

Glass in buildings: Design and Application
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Lecture - 68
The Role of Windows in Building Design

Hello friends. Today we are going to talk about Windows; windows in our life, windows in building, windows everywhere. So, today I am going to talk a lot about windows. It is very simple subject, easy to understand and I am sure in this next one and half hour session we will have lot of insights about windows as well.

So, let us start about windows.

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And the simplest form to understand about window is to look around ourselves. Look around our lives. And then correlate where windows exist today. The first and the foremost I think everyone is aware about the windows when we talk about Microsoft windows which we use in our laptops or probably in mobile. But beyond that our association with windows comes from our homes when we travel in the aeroplane or in the bus or in the car; try to have a window seat. And if I ask you guys why do you prefer to have window seat why not the middle seat or the inside seat aisle seat and the simple reason is that you want to look outside; fantastic.

So, here is the correlation that one windows bring in our life, it is about connecting the outside with inside.

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Now when you are connected with outside there are certain functional behaviours of windows to be looked at. And of course, we also need to understand certain issues related to windows. So, I am sure you all are aware about the windows which are there in your homes and the problems associated with in that. So, what are the typical problem if you look at whether it is: wood windows or steel windows or aluminium windows. The simplest is you have to paint it, there are termite issues, there are oxidation there is rusting. And sometimes, you have beyond these also which we call as either dust ingress, water ingress, noise ingress in to the system.

So, let us look back and see what windows does for us.

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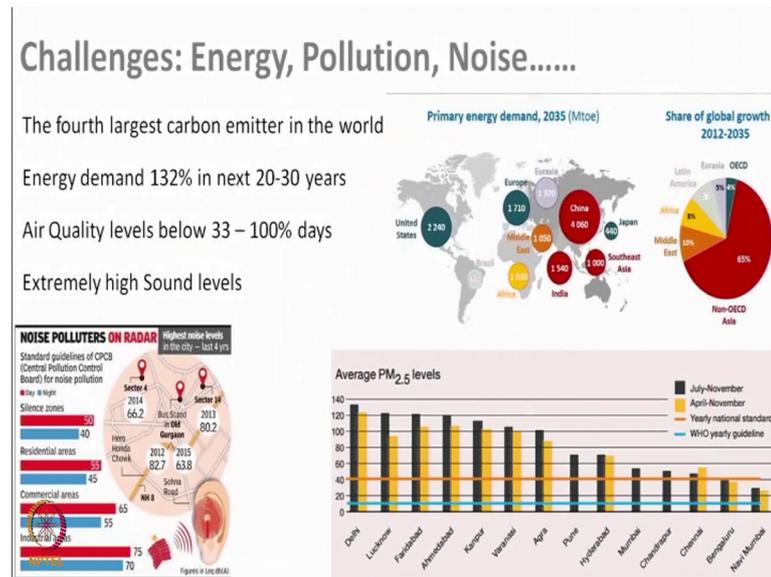
If you open up the window probably you get fresh air; of course, you do not have fresh air anymore in the ambience, but still you are allowed to have that. It gives an aesthetic to the house it is one of the signature style which is used as by many architects and beyond these three functional requirements. Nowadays there are three more critical performance parameter which is added to windows.

The first is the energy saving. And if you are aware about energy saving now appliances have a rating from the bureau of energy efficiency as the star rating. A similar concept in window is also coming in wherein you have performance rating. Other than this you have a low maintenance; you do not want your windows to be repainted every two years or three years, you do not want to be replace the glass of the gasket or for the performance of the windows

And the last is about sound insulation: the people who are living in cities are now having terrible time with the increased traffic on the roads, the crux reaching sound throughout the night. And therefore, windows do have a performance things leave your house from the sound as well.

So, in short we talked about window performances, functional performances, need of these windows in today's context, the problems associated with window, and now the next couple of sessions are we are going to detail out how these performances are established in windows.

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Before we do that let us take a quick snapshot on current statistics on three extreme areas. One is the energy, the second is the air quality, and third is the sound level. And these data is already available on the internet; I am just reproducing it for your reference.

One of the most polluted city in India if you look at of course, on the P M 2.5 level is Delhi followed by Lucknow and so on so forth. Even if you look at the world standard which is given we are much beyond that. And that is one big very how this is going to be controlled. The second biggest challenge is the sound: we talked about as one of the performance parameter nowadays. And in the last year there was a couple of articles in the newspaper talking about how sound is becoming a new big nuisance in our life.

The third and the most important is about the energy. If you look at the energy demand in the next 20 to 30 years as going to increase almost 100 and 50 percent; and therefore, windows to have a role to play in all these three areas. As you move on this presentation we will cover these also in our presentation.

Since we are talking about windows let me also reiterate that India great building is one of the biggest thing happening in the building and construction industry. Lot of builders are following up a green norm. It is a voluntary process; I am happy to share if you look at the data which exist in their probably in the next 10 years are going to be one of the largest green building footprint in the world.

So, that is something which is good for all of us, but what is green building all about. It is not painting the walls in green. It is about you and me. It is about how the building is designed to take care of the nature and the people who are going to live in that building.

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India's ancient buildings speak of a civilisation that believed in a spiritual connect with nature. Its palaces and houses were built in harmony with nature and very often with limited wastage of resources.

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With a last century has buildings reached higher into the sky they became symbols of

modernity in progress, but somewhere along the way buildings also became detrimental to the earth climate.

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Today 40 percent of energy related global emissions are attributed to buildings.

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60 percent of waste comes from buildings are related activities, but all the smarter planet buildings can be designed differently: buildings that harness nature, buildings that need less energy, buildings that breath. If you choose your building to be a perfect Griha this is where it begins.

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Your site planning must conform to the master plan of the region.

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You must preserve agricultural land or protected land and trees on the site.

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The topsoil should be carefully separated preserved and reused for landscaping once the building is complete. During construction we must regulate air pollution.

For example barricades can help stop the dust from spreading into the surrounding areas.

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Your building can use a variety of environment friendly materials if high recycled content.

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During construction you must ensure safety and sanitation standards for your workforce.

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Your building can have pervious or grass paving to allow a rainwater to percolate.

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You may also build a provision for rainwater harvesting, thereby reducing the buildings total water requirement.

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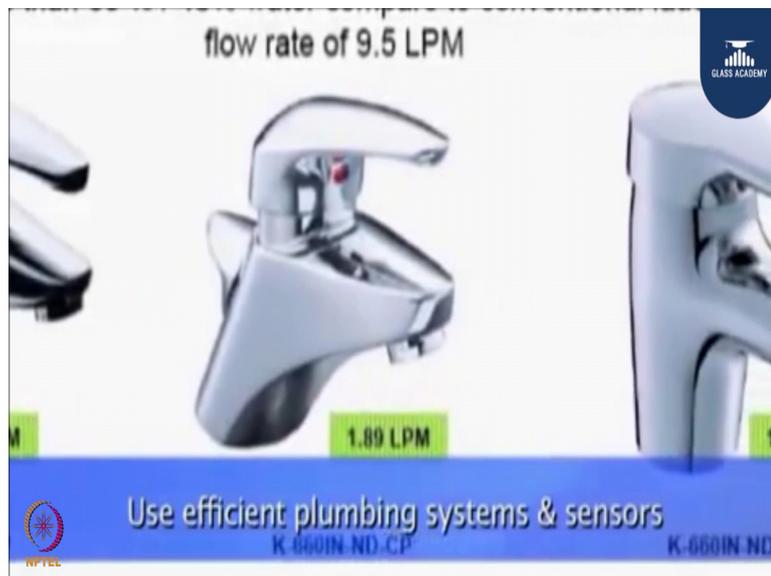
Whole external lights of your building can have automatic controls it can be powered by solar energy.

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You can plant as many native plant and tree species in place of water guzzling lawns.

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You can have efficient plumbing systems and sensors to minimise wastage of water. In a hot climate Griha buildings are designed to allow minimum heat to enter the building.

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Smart shading techniques and controlled glass areas stop direct solar radiation into occupied spaces, but they ensure good diffused light inside the rooms; thereby minimising the use of electrical light during the day.

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The building energy systems such as lighting and air conditioning are designed to achieve high energy efficiency.

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While most upcoming developers rely heavily on generator sets Griha buildings need one percent of the internal energy demand with onsite renewable energy. You know Griha aims to reduce reuse recycle and reinvent.

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Coming to materials in windows: though we are primarily going to talk about UPVC, but I am sure you are aware about other materials like wood aluminium and steel. When we talk about UPVC; what does UPVC stands for?

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UNDERSTANDING 'UPVC'

- ✓ uPVC or rPVC
- ✓ pPVC
- ✓ cPVC
- ✓ Plastics
- ✓ Foam PVC

1. PVC
2. PU, PS, ABS, PC
3. PET
4. PE, PP
5. Bio-based polymers

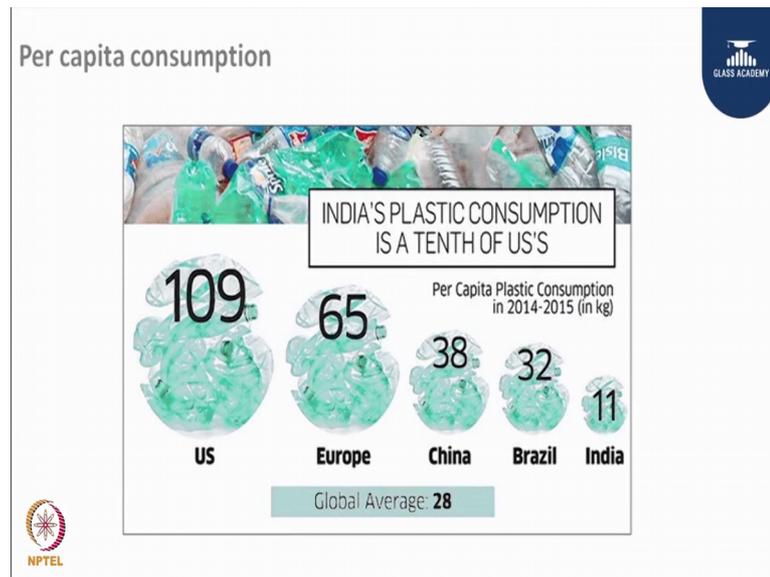
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GLASS ACADEMY

Its Unplasticized Polyvinyl Chloride; that is the full form of it. And before we dive into UPVC let me give a perspective about polymer plastics. In plastics we have various types of plastics for example, polystyrene, ABS, PET, polyethylene, PP HDP nylon and so on so forth; and out of this there is an one gradient which we call as PVC. PVC is one of the most versatile polymer which I have seen in the plastic arena. And I would like to give you certain examples on a demonstration maybe after this presentation why PVC has been selected as one of the most preferred material for building and construction industry.

PVC if you talk about it can be actually converted into different forms, shapes and properties. PVC can be as soft as sponge and it can be as hard as wood. And this change in the properties you are able to achieve because of the various ingredients which you put into the PVC. And they basically determine the properties or the behaviour of the polymer.

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So, let me give you a certain examples of PVC usage.

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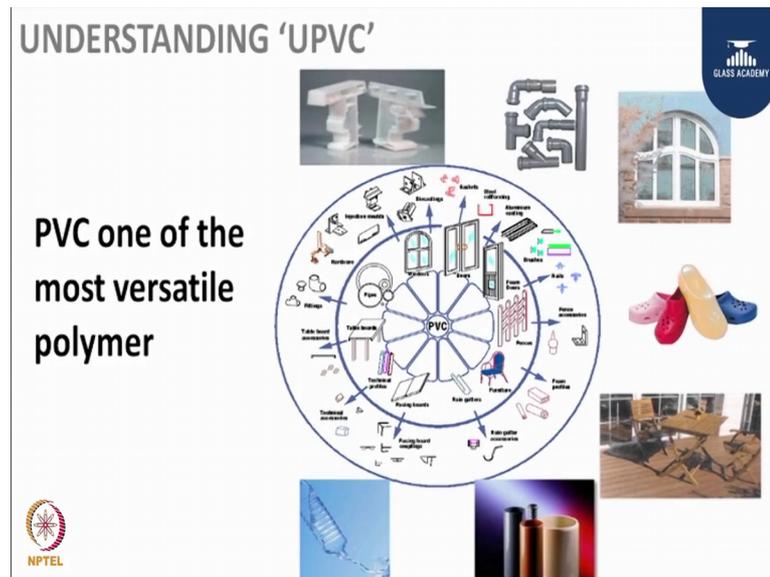


Sustainability means it is such an economic ecological and social responsibility. Sustainability means not wasting energy, looking into the future, providing future generations with a life of health. Sustainability means a clean environment. Modern PVC windows with the energy saving properties post an outstanding life circle assessment from the production to the final circling.

One kill ecological and economical (Refer Time: 13:23) PVC windows is the excellent susceptibility. PVC windows can be fully recycled its means it all of the world can be used again the fundamental requirement for genuine sustainability.

PVC windows a true (Refer Time: 13:40) from the most (Refer Time: 13:41) applications. Not only their sustainability also their antibacterial and antifungal properties make then the ideal choice for hospitals, old peoples homes, schools and nurseries Obtain for PVC windows (Refer Time: 13:56) promotes sustainability(Refer Time: 14:00) the way in to the future: PVC windows with the clay conscious.

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It can be used as pipes, which is used for conveying water; even potable water drinking water. Windows of course, it is being used it can be used in source, it can be used in furniture, it is used in the medical industry widely as blood bag urine bag turbines and so on so forth. So, PVC has is one of the most versatile material. So, far we have seen which is used in various types of application including building and construction.

Now, you may say plastic is bad. We all know that and this is the buzz word which is going on. Let me also ask this question to all of you. If I ask you how much plastic do you use on a daily basis in your life: you will be amazed to see the amount of plastic what we use is phenomenal. But yes, overdoing of anything actually has an impact has an issue. If we use any plastic on a judicious way possibly it can transform things.

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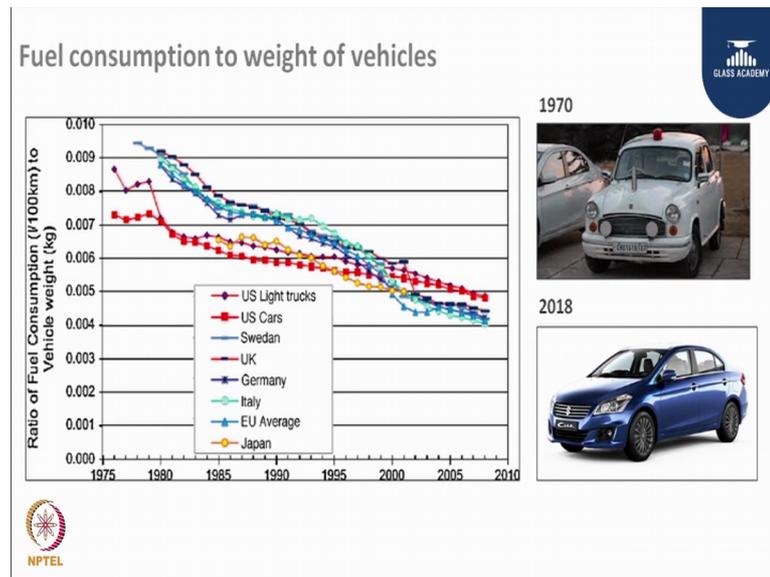


Today most of the nuisance we talk about in plastics is because the way it is being used and disposed off. As we use plastic bottles, packaging and throw it anywhere around our self where does it go nowhere. It is in the atmosphere, it is on the earth, it is not collected properly and therefore, you have all these nuisance of issue which you will see on the slide. This is a recent picture which has been taken after the Kerala flood and you can see lot of plastic bottles after the water receded on a bridge. That means, we are responsible for throwing this garbage into the environment.

You would be surprised to see the amount of plastic which is used in India versus in many of the countries. We are only using 11 kgs per capita of plastic as compared to 110 or 65 in US Europe, which such a low consumption rate how can this beso much bad. I think it is more about education of all of us to use this material judiciously as well as dispose it off sensibly. Using plastic is not bad, disposing of plastic in a unorganised way is what is creating this problem.

Let us look at the other side of plastics. I was talking about how much plastic do we use.

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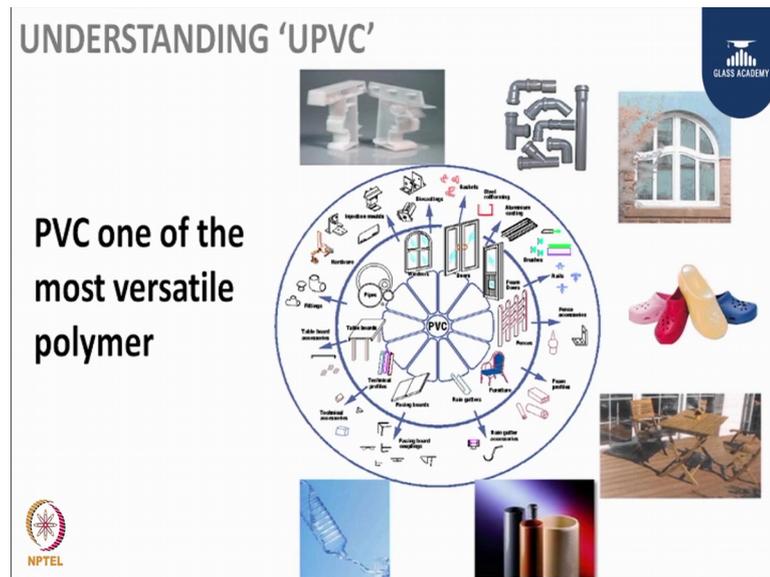


If you count in your day to day life from the laptop, from the projector parts, from this LCD screens, from the mobile, from the pens, from the watches; anything you look around yourself at least 60 to 70 percent of our lives are influenced by plastics on day to day basis.

One of the example which I like to quote here is plastic has also transformed our lives in different way. If you look at automobile in 1970's or 80's versus 2020, the rate of these vehicles have come down drastically and that has been possible only because of plastics. And what it has led to a car which used to run 5 kilometers a litre of petrol today runs at 20 to 30 kilometers per litre. So, if it is used in the right way I think it makes lot of sense, at the same time we need to actually have a mechanism to recycle this material by proper allocation collection systems which I think most of the US and European countries do have, in India we will do lack this issue.

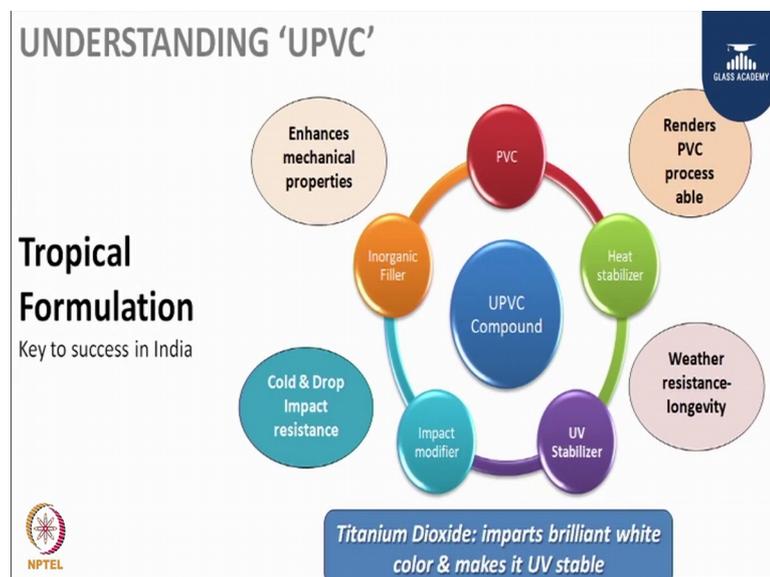
Let us connect back to our window industry. UPVC is also a plastic. And my dear friend UPVC was started in 1960's by Germans. And in Europe this is seeing the second or third life cycle of that product which means these windows are taken out from the industry, from the insulations.

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and they are being reprocessed. Which means if you can recycle a product for two times three times four times I think the amount of natural impact we are talking about is eliminated.

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So, let us understand about PVC a bit because this is important to understand how this material can transform the construction industry. PVC a polyvinyl chloride polymer as alone cannot be processed. It requires certain additives to be included like heat stabiliser impact modifier, pillars, U V stabiliser and so on so forth to get different types of

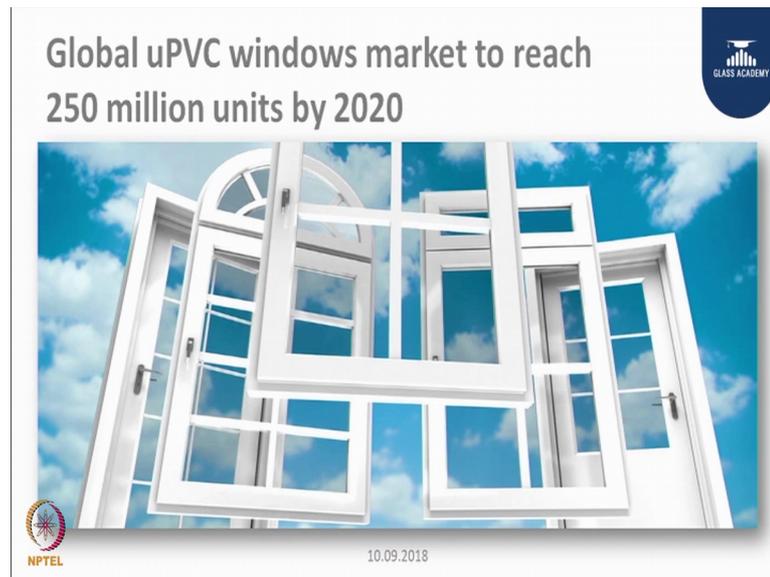
properties. If it is a plasticiser or soft PVC we will also have a plasticiser, but in UPVC we do not have plasticiser. It is a unplasticised polyvinyl which means there are no plasticiser in the system.

These ingredients are very critical to understand. And these are proprietary for many of the processers who exclude profiles. And why it is proprietary is because it is in parts certain properties which you can get by certain percentage or certain it is like a pinch of salt when you cook food, you do not put too much of a salt or turmeric into the system right. You just put a pinch of it and it changes the entire flavour. Same is with PVC as well. These chemicals we are talking about or these additives we are talking about is added into very very small proportion and it can enhance or have detrimental effect on the entire formulation.

So, when we talk about PVC formulation we need to also remember one thing that depending upon the country, region where you are going to use the plastic is needs to be formulated it suit that place. For example, in Europe you have a very cool type of a climate, it go sometimes minus 10 minus 20. So, it will meet those expectations of temperature you need to have cold impact modifiers so that the profile can sustain those types of impact. Place like India which is having high UV, you need have a UV stabiliser which can meet the needs of the country. Of course, the temperature are not that severe like in cold countries, but here the temperatures on the other side. And therefore, the profile should be able sustain on a continuous this is something around 45 50 degrees of temperature.

So, this is one of the critical ingredient in the entire process to understand how do we formulate the PVC. There is no way by which you can figure out whether this profile is well formulated or not well formulated by seeing it, but of course, there are certain test if you conduct on those things you will be able to figure out whether the PVC profile works or it does not work.

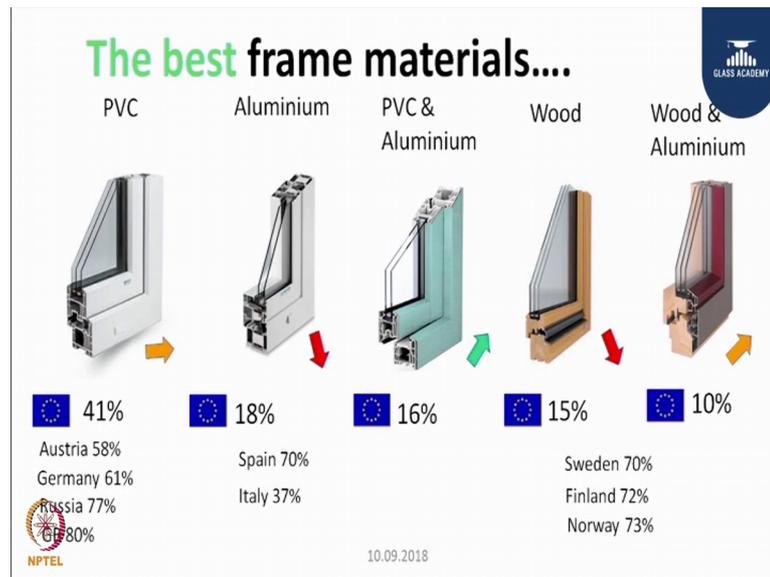
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So, why UPVC in India? As I mention in my presentation PVC in the window industry has started somewhere in 1960's by Germans. And the genesis of this actually comes from basic problems of window we discuss in the opening session. I am sure you are aware that yours biggest enemy is termite, moisture and heat. When you expose you are to continuous high humidity cold and hot climates the self is deteriorates. And therefore, you have to do certain work on this window on regular basis.

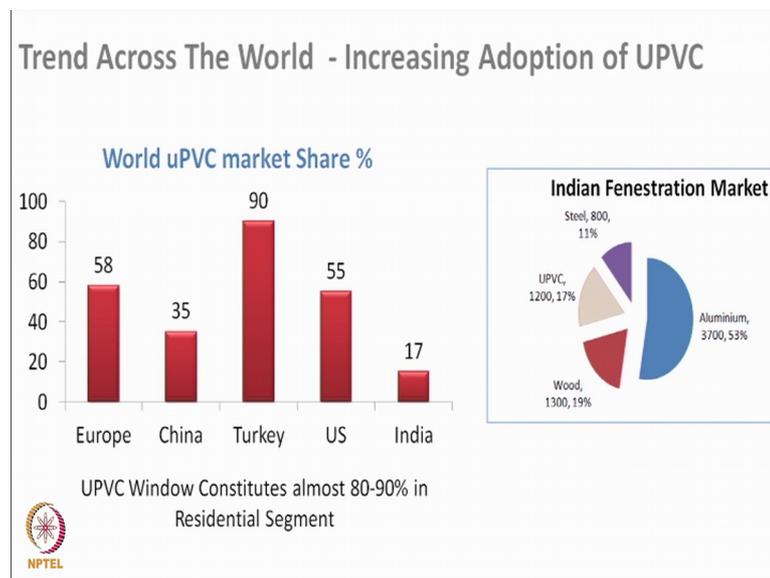
The problem was taken by Germans by creating a UPVC profile with the insert of initially it was wood then it was migrated with steel. And why PVC: because they found certain inherent advantages of PVC; which we will cover just in few slides after this. But let me first complete the global prospective of PVC to give you a feel how this product has been doing across the world.

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PVC has a frame material if you look at Austria has 58 percent, Germany 61, Russia 77, Turkey has almost around 90 percent PVC frame.

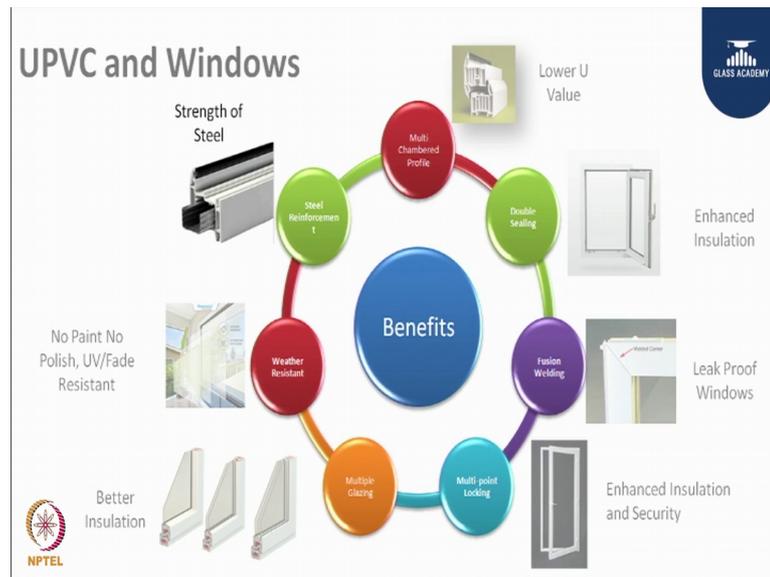
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and as we move forward we will see that there are places like US, China as well at 55 and 35 percent.

In last 15 years India has only need 17 percent of the market share on the window industry. And looking at what has been the trend in the global market I presume that this product or this material will eventually catch up in India as well.

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As I was talking about the benefits of UPVC: the inherent material characteristics of lower u value or high insulation characteristics it has high enhanced insulation, because of its chamber multiple chambers from two chamber to three chambers and it can go as high as nine chambers.

The corners are welded and therefore, it does not allow any leakage from inside to outside from the corner joints. It has multipoint locking systems which actually enhances the sealing in the entire window. It can incorporate single double and triple glasses in the same frame just by changing the bit, and therefore you can have a better insulation using UPVC windows.

Apart from this the characteristics of PVC being very versatile material; it does not require to be painted over period of time. The inherent characteristics of its UV resistance actually makes it to work almost like 20 30 years without any work on the surface of it. And, the strength is the last part which comes from the steel which is inserted inside in close chamber which is actually welded in seal. So, it is not exposed to any air or water to get it rusted. So, you get a strength of the steel in UPVC windows and all the properties of PVC on the surface. So, you do not have any pane requirement any termite resistance high u value good insulation characteristics multiple glass treatment in the same system.

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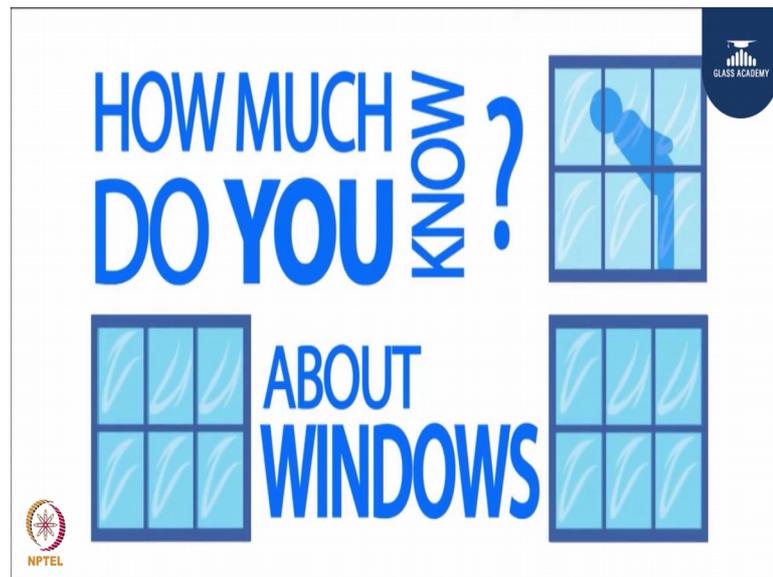
So, to put in a nutshell, I would like run this video for you why windows are important in our lives.

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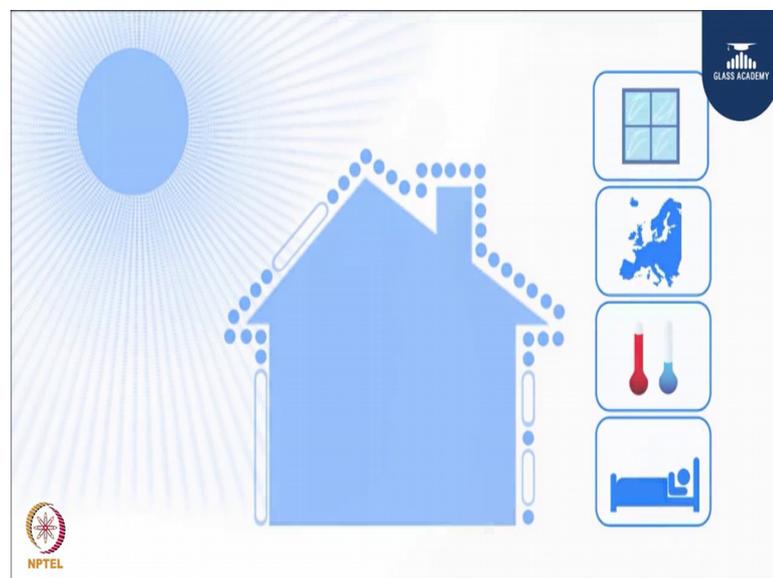
As you know windows connected you to the world and the nutshell environmental around you, but today I suggest not to looks through the window, but start looking at the window itself.

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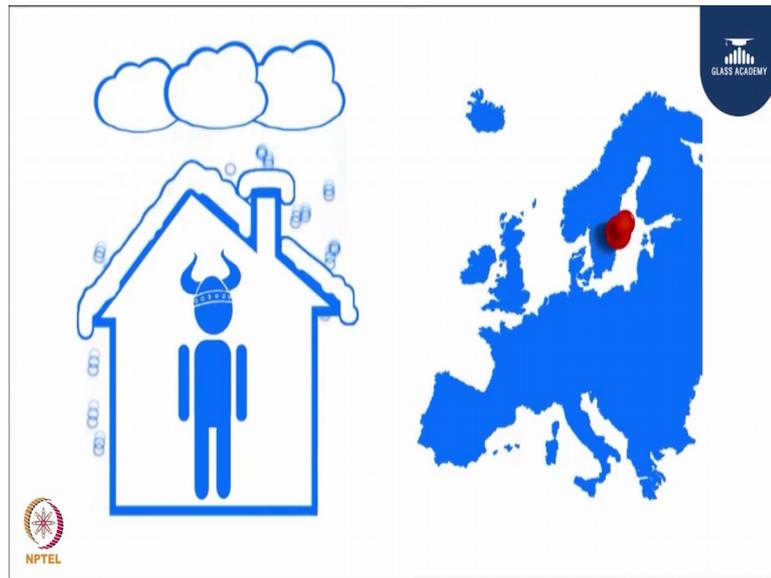
Windows are key component in buildings they bring you light and comfort, but also nutshell ventilation when open.

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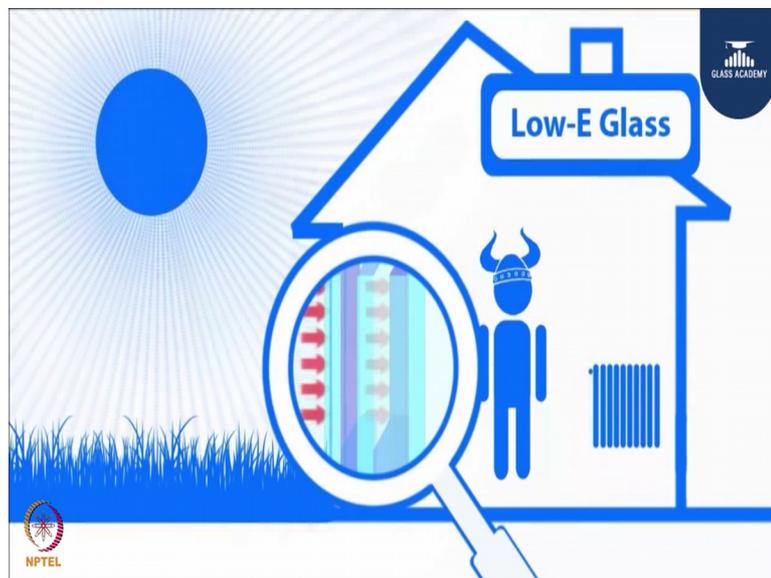
But windows also help make your buildings more energy efficient. They contribute to the insulation of doping, but thanks to the transparency of glass they have the unique property to use solar heat and that is warm your house free of charge. For this reason the best performing window for your house depends on where you live, the climate and your particular needs.

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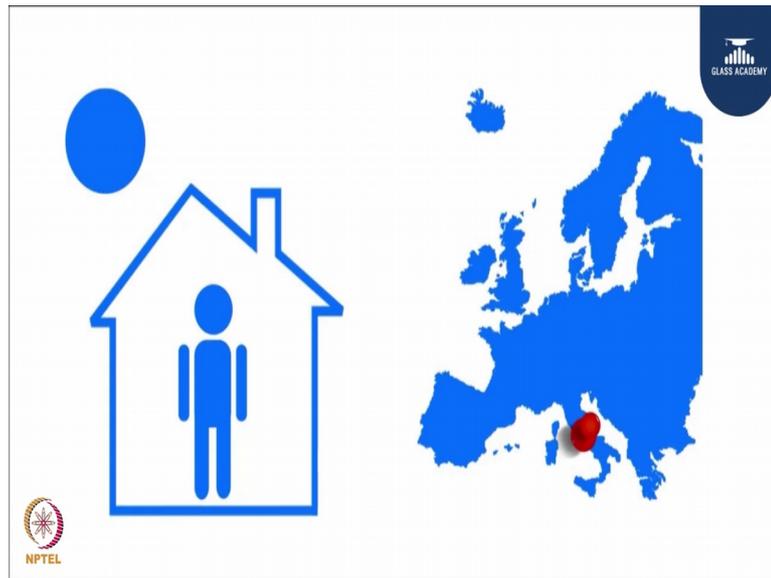
If you live in Sweden for example, may be you would like to have a window that keeps your house warm when it is cold outside.

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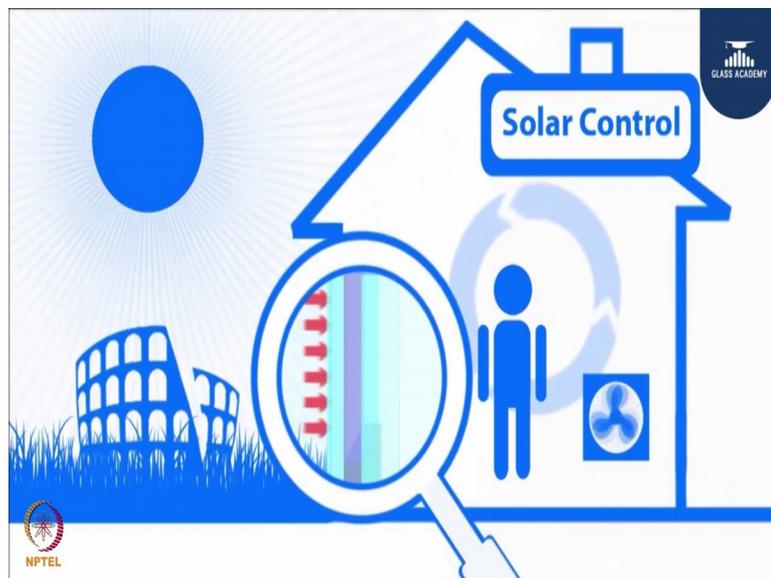
For a thermal insulating window with low emissivity properties low heat is what you need. It protects the comfort of your home reflecting heat back into the room under house solar heat to pass and warm the interior when the sun is out.

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However, if you live in Rome you most likely want to keep your home tempered all your around.

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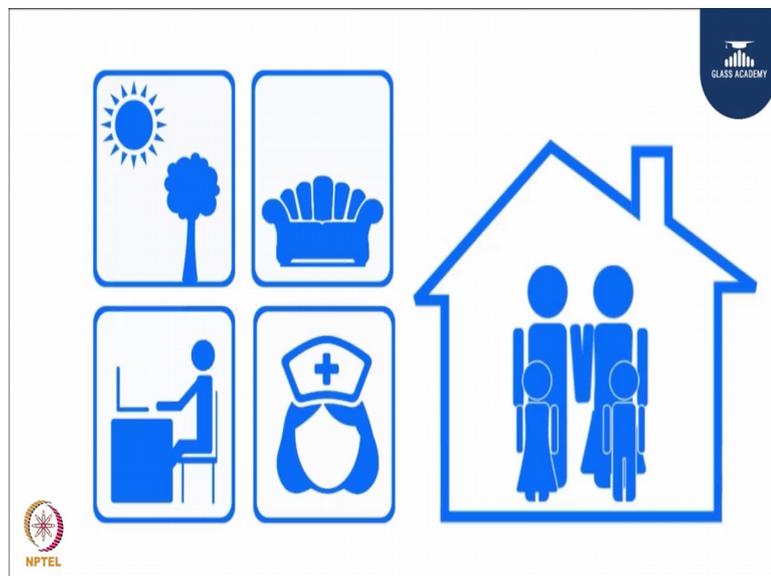
In this case you need a different type of insulating glass combining low emissivity with solar control properties. Thanks to its insulating performance and its ability to reflect solar heat outside. Your comfort will be improved, you use less air conditioning thus save energy.

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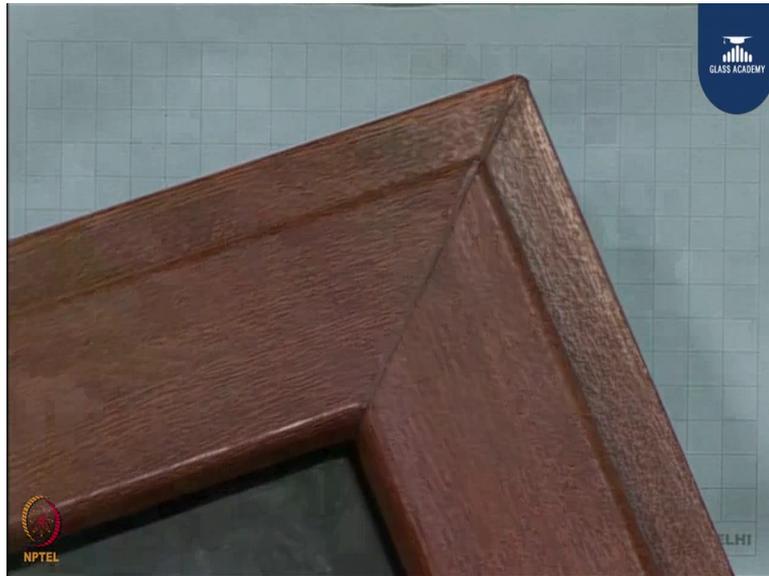
Once properly equipped your windows will help you save energy when both heating and cooling, additionally windows you to save electricity for lighting.

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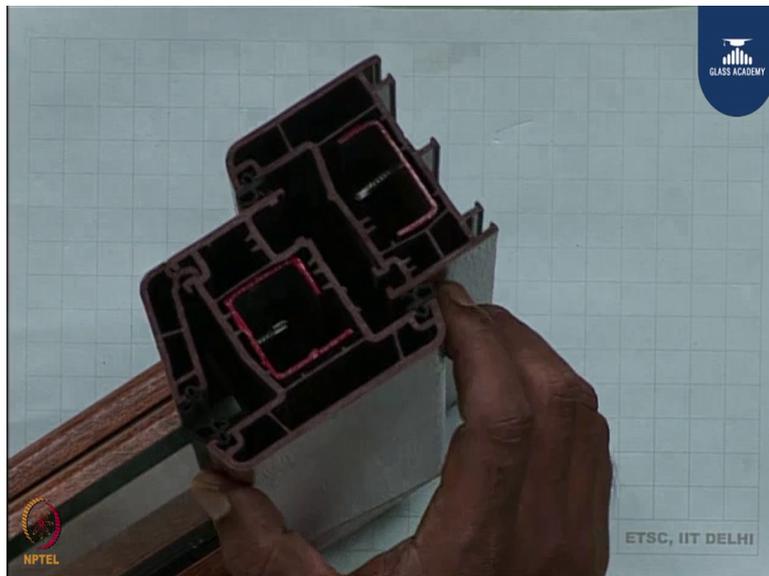
More they light inside will also improve comfort, productivity, health and wellbeing of you and the people around you.

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So, let me show you about PVC welded frame. If you can see this corners, these are completely welded and absolutely like in aluminium or in steel; of course, you can welded, but in PVC. I know you have a finger joints or corner joints this is completely welded.

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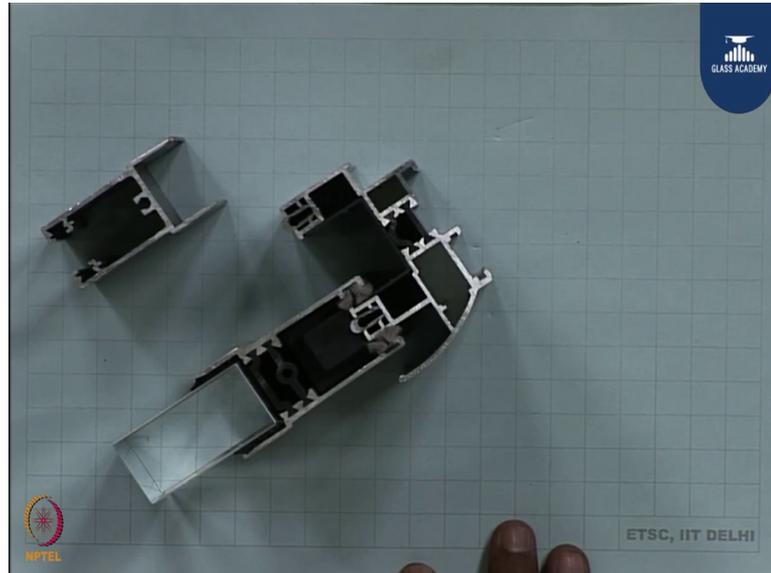


But if you look on the cross section side: there are three chambers and the centre chamber is the steel chamber and this is completely sealed in the welding process. So, there is absolutely no air or water which can percolate into the chamber. And even the

frame is whether string section this with the steel the strength which we are talking about comes from this steel sections.

So, this is one framing material we are talking about.

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When we talk about other framing material like aluminium we talked about non thermal break. So, if you look here this is completely the aluminium from inside to outside and this is a non thermal break aluminium. You also have a thermal break aluminium. If you look here: this is into two parts this side is also aluminium the other side is also aluminium, but between the two you have polyamide which is connecting the two parts. And therefore, it is stop the heat flow from inside to outside or from outside to inside. This is called thermal break aluminium and this has a much better performance as compared to your thermal break with respect to heat, sound, and other insulation characteristics.

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Summary:

By the end of this video, you have learnt about the:

- Windows - Problems with windows
- Functional and performance needs of fenestration
- Green building
- Framing material - UPVC
- PVC in India
- UPVC and windows

