Glass in Buildings : Design and Application
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Lecture – 20
Standards Related to Glass

Welcome back. So, today the session will be on very specific on the Standards respect to the Glass industry. I would say glass industry because there are some production standards, there are some processing standards and we will have some more standards on the structural portion.

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So, today's session we will try to cover about what is the basic requirement as a production when we produce base glass; what are the production related acceptable limits to be followed and what are the kinds of test that I have to pass through to officially make the base float glass. And then there are different kinds of a coating available, how the coatings are been segmented and what is the code recommendation and what kind of durability test it has to pass through to get validated as a different types of coating.

Then I will take you through the processing codes available, then we will have the structural codes which will be we will discuss in more detailed manner. How to calculate the wind speed and other 4 structural codes available from the rest of the world including

American standards, Australian, British and even the Singapore code, how to calculate the glass deflection or the stress requirement based on the panel size or based on the wind speed or based on the aspect ratio.

Then finally, there is an Indian code which is called use of glass in buildings which is highest 16231 which helps us to understand the complete range of application that you can use glass in a buildings we will take you through that.

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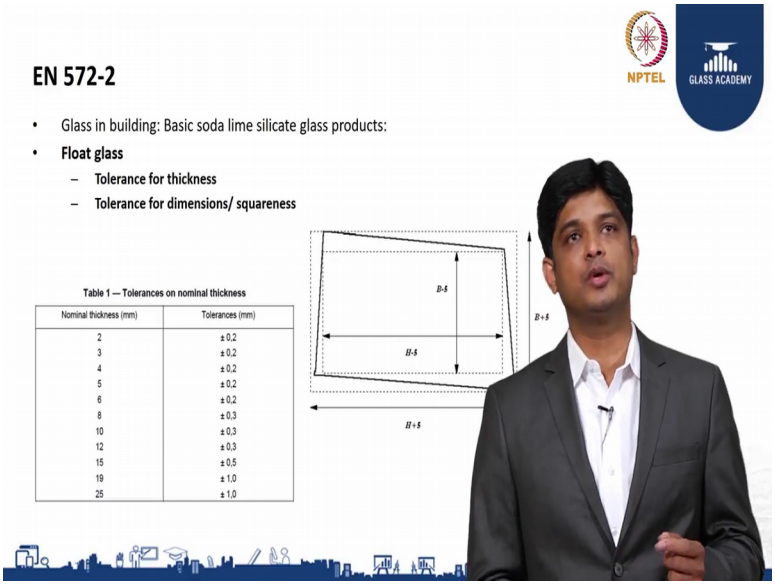

So, respect to the base float glass we refer to EN 572 because of the current is 1400 it is under revision and we will be having the code soon, but there will not be much deviation currently the new version against this EN.

In the EN 572 what very important as a buyer when a glass is been sold or the glass is being bought in the market is what is the tolerance for thicknesses? Currently when we manufacture say for an example you take 6 mm thick; 6 mm thick glass. The tolerance at several limit is around plus and minus 0.2; it means I we will be able to produce a glass the way limit is from 5.8 to 6.2 mm.

So, anything beyond this tolerance deviation it will become a nonstandard glass thicknesses. And it is very important because when you buy a glass it has to be precise to the thickness because all the structural calculations are done based on the glass thickness given. Next important parameter would be your tolerance in your dimension; it is very

important because when you going for a automated cutting line or you are going to do an yield calculation; we assume the glass panel as a typical rectangular section which is the standard sizes from the manufacturer.

So, when I buy if the glass is not of squarish a squareness has not been maintained consistently; then there will be huge wastage on the edges. So, before you going to place the template sizes, you have to first make the glass square which will end up in a huge wastage on the glasses. So, it is very important to understand the tolerances respect to the dimensions. So, as per EN 572; both the horizontal and the vertical or H and B the acceptable tolerance for any dimension is plus and minus 0.5 for standard thicknesses.

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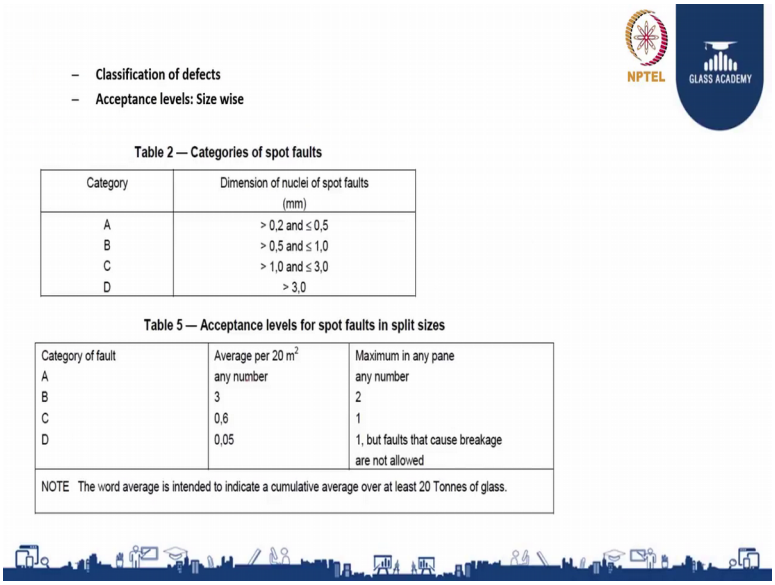

So, the next important criteria that we have to understand is the defects; one is the classification of the defects and what is the acceptable level of defects.

So, there are 4 basic classification done in EN which is class category A B C and D; ideally it responds to the or it relates to the dimension of the nucleate or the spot which ideally you called as the defect in your glass. So, 0.2 to 0.5 mm which comes as a category and then 0.5 to 1 which comes as category B and then 1 to 3 which comes as category C and anything more than 3 mm is called as category D.

So, to make it very simple moment first the first thing we need to do during the manufacturing processes. We need to identify the kinds of spots available and we have to

categorize it; then what is the condition? How many I can have it, yes there is a table 5 which is very clearly give you the acceptable levels for spot falls; for the split sizes which is ideally the cut sizes that going to get supplied in the market. So, these numbers are calculated based on the average of 20 square meter.

So, because every panel there is a 2 conditions here; one is I have to do the measurement for 20 square meter of the glass, but it does not mean that the entire defects can be part of one single pane. So, there is a limitation for overall 20 square meter of glass for limitations for the per pane acceptable limits.

So, for an example in this case in this table 5; you see if I have to do single pane split sizes the maximum acceptable in class B is only 2 numbers whereas, class C it is 1, class D it is 1 still acceptable, but if we feel that it is noticeable or it can have a provision or it may end in breaking the glasses then the particular paint glass has to be rejected.

So, once it pass through this basic requirement of your thickness tolerances; your dimensional tolerances and your defect levels then the glass is acceptable as a glass which can go out of the factory or it is glass which can be sold in the market.

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So, once the base glass is manufactured; the next process that we have to go through is the coating on the glass. So, whether it is the online coating or offline coating or we call

hard coating or soft coating, once we first we need to understand what is the category or the type of a coating.

So, this EN 1096 has 4 part which helps you to understand in very detail and a brief manner. The part 1 defines about the definitions and the classifications what are the kind of nomenclatures will followed the entire code. Part 2 will help you to understand there are in the part 1 even we will be able to classify the kinds of coatings you do. In the classification I mean there are some coatings which is used on the phase 2, there are some coatings which can be used in the phase 1 for different applications.

In phase; in the phase 2 itself again you will have 2 or 3 types of a coating where there are some coatings which is have silver in the coating as a part of the coating. So, in such products this coatings cannot be used in the single glazing format; it has to be used in a double glazing format. So, the durability test it has to pass through versus a product which can be used in a single glazing is different.

Because in single glazing the coating is more exposed to the external environment and it has been accessible for any kind of a cleaning process or it has be accessible any kind of water. So, it is very clearly saying how to differentiate the product for its category and then what are the kind durability it has to pass through. So, in part 2 we have been classification on A, B and S coating which is the standard coatings available.

And part 3; it is specific to C and D which is ideally the silver base kind of a products. So, then there are some typical factory production control methodology and how to evaluate sample; how to even take random samples during the production, it is all been mentioned in the part of EN 1096. So, what is helps us understand is first is a classification of the coating as I said. Then what are the kinds of test methods available for different classification of the products, then for the different kind of a products what is the acceptable levels. So, that it pass through both the durability and the performance requirement.

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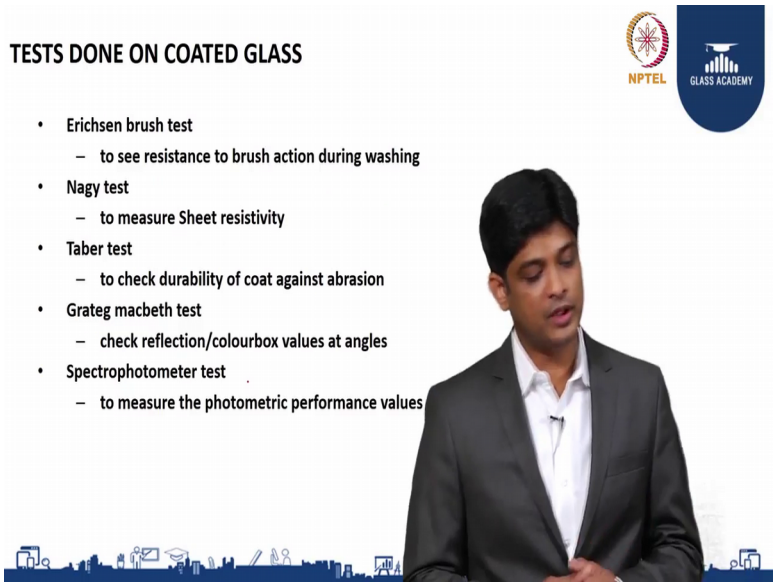

So, these are the few test which is available say like Erichsen brush test, your Nagy, your Tabler, your Grateg macbeth and your spectrophotometer; I will take you in detail. So, precisely this each test going to help you in understand a very unique property of the coating and the functionality of the test.

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For example an Erichsen brush test this helps you to identify if you can see the picture closely, there will be between the red dots; between the red dots here in this portion; there is a kind of a brush which is going to run on the coating side. This ideally I am

trying to simulate it after the coating is done; the glass is being supplied to the processing where the first process will be of washing the glass. So, that is the possibility of the brush going to touch the coating side.

So, I have to make ensure the coating which has been done is durable enough to take the impact due to the washing process. So, this ideally helps you to simulate thus condition in a laboratory fashion. So, the first test you have to do the Erichsen brush test; there are 2 kinds of products again as I said, there are products which is used in single, there are products which has been used in double I would say silver based or non silver based.

So, in case of non silver based the number of cycle it has to pass through will be higher because the vulnerability for the coating or the durability requirement is very strong and stringent. Whereas, silver based coating the coating is get backed into the double glazing format; so, the coating is always safe inside the DGO. So, when a product pass through this any offline coated glass which is which is been coated under magnetrons partnering coating technology. After passing through this kind of Erichsen brush test; ideally we need to say there is no more it is called soft coating, it is ideally call an offline coating or magnetrons partnering.

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So, the second test which has to pass through is Taber test which is again another kind of a test which helps you to understand the durability or the resistance of the coating, how durable your coating is deposited on the surface of the glass.

So, for example, the basic products which is the ST, ET means a non silver based products. You can see the image here there will be a very hardened bristles will be kept and then you have to keep the sample below on the table and this bristles are allowed to run on the coating side; it is kind of an abrasion wheel. So, you can imagine a polishing wheel you might have seen. So this kind of a wheel which has very hard surface, which has been allowed to run on the coating side of the glass.

So, the procedure is I have to measure the light transmission of the glass before the process and then I will be placing the sample like this and the brush and the wheel is allowed to run on the coating side. After then a number of cycle which has given say like 2000 cycles, I have to take the sample and measure the sample again for the light transmission.

If there is any loss in the coating then my light transmission will be increased. So, there is a there is an acceptable limit called delta t from the machined versus tested. So, if the delta t is within the limit of tolerances which again the tolerance are been given in your EN 1096. So, if the tolerance are within the boundary then the product has passed its durability requirement.

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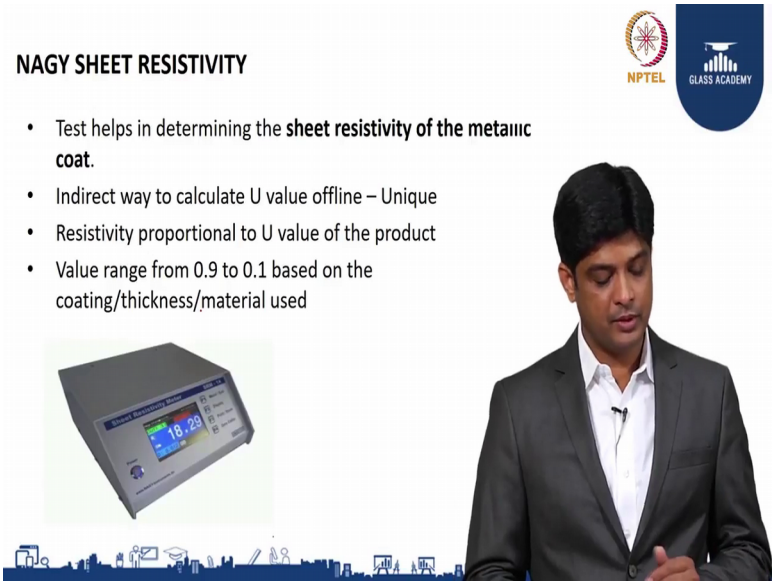

So, the next one will be your Nagy test which will be very precise test that has to be done for silver based glasses. Because when you wanted to calculate the U value which is ideally the indirect heat transfer or the low e or the emissivity property of the glass, you

need to understand the sheet resistivity. So, the Nagy will helps you to understand or to measure the resistivity of the product because if you mesh you are able to measure the resistivity which is ideally will help you to understand the U value of the glass because it is the proportional value.

So, usually the resistivity of the product or the emissivity value of the product will be ranging between 0.9 to 0.1. So, as lower as your value the product is better on its performance on the U value scale. For example, the normal clear glass emissivity value will be around 0.855; whereas, when you take a silver based glasses the single silver based glasses which the your emissivity value will be around 0.2 and whereas, the double silver glasses which will be around 0.1. So, this will helps you to understand or to calculate the U value of the glass.

When I say single silver and double silver; this test will help you to understand the impact of U value because of the number of layers. So, this is how you can measure it.

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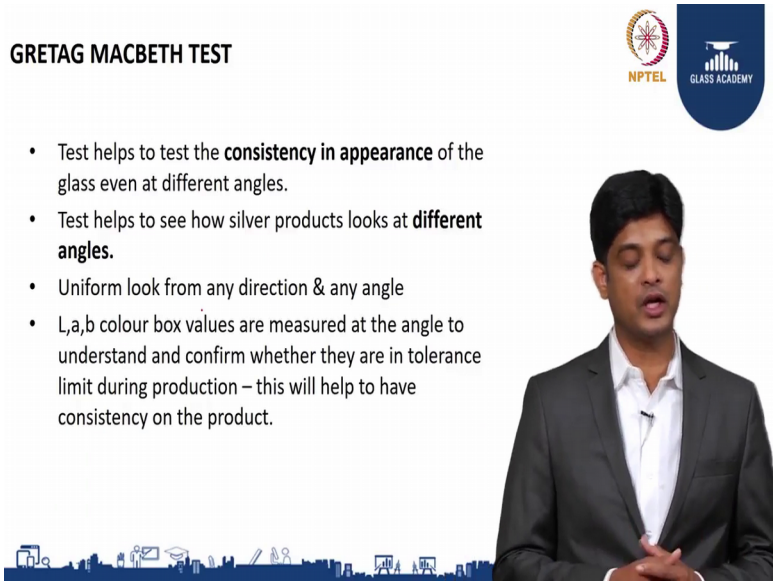

So, then the third the fourth important I would say, it is very important test for an aesthetic purpose. The first 3 test I did is turned as a durability of the product, but the product may powerful at durability, but an on aesthetics there can be an impact. So, how to understand that there will be 2 tests done.

One is this Gretag Macbeth where I need to understand what is the consistency of appearance of the product from outside? When an external; when the glass is getting installed in the building when you are going to see the building from any angle, it can be from 0 to 180 degree angle or from in a different floor level; when you view it from again 0 to 180 degree, whether it is in the horizontal angle or in a vertical angle; the color of the product which we call it as consistency in appearance has to be same.

How do we understand that? We use this test on to measure the reflection values we it helps you to understand or to measure the reflection values in multiple angle you simulate the condition and understand whether this angle the values in different angles or same me. Ideally the colors the way the product looks in reality in any angle both horizontal vertical has to be same.

So, ideally we will be measuring the L, a, b colors which helps you to understand the per angle L, a, b value and to correlate with your overall color of the glass. This is a very important test suppose to be done for silver based glasses because silver based glass has a tendency to show multiple colors in different angles, it can be in vertical or it can be horizontal. So, this test will help you to identify that defect, I would really say it called a defect in the glass; so it has to be rectified.

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The last test which is very important; which is called spectrophotometer because when I when we manufacture glass, there are different layers of coating been deposited and

different generations of products are available; so, if the basic solar control then high performance solar control and low E or clear low E glasses; then single silver glasses, double silver and triple silver all this generation of glasses are vary or varied because there is a performance difference in each product.

Say when you take the basic solar control glasses; the solar factor and the light transmission values are more or less in the same bandwidth which is call it as selectivity. So, if the light transmission is around 50 percent and (Refer Time: 14:12) factor is at around again 0.5, the product is called selectivity with 1.

So, when I when I improve the selectivity means there is a huge difference in the product performance values; moment I put it into the things from compared to the clear versus green, blue, bronze and grey; then there is a huge performance band with the products are getting existed. So, when how to I measure the values and how do I make this consistently the same kind of a product? That is why this spectrophotometer comes into picture where I have to take random samples during the production; this test is ideally to simulate the external condition as such.

So, this test will create as such the natural frequency of light and heat ratios both near. Then when you capture the frequency that pass through the glass and you simulate or you plot it, then you will be able to understand or derive the solar factor, the reflection values, external reflection, internal reflection light transmission values.

So, this is very important test currently as a manufacturer we will be doing this on every random samples at every 2 to 3 hours based on the kind of a products. And there are laboratories now available in India, which can help you to test this values which is declared by the manufacturers.

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