Glass In Building : Design and Application
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Lecture - 70
Standards Related To Glass II

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The portion 1 we have covered about the base Floyd glass (Refer Time: 00:25) which is EN 572 which helps to understand the basic tolerances and basic dimensional requirements. And the basic how to understand or how to identify the defects or the spot false based on the kind of or the classifications. Second portion be gone through when you do a coating on the glass. What are the kinds of test it has to pass through and what is a purpose of each test and why it is important. The third portion is on the processing standard we will not be going so, detailed because this will be covered as an individual topic and the processing standards.

So, whereas to just to give an understanding there are different E N standards for different processing say for example whether it is toughened or tempered the process EN 12150 will help you to understand how the process has to be done what kind of test has to be done. And how it has to be evaluated as the glass has been properly toughened or tempered. Then we have EN 1863 which help you to understand the same conditions like how to make a glass heat strengthened.

So, what should be the breakage pattern how should be the breakage pattern of the glass has been defined in that. In case of lamination we need to refer EN 12543 which again precisely helps you to understand what are the kind of a test like a break test or boiled test or the delamination test to understand what is the bonding between the 2 glasses and what kind of defects can be expected and how it to be classified and how it to be understood.

In case of EN 1279 which is (Refer Time: 01:48) for double glazing unit. Here there is a different kinds of test has to be done as a unit double glazing unit then specifically on the individual elements like your disincentive use, your sea lanced used and what is a quality of sealant. How the sealant has to perform in the shorter run and the longer span. So, that is in very clearly defined in E N 1279. So, we going to the third portion which is called the Structural Standards.

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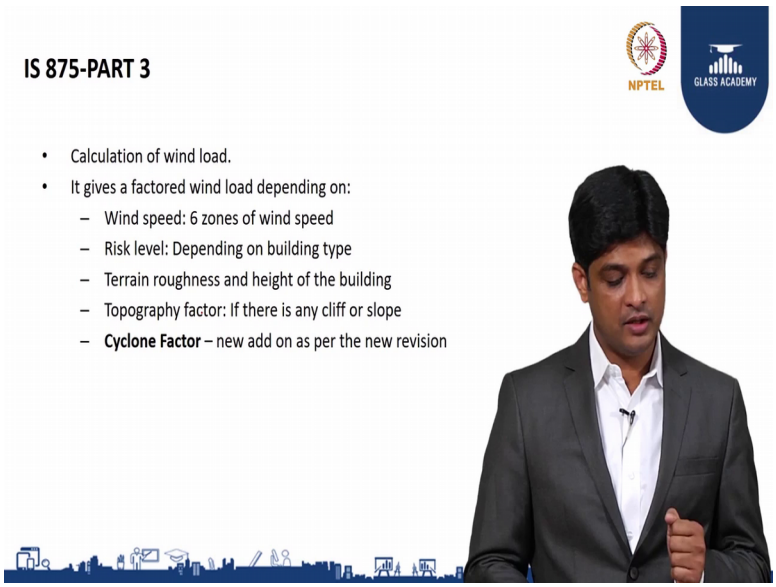

Under structural standard the first one is when whenever I am here we mean structural standards to identify the glass thickness, to understand the glass thickness there are 2 3 important parameters I need to know. One is the first panel size ideally which is going to be the design requirement. So, it can be any panel size. Moment I know the panel size I need to understand what is the kind of support it is going to be given. Whether it is going to the be all the 4 sided support or it going to be given in the top and bottom are you going to give a pointed supports.

So, we need to know what is the kind of supports, then we need to know what is a kind of load is going to applied on the glass. So, one was the wind load another one is dead load. In case of glass design we much worried only about the wind speed because it is dead load is getting transferred into the system. To calculate wind speed we have a code which is called IS 875 and specifically the part three help you to understand to calculate the wind load. So, this code has gone for a reason revision in 2015 and 16. Where there is a new factor call cyclone factors has been added which I will I will take through where it is getting added into the adjustment factor.

So, when you get into the code, the code we need to be very clear on what is a kind of a building I am going to be build in the sense what is the height. Where is a, what is a bandwidth whether it is 0 to 20 meters 20 to 50 meters or it is going to be above 50 meters. Then I need to understand what is the terrain category? Whether my building is placed in open environment or just it is just or it is just away from the city with not with much disturbances or it is within the city where it has much disturbances.

So, we need to be very clear about understanding and terrain. Or whether the elevation or the location of the building or the terrain itself at and height, say like Bangalore which is about 1 kilometer from the mean sea level. Then the topography factor which we need to understand about the undulations on the surface of our project. Is all will help you to understand how the wind is going to impact the building. So, there is a lot of adjustment factors has to be integrated considering this and the last one is a cyclone factor.

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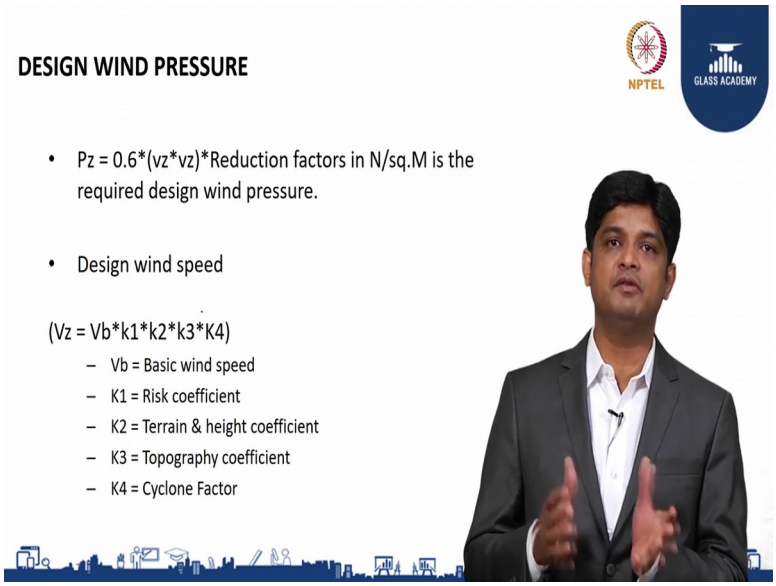

So, it calculate wind pressure which is the Pz it means it is 0.6 Vz square ideally we need to calculate the first the wind speed and then it converted into pressure wind pressure.

So, calculate that you need your basic wind speed which is given in your IS S875 based on your location. So, it is a graphical representation. So, based on your location you will be knowing the color of the color code and for the color code there is a wind speed is given. Once we know the basic wind speed, then I have 4 parameters I would call or the factor of safety I can say it which is k 1 k 2 k 3 and K 4. K 1 which is the risk coefficient based on the type of the building.

Whether it going to be permanent structure the structure which is build for emergency purposes or the structure is going to be build for design period of say 35 to 45 years. Then you have you are both terrain and height coefficient and you are topography as I mentioned then the fourth one is a cyclone factor which is recently added in the latest version considering the recent cyclones the last 10 to 15 years which has reached extensively high which we have not seen in the past history.

So, this is precisely based on the location for example, when the building is going to be come on the eastern side of the country say starting from Trivandrum till a Calcutta. So, the possibility of this kind of a building x getting exposed to a high vulnerability on cyclones is very high. So, they are given a cyclonic factory it ranges from 1.12 and 1.3.

So, I delete as a factor of safety to be added when there is building going to be come in this area.

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So, once I know the wind load next one I need to calculate the glass thickness there are 4 different standards available internationally which can be referred to do the glass thickness.

So, the first comes which will be the American standard which is ASTM E 1300 which helps you to understand based on the composition of the glass. Whether we are going to use or the design the glass a single glazing or a double glazing are going to be a laminated. Again what kind of process the glasses passed through, whether it is an annealed we are using a shield (Refer Time: 06:18) or we are going to use toughened or tempered, then we need understand what is the dimension of the glass I said.

So, we need to be very clear based on the aspect ratio of the glass because ASTM defines the kind of behavior of the glass based on aspect ratio which is ideally the area of your glass pane. Then it helps you to we need to understand whether I am going to design the building with or the facade with or the particular panel with 2 sided 3 sided and 4 sided. So, unless we have all this clear before the design it will be a challenge or to find the glass thickness.

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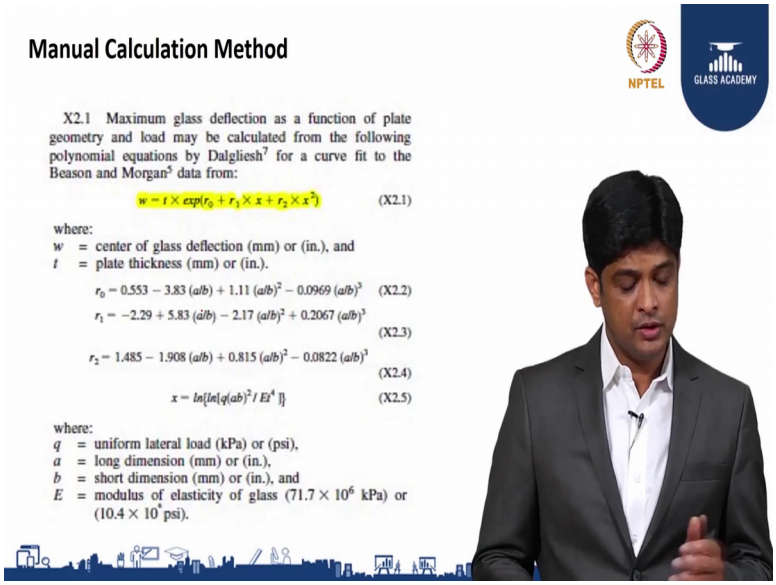

So, this screen shot where you can understand very clearly how even the manual calculation can be done. So, ASTM has two approaches one is the graphical approach another one is an empirical approach. On the graphical approach once you are able to know what is a kind of a glass, what is the kind of support condition, what is the kind of processing we have to interpolate the graph and understand what is than acceptable deflection values. Or in other side you can do one still an empirical formula so, that you can very precisely or very accurately you know what is the glass going to be deflect.

So, very simple empirical methodology where you need the wind speed, the dimension of the glass and the basic modulus of elasticity of glass which is against still given in the code. So, once we all integrate into the formula which is mentioned here w which takes the conditions of your glass plus your constants. Once we able to integrate the values we will be able to accurately calculate what should be the deflection, what is a actual deflection.

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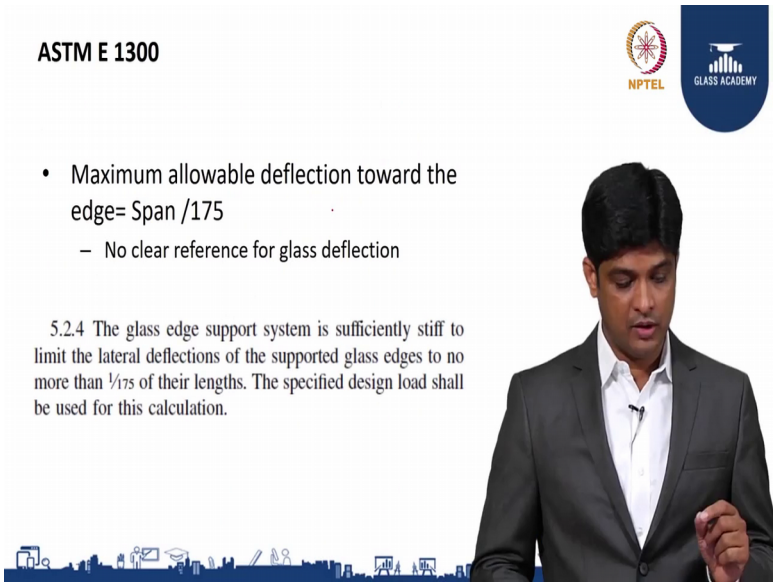

So, I know the actual deflection only challenge with the code is, code is not very clearly communicating specific to glass what is a acceptable deflection. In case if you can see the definition given in the code it says the glass edge support system is sufficiently stiff to limit the lateral deflection of the supporter glass edges to no more than l by 175 of their length ideally it is span by 175.

So, here there is always debate between the designers whether this can be considered for a glass or it has to be considered for the system, but since there is no where no reference given. There is methodology to understand what is actual but there is no methodology or there is no reference for what is allowable. So, still this can be considered as span by 175 it might be a stringent design or it can be a more safer design to go since, it is glass facades still it is can be go on.

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Another one validation that we can do is the reference aspect to the other codes available. When a take British standards which is B S 6262 which is actually in similar line to ASTM. Now only add on here it is done is it has very clearly given the maximum deflection allowable for a glass which is span by 175.

So, ideally it is helps the ASTM to we can make a prediction that ASTM span by 175 can be considered for glass. In case of single glazing unit ASTM has a methodology where you need to do the load sharing means you have not to glass 1 and then glass 2. So, whenever there is a load applied ASTM says a logic to understand. If we need to divide the load that going to applied on one surface of the glass with a load sharing factors and then you calculate the deflection. Similarly in case of single glazing unit in case of ASTM there is no clear definition been given how to do this.

So, we need to understand that the entire load is applied on single glazing and still the span by 175 applicable, whereas in B S is very clearly given if it is single glazing it can be at span by 125. And this is the definition as per the code is for the glass to be considered as 4 h fully supporter the deflection of each edge should be limited to glass span by 175 for single and span by 175 insulating glazing unit these were as per BS 6262.

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The third code available for us to understand us AS 1288. It is an Australian standard. So, again it says in this code if you see it is completely different from there other 2, here it is very clearly space span by 60 where it can be a 2 3 or 4 8 supported the only unique notation given here is in this code as I said if it has 1 by 60 on the definitions as per A S 1288 is very clearly say span refers to the shorter dimension of the panel.

So, for an example I have a panel which is 1800 millimeter verses 1200 millimeter. In case of ASTM since a definition of span generally called as distance between the 2 longer supports. So, we will take the longer length which is 1800. Where as in this case when I do ASTM AS 1288 it very clearly says man has to be considered shorter.

So, I will take 1200 as my span so, 1200 by 60 which is ideally the 20 mm. So, in this case I have to do that actual calculation the actual a deflection values has to be lesser than the allowable which is 20.

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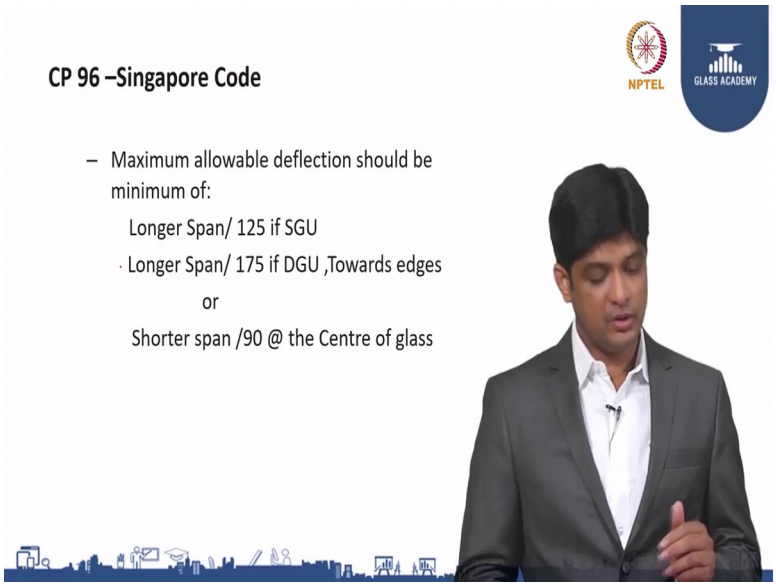

So, there is one more reference for this calculation which is the C P 96 or the Singapore code. As per Singapore code it has 2 conditions what it says is towards adjust it has to be span by 175 for double glazing. And at the centre is saying the maximum allowable is span by 90 of the center of the glass.

So, with putting to all the 4 codes in a nutshell we can understand that span by 175 can be for the edges, for the centre it can be expand by 90 if it is Singapore or A S or ASTM. Only references in case of your AS 1288 any way very careful that here the span refers to a shorter span. So, the forth portion where we need to understand what is the I S or the Indian Standards available referring to all the above. So, referring to the Indian Standard currently there is one code which is functional which is launched which is called I S 16231.

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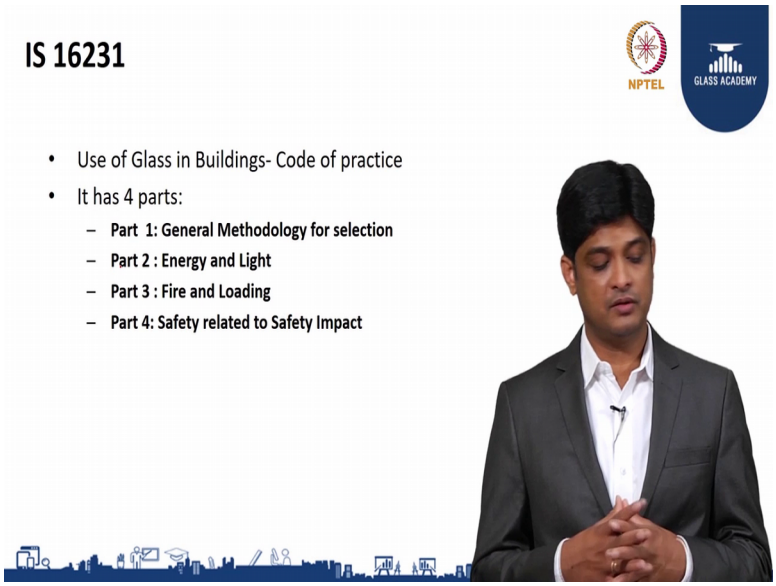

Which defines about how to use or it the name of the code itself call use of glass in buildings. So, in this code data 4 parts, one is the general methodology for the selection second one is an about the energy and the light, the third one is about the fire and loading conditions and the forth one is safety related to safe human impact or the safety impact.

So, on the general methodology it helps you to understand what are the conditions we have to go through or how to select glass for any building for safety for aesthetics or for sustainability. And energy and light it very clearly refers to the recommendations in the energy conservation building code. And it brings back some inferences from ECBC how to select glass or how to identify a particular bandwidth of light and energy required. In case of fire and loading again it refers to the part 4 code of National Building Code. It helps you to understand what the kinds of fire rating products available and what are the critical locations and what is a timeline that we are supposed to have a resistance for the fire and what kind of product can be used.

So, it helps you understand kind of manual. On the part 4 which is a safety related code where it is helps to understand what kind of products process glass has to be used based on what kind of usage.

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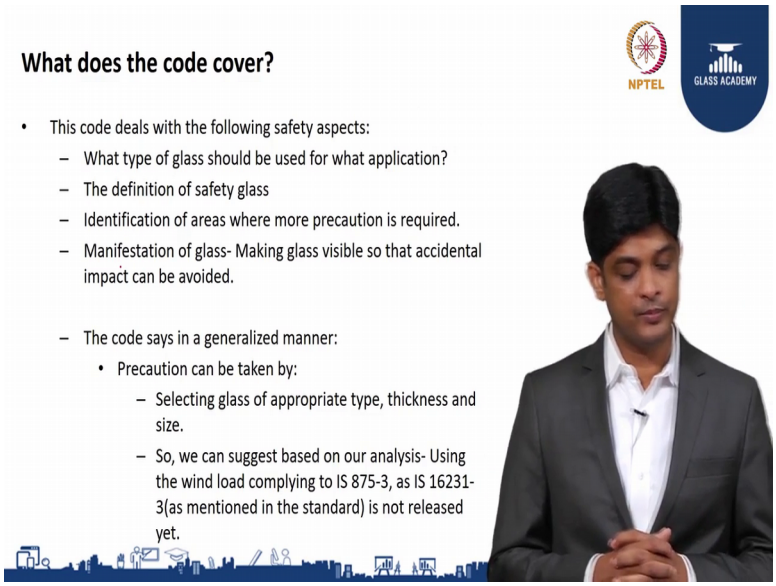

So, the code helps you to cover the, what is the code of cover? Here in this code it helps to understand what type of glass should be used for what kind of application. What is the definition for the safety glass? We always use the word called safety glass. So, what kind of process glasses call safety glass and where to use what kind of safety glass? And then the code will help you to understand what is the appropriate type and thickness and the sizes to be considered the tolerances. And we can even use your IS 875 to understand the design of your glasses.

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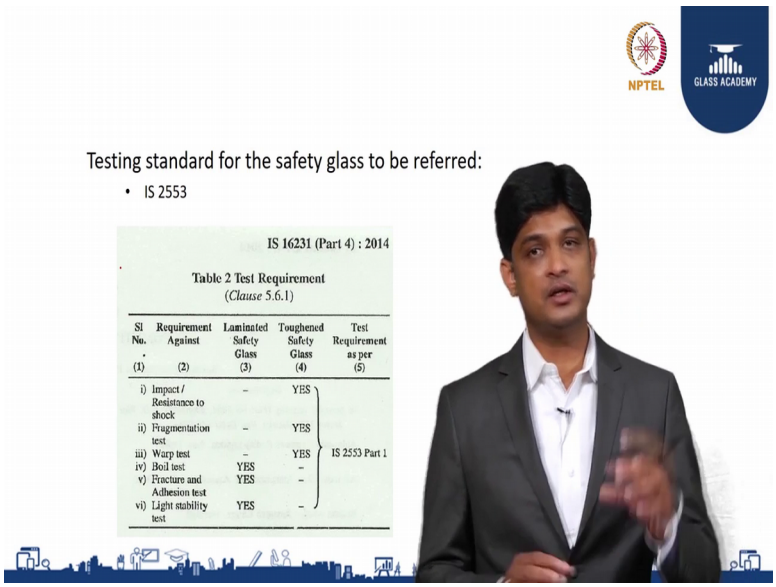

So, in case of testing standard so, it helps to understand two three things. One is the critical locations kind of safety glasses to be used and how the safety glass has to be tested. For example, in this code it is very clearly says as a definition safety glass means it has to resist the human impact.

So, there is only two kind of process to glass it suggest one is toughened glass and another one is laminated glass. One is the 2 glasses can be label as safety glass. Again in this 2 glasses based in the critical location it suggest you where you can use toughened glass and where it is mandatory use laminated glass.

So, whether this process glass how to be tested is a table which is given in 16231 part 4 table 2 which is gives a very clear the test requirements it has to pass through. Whether it is test for toughened and whether it is for laminated.

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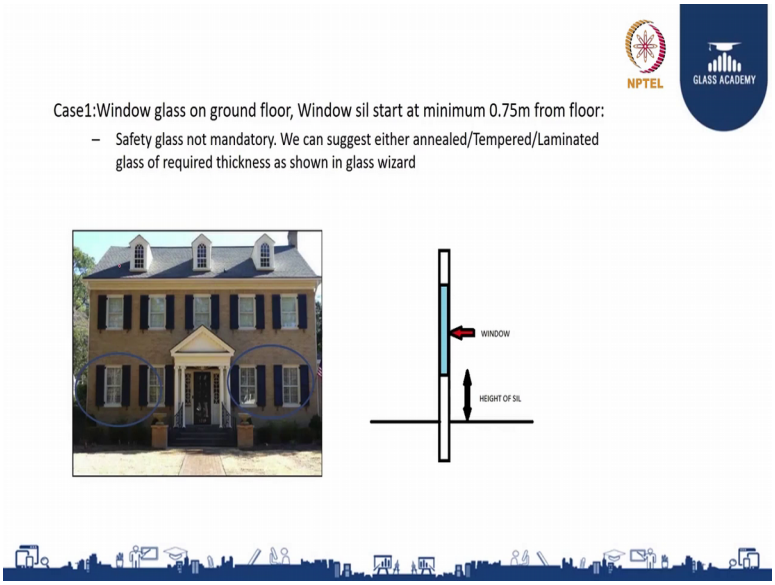

So, as a case 1 if there is a window as you see in the picture if there is a sil is being, which is sil is been given under the glass which is above means ideally we the provision to hit the glass by a general human which is not easy means by hand or by accidental you may not able to hit the glass. In such glazes there is a provision to be given where you can still go is the panel size like smaller and windows which is as represented in the images. You can go with annealed glass or still it is suggested to go with the toughened and laminated because the breakage pattern of annealed will be quite sharper.

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When the case 2 where you can see the window; the window height is still the floor till the ceiling. Means even by just a walking or by accidental thing we are we can we have an access to or we have a chance to hit the glass as for indicated in the picture. In this case the code suggest very clearly it has to be safety glass and specifically it has to be minimum is tempering, minimum requirement is tempering. Still always it is kept open to go for lamination because at the highest level of safety that we can go for.

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When it comes to the facade glazing, where the external facade glazing it says minimum or mandatory would say it has to toughened glasses because even at the event of the glass breakages it breaks into very small (Refer Time: 05:59) and even at the verge of it going to be get shattered to the inner space of the building or to outer space of the building. The impact that is going to create is minimized, but again as a manufacturer we always prefer to suggest lamination in the vertical façade.

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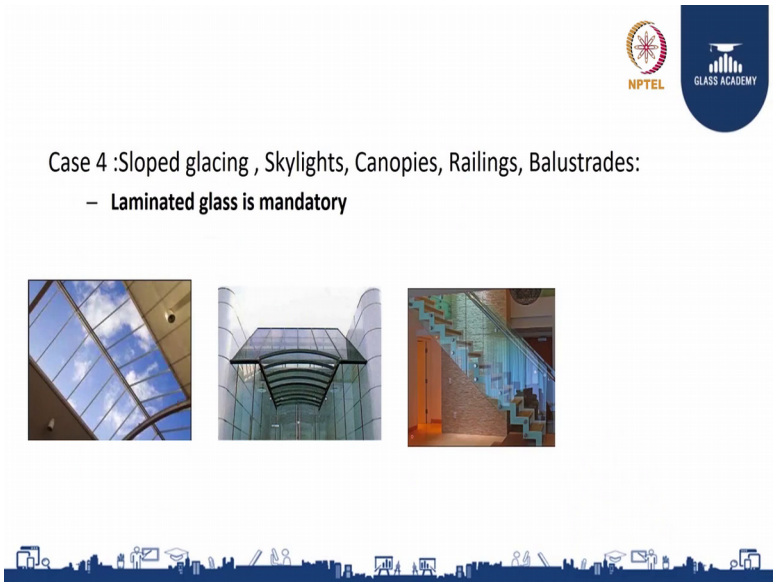

The case 4 where there is a provision as you see in the images there is a skylight or there is an inclined skylight or there is a glass used for the glass balustrades or in the stair cases all these glasses lamination is mandatory.

So, there is no option to here you need to go with the laminated glass. Because these glasses which are accurately going to be above the head and a for any user at any point of time due to anyone in any disturbance external disturbance. If there is glass breakage, this panels are not allowed to come out of the frame. So, the only way to hold within the frame is you need to laminate the glass. So, that is why in this such condition whether it is for the sloped or skylight or canopy or railings or in balustrades it has to be laminated.

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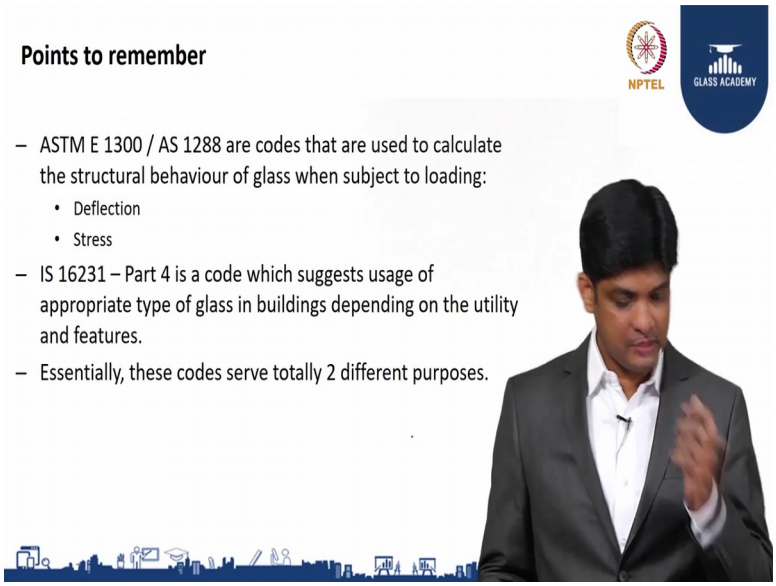

There is what are the important points are we need to understand by this session is when you do the structural calculation as per the ASTM A S BS or CP 96. We need to understand what is the actual deflection and what is the allowable deflection. And always this actual deflection has to be two third of the allowable. That is good to go or it is a safe for it same to do. Second one is we need to be very careful understanding what is the critical location where I am going to use glass. And what kind of glass I am going to use which is very clearly defined and your IS 16231 part 4.

So, based on the location like whether it is on the adjust, whether it is going to be accessible, whether it has a provision to hit or to get human impact then it has to be a safety glass again an safety glass only 2 kinds of process glass being considered safety glass one is the toughened and another one is a laminated glass. In case of skylight or canopies it is mandatory to use a laminated glass. So, thank you. So, this session will help you to understand the kinds of standards available for glass, start from the base manufacturing, the coating and then the structural standard and how to use a glass in your buildings will meet you soon.

Thank you.