

Course Name: Architectural Approaches to Decarbonization of Buildings

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Lecture 1

Low Energy Envelope Part 1

Dear all, from today for the next four classes, we will be transgressing into a very important and slightly advanced concept which is low energy envelope. We already know that we have energy efficient building envelope and it refers to the effective boundary between conditioned inside and the outside environment. This boundary includes The building materials on the facade, the air tightness of the windows to prevent infiltration, effective vapor controls and barriers and so on and also air flow controls. But low energy envelope is another concept. And it can also lead on to very smart envelope, small smart envelope of buildings. Today's class will be more like an introduction towards what is to come in the next three classes.

Now we all know that the building envelope is the outermost layer of a building. And it separates the inside from the outside. It is the skin of the building and it is the first barrier between the harshness of the outdoor environment and the comfort of the indoor environment. So it's not just a passive shell.

It has a very important function also. especially when we are discussing embodied carbon and operational carbon. The buildings envelope has a very crucial role to play in making the building an energy efficient one and also to ensure overall sustainability. So, a low energy building envelope takes the role of reducing operational energy to the next level by minimizing energy consumption for heating, ventilation and probably cooling whichever is pertinent. So, imagine a building envelope which is like very well insulated.

But you also imagine an envelope which is not only insulated but it also doubles up to allow control of ingress of solar radiation and day lighting in a building. And that is what we will be looking at in the next three weeks. As of now, we know that the building envelope is made up of the shell which is the roof structure, the walling, the envelope or sorry the openings. And the structure. But having a.

In order to have a low energy envelope. We must also have this building. Plus an x

factor. On the envelope. As our aim is.

to have reduced operational carbon. The basic building envelope design variables include having a building which is thermally comfortable. So it has a thermal mass by virtue of the materials it probably could have a insulation. It has a particular geometry which responds to orientation and in the first class we saw when you talk of orientation mass and form will also follow suit. You also have the physical aspects such as opening ratio and external shading device and we also have day lighting factors.

When you have the thermal mass having the x factor along with the thermal component on the facade on the elevation will result in reduced heat gain in warm places. It will also have increased day lighting. as needed by the user. So, who becomes king here? It is actually the user who becomes a king because user has greater control on how the building behaves, how the building can be made to behave when you have a low energy envelope. Now, there are three primary functions of a building.

The three primary functions of the building envelope would be you need to have a structural support. Since the building's envelope includes the wall of the structure, it should be able to provide support keeping the building structurally sound. building must have a sound foundation to support the structure's weight and the walls must also be strong enough. The exterior of the building and the foundation support must meet the local guidelines but beyond that they should be strong and in a low energy envelope you must the building must also be able to withstand the load of the x factor which we will be discussing in the next three classes. The building must have climate control which is a very important function of a building envelope.

And as we have dealt with previously, the envelope should ensure that whether the indoors has to be air conditioned and it remains inside while the outside air remains outside. So, it should ensure that the energy is not wasted in the process. So, we have to be very careful about the choice of all the materials that we use to ensure that the building is climatically supportive. But having the x factor is going to make the building optimize. to ensure least operating energy and therefore reduced use of reduced operating carbon.

Now Why low energy envelopes are crucial? They are crucial because they will ensure that we have reduced energy consumption. How does it ensure reduced energy consumption? By minimizing heat transfer. And low energy envelopes can lead to significant energy savings. So you can have energy savings. You can have lower operating cost and lower environmental impacts.

So the low energy building will ensure that the heat transfer is minimum. You can have

significant energy savings. The operational cost gets reduced, operational energy gets reduced, operational carbon gets reduced and the impact on the environment is reduced. You can also have improved thermal comfort because you will have consistent indoor temperature which contributes to occupant comfort and well-being. which will lead to greater productivity and user satisfaction.

The third advantage you would have of a low energy building is they contribute to endorsements by green building certification because they help in creating sustainable built environments. In a gist, what are the advantages of low energy buildings? They minimize heat transfer Number two, they lead to significant energy savings resulting in low operating energy and this in turn results in low operational carbon. and thus it helps on environmental impact to be reduced. Besides, they create comfortable indoors for the users resulting in occupant satisfaction and also occupant comfort and well-being. Besides one could apply for endorsement by green building certification agencies.

and overall they create a sustainable environment on the long run. These are the reasons why we must have low energy building envelopes. Let us quickly see what are the key elements of a low energy building envelope. First is it must have a high performance insulation. So, it should have walls, roofs, floors that are insulated to avoid infiltration.

You yourself can have a look at the air conditioned buildings around you. You will find a lot of cool air gets infiltrated from gaps under the door through the jams of the windows and things like that. So a lot of energy wastage happens due to infiltration of air. One must have airtight construction when it comes to air conditioned buildings and therefore these gaps and cracks around the windows or any of the fenestration must be sealed so that we can prevent unwanted air filtration. The windows must be energy efficient You can have double glazed or triple glazed windows with low emissivity coatings so that heat gain is minimized.

You must have good shading devices because the shading devices are very important because they can shade the windows, shade the glass. And therefore they can prevent solar radiation direct solar radiation from entering inside. Shading devices could be your overhangs or louvers or blinds and they can be used to control the solar heat radiation inside. When needed depending on the climate. The building should be able to facilitate natural ventilation.

So strategically placing the window and ventilators become important. You must have good solar design by orienting the windows and the thermal mass elements to capture and utilize solar heat gain during winters and you must prevent overheating in summer. One very important factor along with this is daylighting. In typologies, building typologies

which involve the use of humongous amount of artificial daylighting such as offices or reading area of residences, Providing adequate day lighting will also ensure that the envelope functions as a low energy envelope. But beyond all this there must be a x factor which is going to accelerate or exaggerate all of these points.

give a very sustainable building which has low operating carbon and that is what and this class is primarily an orientation towards it. Let us see the benefits that we could have by adopting low energy building envelope. Low energy building envelopes are less expensive because there is reduced energy consumption in order to increase the comfort of the user. When I say comfort, two kinds of comfort, thermal comfort as well as day lighting. So, the reduced energy consumption leads to lowering of energy bills.

the overall carbon footprint of the building gets reduced dramatically because lower energy use means we will have less reliance on fossil fuels and therefore our reliance on electricity will get reduced which will result in low operational energy and therefore low operational carbon resulting in smaller environmental impact. There is a factor which is added to this kind of buildings and therefore the property value of a energy efficient building is bound to rise. It is found that occupants are normally very happy and healthy in buildings like these because there is consistent thermal comfort and there is good indoor air quality both of which are directly related to occupant comfort and well-being. You must also understand that in buildings in the x factor that we have been talking about which we will see in greater detail. the occupant has greater control on how the building must operate in terms of daylighting and in terms of ingress of solar radiation.

So, investing in low energy building envelope is a very important aspect for the future because it is directly related not only to economics, but also to the operating energy and operational carbon. So it is basically a situation where everyone is happy, the building owner is happy, the occupant is happy and most important, the environment is happy because lower operational carbon means reduction in greenhouse gas effect. By prioritizing energy efficiency, right from the beginning, from the early design stage, we will be able to create buildings that are comfortable and sustainable and which are also operationally cost efficient. So, either ways we must look at low energy building envelopes as an aid towards decarbonization of buildings and the next three classes that we will be talking would focus on how this is done with case study examples. The heads up to what is to come I would say that these low energy building envelopes also make the building look very exciting because those buildings look dynamic.

The buildings are more like sculptures. I agree that the embodied energy of those buildings is slightly higher but it more than outdoes what it would do to the environment on a longer run. in terms of operational carbon besides you always have the power or

strength to choose building materials or the techniques and the technologies for the low energy envelope fittings to ensure that even the embodied energy gets minimized so I had a shorter introduction today because let us focus on what is to come in terms of the smart building envelope with case studies and examples. So, I will stop this class today here and we will continue our next classes with building examples and case studies. Thank you. you