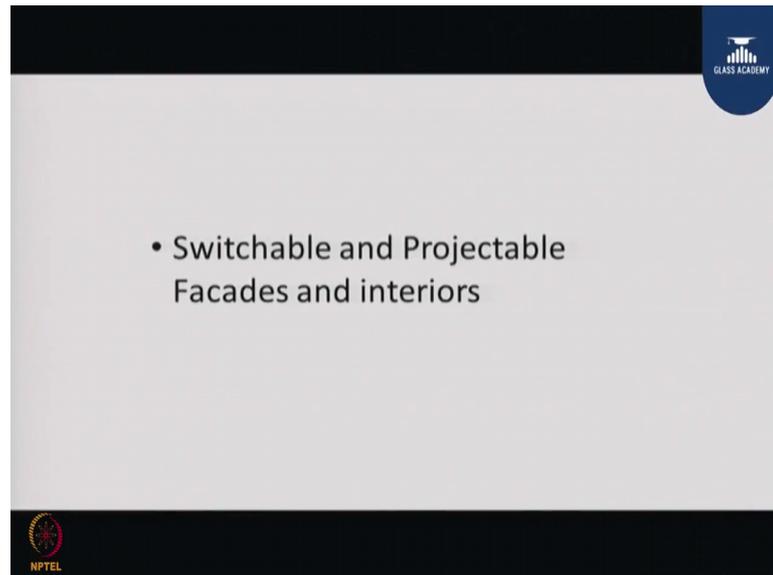


**Glass in Buildings : Design and Application**  
**Prof. Manish Sisodia**  
**Department of Civil Engineering**  
**Indian Institute of Technology, Madras**

**Lecture – 19**  
**Innovations in Glass Future Facades**

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So, I will talk about the second technology which is a switchable and a projectable facades and which has also used for interiors. So, to set up the context this has been technology which has been there for almost like 5 years now. And then it is trying to find out the space in the market wherein these are the applications are numerous.

So, in terms of to tell you about how the technology behaves and what is this product about. So, as a general generic product name it is called as switchable glass.

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**What is Switchable Glass?**

It's an laminated active glass which under the effect of electrical current switches from transparent to opaque.

It has a liquid crystal film encapsulated between lamination layers which imparts this functionality.

A unique solution in space management  
Instantaneous control of opalescence  
Dynamic projection of videos and images

**OFF** **ON**

Labels: Glass, EVA/PVB, Liquid Crystal foil, EVA/PVB, Glass

Icons and labels:

- PRIVACY @ A TOUCH
- CE CERTIFICATE
- PRODUCTION
- SPACE SAVING
- LOW POWER CONSUMPTION
- CUSTOMIZATION
- ENVIRONMENTAL LEVEL OF TRANSPARENT
- EASY MAINTENANCE
- 3 YEAR WARRANTY

NPTEL

So, to explain you what is switchable glass? It is an active laminated glass which under the effect of electrical current switches from transparent to a opaque. And it is a liquid crystal film which is encapsulated between the lamination layers and which imparts its functionality.

So, it is an unique solution to improve the space and actually instantaneously control the opacity through the glass. So, it is like you are you are creating an on and off situation. So, if you look at this picture it explains you how this technology works. So, in an off situation these ions in the glass which has been sandwiched almost like four surfaces which are laminated, we have one glass at the top and then you have a PVB or an EVA layer; it is being laminated with the liquid crystal foil and then it is laminated again with an EVA and PVB and then there is another glass.

So, it is like a sandwiched laminated glass and then if you put it on. So, all these ion if you look at this picture the ions gets aligned and then you are able to see from inside to outside and a view condition is being created. And once it is off; so all these ions actually gets moving in random directions and there is an opaque condition which is created.

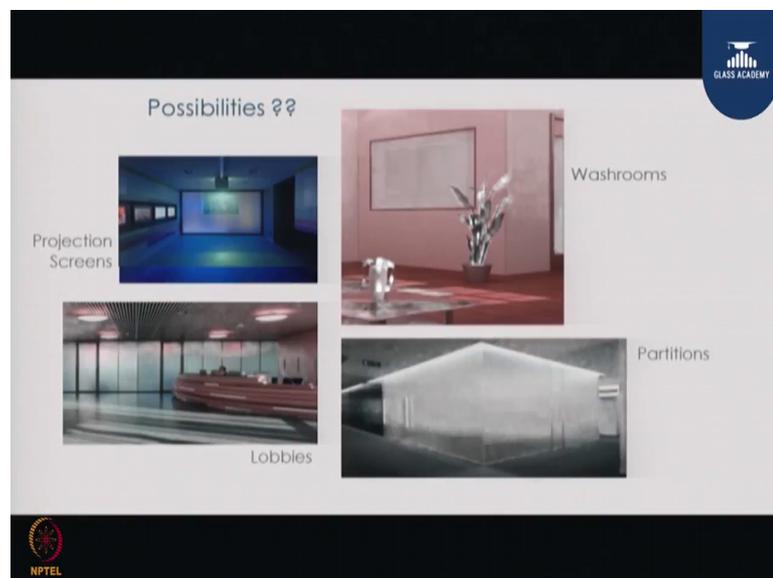
So, as a product it can offer privacy with a touch of a button; so, this is a switchable technology as compared to the technology which I have spoken to you in my earlier slides. So, this technology is switchable technology; we talked about facades which are controllable, which are then make in terms of electrochromic facades wherein this

distincting happens with the elapse time. But then this technology this is like a push of a button technology wherein by a switch of a button, you can actually make the glass opaque and transparent.

And the most important thing also as a next thing which can be done with this glasses there is a back projection which can be done on the glass. And then this glass can actually become like a bill board if you use it in the facades. You are able to do a space saving; so, I will be talking about all those applications which can be done with this glass. So, there is a huge amount of space saving which happens when you use this kind of a product.

It consumes low power; so you are not worried about your energy bills by using this kind of technology because it works on electricity. You can customize it because there are lot of now options with the with manufacturer which can actually make this in different colors and you know lot of sizes are available. And it is easy to maintain because it is a glass at the first place to it is easy to maintain.

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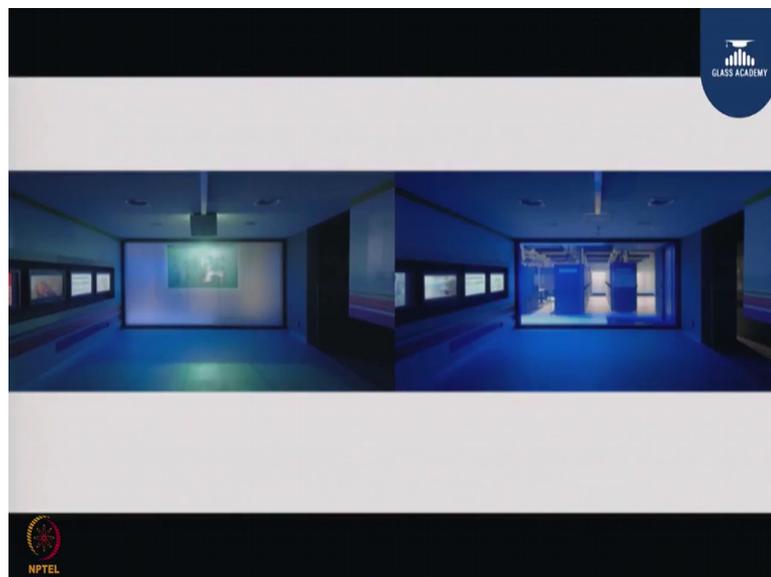


So, let us talk about some of the possibilities which can happen with this kind of product. It can be used as projection screen; yes you can do a bad projection on the glass I will show you some of the photographs; how it can be used as a projection screen. It can be used in washrooms, yes it can be used in washrooms also wherein you can actually use it in a wet area; provided that it is sealed and it is insulated.

And then can be used in lobby areas in you know you are imaging your conference rooms where which is next to the reception area. So, those areas definitely you can use this kind of a product; partitions? Yes all those it buildings which are which has lot of this glass partitions and you are able to do a space saving by using this kind of product in the partitions also.

So, let me show you some of the photographs how this possibilities can be done with this kind of a product.

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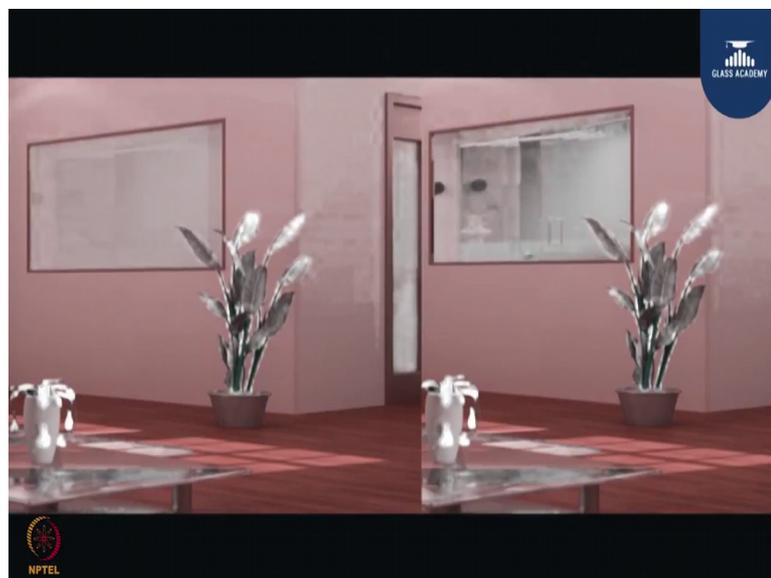
So, imagine now this; so, this is a data center wherein you know you are you have put this glass at the first place and then you if you switch it on you can see what is happening to the center.

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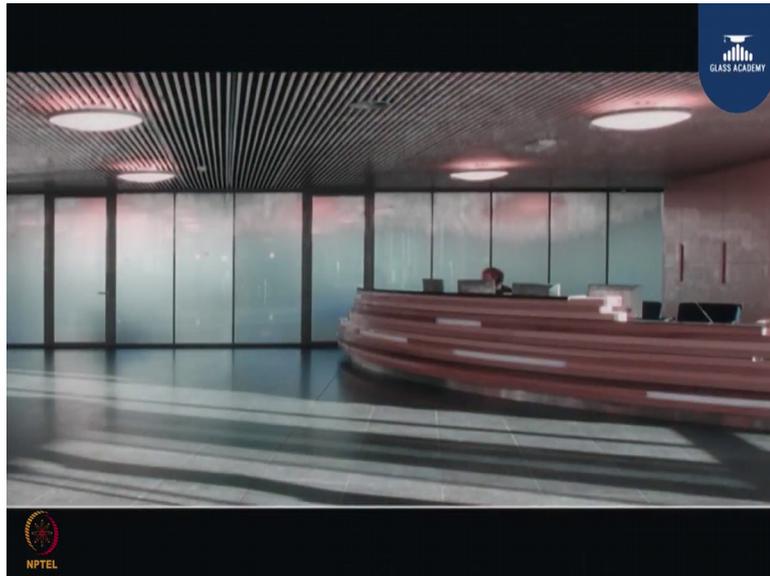
So, this is a kitchen area application you know you can actually put it in the partition and then you can see from whenever you want to have a vision, you can actually create a vision through this glass.

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So, this is a washroom area application wherein they have used in a washroom window wherein you are able whenever you want you can actually switch it on and off. So, this is one of a very good application which also I have told you in the beginning of my slide is the lobby area application.

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Wherein if you see now, this is a reception area and then you have a lobby at the back; so it is an off state. So, if I put it on; so you can actually see this entire conference room. So, this is the way this application can actually this product can actually bring up to.

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So, this is a again the conference room they have used in a confer or in a conference room and can be made clear whenever there is no meeting; which is going on and when there is a meeting which is going on, then it can be you know made opaque.

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So, in the retail application if this is a showroom of a of a automobile manufacturer wherein he wanted to create a buzz around the product; around this car itself. So, actually he made a checkbox and made some of them clear and then some of them tint you know opaque and then in the morning it made all clear. So, that is how you can actually create lot of these possibilities with this kind of product.

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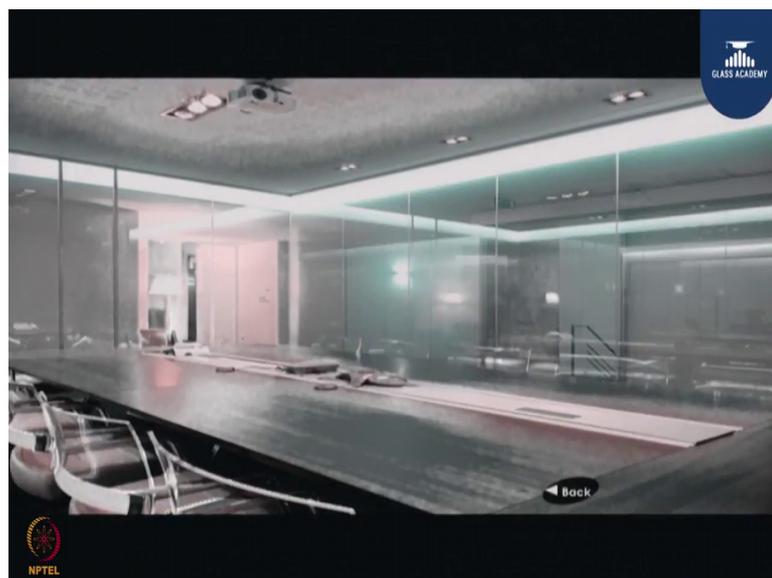
So, we can use it also in the facades. So, I have talked about the interior applications, it can be used in facades and it can you can do n number of things on it, you can do a logo projection. So, there is a logo which is being projected now on the façade.

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You know you can actually project a pattern; all those things can be actually done on the facades and this becomes like a bill board. So, you can actually earn revenue by projecting different logos on the facade.

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Now, this is a conference room and you know the next the technology; the next thing which you can do with this product is you can actually do projection, the back projection and then this glass can actually become lighter projection screen. So, this is a conference room I have made it opaque; now I m actually can do a projection on it.

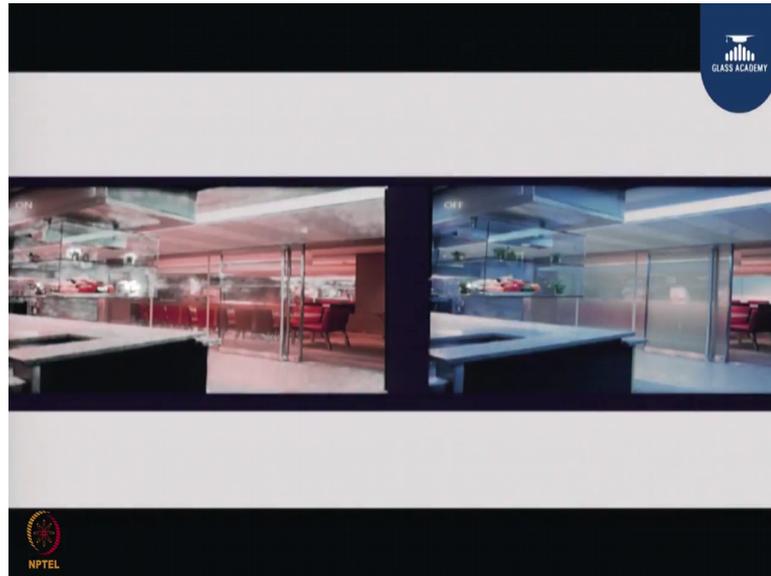
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So, imagine now you have actually done a, you know you created like a sea in the conference which is going on. So, this is this is the possibilities which you can actually imagine with this product and possibilities are limitless.

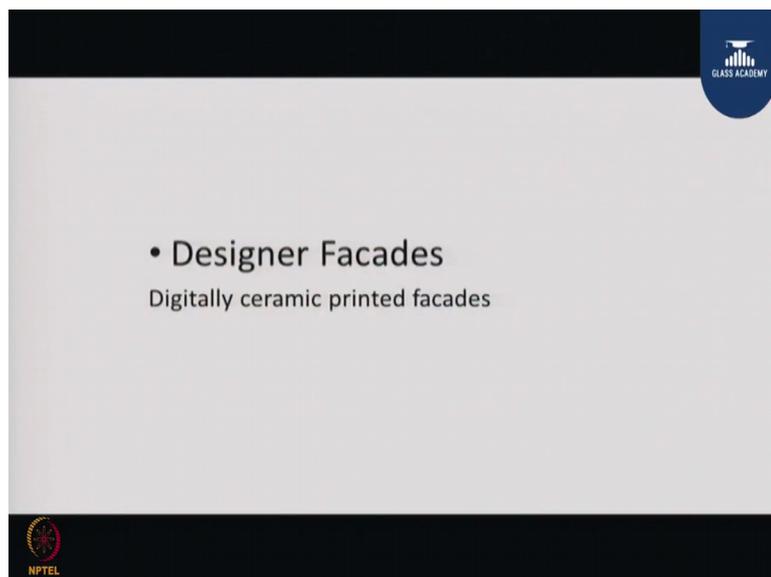
It is actually dependent upon the user how he wants to use it and where he wants to use it and this technology can definitely do lot of things, which were not possible earlier at least from the glass point of view.

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So, this is one of the you know picture which can actually show you how it looks from on and off condition. So, this is a lobby area where this has been used; so, on the left it is an on condition which is completely clear, you can actually see through the glass and then there is an off condition wherein it is all brittle which is 100 percent opaque you can even do the projection on the glass.

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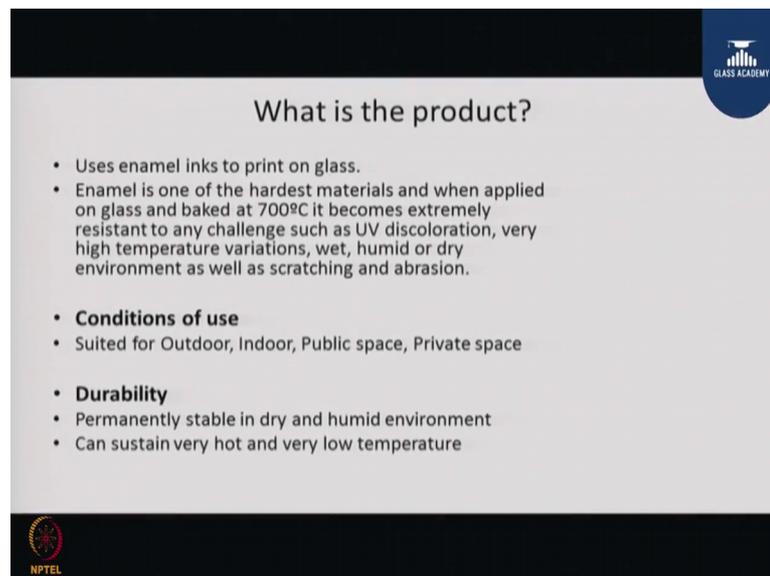


So, this is about we talked about in terms of this switchable technology; the facades which can be switchable. And now if you look at how the facades are changing people

are getting bored of the colder static glasses, this colored glasses. And then they are looking at in terms of making this facades very you know; looking very novel, very different and every designer actually wants to make a different façade to create a zone image.

So, from that prospective there are there has been innovations which has happened in terms of making these facades very different and create a novelty through the facade and we will be talking about designer facades. So, designer facades are what? Is basically these are digitally ceramic printed facades and this technology has been recently bought in to market and you can print anything on the glass. So, as a product I would like to tell you what it is.

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The slide is titled "What is the product?" and is presented in a dark-themed layout. It features a blue circular logo in the top right corner with the text "GLASS ACADEMY" and a stylized building icon. The main content is a list of bullet points. At the bottom left, there is a small circular logo with the text "NPTEL".

- Uses enamel inks to print on glass.
- Enamel is one of the hardest materials and when applied on glass and baked at 700°C it becomes extremely resistant to any challenge such as UV discoloration, very high temperature variations, wet, humid or dry environment as well as scratching and abrasion.
- **Conditions of use**
  - Suited for Outdoor, Indoor, Public space, Private space
- **Durability**
  - Permanently stable in dry and humid environment
  - Can sustain very hot and very low temperature

So, it is actually the enamel ink which is actually printed on the glass and then the glass is being heat rated. So, once this printing is done on the glass and then the glass is actually cut and then it is being sent to the tempering. So, once the glass is being tempered or heat rated then after you cannot peel off this ink. So, it becomes a more the thick part of the glass it actually becomes a part of the glass itself; so, it is very robust

So, enamel is one of the hardest material and when it is actually applied on the glass and baked at 700 degree Celsius; it becomes extremely resistant to any change such as UV discoloration, high temperature variations, wet, humid or dry environment as well as

scratching and abrasion. So, that is that is the amount of robustness which is being created by putting the ink on this glass and making the digitally ceramic printed facades.

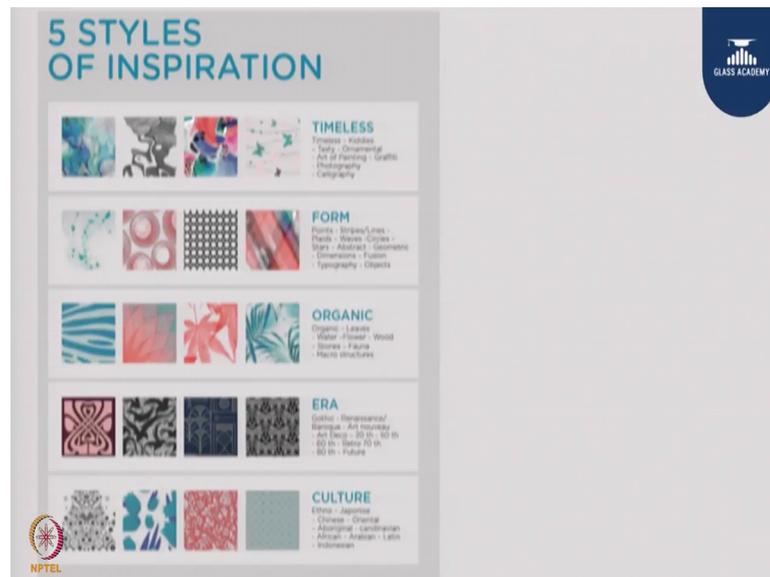
So, as a technology there has been improvement in the way this printing has moved forward in the glass. So, if you look at the history; it started from screen printing you can actually print in two colors white and black. And you can do a screen printing then these screens were made and then they were being they were being printed on the glass and then they were tempered.

So, then that ink became the part of the glass, but the challenge was that if you need to create a high resolution photograph or you need to print something which has in which like an HD image a lot of colors in a; so, it was very difficult at that time. So, now, we have this kind of facades wherein you can actually print a image which can actually which is like almost like a photograph of somebody. So, which has 4 million colors; so, that is how you can actually print that image now.

So, the condition of use for this kind of product is for outdoors, indoors, public spaces, private spaces and it is a very durable product as a first place. So, this ink is going to stay permanently on the glass and it is going to be becoming the part of the glass till the life of the glass itself. It can also sustain very hot and very low temperatures.

So, it is not a technology wherein you will be worried about how it is going to behave in a extreme weather conditions. So, ceramic printing or digital ceramic printing is going to stay till the glass life and it is it is being insulated for lot of this temperature variations, climate variations and even the variations and the scratches.

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Basically talking about from the aesthetic point of view. So, there are the styles of inspiration which generally an architect would be looking at; creating a timeless façade, creating a form through the glass itself; being making an organic printing on the glass and talking about the newer errors and how this errors has been evolved and talking about the culture.

So, all these inspirations can be actually taken as style of inspiration which can be actually printed on this facades and actually make this facades look very very novel, very interactive. And then you know it creates a benchmark in terms of how this facades are going to look.

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So, we are talking about design which is a digital design. So, you can actually print anything which you want to print on it and it is meant for, it can be an interior application, it can be into the facade application and you can print any kind of image on it.

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In terms of how this overall as a product can offer you the benefits. So, we are talking about a product which is very functional. So, this is the first aspect of it has been seen that this is something to do with the aesthetics. So, it is a very aesthetic product, but yes

we are also talking about something which is very functional. So, you now when you use particularly this digital ceramic printing; then you can actually control the light. And then you can actually you know get a diffused light which is not getting directly into the glare. So, you are actually controlling the glare by doing the digital ceramic printing on the glass.

You control the light transmission; so, that is how you are actually being able to have diffuse light. And then you know by all these designs you can create different lux level how much lux you want to have inside by using the ceramic printing technology. We can do energy savings with it because with the amount of printing what we when we do on this kind of product it actually lowers down the heat gain.

And then you know that there is a lot of energy saving which is happening because of this lower on lowering of the heat gain; which you are controlling the sun because by reducing the light transmission and by reducing the heat gain from this glass. It also creates a privacy, so imagine now this has if you use in a gradient. So, from inside you can still see from the glass and then from outside, you are not able to see. So, this is like a privacy product which can also create a privacy.

One of the also the benefit which has not been mentioned in this slide is that it also creates bird safe facades. So, you know when you look at the glass at the first place; the building which are now making made up with lot of glass in the facade. So, what happens it sometimes also creates some amount of trouble for the birds to go and hit the glasses the first place.

So, by doing this ceramic printing on the glass; the glass can also be made bird saved glass.

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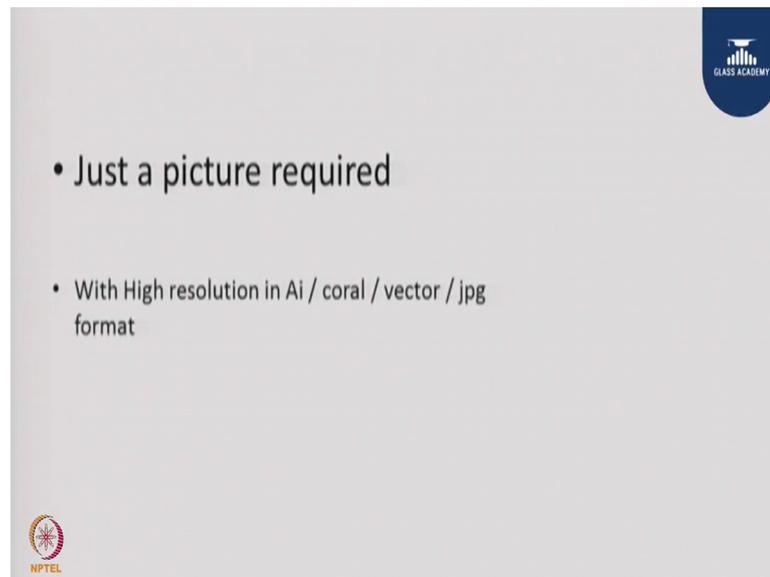


These are some of the pictures through which you know you can imagine what this particular technology can do this is like phenomena.

You can actually create its basically you can print anything and everything on the façade. And make this facade or this your building actually look unique you know very different from the entire you know all the all the set of building which are there in the vicinity. So, if you see all these pictures; so, these are the these are the amount of creation or the creativity which you can be actually exploring and can be doing on the facade itself and these are all printed digitally.

And this can be done now with the technology which is available, you can be actually printing any kind of thing on the facades. And so, imagine this photograph which on the lower right hand side of me on the slide. So, it is a picture of somebody who can actually be printed on the facade itself. So, you can actually create facades which are standing out, which are looking very elegant, which are looking very different which are; which are something which can give an inspiration to other people around it. So, these are some of the images of the facades on which this technology has been already been used.

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So, what is required? It is just a picture which is required to get printed with this kind of technology on the façade, it is a high resolution photograph which is required in any kind of format which is Ai, coral, vector or a jpg format and then you can actually print a photograph on it.

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