Course Name: Architectural Approaches to Decarbonization of Buildings

Professor: Dr. Iyer Vijayalaxmi Kasinath

Department of Architecture,

School of Planning and Architecture, Vijayawada

Week: 07

Lecture 04

Carbon neutrality through strategising building materials

Hello students. So we have seen most of the basics of how to decarbonize buildings. Now let us look at the strategies to achieve low carbon architecture. Now, in this class, we will see what is the significance of embodied carbon and how can we reduce it in buildings, what are the strategies basically. We will just get into the introduction of renewable building materials, non-renewable building materials, and building materials and their embodied carbon, the next few series will focus on this. We will also see the impact of building materials on embodied carbon, the choice of materials and of course we will see which materials are renewable, non-renewable and so on.

We will also see some case studies. But that is for the next slides to come or next classes to come. Let us look at the strategies to reduce embodied carbon in building. Now, embodied emission must be considered from a very early planning stage.

So, when the building is being conceptualized from that stage itself at that point itself one needs to consider embodied emissions because that is directly related to choice of building materials. So, from an early planning and design stage itself we must start looking at what would be the embodied emission of the building. building that we plan. We must also look at the potential of how we can contain or control these embodied emissions and ensure that it's very low, which means the more you are moving towards the project, the lesser are the chances for the designer to have any control over embodied emissions because he will have less control over the choice of building materials and construction techniques because both of these are decided at an early planning stage. Then what we must do is, we must first determine what is the scope of the project? How big is the project? Is such a scale necessary or not.

So, whether we must go for building it, reduced building it or not at all building because some of the projects may even seem not necessary. So, we should even consider no build. So, by reusing existing structures, whether we can retrofit existing structures whether we can alter existing structures because when a new project is to be built one needs to consider if we are going to demolish the existing project completely which in a way is a

huge loss of resource. All the resources that went into building that particular project in terms of building material, construction technique because you need a lot of equipment to construct and equipments can contain I mean can consume lot of fuel in the form of diesel. So, whether you need to build or not build or whether you can scale down the project.

Suppose a client comes and says that he needs a six bedroom apartment or a six bedroom house. As a designer or architect, you must be in a position to counsel him and suggest to him that such a large scale is not necessary and we could always do for their requirement. For the client's requirement, we can always make do with a three bedroom house or a four bedroom house and probably give a provision for expansion and can be built when necessary. Of course, there are many other ways of dealing with it. We can even build in either a phased manner or in an adaptable manner where you can postpone the extra that is built, and at a later stage if it is not needed, it can be dismantled.

So, we can look at those things also. So, you need to first look at whether that particular building is necessary or not. If it is necessary, is the scale that is being proposed by the client, is it necessary or can we ask the client to scale it down? And we should also look at the sizes of the rooms that the client is proposing. Sometimes clients can also be, saying- it's their dream, after all it's their dream project. So they would want everything to be in grandeur.

But with grandeur also comes so many other things which may not be necessary such as increased embodied emissions. And sometimes intervening at this stage can lead up to even 50% reduction in embodied emissions. Therefore it becomes our duty as architect and designer to intervene even at this early stage which i would call as the architectural programmatic stage to ask the client whether you need this building. And if that new project involves demolishing an old project - all the more necessary that you have a series of deliberations to assess if it is really necessary to demolish what is existing and build a new one or we can retrofit what is already there and yet meet the client's requirement. The second aspect is you need to build right.

So, first is to determine the scope for building not building maybe avoid demolition of existing building and also retrofit of existing building. So, this is the first one. The second is to build right. Now, we must have or we must deliberate and get into the right design solution for that particular design challenge. Now, think about efficient material use and consider the best use of the materials properties.

What I mean to say is, if for that particular problem the solution lies in a material which has less embodied emissions, we must be able to advise the client to go for the alternate

building material or alternate construction technology rather than pumping in more of the material. For example, if M20 concrete is sufficient, then we must advise the client that there is no need to go for a higher concrete strength because it would mean higher embodied emissions. Just this decision can have an impact of 10% on the emission reduction. But again this must be implemented at a early design stage. Third is we need to build smart.

By saying that we need to build smart I mean that we need to reduce the burden on the natural systems for raw material extraction and processing. So, how do we build smart? It is not necessary that for every component of the building we had to indulge in new components only. Recycled products, they offer a humongous amount of reduction in embodied carbon because already that particular component material or component has been used elsewhere and all that is involved in the embodied emission of using that material is in transportation and erection. For example, there are many examples of how we can use recycled materials, whether it is in the form of doors, salvaged doors, windows, sometimes vintage doors, windows, cupboards and so on. But imagine if you are able to salvage an entire component like using recycled container, shipping containers.

You must be aware that shipping containers come in modules of 4 feet or 8 feet. So, imagine a shipping container being used as a room. And what is the embodied emission of the original shipping container? It is humongous because shipping container is made up of one of the finest quality of steel and steel is a very high embodied energy material. Large amount of embodied emission is involved in the manufacture of steel. And this shipping container is a very very strong building component.

Why? Because it has withstood the savages of extreme saline environment for months together in its transportation. Some of the shipping containers cannot be reused by the shipping agencies and they are discarded. If we are able to salvage components like this, there is a huge reduction in embodied carbon and therefore embodied emissions. So, we need to build smart. Then another component is another strategy for reducing embodied carbon is- supply chain impacts.

Now, consider the supply chain impacts of the materials used. For example, manufacturing in different regions due to energy grid mixes. Now, doing this kind of planning for appropriate supply chain from where does your material come? How locally is your material available? What is the source of your material? That has a huge impact on embodied emissions. For example, you have a tile. You need to lay flooring tiles.

Now, flooring tiles, the choice will come. How does this start actually? First and

foremost, do I need this? Do I need this quality of tile? Can I not go ahead with in situ flooring? That would be this component. Thinking so would actually be this component. Then first is do I need this type? Then second is which material should I go for? So, material use. That choice will come from this component.

Then next I would consider- can I go for either an alternate tile or can I go for any recyclable material like construction demolition waste; can I recycle construction demolition waste to add as a cycle? Can I use recycled construction demolition waste as an aggregate in the flooring? That aspect would relate to this, and suppose you decide you would want to go ahead with a marble tile. So, marble flooring. So, from where would the marble flooring come? Will I get it from the local area? Would I want to get it from Rajasthan or would I want to get it from Italy? What is the difference? The embodied energy and the embodied emissions are going to be stunningly high because there is going to be a humongous contribution of transportation emission. So, just with one example of flooring tile you can imagine how much of embodied emissions we can reduce with appropriate choice, but again all this has to happen at a early design stage. What are the ways to reduce embodied carbon of building through materials? So, the first one is; we need to avoid.

When I say avoid, we need to build less. Please question the brief. It is very important to It's very important to question the brief. Do I need this? Does the client need this? Or can I advise the client? You could advise the client to build less. And how do you do that or what is the way to convince the client? The way to convince the client is by showing the client in numbers the impact his decision has on whatever he takes- whether it is to build less or not build at all or just go for retrofit.

Then second is use of alternate building materials. We need to have a major shift in our thinking by going into use of alternate building materials which have less embodied emissions. So, this could be in the form of using either recycled products completely as a products or recycled components or it could be in the form of recycled building materials in that component also trying to go local. Then the next one is to improve. So, the ways to improve would be to decarbonize conventional materials by having appropriate choices, appropriate building material choices.

I would like to reiterate here again and again that building material choices are very important and you have various types of building materials, but that is for another day or another course itself completely. So, appropriate building material choices in the form of the actual material in the form of source of the material, whether it is local or whether it is from some other region of the country or it is from some other region of the world. So, the transportation energy also increases and also the construction technology which we

rarely talk of. So, the construction technology is another important component. So, a little brief on this will come in the following classes, but a lot more on this will end up in another course itself.

So, we need to take care of all of these. So, to reduce the carbon footprint of building materials and construction. We need swift action to reduce the carbon footprint of conventional building materials while increasing the market share of bio-based or agro-based building materials. There is either this or that approach.

Both approaches are necessary. concrete, steel, glass, aluminium, plastics and other modern or now I would even say conventional building materials- considering the scale at which we are using it. These still dominate the current models of construction. So, with these materials there is no way around addressing emission issues. But we should definitely consider more humane ways of handling nature by our decisions of appropriate building material choices. We could a life cycle analysis based on the data available to guide our design decisions.

Life cycle analysis is a method to quantify embodied emissions. We will not dwell much into it, but I just wanted to introduce this terminology. In case you are interested, you could take it further. Should look at building materials with optimal properties for the local climate. So, we must avoid bringing in irrelevant building materials because that will also end up in our buildings not being climate responsive.

And low carbon materials must be used and we must avoid carbon dioxide intensive materials. Some of which are, as I told you, the modern building materials like aluminum or steel or plastics. Low processed materials that consume less resources for production and are easier to recover and recycle must be used. Resistant materials with longer lifespan and less replacement or less maintenance must be used because every time you end up having to retrofit a particular material in the name of maintenance, you are going to increase the embodied energy and embodied emission. Recycled material, especially carbon intensive materials must be used.

In case the design decision is such that you end up using carbon intensive material, try to make your choices so that you end up using a material which can be easily recycled- like aluminum. Aluminum's recycling potential is very very high. Same -steel is a good material to be recycled. Glass is a good material to be recycled. The local value chains to lower transport emissions and strengthen the local economy must be considered.

So, the more you buy local not only is the embodied emission reduced because of reduced transportation emission but also you are supporting the local economy and the

local market. The onus of explaining all of this lies in the hands of the designer. So, as a designer the important things that you must consider are or the important strategies you must follow are you must first look at the necessity of the building, whether the building is necessary, whether the scale of the building is necessary, whether we can build less or we need not build at all which is a very early design stage decision. In case you have to build, consider whether you need to demolish the existing building completely or you can go ahead with retrofitting of the existing building and expanding it to the need of the client and also you should make appropriate building material choices such that you include more of recycled component and you must improve your material choices by going in for decarbonized materials. Decarbonized materials are materials which have low embodied carbon and low embodied emissions.

What these building materials are, we will see in the forthcoming classes. So, with this I will stop this class and we will move to the continuation of this topic in the next class. Thank you.