Course Name: Architectural Approaches to Decarbonization of Buildings

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Lecture 3

Natural Daylighting Strategies

Hello all. Today we move on to another important section which contributes to decarbonization of buildings and that is daylighting. Daylighting, the amount of electricity that is used for daylighting or lighting in a building is humongous, especially if you look at some of the energy intensive buildings such as offices or commercial complexes. As architects, we need to understand how to design buildings for efficient daylighting using certain strategies. Let us start with some of these. In this first segment, we look at the advantages and disadvantages of daylighting.

How to introduce daylighting into buildings? What are the likely strategies of daylighting? What are daylighting systems? Active daylighting system as well as passive daylighting systems and daylighting strategies and embodied carbon emissions. we end this segment when I mean segment not this class but the series of lectures on daylighting with some case studies. Now here in this picture you can see how natural daylight comes into the building's lobby. Now this building is a green solution house and a conference center and hotel located in Denmark.

The building was created with a focus on providing environmentally friendly solutions, including daylight. A large amount of skylight present in the building delivers high levels of daylight. These also maximize heat gain from the sun as heat gain is needed in that climate. It retains the accumulated heat inside the building during the much needed season. Whereas, if you see this second figure of the Langara Science and Technology.

This building again has a massive light well to light the inside with the help of large windows. So, in the first building it was the skylight or the atrium and in the second building it is the large windows which provide sufficient lighting inside. So day lighting is actually controlled admission of natural light, direct sunlight and diffused skylight into the building to reduce electric lighting and in order to save energy. Day lighting contributes to a visually engaging and productive environment for building inhabitants. It can save up to one third of the overall energy expenses for the building.

The fenestration or placement of windows in a building must be planned to ensure adequate sunlight enters the building. Adequate daylight exposure particularly in winter is very very important because inadequate daylight during winter is associated with mood disorders and other psychological impacts. Skin exposure to direct sunlight enables us to synthesize vitamin D which is a key nutrient for our health. There are several other health benefits associated with exposure to daylighting. It is known that in our homes and hospitals, it's important to have daylight for mental well-being.

And this can even accelerate the recovery process of patients when it comes to design in hospitals. So, a view through a window connects us to the outside wall enabling us to place ourselves in time and space. We specifically benefit from views of nature or views containing nature elements through a dramatic view of a cityscape. We also know that a comfortable workplace makes for a happier, more productive workforce. And the same applies in schools, colleges and universities.

The best daylight specialist will understand and consider the integration of daylighting with architectural lighting design. Daylighting in the context of other competing demands such as thermal comfort, security, acoustics and fundamentally sustainability endeavor to meet the most rigorous building recommendations without compromising on energy use or the visual comfort of building users. Least to say, Daylighting design is an important part when it comes to our physical and mental health and using daylight also makes sense in terms of the reduced energy consumption and the psychological association of being able to peep outside closer to nature in terms of aesthetics. So, how do we introduce daylight into buildings? There are various ways of doing it which we shall be looking at it in detail. The next few slides.

The most or the commonest form of introducing daylight into buildings is through windows. Skylights. Which are lights on the ceiling are another source. Clear story window. Clear story window is nothing but windows that are located near the ceiling.

Windows located near the ceiling and which are covered. These are called as clear story windows. Solar tubes. Solar tubes are contraption which trap the light and lead the light into areas which have no source of openings. And you have the light shelves.

through which you get diffused light through reflection. Let us look at some of the day lighting strategies. Some of the day lighting strategies includes having a overhang, side lighting, having a side lighting, and having overhangs. So, what happens is even though top lighting is important to reduce know the electricity use, but having side lighting like this with appropriate shading device brings in daylighting. We have what is called as the

light shelves.

Light shelves are nothing but these are surfaces. Sometimes this could also be a shiny surface and this is a reflective surface as much as this. Light strikes on this and gets reflected and diffused light falls on the working area. So, light shelves are another source and at the same time you have reflected light from the roof. So, the roofs have surfaces which reflect light inside which cause a diffused light.

then very important is having vegetation blocking the summer light and vegetation permitting this light from entering during winters. When you have deciduous trees The winter vegetation allows the winter light to come in. Then you can have anti-glare screens because it diffuses light and views in the form of Jallis. This is a common technique which is used in India where you have Jallis and therefore the quality of light inside is diffused and anti-glare. Lovers are a very important architectural strategy for day lighting as it blocks the summer sun but allows the light.

So, the sun gets, solar radiation gets cut. However, diffused day lighting still enters the room. Then let's move on and see what are the other strategies. Light well is a good source. What happens in light well is you have a courtyard, open courtyard with built form around.

This is how it looks. and light gets either reflected inside or light passes through either the windows or it gets reflected and we get diffused sunlight. So, courtyards are a good source also called as light wells are a good source of getting light. Another method is to have roof monitors. Roof monitors are nothing but something similar to clear story and therefore, the light comes from the The light could be diffused or sometimes it could be direct and glad depending upon the position of the sun which is that part of the year. Light shelves as I mentioned is another way of getting reflected diffused light.

Light which is got due to reflection on a light shelf. External reflectors are similar to light shelves, but they are located closer to the sill of the window rather than near the roof, which is what happens with light shelves. Atriums are good source of light but the small disadvantage with atrium is that it can allow direct solar radiation and make the space very warm. If it is a cold place it is a worthwhile strategy to have an atrium. Light ducts are another form of roof monitors but they they allow the light to reflect with the help of reflectors and bring in light into spaces that have no openings or no access to openings.

Clear story lighting happens at the roof level and brings in diffused light and you have reflective lures on which solar radiation strikes gets reflected in the form of diffused solar

radiation and diffuse lighting. Other lighting strategies, these include a day lighting system consists of systems, technologies and architecture. One can follow daylight optimized building footprint, have a climate responsive window to wall ratio, have high performing glass, have daylighting through optimized fenestration design. have skylights, tubular daylight devices, daylight redirection devices, solar shading devices, daylight responsive electric lighting controls and daylight optimized interior design. So, one can have a daylight optimized building footprint through use of optimal orientation, building orientation can be made optimal to achieve this.

Appropriate climate responsive window to wall ratio, it means the size of openings should be appropriate to allow good amount of lighting inside. High performance glazing implies use of glass which is appropriate to the climate. So, climate appropriate use of glass. Then daylight optimized fenestration design includes size of window, location of window, location and size of window. Skylights we have already seen these are nothing but know in the form of say atriums and light strikes the enters through the glazing.

It could be direct or it could be reflective. So, and tubular daylighting devices are which we will see in detail. These are devices which capture daylight and let in the daylight into spaces which have no access to openings. And that happens through a series of reflectors. So, a series of reflectors direct the light inside a space which has no access to windows.

Light redirection devices is also similar to tubular daylight devices. Solar shading devices include sun shades which are horizontal shading devices horizontal shading devices. Then vertical shading devices are vertical fins which are vertical shading devices and you have the third type which is lures which are multiple horizontal devices. You also have in the Indian system what is called as the Jali. So, Jalis are or honeycomb type of shading devices are a combination of horizontal plus vertical shading devices.

Light responsive electric lighting controls. and daylight optimized interior design. These are some of the strategies for enhancing daylighting in buildings. In our forthcoming classes, we would look at each of these in greater detail. Because it is important for architects and designers to understand daylighting strategies so as to reduce the load on artificial lighting which is a major component in daylighting.

enhancing or increasing operational energy. When operational energy increases, operational carbon also increases. And therefore, as part of decarbonization of buildings, it is important for us to learn and understand strategies to reduce the load of daylighting from the electricity grid by adopting daylighting strategies which will bring in natural light inside the building. Thank you.