Glass in buildings : Design and Application
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Lecture - 50
Facade Fundamentals

So, we are going to discuss about Facades and Fundamental of Facade. So, I am Selvam. I am part of a glass academy board. So, this subject is purely to understand the basics of facade and just to highlight you how the facade element plays a important role in our building first what is façade.

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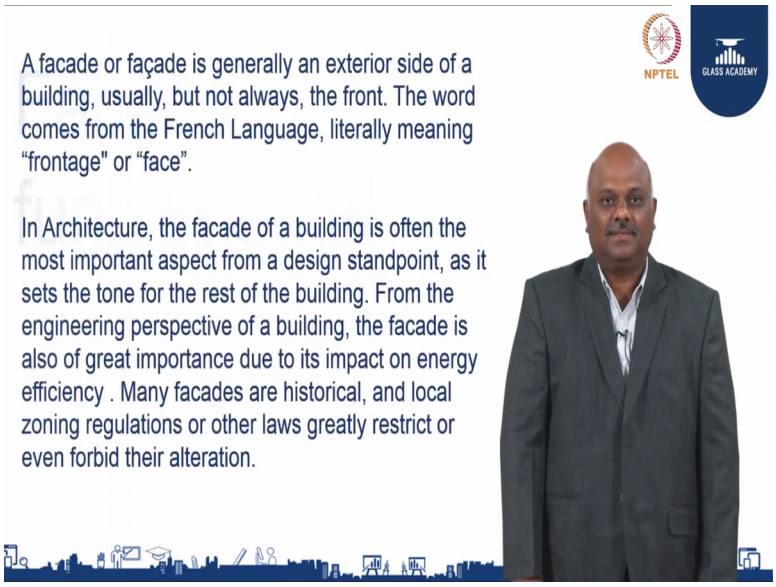

A facade is generally an exterior side of a building, usually, but not always, the front. And word French it is called frontage or face of a building like our "face".

So, building got different forms of faces. First in architecture a facade of a building is often most important aspect from a design standpoint. As it sets the tone for rest of the building, as it says yes a building is of a good facade will have lot of yield in form of savings, in form of energy and lot of complier and other things.

From engineering perspective of course, facade plays a bigger role. It shelters the building against lot of energy impact which you know, it is a nature many facade are historical and local zoning regulations. And, it is governed by most of the time local

bodies, when I say local body the government and the terrain and to lot of those parameters who govern the facade.

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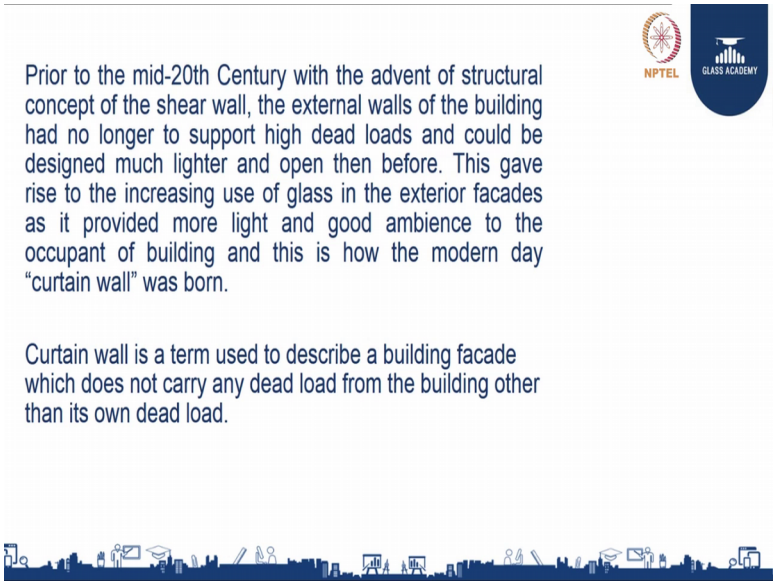

In mid-century is on a twentieth century a structural concept been there just going to a shear wall a external walls of the building. No longer had support high dead loads and it could be designed much lighter open then before. In olden days of course, you can see the whole facade wall like a palaces like fort, there they use the wall as an structural element. But, nowadays we are finding ways to minimize that amount of load and hence making it much lighter. So, that invention has given rise to finding use of glass as a material and so and so forth. There are lot of materials involved in forming this new breed facade systems.

Curtain wall term is used to describe a building facade which does not carry any dead load from the building other than it is own weight. So, it did just non load bearing wall which is attached as a skin, but it should take care of lot of other factors which governs the building function.

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Now, let us start looking at transformation of façade, how we transformed? Let us go back to what we believe we are and so, this is the transformation taken place with us. So, I always like to compare ourselves to a building, because I believe the building is in a live form it lives, like us it breaths, it contracts, it expands and moves. So, when you believe it almost same like us.

So, when we look at old ages yes there is a first known manmade stone house maybe something else would have been there. Then, yes the marvels what people believe they built? A nice facade you can see here pyramid and the other things of course, it shelter lot of ah a good things inside the tomb, but that is a good stone façade. Same here if you see during those days they used leather as an facade for sheltering them self, against adverse climate. Eskimos of course, you know they used ice itself as a igloo and then they started living there.

Then, came slowly where this is where you know they started building a structure, where the facade became more of a load bearing system. Then, yes they added light vent everything to the facade to bring in more of natural element into the building, that then got transformed to much more colonial type of structures, where this facade have taken lot of transformation. And, today that is what we are you can see a buildings slender tall light, but taking care of all the other factors which affect the building function. So, today this is what we have.

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Now, look at various habitats like us what they do? Where they live? And, what is a façade? Look at ant nest. It carries lot of function and of course, they live inside, but it protects them against the weather look at birds nest. It is cuckoo bird nest is one amazing thing which keeps the bird away from all natural disasters you know like rain water wind everything they hang there and it is been built by them, but still we cannot find a way, how they make those things you know to stand against all these weather conditions bee hive spider web.

Then of course, from there the human being started learning, how we can build a shelter for our self. Then came a form of hut, they use straws, grass, wood, whatever they can find to form the hut. And, then yes they went to find a way to build a stronger structures is using stone and other material.

So, the life have transformed as well as the facade element or the skin of the building or skin of a dwelling have transformed in various ways.

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Now nature has given so, much to habitat where our living habitats have started to build their own shelters to comfort them from ok, this is a nice picture we can see a cat inside a boot. Of course, she feels comfortable inside she feel warm maybe; however, they take I have to take care of a environmental impacts. What are environmental impacts? Not limited to though wind, then we have rain, then you have seismic things happening, then lot of factors environmental impacts are something which you cannot really predict what will happen you know, when a wind blows we will not be able to really justify our self ok. This is how the wind pattern is going to be or wind is going to be stronger or lighter.

Then climate conditions of course, a facade have to take care of all the climate conditions, but it has to be well design in a way that it is taking care of the local terrain. We can as say example do a facade considering a different climate conditions and then say I have done this because it was done elsewhere. So, we had to be very careful when an approaching this facade.

So, climate condition play a very big role in while you design the facades comfort and privacy what are those of course, if I put a glass, I do not want not in my bedroom wall where I want to see the outside what are people to pick in. So, we need to see the privacy factors as well how to design it, what sort of glass I can use or I can put something else to blank it off comfort.

Of course, we do not want to stay in a building or in a house or in a office, where you know you start to hear. So, many things happening around you like noises around the building or traffic or anything of that kind. So, you need to have a design which takes care of comfort as well as privacy for the dwellers. And, now most importantly safety and structural stability, whatever we design it has to be designed for the building life cycle say 30 years or 50 years.

So, the material what you choose and the system what you build have to be focused first start with safety, structural stability, at the same time look at the life expectancy of the other thing. So, your choice of facade this small things you can group together to bring up a system.

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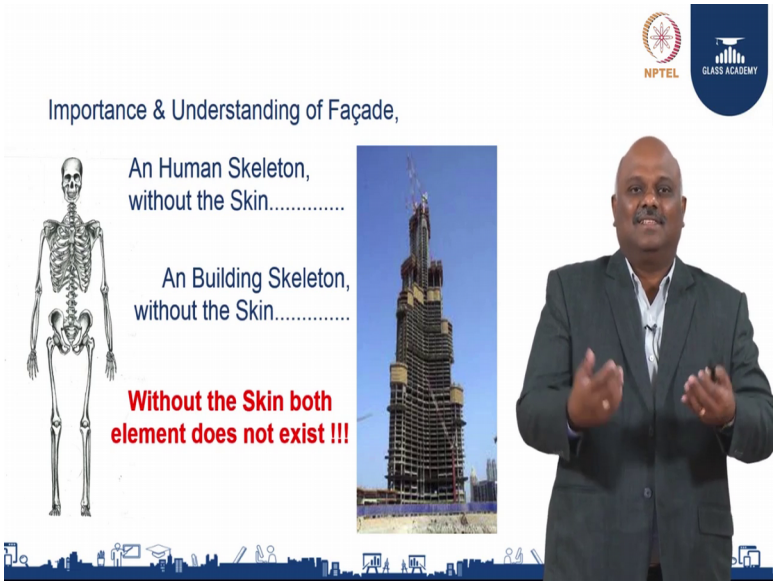

Next, understanding about facade, as I said in the beginning I always look at building like equal to us our self. Now, let us look at a human skeleton. Say a skeleton does not have a life no form it is a skeleton. So, human skeleton without a skin imagine. The same way you imagine a building without a skin. So, they do not function we you cannot stay in it you it does not work right. So, without skin both of these elements does not exist, I they do not help you. So, you need a skin not only a skin, but still lot of things which goes inside. So, if I compare our human. So, what are the parts, which goes inside?

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So, if I go little bit more to understand a human skeleton. Now, if you see it got nerves, flesh and bone everything the life organs they are, I look at them like the main systems of the building, bone and other things considered to be a structure along with that all the nerving system which you call your electrical, your plumbing, your fire all other things which parts which forms part of the building I consider as the main nerve system.

So, now apply a skin. So, without the skin again the body does not function. So, a skin protects all the important system of our body, whether it is your heart lung your nerve system and everything. So, now, I hope you all can understand how important a facade is? So, the sad thought also is people do not give attention to detail.

They always feel like you have done a structure, facade I do not I do not bother put something else as now is building get closed, but if you have understand the importance of having seeing our self how we function? How our body is made, then you will understand the importance of facade in a building.

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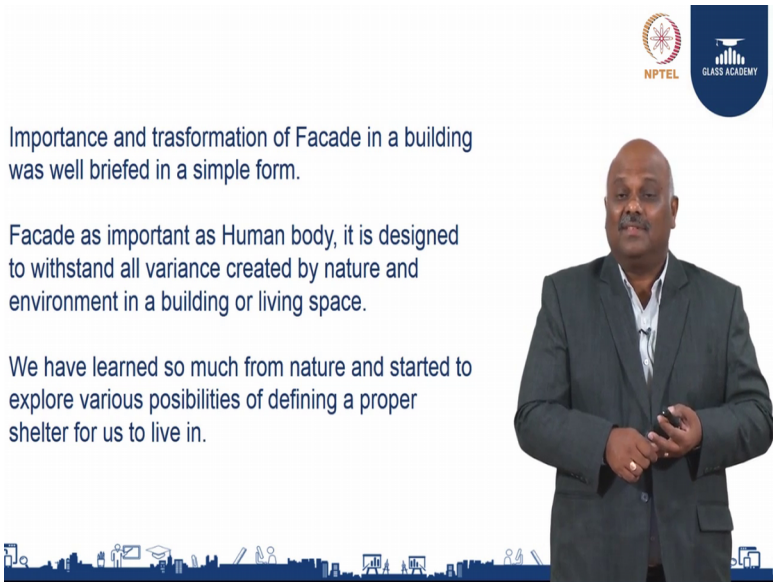

Importance and transformation of facade in a building was well briefed in a simple form that is what I did.

So, to make ourselves to understand easy at the same time how important is facade, I have taken ourselves compared. Facade as important as human body it is designed withstand all variance created by nature and environment in a building or living space. Of course, a facade is not just a simple element which stays dead there. It has to react to the weather condition; it has to communicate to the outside world it has to you know live within the environment.

So, that is how facade plays a important role. We have learnt so, much from the nature and start a explore various possibilities of defining a proper shelter for us to live in. Of course, the trends are changing today, we are going back to find what are the best possible ways. We can improve our livelihood look at our self today we cage our self-inside buildings with air condition with light with so and so forth.

Back go back in old ages what they did not had electricity they did not had anything else, but they lived happily, they lived healthy. So, what they did they went to design things which bring them more environmental I like light, like wind, like bit, if heat. So, they made the comfort they use that comfort, but today we are trying to create a comfort by means of inventions. So, the balancing of environment against the invention is very critical and is very important when you start designing a façade.

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Now, let us see some of the materials, which is been used in facade systems. As, I said the skin can be of any form. But, during evaluation if you start to see they use husk that was the prime thing they have done in an olden days they go to forest they pick up the leaves, trunk, they have started building up.

And, then they started using leather ok. Then the animal gets killed for their food or anything, they use their skin as a shelter it is a good shelter of course, it gives a little bit of warmth and then they started using stone. When human being started to understand how to put stone together, then they started building facade wall with stone that become a bearing structure. Then came slowly you know steel, then we have timber, now when you now we have started using aluminium brass.

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Ceramic like the ceramic ceramic tiles, they have copper, paper; paper also now been used as a facade component. Glass of course, is one of the prime substitute, because it plays a major role in communication.

When, I say communication people can communicate to the outside world through glass because glass you know it is transparent. And, you start to see the outside world. So, the invention also helped in a way to keep the dwellers or the people. With the comfort of communicating to the outside world, yes stainless steel gold example zinc. So, that is what limitation that is what I am trying to explain with material; material is a choice, if you know how to engineer it if you know how to form it to put it into the a facade system. That is how they proven they have gone beyond a types of material got changed and the invention is still going on. So, your choice of material plays a major role as well in while you are designing a facade or understanding a façade.

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So, these are the things which you know governs the material as well. Now, today if I am going to choose a material, what it has to be it has to be stronger, strength on it has to have a strength which can with stand the environmental impact. Second, it has to be malleable you know you used to be able to work around that material.

It should not be hard enough where you know you start to work, then it breaks or it get distorted or whatever, it should be easily made up of easy to machine it, using a machine, stronger and less weight. If get the more weight you create and then you spend more money and more into your building or structure whatever you are building up; so, it has to be less in weight, but stronger good conductor. It should be a good conductor of any environmental impacts and it should expand as well because the building they breath they move.

So, your system or the facade what you design have to have all these compatibility and corrosion resistance that is very important, because your environment carries lot of pollution. So, whatever material you choose it has to be corrosion resistance, because your air is polluted your complete environment is polluted today. So, with material what you choose have to withstand those. And, it should be non-magnetic, if it is magnetic of course, you know what will happen to you building and non-toxic and recyclable. That is more important, you know even if any accidents you know happen or fire it should not be toxic.

See now what is happening? This became a prime discussion today all around the world as I speak today yes it is a debate going around the world.

Recently as there are lot of accidents happened and now the world woken up oh god I have chosen a material, but it became toxic lot of people die. So, the cladding material choice is not just simply to (Refer Time: 17:26) first, but it is more towards safety as well. So, non-toxic, but unfortunately today people do not understand those factors, but they start picking up material which will hurt them.

So, facade elements in the simple form the material choice, if you ask me and what I would recommend or I would strongly suggest use material, which are non-combustible. The word non-combustible should give you lot of things it means it should not burn. Even you touch it even you know any electrical damages happened, the material what you choose should not create any form of additional impact. It can break or do something, but it should not burn. So, non-combustible material is a choice that is the only way you can have a beautiful façade, which helps which covers you and keeps the building going up and recycle over.

Once, you start to see one of the material getting deteriorated you should be able to recycle and bring it back because there is no more place left in the universe to go and stockpile all over rubbish. So, we should find a way material or a choice of material should be recycled. All the material today whatever they use most of them are recyclable example glass you can recycle it 100 percent aluminum 100 percent. So, all the material most of them, which you will see in further discussion, when we are going at the presentation.

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So, hope until here we have seen what a material as how the material have transformed and what are the factors which govern them and your choice of material.

So, when you are designing a facade the importance you would have seen it material choice you have seen availability of material, the invention everything you have run through in the program you have seen it, but the choice is ours choosing the right thing. So, until here we touch base clearly what is facade and how important it is for a building and what are the materials, which were used in today's world or in the past to create a building shelter.

So, now, look at you know let us start looking at the important aspect ok. We have seen the material; we understand what is the facade now, how I am going to design a system? The system when you design not limited to what is written here of course, it should be structurally safe, it should perform well structurally it has to be seismic proof as much as possible.

And, thermal expansion of course, when you talk about thermal expansion it is a good subject. Whatever material you choose it has to withstand on climate condition say a example there. So, much of heat it is should when heat is there metal trying to expand like us when you breathe as I expand. And, then I contract when I get colder the material in same, when I inhale then I get you know going in. So, inhale and exhale same with metal they breath when there is heat they expand. So, the system what you choose or

material you what you choose should be able to expand and contract without effecting the performance of the building.

Corrosion as I spoke a material should not corrode then it will become a risk for the building, it will collapse, movement. What are movements available of course, the building move? When there is a seismic a building starts to move, when there is a seismic force acting on in the ground are normally with wind a building move, if you look at tall structures. If, you start restraining yourself against the wind then your structure will become very very strong which you cannot design.

So, today the designers gone forward to design buildings they are flexible, which can move against your wind or any form of movement which happens or unlike seismic movement structure creep. Of course, today when you talk about concrete, it is creep happens to the concrete. Throughout the life cycle they start to shrink you know in the beginning of at least, now when after the structure casting everything is over they try to shrink little bit. So, the designer have to take care of that.

Then internal comfort as I said what are all comfort factors, you can keep on telling I would like to have a wall, which should talk to me ok. What a wall can how the wall can talk yeah. Today, there is technology available a glass wall which faces exterior. Can be a medium wall it can talk to you I mean it can be there can be a tv, but it is attached to it. So, comfort you know there are lot of actors I do not want to hear outside noise. So, I want a silent glass I do not want the heat to come in yes I want to have a uv glass.

So, the comfort is not getting limited day by day the requester for comfort is building up. So, we need to find material, we have to design for all these. And, it should be light weight as I said in the beginning. If it is not light weight then you start adding more weight to the system. So, your building will not perform they will get heavier and heavier they do not move.

And of course, it has to be commercially viable and also it should resist the other impacts of nature. So, when you design you know there are unknown factors, you do not know suddenly one fine day you will see the whole environmental condition changed, around your around your place of dwelling or due to the terrine condition your whole wind pattern got changed. So, we have to think all those when you know start designing any building facade. So, there are lot of process involved while designing a façade, it is not

just simply put a building you just put some glass and metal panel and done with that no I design a facade carries lot of requirements.

So, I will play a small video now to show you are proof, what I said like it building breath or building move.

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Ok. Now, you can watch closely how that black building is moving. This is a live video shot in Japan, you know in Japan always there is seismic movement every half an hour. This is a 50 plus floor building, if you watch the building very closely see how it moves. So, the system what you design or the building what you design should with stand all this movement.

So, facade you look at there is nothing happening to the façade; glass is fine all the things are designed fine. So, these seismic movements can happen anywhere any part of the world. So, the design of have to take care of all this factors when you are designing it

So, a material transformation have taken place, but material when they design have to consider all these not only these wind rain. So, when there is wind there is water, when there is water you lot of factors will govern it you know we should create a shelter for all this. So, your design of façade plays a very important role yes you can have a beautiful building, if you do not know how to design your facade right then yes your building will start to deteriorate immediately.

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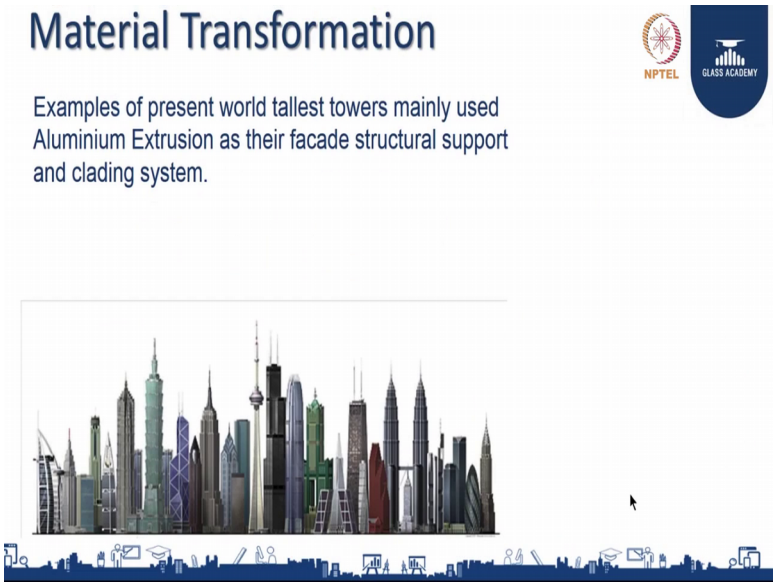

Examples now, now you can have put up a collection of world's tallest building. You can see they are tall they are big you know they are 100 floors they are now I believe in the world they are planning to create a 1 kilometer tall building. So, s challenge is there because the urban development has gone. So, big the population is grown. So, people are trying to see how I can create vertical buildings, because there is no more land mass available for us to create.

So, people wanted to go vertical. So, when you go taller, then your building have to have lot of controls you know lot of points you have to think while designing a facade. So, it is not just simply you can choose anything and put in this kind of building. So, you have to run lot of test your have to understand you know which material will perform well in this building.

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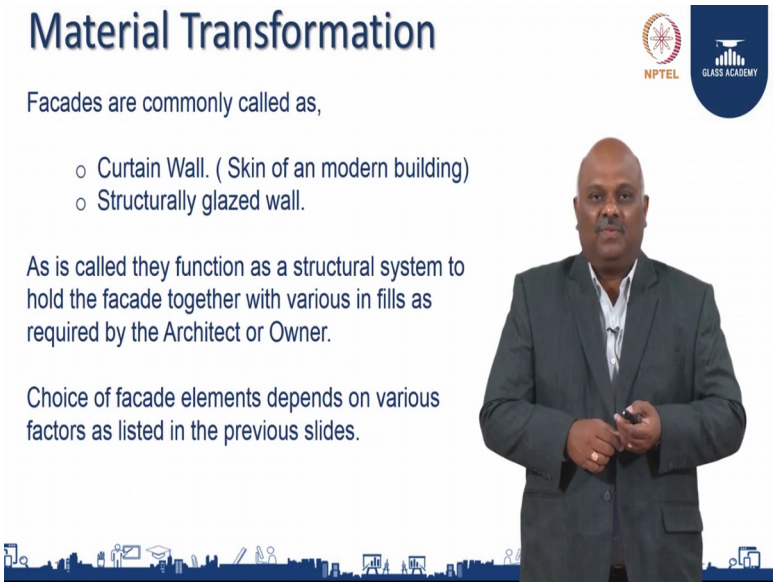

Facades are commonly called as curtain wall, skin of a modern building a structurally glazed one. This is the common word today they use around the world, how you call a wall, as is call the function as a structural system to hold the facade together with various in fields as required by architect owner.

Yes, when I design a facade there are there is a commercial ah viability also have to be taken into account not only that like us, yes see here I am dressed today with a blazer, with a shirt, it adds more presentable a future like same to the building. So, you want the building to be presentable to the outside world you want the building to be you know in a better form, where you know people will start looking at the building and start you know moving inside. So, the façade plays a very important role, you know you can use a facade to invite people you can use a facade to you know invite environment around you.

So, today there are lot of things can be done with facade. So, choice of facade element depend on various factor as listed in the previous slide. So, your choice yes the requirement is there by client and architect, but the choice is limited to the elements what you choose you cannot have an unviable selection, where you want to put in on the facade and the structure cannot support. So, your choice and the elements what you choose have to have an simple compatibility, then only you will be able to create a better façade.

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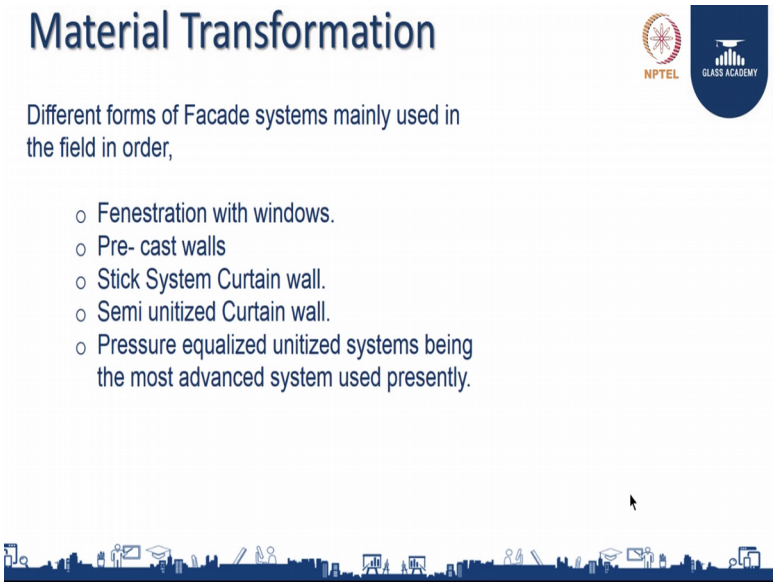

So, now we are going to talk about different forms of facade hope until here we are clear where we started, we understood how the environment impacts the façade? What are the different kinds of movements happening to rebuilding which the design I have to take care or the facade have to take care of those. Now, we are going to talk about different form of facade systems mainly used in a field in order.

So, it started with fenestration with windows what is fenestration yes of course, you make a opening on the wall you fenestrate. Then, you put a window that is how they started you had a brick wall or a solid wall or stone wall they made a opening. And, then they put a window there before glass was invented of course, they had wooden windows they have jalis or you know some sort of barriers, but they wanted only air and light to come in.

So, then they started to understand you know how we can change the things. So, like instead of brickwork and stone work they went to do pre cast wall pre cast it is just like an I do it do a wall in your factory and you attach to the building you precast system. So, then came the invention of the stick system curtain wall. When we talk about a stick system curtain wall curtain wall the term we discussed what is stick? You know you stick something and on to the wall.

So, you create a grid and then you stick something. So, as the name specifies a stick curtain wall. So, you have a wall with a stick on system then as the invention went up.

So, we started slowly you know building up with invention then they called a semi unitized curtain wall.

Later we will you know ah go in depth to understand what is the stick system and semi unitized. Now, the trend when I say now not today maybe for last 40 50 years or more they developed a system, which takes care of all those what we saw the movement, the creep so, called expansion contraction. So, the advanced system what is available today, where people wisely use for doing all these taller or shorter whatever building form it is called pressure equalized unitized system.

So, later when we go through this presentation you will start to understand, what are the pros and cons of each system? And, how they perform and why the transformation are happened for what is the reason, that is what we are going to see.

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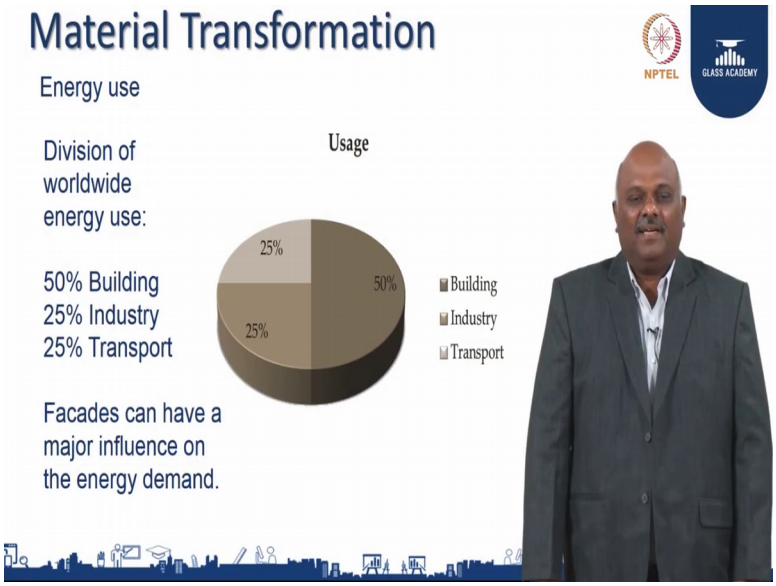

Prior to that I just added the slide to show how the facades influence a building? Look at the chart 50 percent of energy consumed today this was a old slide maybe today it is little bit more, but all around the world this is the factor of 50 percent of energy is consumed in buildings, when I say building your house your office spaces you commercial retail whatever you call 25 percent is only to the industry and 25 percent to transport. So, look at it we have lived in a environment without energy, but today we spend more money and more energy to buy energy and spend.

So, that comfort is what now you are return by the now world realize this. So, they are going for reusable energy, they trying to find energy source, where they will be able to compensate. How much fossil fuel we can burn it is all over the more you go and take you earth is getting weaker.

So, they started going with wind they started going with how understanding how I can use a sunlight more efficiently, but think why we cannot go back to olden days. Say a example in this part of the world a place like say Bangalore. Throughout the year the temperature there is very moderate maybe a 3 months or 4 months in a year yes it goes slightly closer to 26 to 30 degrees, but rest of the year it is colder, but why I still need a AC. Why I need to energize the building (Refer Time: 32:39) why I cannot use fresh air think about it.

So, why I introduce the slide is to tell you how reverse we are you know going in our living we are trying to kill ourselves by over doing it. So, let us start going back to the past learn from there understand about the material use material which can breathe which can bring in more air and more light.