Glass in buildings : Design and Application
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Lecture – 53
Facade Fundamentals Part III

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This is a simple form one more system commonly used point fixed glazing, but it is will be a small part sometime you know people tend to use they want to see only glass. Of course, you know you can use they call it point fixed glazing or spider glazing. I do not touch here with this brief, I draught lot of varieties.

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Now, let us start going in depth. So, we have seen façade it is how it got a wall how the things started going forward and choice of material different kinds of material, then how you design a system what are the different systems available. And then we went in depth to understand how unitize system is done, why a unitize system.

So now we are going to touch base on various material so for this again I am taking system whatever semi or unitize system as an example, but primarily focusing our aluminum based system. Because that is what with that value the facades are done mostly some places they are used steel, but it is not wisely used and it is not advisable as well. So, simple a system a good system, if you want to design then use aluminum as base for façade.

So, aluminum let us touch base. It is started during 1886 after testing various material which qualifies to require research for the aluminum as good material. Now it is from bauxite it can be extracted and it is good for the next 300 years. So, we have an material which got 20 to 30 percent of aluminum inside. So, it is abundant, but; however, 300 years will maybe for next two I do not know when this say this 300, but it will be exhausted soon not so, soon during our lifetime maybe another 100 150 years. So, aluminum is a versatile material which can be used as a structural element to design a façade.

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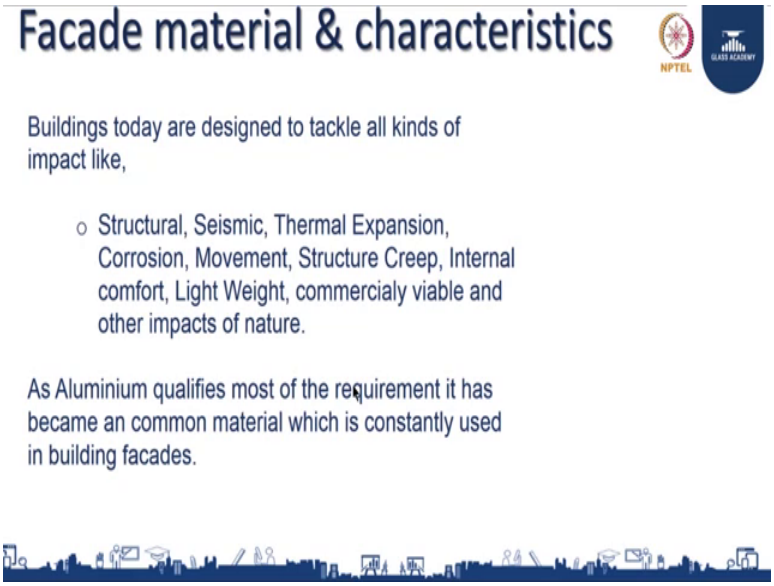

So, today a buildings are designed to tackle less we saw before. All is movement the impacts of nature commercially viable thermal expansions aluminum qualifies to all this. And any other material example you use any other metal they will become expansive one not malleable. It is very hard work with them. So, aluminum became cost effective solutions for people to consider using it façade method.

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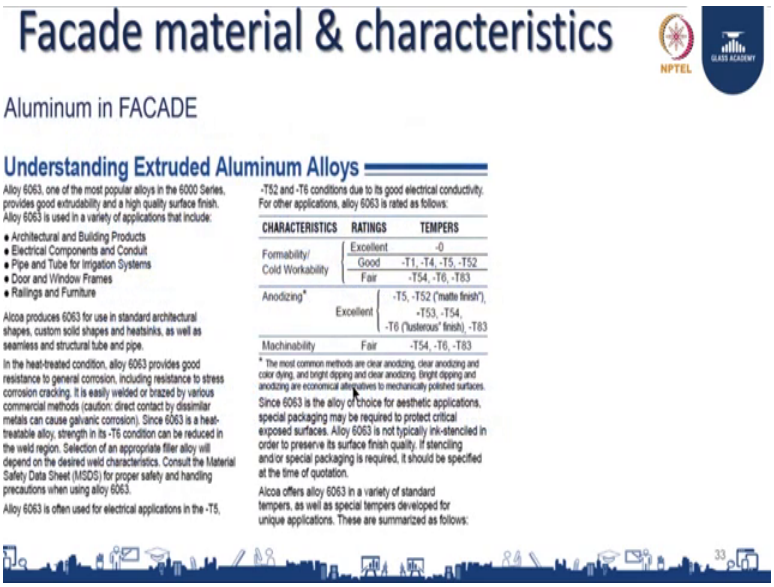

Because of the nature if you see a little bit briefing about aluminum, it is excellent and may be it does not corrode and you know it is strong. If you even you look at the aircraft

they use lot of aluminum. So, aluminum plays a major role in an designing, it can be a student it can be done for any shape what you like to be a extruded, but the same time it is excellent for heat, whereas, a heat of course, I cannot expose it transmits heat, but it expands well and contracts well if you design here properly.

So, aluminum been a material it works well you know from a bready cold work a bready. It is a excellent and you know anodizing and means surface protection against corrosion. So, it works very well compared to any other metal like the next metal available is steel copper it is not too strong. So, strength wise malleability function aluminum plays a major role. So, it can be done in any form assessed by it can be extruded it can be the caster aluminum is there for us to use for as element.

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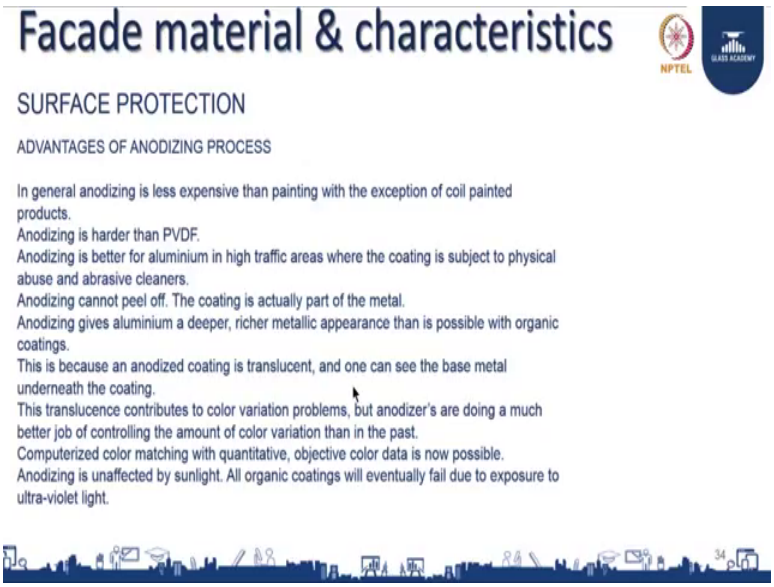

In general you know surface protection. Now you are talking about how you protect the surface of aluminum, yes we have choice of aluminum to use as a material, but you have to protect them. There are the various forms of protection available. First thing is you do a anodic process you call it anodizing what you do you take the material you would dip it in a anodic solution to change the surface of aluminum by making a more stronger in form of, you make an coating in form of structure change to the system. So, the surface of aluminum will get an anodic process by means of dipping it into solution and electrolyte process, where it will seal the surface. So, you get a natural change of skin condition it is, if I say just like you know applying cream for your face, but it that is call

a coating, but toning your skin the skin color changing by means of toning it is just like anodic process. So, aluminum is toning up.

So, you would makes it more fairly and you get a natural color the color also can be changed nowadays (Refer Time: 05:44) they do various colors also by doing adding some advance systems to it, but it is good because you are changing the material you are not depositing anything you are changing the aluminum surface by anodic process. Hence it acts as a protected coating. So, it what it does you know it protects and seals against any form of rust or anything or surface rusting or pitting, whatever can happen in the environment impact again it is harder.

Because it is not coating because it is the surface change, PVDF it is a form of like your car paint all right. You can paint it by spray painting the system as well. So, there are difference you know you can (Refer Time: 06:29) through the things, the systems call for different colors, there are advance system available PVDF is good for external conditions, where you have lot of corrosion happening building facing the (Refer Time: 06:43) so, there are plus or minus you know.

So, anodic case it is harden, but if there is no fixation, I you have a scratch or they become pair it together is no touch up for available unless you know you just do some superscript, but when you go for PVDF, you know it is like it is a coating like what we do like makeup. So, you apply a paint that is fixable even if you dent or a scratch you (Refer Time: 07:12) it you need pair like how you do with their car with the proper quality control and place. And you got variety of colors you can do million colors you know with the PVDF. So, there is a provision cannot send in a advance of systems.

And the same time and we are choosing the coating system we have to be very careful. What surface protection and going to give, why? It is not for fun fare you can you say example I do not want to put a PVDF on the internal of within the it is not only expensive, but it does not help. Why I have to spend so much money I m doing a PVDF rather I do some other coating like a powder coating. So, there are lot of different varieties of system available, but there are 3 common ones which are analyzing, powder coating and PVDF. So, anodizing is changing the material hardness by improving the surface in form of anodic process powder and PVDF they are deposit, means something you deposit on top of them earlier like paint.

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So, PVDF and it is advantages you know as I said it can be fixation there is scratches then sort of (Refer Time: 08:20) so, we saw aluminum as a material. So, you when there is, when you when you go back to see aluminum you know it just not simply you take an aluminum and you can use it. If you see here there is a coat right. What they do here is they go and temper the aluminum; they go to make it stronger. So, even aluminum comes sort of extrusion the extrusion comes sort of your die process or you know extrusion process they are would like soft like sponge you can crush it.

So, what you do you go and temper it. You make it stronger by putting it in oven you heat it you know temperature where it can be made to your requirement, like commonly what is been use for our industries T 6 which is a tempered alloy, where you know you still can work around it. So, depends on the choice you know if I am going I need something little bit flexible where it has to expand more like your capping zone something then yes, I can do that used to T 5 or T 4, but that is how you decide. So, aluminum goes through the process. Of course, you saw what are the surface protection available. So, by applying the process of paint or anything you take care of the surface against corrosion, against splitting, against damages together.

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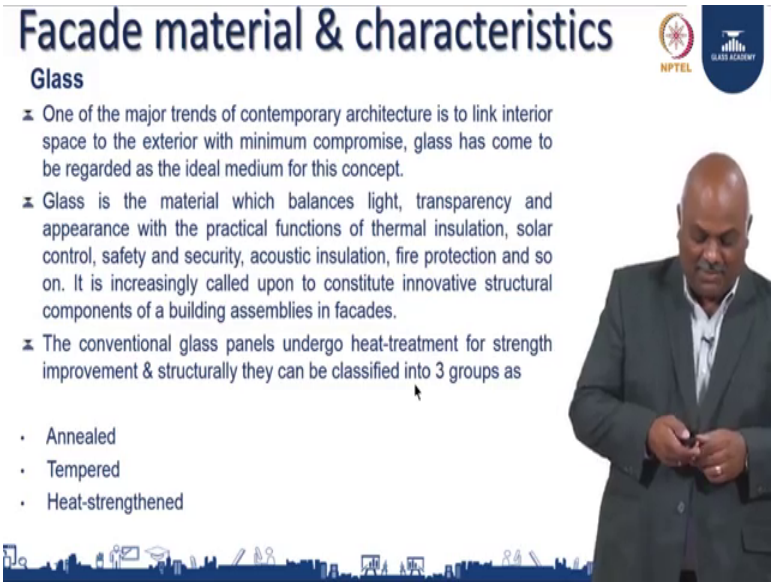

So, next what is the thing? Glass; glass is a good invention of course, you know in the previous sector I believe they were spoken a lot about glass, I would like to touch very briefly here. Glass is an element it is a good invention which brought has to the nature closer. Imagine your are sitting against a bear wall you do not have any life you do not communicate with the outside world, you do not know what is happening outside you do not know whether it is sun, rain water only if you here something then you know mug glass change that (Refer Time: 10:25) what it did it acts as an sheet or whatever form they put in it communicates to the outside world. You will it to let us you to communicate let us you to see through.

So, that invention is brought to the façade and you know it is playing a major role today. And there are lot of act us while choosing a glass that will be brief by our colleagues in the next classes. So, mainly this is how we do.

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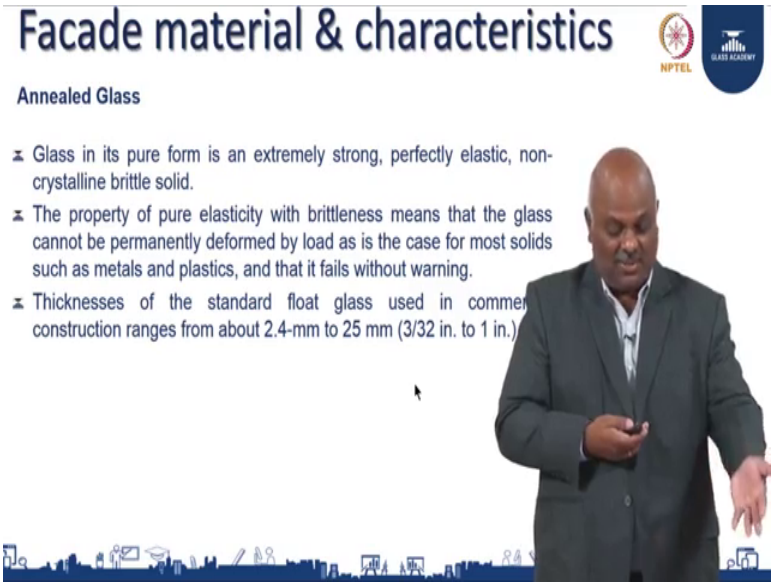

When you choose a glass you go and temper them or annealed glass whatever you can put a float glass briefly, depends on your requirement. Are you heat strengthened your glass depends on the requirement by the structural engineer or you temper the glass.

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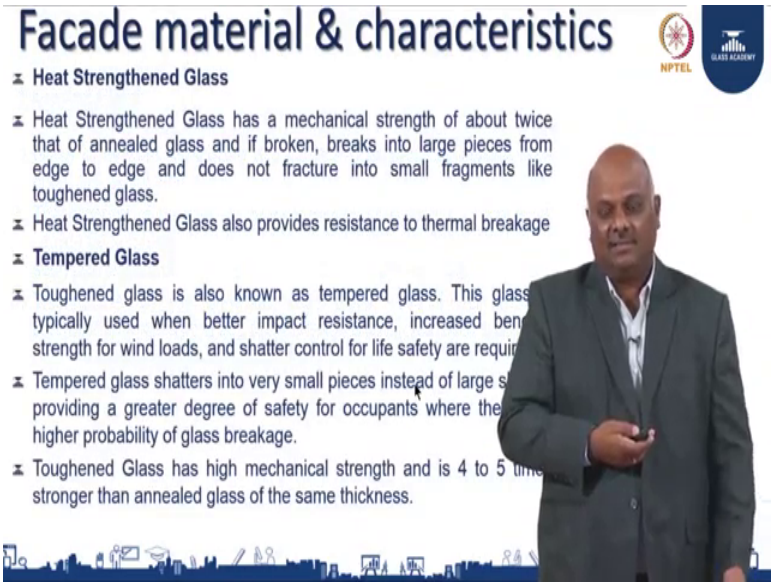

So, these are all few things to harden it like when you see an aluminum T 3, T 4, T 5, T 6. It depends on the building requirement and what you are designing for so, glass also same whether I want a heat strengthen glass or a tempered or a flow glass depends on the structural requirement by the engineers.

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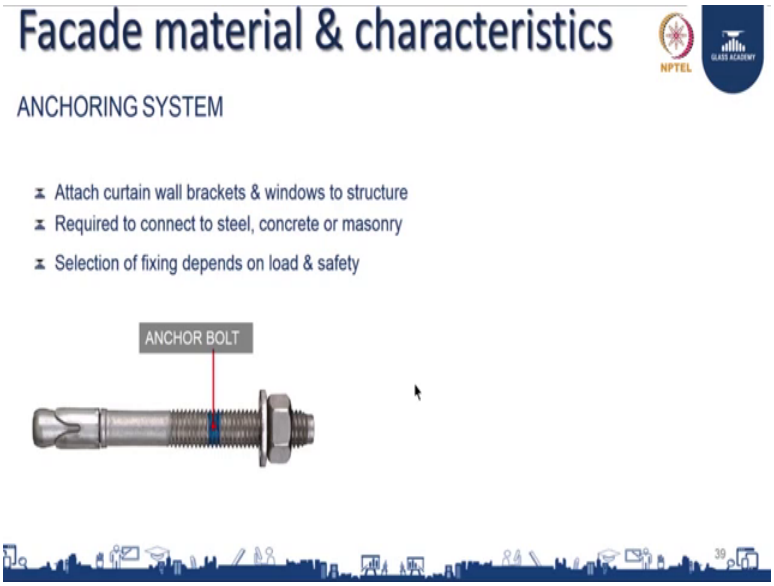

Now, we talk about anchoring system. I did not go in depth to talk about different anchors, I have taking a simple anchor I believe a construction and (Refer Time: 11:40) commonly used anchor. So, you drill a hole and you just put this impact anchor at site and you tight it that is all; this is the commonly used system available. And it comes in various material as per heating stainless steel you can do it with a galvanize it depends on the choice of the substrate. So, anchor bolt what does it carries a load back to the stuff. So, you had a bracket, you have a system now how you connect them together is through this anchoring.

So, you anchor your system to the mother structure. Sometime you can bolt it, if it is steel if it is concrete, then yes of course, you need to get an impact anchor or we can use a gas chain channel or you can you can use a gas chain plate various anchoring system available, but what commonly used system is just simple, what you see over here it is impact anchor you drill a hole on to the structure. You just hammer this is and you know put a bracket and you try it extension start whatever you see here in this question. The structure line is until here and then when you tighten it expands like this what you see here.

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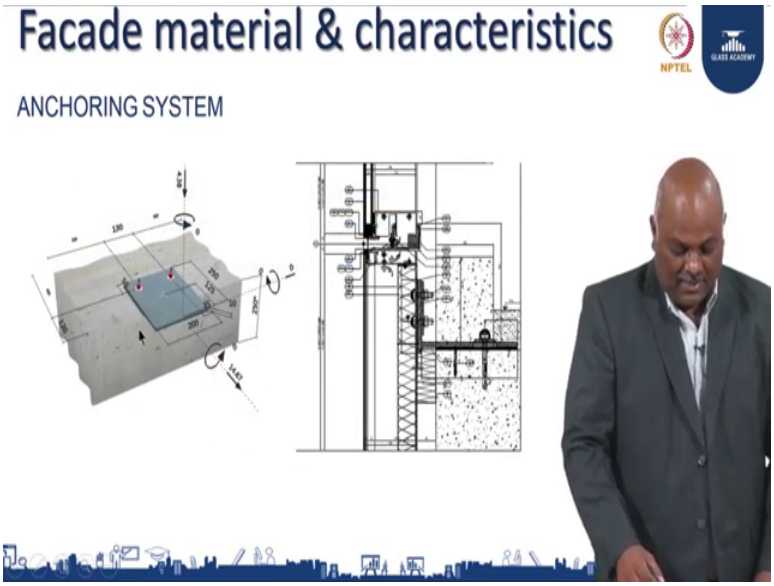

So, whatever it is here these are the brackets what you see how I will get (Refer Time: 13:02). So, this anchor bolt is the main thing which governs the whole system. So, you bring the system and then you dry the anchor through this of course, you know you have certain factors to consider, how you know controlled them based on the calculation the engineer should be doing it. There are limitations of course, you know you cannot do it too much towards the edge of the concrete here what you see is you know anchoring to a concrete. So, similarly here the whole system gets connected via this bolts.

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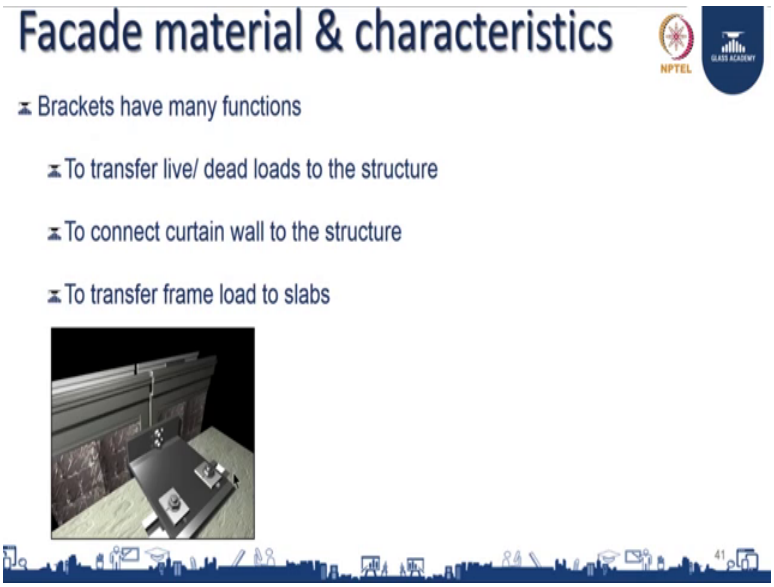

So, you can see here. Here what we see is the channel what you saw before it is attached to a cast in channel. If the channel is not there you can do away with the anchor bolt. What it does we transfers the live and dead loads to the structure to a mother slab or mother structure. So, bring the facade and you attach it to a mother slab. So, this anchor bolts are channels where you tighten they transfers the load and then they connect the curtain wall to your main building. This is what this anchors do.

In the system, now we are going a little bit more deeper to understand the system. We understood about aluminum, what aluminum does and how friendly it is to use for curtain wall. We saw glass very briefly because that will be cover you know in depth in your other courses. So, glass is a good material for communication, but not limited you know. We saw in the beginning you can use anything, not only glass you can put stone you can put ceramic tile, you can put paper board, you can put copper you can put gold whatever it is. So, material choice is yours, but what we see now is briefly what commonly we use in the system.

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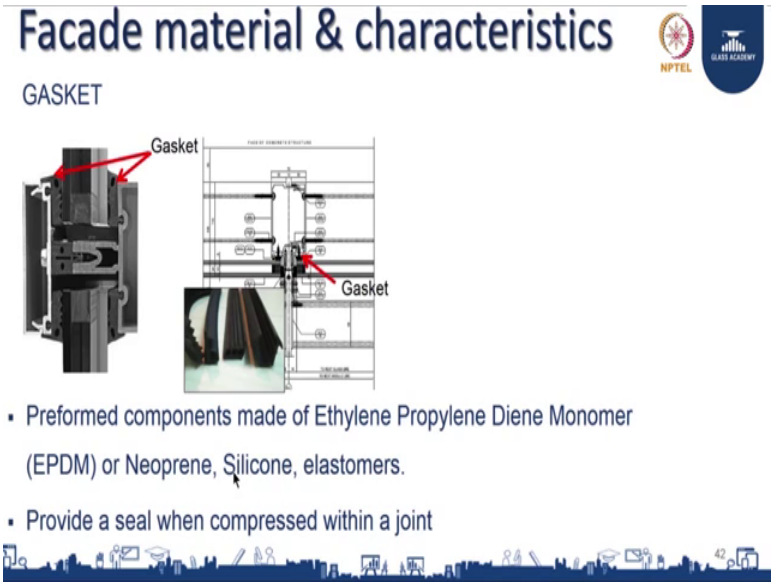

Now, you talk about gaskets. What gasket does, what is the gasket? See any material when you put them together there is a abrasion and you have to separate them. If you do not separate metal to metal what will happen they will start making noise they we will start binding together they will sometime you know we excess heat is there you go automatically to go one (Refer Time: 15:20) both together. So, we have to separate them,

we have to keep them separate at the same time taking care of little bit of expansion and contraction in different direction. So, good material available is called EPDM Ethylene Propylene Diene Monomer are neoprene or silicon or elestomers. So, this kind of special rubber which takes care of this function, which acts as a seal, but at the same time it expands and contracts with system and it wedges through like what you see over here. This gaskets are used as a wedge and this is the glass so, there are 2 gaskets in the system which wedges them together, it means they keep them together.

But at the same time it will allow the system to more say, if there is something is happening with the moment the glass can move, but it keeps under the friction. So, different types of gaskets are available. People have to understand and design what is a requirement, where I have to you know put the gasket.

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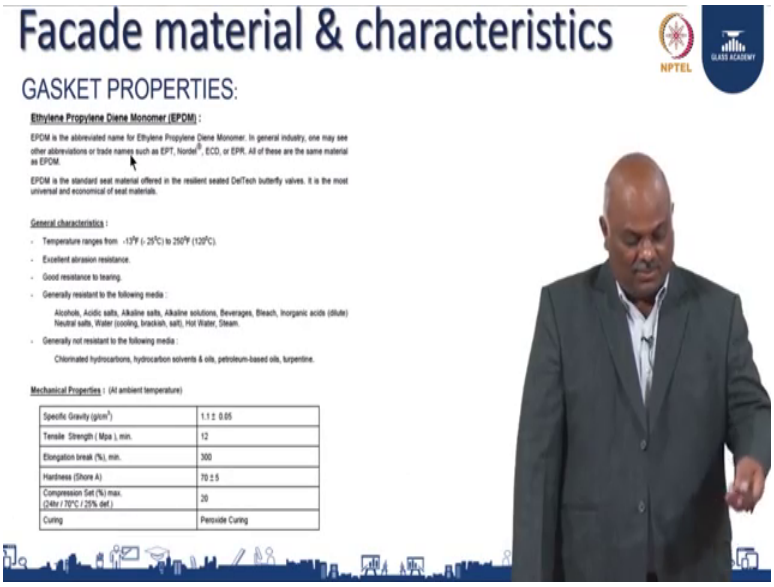

So, these are the properties you know if you run through you will see you know EPDM and again choice of gasket and it is hardness depends on your requirement it is not something you know you just get it optional and put it them.

So, you design it you understand what is the strength I need whether it has to be 2 flexible or I want it harder. So, increase the hardness of the rubber, whereas, a rubber it is EPDM or silicon or whatever material you have. So, you the choice of elasticity you choose these are the factors you see here elongation, how long you want to elongate when you want that to break. What is hardness you can put 2 hard gasket into a cavity

where there is lot of expansion then there is a glass against with the glass will tend to break. So, we need to have a flexibility also. So, designing a gasket place a very key important factor in the system.

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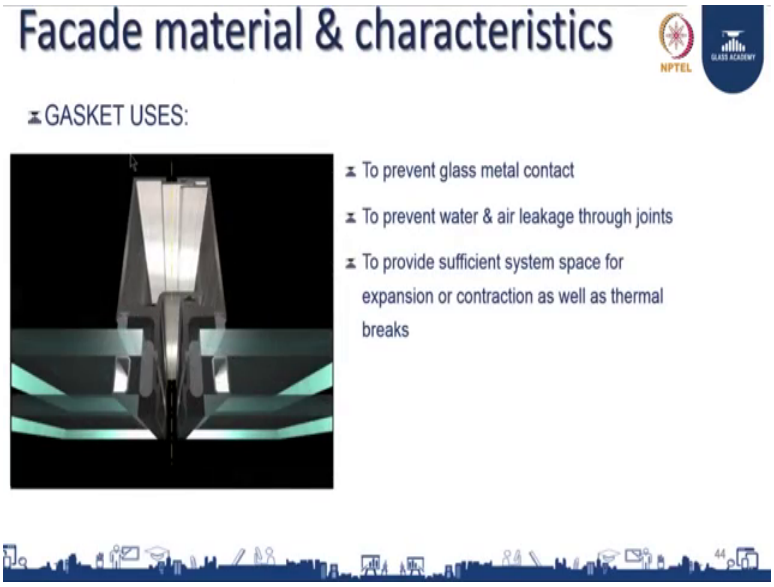

Like example, if you see here there is a mullion which moves, you see that black color thing here what you see over this is a gasket. So, here what it does? It acts as a thermal barrier as well as material contact. Because there are 2 aluminum this is a aluminum mullion split mullion and there is a leg. If you do not have a gasket here what will happen there is a thermal bridge plus metal to metal contact it is worst. So, you keep the gasket as a barrier. What it does? It splits again same time you know these are the joint where air can go through, you know heat can go through. So, you rubber is a good conductor, the means it does not conduct heat inside it is a barrier. So, you create more gaskets here do not let any heat or air or water to go through.

So, gaskets play a very important role when you are design. It not only acts as a separate, but it controls air water through the joints. And also to create expansion in the system it prevents from thermal cracks.

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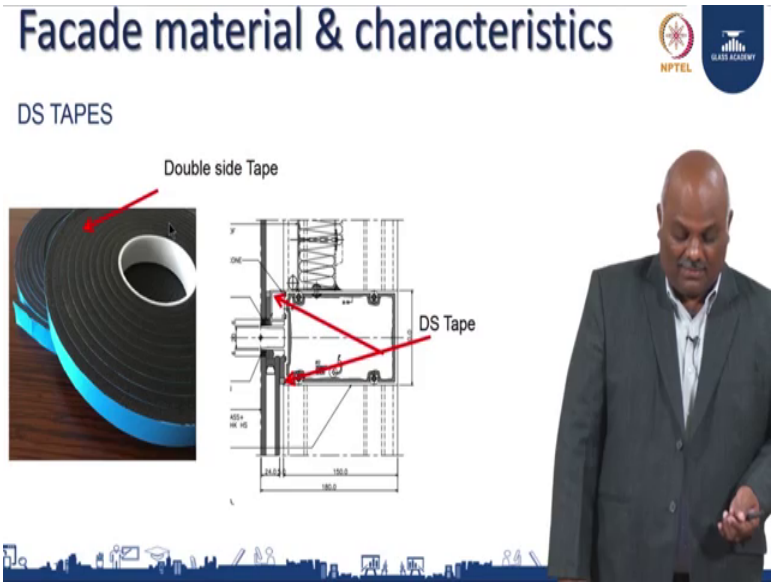

Now, we are going little bit more to understand about the system, yes we saw about gaskets and how they work. Now we are going to see how the bonding of glass takes place in this advance system. We saw stick system where you know the mechanically held the glass. Then in semi unitize and unitize they found a way to glue the glass to the frame or glue anything material through the main grid. So, how you do that? So, the process starts with this.

So, before even they can glue they have to understand the requirement there are of requirements there structurally as well as with weather with all the other factors. So, you need a system where you can bond the material to your main frame. So, I have a gride of aluminum, create and we saw, but I need something which to keep them together. Mechanically yes we can hold them together like what you see here.

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See example what you see here, this is mechanically held there is no gluing. So, they are gasket a wet gasket, then they have a glass and then they have a mechanical system which compresses on both side. So, your glass is held mechanically not glued on.

But we cannot keep on doing this mechanically fixing them at site and keep doing. So, the invention went into find a system which can glue. So, to create that yes if you see here, this is what the color structural seal at, we will see them in the next few slides. So, this is the glue they used to glue the glass or any other material to your main system what you see here. To get this sealant there you need a space, you needs a flow able glue where you pump through a nozzle. So, it goes in. So, for that yes there is a way you calculate how much of sealant need to be there to hold this glass via calculation, but to create that cavity or to create the space first thing you need to this double side tape. What is a double side tape?

A tape, a foam which got glue on both sides that is how simple. You put the step in this place and then you glue the glass. So, that their space you created for the glue. So, you create a space required for the sealant to travel. So, you put the double side tape and then you glue the glass to the frame temporary hold it there. Then what happens you are ready to apply a sealant. A sealant is here what you see. So, you have to pump this through a joint whatever detail you have done, but this double side tape is very crucial because it keeps the glass away from the frame so, that you the required sealant can be pump

through the joint. So, double side tape is important as wherein yes we have putting into the system.

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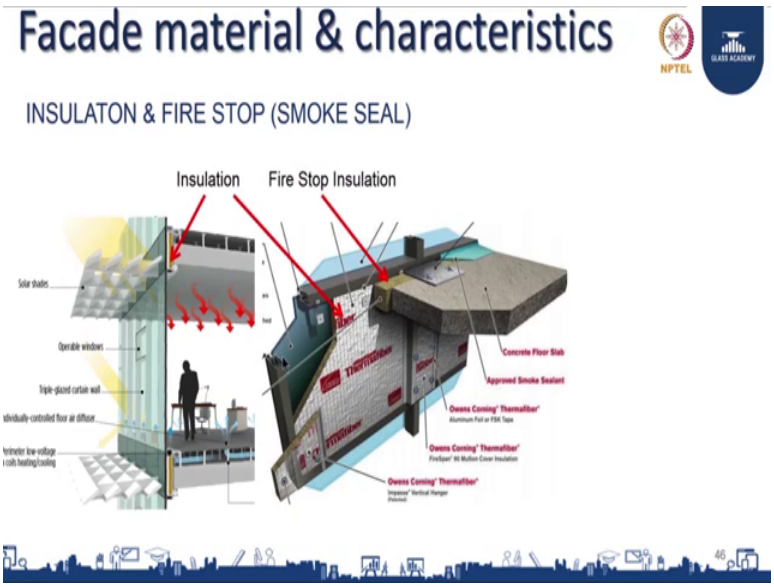

Then a different topic altogether, but here also when you start looking at building there are lot of factors involved one of the major factor we spoke about factors affecting from external. So, when water, whatever comes out heat. So, you design a system it is takes care of all those.

But now, what will happening if there is a fire inside the system inside the building. So, you cannot put the whole building at risk. So, you have to design a system which can contain the fire within the floor space or within the room space so, that the fire can be contained easily. If there is a spread, then whole building will go for at all; however, glass there are different glasses available today to take care of fire not to spread is very expensive, but commonly used glass you know they do not stand even for 5 10 minute they will break. So, hence letting the fire to keep bridging.

So, in this images if you start to see, they have systems available to stop the fire spreading to floor to floor. So, it means what will happen there is a curtain wall what you what you saw in the previous slides. I will go there to show to you, example here. So, your curtain wall attachment now you see here what happened there is a gap between these 2 sometime 50, sometime 100 whatever. So, this gap is through gap from the floor below. So, you have to seal the gap by means of a fire stop, rs smoke seal commonly in

all the buildings you do not use the fire stop because your system is not fire rated. Unless your system is fire rated the hourly fire rated system may 1 hour, 2 hour, 3 hour whatever, but in any common building you see mainly they use non fire rated wall earlier your wall cannot withstand any rating. So, either they are half an hour or less or even 5 minutes.

So, your system what you are going to do between the slab you should call that first a smoke seal, when the smoke seal means first you should prevent the neighbors or the people above the floor or below the floor not get suffocated. Second you are to make sure the smoke is contained within the floor below not to get spreads. So, you seal the joint by means of non combustible material. So, which is which is called a fire stop insulation even you do not let the fire to spread. So, you can call this as a fire stop, but you your prime important things over there are to be first smoke. Because the first killer in a fire smoke, if there is a fire lot of people get injured first with this smoke they cannot inhale and then you know they (Refer Time: 24:45) decision you know a worst thing happens.

So, smoke it is the first thing you have to take care then fire. So, fire spread and smoke seal have to be contained within the floor. Hence you know the fire stop and design of fire stop is very crucial, between floor to floor or between wall between an adjacent rooms. So, the design have to take care of all those things and these are the material available. They have you know mineral wool they call they have the rock wool they are all made of non combustible material. So, they use that and you know trig the joints properly with the proper design. So, when you design a system, these are the factors you have to take care it is not just simply moving on.

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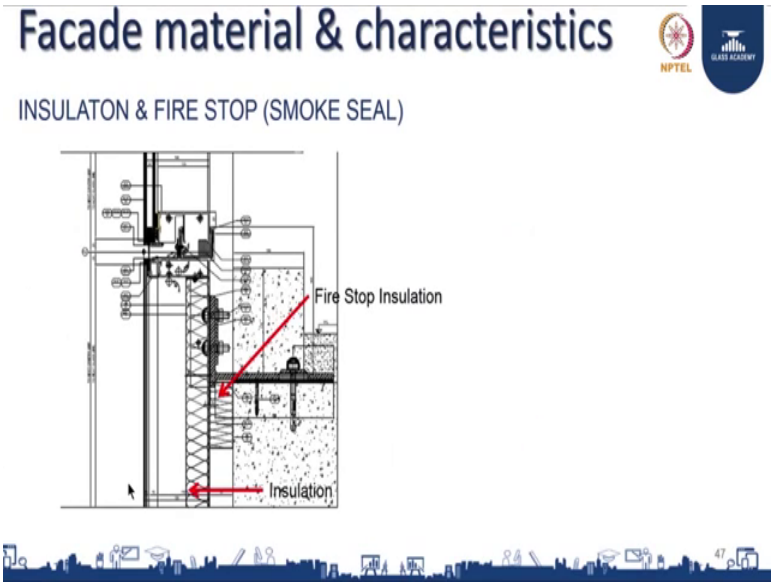

So now you see this gap here whatever I shown in this previous video. So, there is a gap between the wall and the mother slab or mother building. So, this gap is now filled with the fire insulation, fire stop insulation or smoke seal whatever we call. So, the insulation takes care of is the fire spread; that means, you have a compact head system inside, you know it you know just you know it is compressed within the floor capped with a tray or some other system. So, the smoke does not go from below. And the fire spread also has being a non combustible material. It does not let the fire to spread to the next floor. So, it is both together.

And then you also can see one more insulation here, this we call as spandrel zone it is means known as spandrel you create as panel at the floor level to hide the structure behind or you create that as a standard the system where you do not let the fire to spread between floor to floor. So, your spandrel design plays also key role while you are designing a facade. You cannot just simply say I want to put glass all the way because glass with brakes unless you have a fire rated glass. The normal glass will break when there is fire immediately it will break. So, it is advisable always see, normally a fire spread takes 1.2 meter you know when it goes from floor above to floor below. So, a common practice is to have a good spandrel zone insulated. So, the fire you know takes time to spread to the next floor. So, it gets contained, the idea of all this fire stop smokes you know insulation, they should contain the fire within the floor where the fire happens.

And not only that of course, this insulation also plays an big role in form of thermal. So, when the glass was going on there they may be talk to you about more about thermal and comfort and so on so, forth they also play a major role being non combustible. They also good in servicing heat they mix they do not get a heat to travel through. That because it is a non combustible and the non transfer of the material it does not transfer heat. So, it is a good heat retire and as well. So, your smokes here plays a fire stop plays a crucial role in your design and it has to be done properly otherwise if they in case of eventual accident the flow belonging the whole building will be going for a toss.

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These are various examples of fire stop, how they do it is slab and then the seal it with the rock wool, mineral wool. So, this is the systems available for them you know depends on the detailing required by architect and client you design your fire stop system.

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This is openable windows how you attach then there are hardwares available. I do not want to go in depth because the big subject on it is own, but you create openings why you create opening you know in a wall if you have a complete wall of course, you know if any you know anything happens internally like you know ac is not working here we can make some openings and valves.

So, you let fresh air to come, but there are theories available in this part of the world. Which is you know personally I do not thing it is right, in the a most of the building you see the lot of openable windows, they do not work first of all when you ask them why you are providing, because for fire. I do not understand the relationship between fire and openables. However, is a debate going on for years. So, openable helps you to get more added side from outside. So, creating the openable in the façade, here there are lot of hardwares available to attached them to a wall. So, there is a design when you design them you have to take care of those allowance.

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Now, we will go in depth to understand each and every single material. What they do, how they help as I already we have seen, but we will go down in depth to see that.

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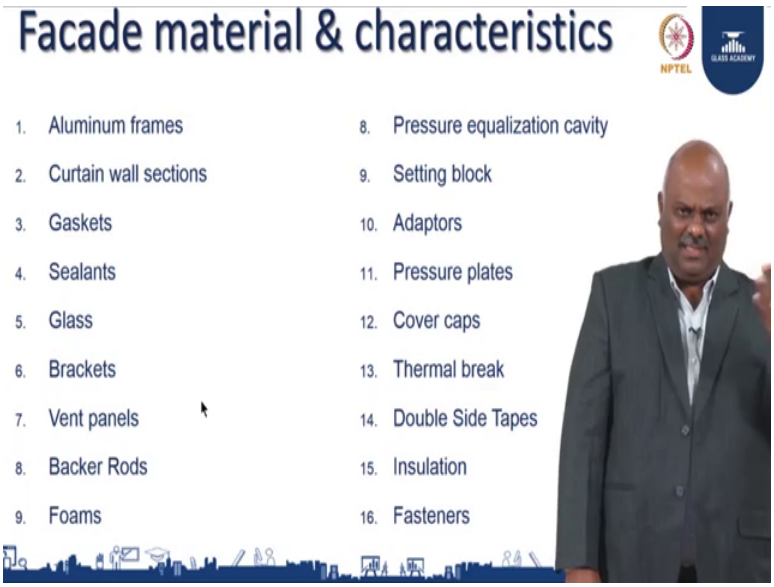

Those are all things you know we put them together, see to make one system. One catalog how many 16 of things are available, these are the factors you know you look into when you are you know starting with this an aluminum frame curtain wall section, gaskets, sealant, glass, brackets, vent panel, backer rods, foam, fasteners, insulation. So, there is a checklist you know I keep doing.

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