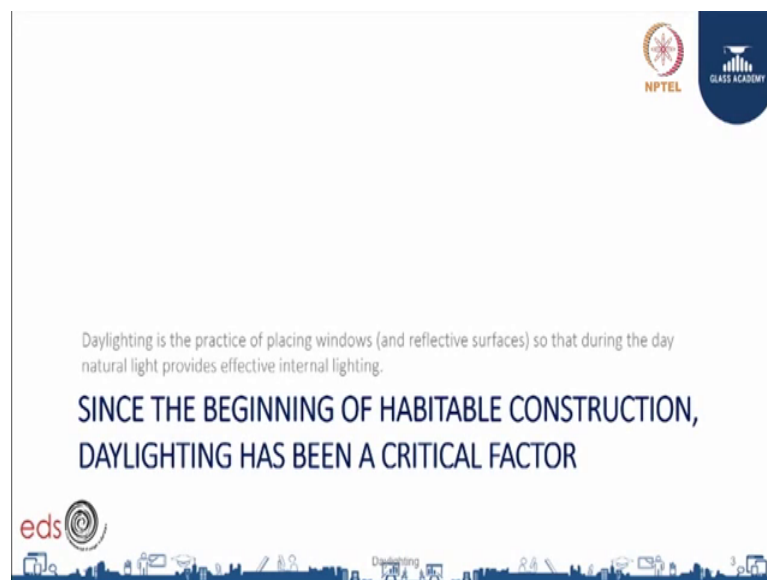


Glass in buildings: Design and Application
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Lecture - 21
Introduction to Useful Daylighting in Buildings

Hello and welcome to our course on delighting. The importance of delighting is cannot be emphasized enough and in this particular presentation, we are going to talk about what is delighting, why is it important, and what role it plays in our lives. Light from sun has been the source of all life on this planet. This light comes in forms of electromagnetic radiation and has been the life giving force since then.

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Since the beginning of time it has shaped how life has evolved, and now ever since humans have started construction, started living in buildings and in structures designed by them, light in daylight has been the most critical factor that has shaped the form of these buildings.

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Why is Daylighting important?

1. **Aesthetics** (light and shadow, color, views)
2. **Human performance** (psychological and biological benefits)
3. **Energy** (sustainable design)

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It is important because it has an aesthetic function; light, shadow, color, views shape are appreciation of the universe of things around us. It is important because it has a psychological and biological benefits and of course daylight is one of the most sustainable form of providing lighting in (Refer Time: 01:47) space.

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Daylight Benefits

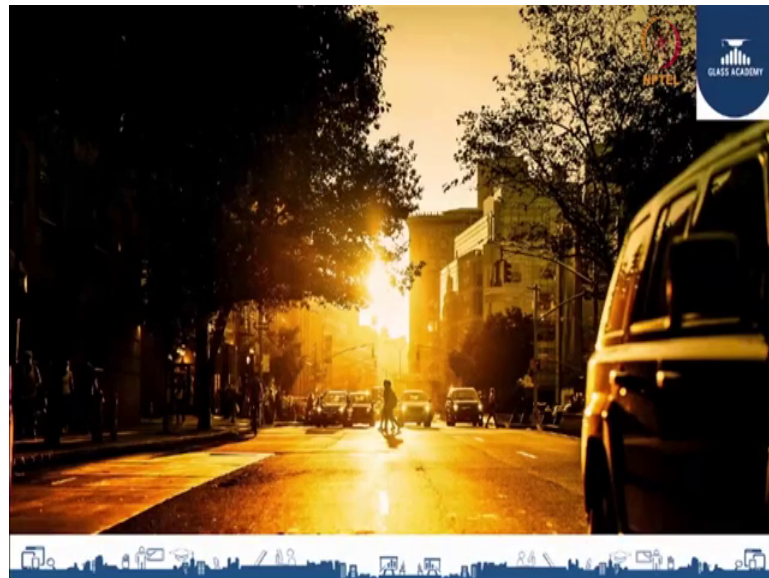
- ⌘ Based on User Survey, Top three perceived benefits
 - ⌘ Occupants' feeling of well-being
 - ⌘ Comfort
 - ⌘ Feel good about self
 - ⌘ Like being outdoors
 - ⌘ Productivity
 - ⌘ Energy savings
 - ⌘ Improved aesthetics

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So, although we understand all of this intuitively, a lot of quantitative surveys have been done that have looked at users responses and how people look at daylight in their lives and its importance in their performance. So, the feeling of wellbeing, comfort, the

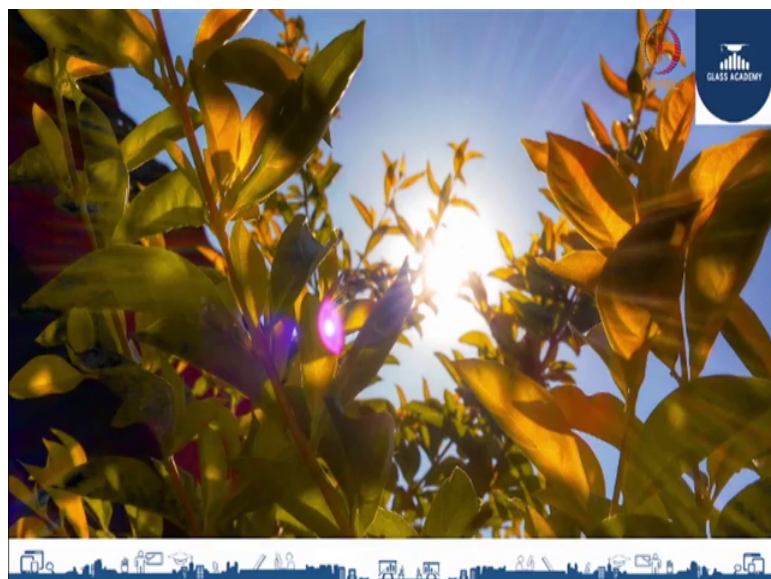
connectivity with the outdoors and its direct linkages with productivity have been now very well documented this is also been a lot of studies that have looked at the energy savings aspects and the linkage that allows us to get daylighting into the building so, that we can switch off artificial light and therefore, save on energy.

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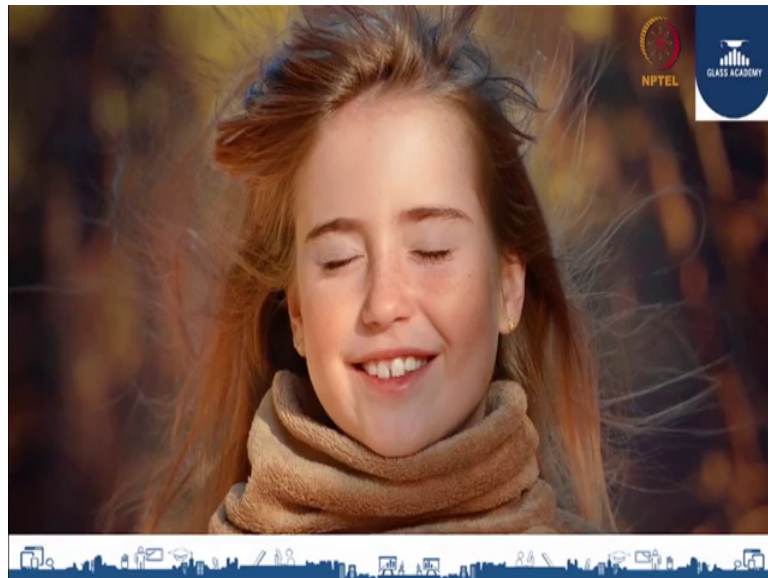
A recent study by a scientists in universities actually this one is particular from North Western University of Illinois, at Urbana Champaign investigated the effect of day lighting and exposure on the health of a group of office workers.

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And it said that it found out that those who received exposure to more daylight through windows or any other means, slept on an average 46 minutes more they were more productive and they were more focused in their working and a wake hours.

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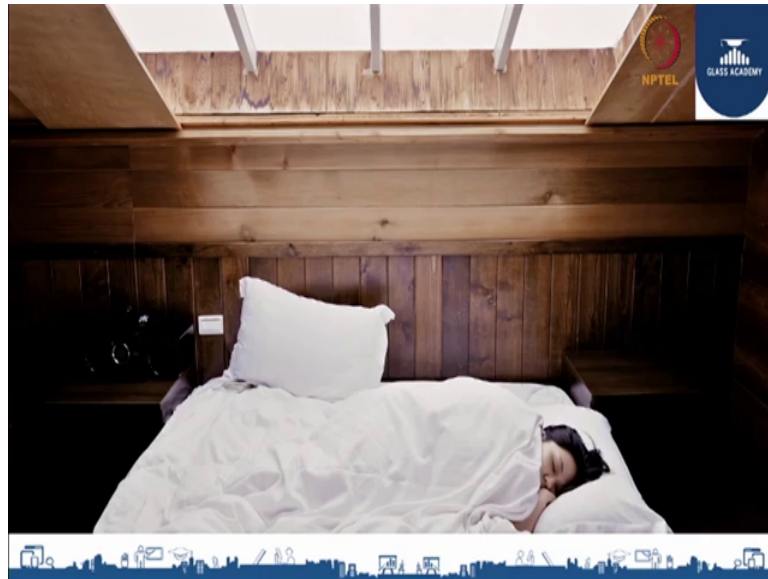
So, they clearly showed more energy vitality and productivity during those hours.

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Day lighting has this impact on the perception of space, which is quite distinct from artificial lighting.

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Day lighting also connects with the architectural intents.

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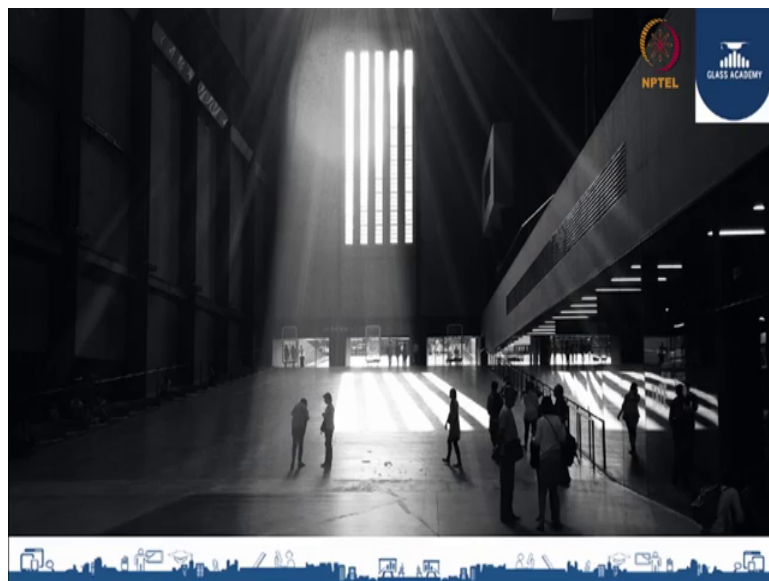


So, when you look at design, when you look at shape of an object the look and feel whether it is dark light and the appreciation of form is directly linked to daylight. And the fact the daylight is dynamic, it means that these perceptions can evolve and change, they do change during the day during the course of the year, during different seasons. So, it creates a dynamic effect which artificial light rarely is able to match even with all the controls.

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So, you see this in forms and shapes of buildings around you in the appreciation of spaces and how they change over the course of the day.

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I did talk about the effect of daylight in energy savings, because wherever you have natural daylight you can either manually or very often through automatic controls reduce the energies used in artificial lighting.

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This also directly reduces the amount of heat that is generated in the space, which can therefore, result in (Refer Time: 04:48) demand for cooling, specially in climates that are dominated by a cooling demand.

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Daylight Design

1. Provide sufficient illuminance
2. Minimize glare
3. Provide overall visual comfort
4. Improved aesthetics
5. Occupant comfort, productivity and health
6. Reduction of electric lighting energy usage

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The objective of day lighting design or a good day lighting design should be to provide enough illuminance without glare. So, this is the fundamental rule of day lighting that if the lighting level is beyond a threshold, then it will become a problem for the viewer and they would tend to either put down their blinds or move away so, that the glare does not

interfere. So, glare free illuminance with while providing overall visual comfort improved aesthetics, overall productivity health and reduction of electric lighting energy use, these are the driving principles for getting daylight into a space.

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The slide is titled "Daylighting Design Problems" and features logos for NPTEL and IIT Bombay in the top right corner. It lists five primary barriers to daylighting design:

- Primary barriers
 - First cost and cost effectiveness
 - Problems with technologies
 - Building's site location
 - Added design risk
 - Inconsistency in daylight availability across the building and during the course of the day

The slide also includes an "eds" logo and a decorative skyline graphic at the bottom.

Very often this is not done because you are just providing a window without shade for example, is the easiest option for most designs or most I would say most developers. Because the addition of a system of providing day lighting deeper into the space can often mean more design time and also more cost in terms of a shading device.

So, you know very often you will see that the more these things are not very commonly done. Secondly, there is a problem with technologies where the integration of daylighting and with different facade systems or with different lighting technologies is not very well understood. Finally, sometimes because of the orientation of the building or where the site is located, where it cannot have the optimum orientation or there is another obstruction that prevents daylighting can also be a problem.

Sometimes it is seen as an design risk, because if you do not do daylighting correctly, then it will often create problems of glare or of very high contrast ratios in the field of vision even if it is not directly glare of a desk or a screen and this inconsistency in daylight as it changes through the day or the course of the day it is not well understood, creates a sense of apprehension in many designers. So, they tend to rely more on

artificial lighting, to provide that overall uniform lighting and without resorting to daylight.

So, all of these problems are easily surmountable, they are addressable and there are many projects and case studies, which we will see through the in this course which will demonstrate to you that is fairly easy to overcome these challenges.

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The slide features a title 'Sun is the source of daylight on earth & heat' in blue and orange text. It includes logos for NPTEL and IIT Bombay. A bulleted list defines solar radiation as electromagnetic waves (ultraviolet, visible, and infrared), measurable in Wh/sqm, and varying by time, latitude, and season. The slide also has an 'eds' logo and a decorative city skyline at the bottom.

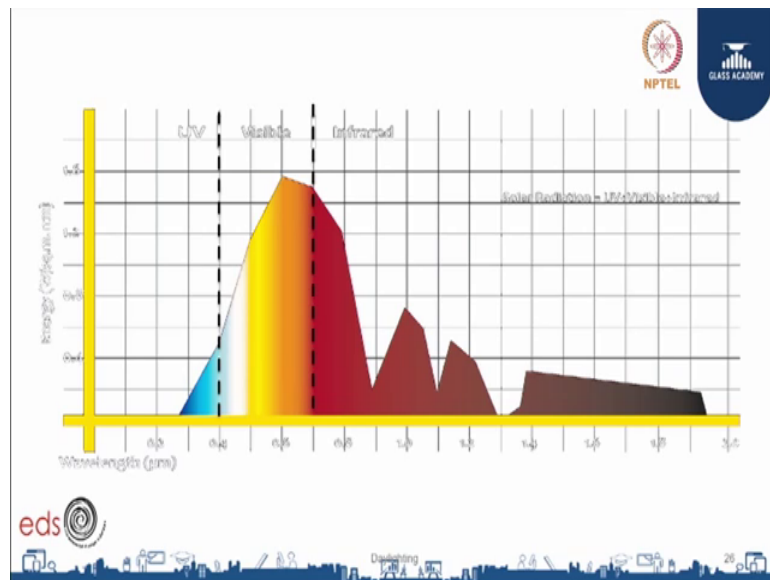
Sun is the source of daylight on earth & heat

- ⌘ What is solar radiation?
 - ⌘ Electromagnetic waves
 - ⌘ Ultraviolet radiation
 - ⌘ Visible radiation
 - ⌘ Infrared radiation
 - ⌘ Can be measured (Wh/sqm)
 - ⌘ Varies with time of day, latitude and season
 - ⌘ Published data available for numerous locations

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So, one major concern that we see is with the concept of understanding of day lighting from a pure physical sense, sun is the source of daylight it is also the source of heat. So, when you look at solar radiation, it in consists of different waves ultraviolet waves, visible radiation, infrared radiation and it can be measured in terms of the energy that is coming on a per unit area of a building.

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So, if you look at a published data and if you look at the locations, you will find that you know the amount of solar radiation that comes is more or less uniform in the upper strata and would change from location to location. But when you talk about daylight you are only concerned either in the visible spectrum, and the objective of a good daylight design is to only get this and not the other part right.

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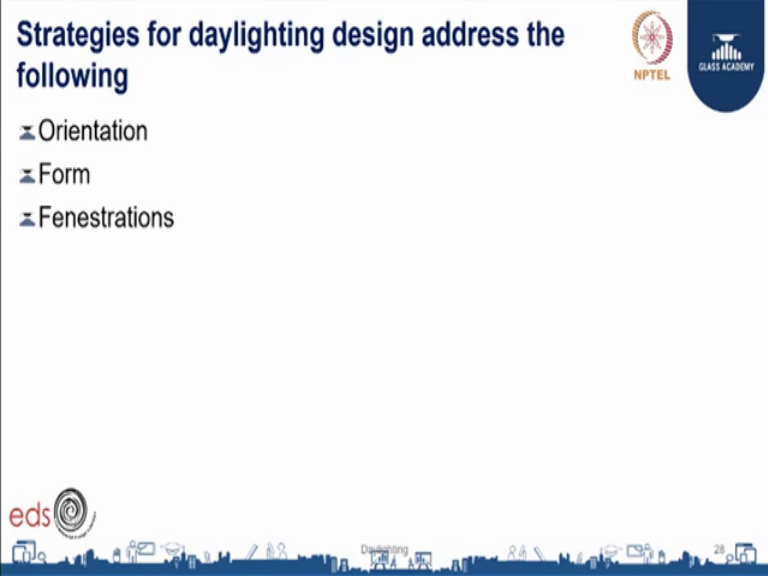
Goals of daylighting

- ≧ Provide sufficient illuminance
- ≧ Minimize glare
- ≧ Provide overall visual comfort
- ≧ Improved aesthetics
- ≧ Occupant comfort, productivity and health
- ≧ Reduction of electric lighting energy usage

The slide includes logos for NPTEL and GLASS ACADEMY in the top right corner, and 'eds' and 'Daylighting' logos in the bottom left corner.

So, the goal of day lighting is to get into all of these without getting into the heating.

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Strategies for daylighting design address the following

- ± Orientation
- ± Form
- ± Fenestrations

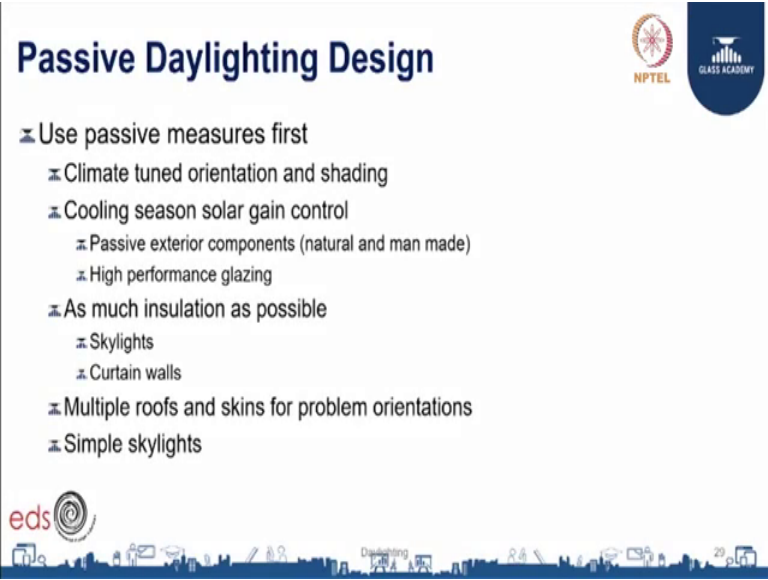
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NPTEL GLASS ACADEMY

Daylighting 28

That means we need to look at orientation, the form of the building and fenestration. Fenestration means a combination of class, a view, shading and daylight penetration.

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Passive Daylighting Design

- ± Use passive measures first
 - ± Climate tuned orientation and shading
 - ± Cooling season solar gain control
 - ± Passive exterior components (natural and man made)
 - ± High performance glazing
 - ± As much insulation as possible
 - ± Skylights
 - ± Curtain walls
 - ± Multiple roofs and skins for problem orientations
 - ± Simple skylights

eds

NPTEL GLASS ACADEMY

Daylighting 29

Day lighting very often when it comes as a part of a design intent from the concept stage, is mostly passive; that means, it is an intrinsic part of the thinking of the form of the building, it is based on the climate, it is based on the impact of the cooling heating that it has and it ensures that through proper insulation through proper selection of glass, you are able to get only the daylight and not the heat.

There are active daylight management options, which include exterior devices, building integrated solar and of course, solar collectors which sometimes are added as sun tracking devices or light pipes, which are a very good idea when you are doing a retrofit, but it is not a great idea at the concept stage when you are starting off a new building unless there is no other option alternative, because these are expensive and also tend to be very limited in their use. So, this is the basic introduction to daylighting and how passive and active daylighting systems are available for us to use in the concept design.

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Summary:

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

- Daylighting - Definition
- Importance of Daylighting
- Benefits of Daylighting
- Daylighting design
- Daylighting design problems
- Goals of daylighting
- Passive daylighting design
- Active daylighting management options

Thank you.