or a fully toughened glass will not will minimise the deflection of glass this is the myth, but the fact is it will not. Heat strengthening or fully toughening is only a process, which will impart more strength to the glass. Making the glass stronger is not actually going to make it deflect less, it is only strong and it is going to resist against impact.

But, it is not going to resist against wind load. So, what actually resists against wind load is the thickness of the glass. So, higher the thickness the better the resistance against wind load and lower the deflection. So, the deflection of glass purely depends on the thickness of it and it is it does not depend on the strengthening process. Now, people I mean the designs of most of the facade these days have a DGU in it and the outer let is what is exposed to the wind load.

So, is it only the outer light which deflects and is the inner light safe? And so, does it mean that I can keep the inner light as thin as possible and only focus on the outer light, because that is what is taking all the load actually no. When the DGU deflects because of wind load, it is it deflects as a composite unit, it is not just the outer light which deflects, it is also the inner light which deflects along with it.

So, the load actually gets shared between the outer light and the inner light. So, it is important to choose in the right thicknesses of the outer light as well as the inner light. So, of course, going for a DGU we will make the panel safer against wind load, because there is more load bearing capacity now.

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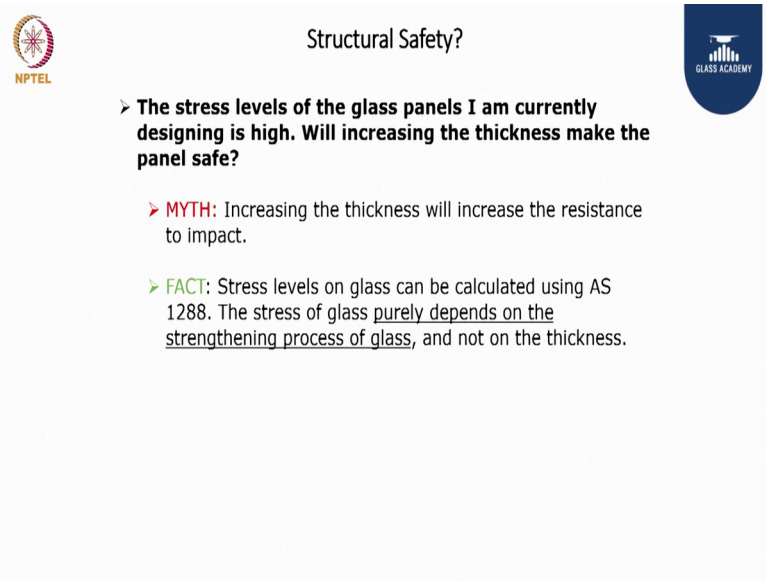

So now, the stress levels of the glass panels which we are designing are currently high. So, will increasing the thickness make the panel safe. So, while we talked about the panel becoming safe, because of increasing thickness against wind load, it may not be true when I talked about impact. Impact can be resisted only when the (Refer Time: 12:46) panel is subjected to a heat strengthening mechanism or a fully toughening mechanism.

So, the stress levels on glass can be calculated using American-Australian standards and this purely depends on the strengthening process of the glass and does not depend on the thickness of the glass.

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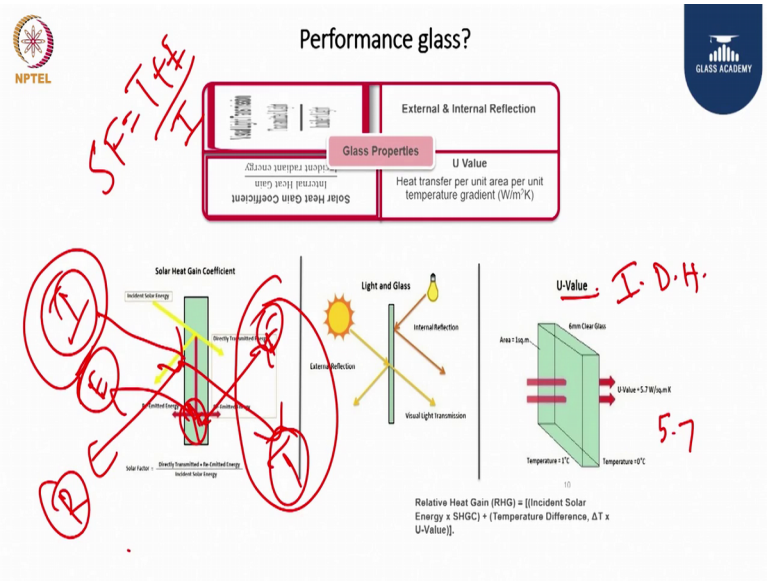

So, coming to the performance of we discussed in length about acoustics safety and stability. So, the more important of all of these would be a performance of glass. Of course, you would have heard of different properties of glass such as a solar heat gain coefficient visual light transmission and U value. Now, solar heat gain coefficient is the extent to which heat is transmitted inside the room.

Now, there is a certain amount of heat which is actually falling onto the glass. And, portion of this gets transmitted inside portion of this is incident, portion of this get transmitted, part of it gets reflected and some portion gets absorbed and re-emitted inside and outside. So, the fraction of whatever comes in over the incident is what I call as my solar factor.

Now, this solar factor has to be as less as possible for us to allow or for us to design energy efficient building. Now, coming to the U-Value, U-Value is something which controls the indirect heat solar factor controls the direct heat, but U-Value controls the indirect heat. Direct heat is that which comes from the sun indirect heat is that which enters the building by virtue of the temperature difference from between interior and the exterior.

So, what I have shown here is a 6 mm clear glass. So, let us say I have 1 square metre of glass and for every temperature for every degree temperature difference about 5.7 watts is what comes in to the comes to the indoors from the outdoors. Now, higher the

temperature difference of course, for a country like ours we would be running the interiors at a temperature of 24 degree Celsius. And, the outdoor and yet may vary from anywhere between 35 degree Celsius and 40 degree Celsius.

So, higher the temperature difference more heat (Refer Time: 14:50) in glass. How can I minimise this is by having a product of a very low U-Value. So, going further I will take you through a few frequently asked questions about these parameters.

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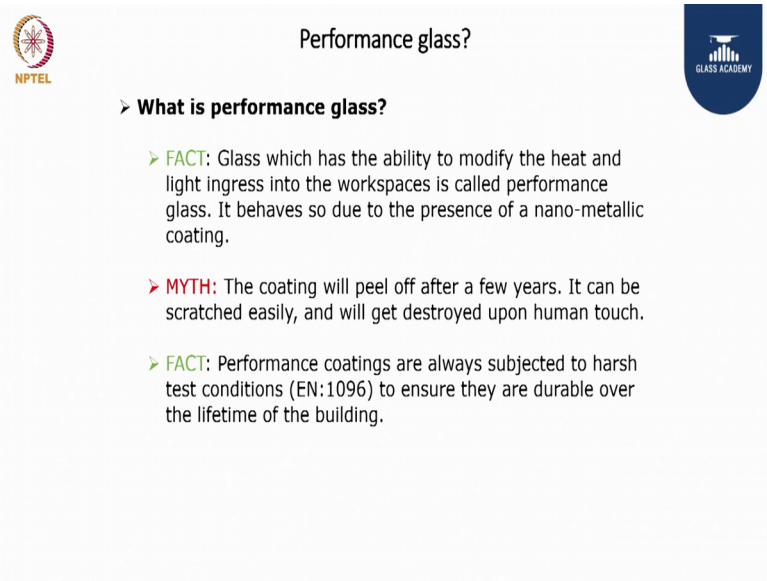

So, what is performance glass can clear glass perform is a one question which is frequently asked. So, if the glass which has the ability to modify the heat and the light enters into the workspaces is called performance glass. It behaves in such a way because of the presence of a Nano metallic coating, it is just a very nanometric deposit about 1000s of the thickness of human hair, but this is good enough for us to selectively allow in light and selectively allow in heat. Now, when I say a Nano metallic deposit and when I say the thickness is very less one myth which is there is at this coating can peel off after few years.

It can be scratched off easily and it can be destroyed easily upon human touch. This is purely a myth, because performance coatings which actually control the heat and light entry into our work spaces are always subjected to very harsh test conditions, before they are actually released. Now these tests ensure that they are durable over the lifetime of the building.

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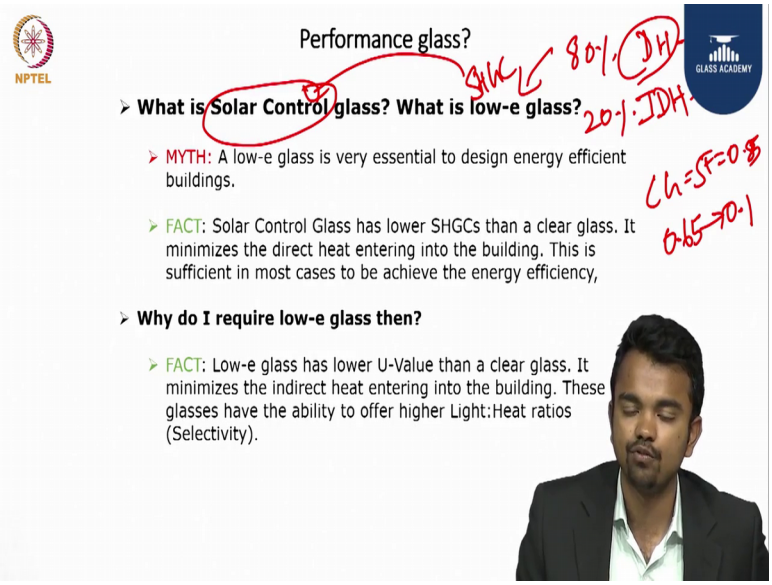

So, when I say performance glass there are 2 types of performance glass the one is solar control glass and one is low-e glass. So, another question is what is the difference between these 2 what is more important for us out of these 2 and what is going to actually help me achieve a energy efficient building. A myth is a low e glass is very essential we see many people specifying or mentioning that, the project which they have designed is using a low-e glass and hence their building has energy efficient.

So, this is only a myth, but the fact is that solar control glass is actually more important to us than a low-e glass. Now, a solar control glass has a lower solar heat gain coefficient than a clear glass. Now, clear glass has a solar factor of about 0.85 whereas, a solar control glass has solar factors starting from about 0.65 ranging up to 0.1. So, this denotes the extent to which heat is allowed in.

So, when I am using a solar control glass, I am automatically rejecting out a lot of direct heat which is incident. For a country like ours approximately 80 percent of the heat which enters the building is because of the direct heat due to the sun it is controlled by the solar factor or SHGC. And about 20 percent of the heat approximately which enters the building is the indirect heat which is controlled by my U-Value.

So, for me to make my building more energy efficient I need to be focusing on the controlling the direct heat increase. And, hence in turn I need to be focusing on a product which has a good solar factor and thus it being called as a solar control glass. So, what is

low-e glass? Low-e glass is something which has a very low U-Value is it essential yes it is essential, but ideally we should be designing a glass facade with a solar control glass and then maybe look at low-e properties.

So, why do we actually require low-e glass then of course, one is to reduce the U-Value to control the indirect heat and low-e glasses have this beautiful property of being able to allow in more light and less heat. Now, if I had a product or if I had a glass product which would offer only 20 percent of heat inside, you would be amazed because it will it will make your building more energy efficient.

But, if I also say that it is going to allow in only 20 percent of light inside, then it may not be appealing to you. So, instead if I say I have there is a product which can allow in 20 percent of heat and 30 percent of light you would be more interested, because there is a difference in the light and heat in (Refer Time: 18:35).

So, this is something which low-e glasses can do they can selectively allow in the visible light and they can selectively reject the infrared heat radiations.

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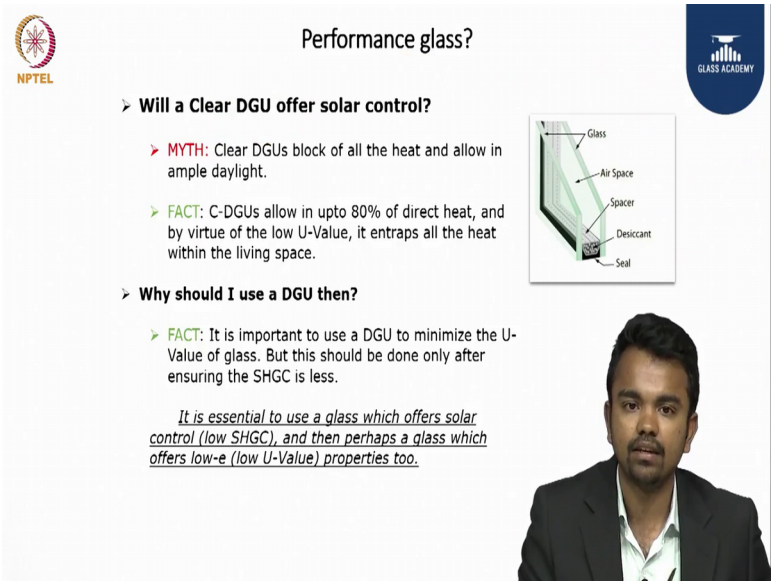

So, when a clear DGU offers solar control because there are so, many buildings these days which extensively use clear d use on the windows or on the facades, are working under the myth that clear DGUs block all the heat and allow in ample daylight or abundancy of daylight.

Now, the fact is that clear DGUs allow in upto 80 percent of direct heat and by virtue of the low-e value it entraps all the heat within the living space itself. So, you are actually allowing you are not cutting the source, we are making the glass allow in about 80 percent of the heat enter our interiors, but what we have also done as we have used a DGU which has a very low U-Value, which acts as a partition or a damn. It does not allow heat to travel from one side to the other side.

So, what the clear DGU is actually making is trapping allowing in all the heat and trapping everything inside. So, why should you even use a DGU then, because it is going to trap all the heat? So, the fact is that it is important to use a DGU to minimize the U-Value, but before you reduce the u value please ensure that you are reducing the solar factor.

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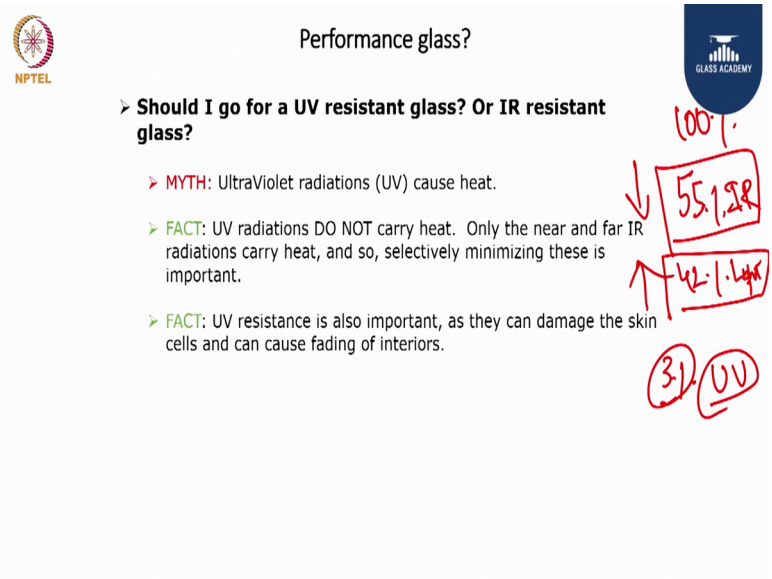

Now, should I go for a UV resistant glass or should I go for a IR resistant glass? There are many windows which come these days which say UV resistance and they seem more they appeal more to the end user.

Now, the myth is that ultraviolet radiation cause heat or ultraviolet radiations carry heat with them, but the fact is that ultraviolet radiations do not carry any heat at all. So, out of about 100 percent of energy which is falling onto the glass about 55 percent is IR, which is heat and about 42 percent is light is a visible light spectrum which carries the light inside the working workspace only 3 percent is UV.

Now, this UV does not cause any heat and it also does not cause any light. So, for glasses actually UV resistant it is only focusing on 3 percent of the total 100 percent which is incident on it. Whereas, what should we be ideally focusing on is allowing in as much as possible out of this 42 percent and allowing in as less as possible out of this 55 percent. So, the glass should be able to selectively understand the difference between light and infrared radiations and thus highly selective glasses are more preferred these days.

Now, coming back to UV radiations do we have to focus on minimising it not so, much, but also yes because they can damage the skin cells and can cause fading of the interiors.

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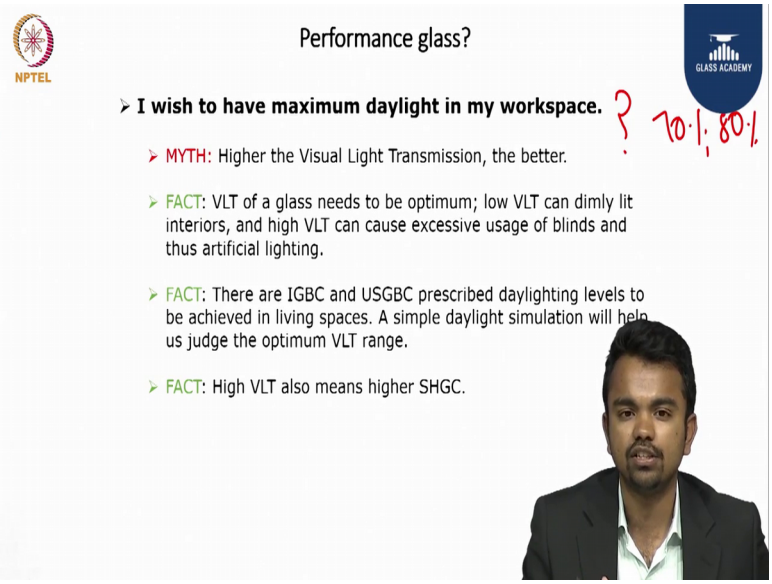

Now, I wish to have maximum daylight in my workspace. So, what do I do? Why should I not choose a product with a very high visual light transmission like say 70 percent or 80 percent, is one question we just also which may pop up into your mind when you are designing a workspace.

Now, the myth is that higher the visual light transmission the better, because we all have this crave craving towards natural daylight. Now, but the fact is that VLT of the glass need to be optimum. It should not be too high and it should also not be too less. Of course, when it becomes too less we all know that it can lead to a very poorly let working conditions, and dimly lit interiors making us use artificial day lighting.

So, what happens when the VLT of the glass goes above what is required? It forces us to use blinds I am sure you would have come across a lot of buildings which use blinds extensively, and once when a blind is used once when it is pulled down people will rarely pull it back up. Blinds are always pulled down and people are comfortable working in the artificial day lightening conditions.

So, this in turn affects the energy efficiency of the building and, but not only that the purpose of having designed a building with glass itself is lost, because now we are staring at opaque blinds, when the glass could have offered you the transparency which you initially desired for. So, how do you ensure that the light transmission of the product which you have chosen is optimal? What if it is too less or what if it is too high?

So, there are prescribed day lighting levels by the Indian green building council as well as us green building council, which actually say what should be the optimum lux level to be achieved on the floor played or on the workspace. Now, in order to achieve that the light transmission of the glass can be varied and a simple very simple daylight simulation on the many software's available these days will help us to judge the optimum VLT range. Should it be between 25 and 35 or should it be between 45 and 50 is something which you can take a call purely based on this very simple simulation.

And, it is not a very difficult thing to do also. Now, one more fact is that when people say they want maximum daylight which means maximum VLT in the workplace, when you actually go for higher light transmission glass products, the solar heat gain coefficient also increases along with it. So, care should be taken to ensure that the right balance between light and heat is achieved.

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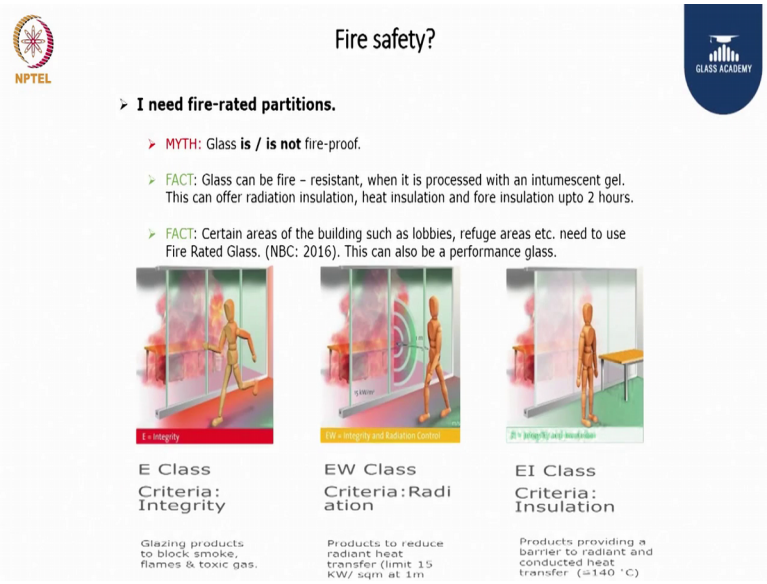

Coming to fire safety so, people have often asked they wish to design partitions with glass which have to be which need to be fire rated. Now, one myth is glass is or is not fireproof. This may sound pretty confusing when I say glass is fireproof is also myth and glass is not fireproof is also a myth, but the fact is glass can be fire resistant; it can never be fire proof. So, glass can be resist fire for a certain duration say 30 minutes or 60 minutes or 2 hours only, when it is processed with an in tumescent gel this in tumescent gel is the ingredient which protects the partitions or protects us against the fire.

So, this offers radiation insulation this offers heat insulations and fire insulations also up to 2 hours. Now, in the latest revision of the national building code certain areas of the building such as lobbies or a refuge areas need to use fire rated glass mandatorily. This can also be a performance glass when a solar control glass or a low-e glass is coupled with it.

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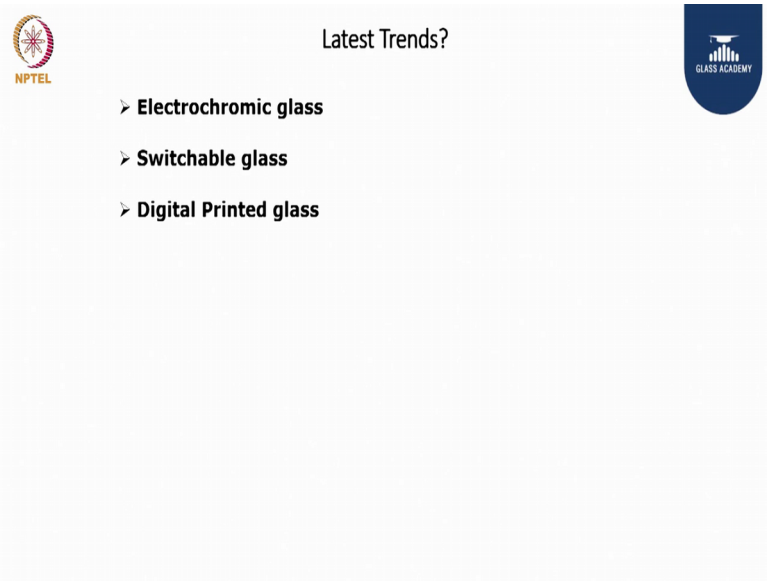

So, what are the latest trends in the market or latest developments in the glass industry are there is electro chromic glass, which changes it is tint based on your requirement.

So, till now what the world has seen is static glass. Once you install it is going to behave in the same definitive way, when I say definitive definite light transmission levels and definite solar heat transmission levels, but now with the new technology which is out there in the market. It is the electrochromic technology where the glass is actually coated with a electrochromic layer.

This electrochromic layer has this beautiful ability to adjust itself based on the amount of light or heat available outside. And, this actually helps us to eliminate the usage of blinds completely. This can filter in the amount of light to a very great extent it can also allow in a good amount of lights during the known direct heat hours. Thus making design beautiful glass buildings which change their colours and also the same time offer good amount of daylight and heat comfort.

Next, we have switchable glass which changes it is opacity upon the click of a switch. So, it can be completely opaque or it can be translucent. So, this switch happens in a matter of milliseconds and can be used for partitions. Then, we have digital printed glass I am sure you should be aware of what is cenomic fit glass by now, they have certain patterns and certain colours, which can be printed on glass and further baked to ensure that the design which you wish to see on the facade can be replicated.

Now, with the advancements in technology; now, we have a digital printed glass where not necessarily patterns of not necessarily patterns that need to be repetitive, you can also go ahead with printing of images of your choice. Let us say you want to get your face printed or you want to get the atlas of the world printed, it is up to you all you require is a high resolution high definition image. And, this can be spread across multiple number of panels on the facade in high resolutions to achieve the intent which you are desiring for. So, these are the latest trends in the market and some frequently asked questions.

So, with that I come to the conclusion of my presentation which I have taken you through frequently asked questions which I commonly inter phase with when I meet with various stakeholders in the market. So, I have touched upon acoustics, I have touched upon structural safety and structural stability. I have also touched upon the performance of glass solar control and low-e and how to design wind buildings. And of course, the latest trends in the market.

With this I come to the conclusion of my presentation and thank you for your time. I hope this was of some value to you and you can reach out to me on the email id at any point of time.

Thank you so much.