

Course Name: Building Materials as a Cornerstone to Sustainability

Professor: Dr. Iyer Vijayalaxmi Kasinath

Department of Architecture,

School of Planning and Architecture, Vijayawada

Week: 01

Lecture 02

Vernacular Materials

Dear students, in our last class, we had a small discussion about the emphasis of the vital role of building materials in construction, shaping the life, quality and safety of the structure. As we look back, we notice a shift from natural to man-made materials sourced globally. Examples like masonry concrete, wood, steel and glass showcase the diverse choices - each selected for specific reasons. Understanding properties like density, porosity and water absorption is crucial for successful projects. Shifting to contemporary concerns, we explore green building materials known for sustainability. These materials actively capture carbon, use renewable resources and prioritize low carbon impact offering a proactive approach to sustainable construction.

In essence, the ongoing evolution of building materials is a promising path towards constructing resilient, sustainable structures addressing current needs while contributing to environmental well-being. Having said that, we must have an understanding of the vernacular building materials as we had discussed that as the first classification in our previous class as you had seen here. So, let us move to understanding vernacular building materials. So, now vernacular building materials which I also call as traditional building materials, are the materials used in construction for an extended period of time which is passed on to us from generations to generations and these are derived mostly from local sources.

Thatch materials have a rich history in India, enduring over generations. Similarly, many of the traditional building materials, they have had enduring time in our buildings over generations and these are derived from local sources. Now, the examples include adobe, stone, thatch, timber and these are also known for durability because even today if you look at some of the buildings which are even not very well maintained. They are 100 year old buildings made out of mud. They are maintained well, no doubt they still stand sturdy.

In the context of Indian architecture, the four pillars which is context, climate, craft and

sustainability, these serve as guiding principles for constructing towns and buildings. Jali or perforated block is a local term and it encompasses brick, cement, terracotta and wood units. These intricate blocks, they create beautiful patterns of light and shadow, ventilating indoor spaces, creating patterns as a play of light and it symbolizes contemporary Indian architecture. Earth in various forms such as rammed earth or wattle and daub or compressed earth blocks have been popular for millennia. The red oxide flooring creates a kind of a nostalgia in us because it was introduced in old buildings by Portuguese and Italians and it adds an earthy finish.

Lime plaster which is witnessing a revival now is appreciated for breathability and aesthetics. Mud and cow dung known for insulation and antiseptic properties have seen a revival in villages as well as cities. Thatch roofing is an early vernacular architecture form and it is embraced for its meditative and natural qualities. Locally available stones like granite and marble offer unique textures while wood is prominent in the Himalayan region for both practical and religious regions. Bamboo is abundant in India, especially northeast region and it is gaining popularity in many experimental projects.

These materials not only reflect India's architectural heritage, but these also showcases sustainable and climate responsive construction practices. Let us now look at the characteristics of vernacular or traditional building materials. These materials are to be first locally sourced. So they are very context specific. So traditionally these materials that were used-available materials they have stood the test of time.

And these materials have enduring qualities that make them stand out in construction. These materials are typically found locally, ensuring easy access and reducing environmental impact by means of absolutely no transportation energy requirement. These materials are known for their strength and ability to withstand different weather conditions. They contribute to the long-lasting nature of structures, long-lasting nature of the building and with deep cultural significance, they reflect the traditional style and techniques of a region. Sustainability is a key feature as many of these are sourced from renewable resources which aligns with eco-friendly construction.

So, these materials are climate responsive and they have been used over a long period of time. They have been experimented on until it is realized that they are climatically responsive. These are also very low embodied materials and sustainable because they are sourced with very minimum harm to the environment and less requirement for processing of the material into something else. They are also versatile and adaptable. And they are adaptable to the local craftsmanship because local craftsmen are involved.

The use of this traditional material, it connects to the heritage and the cultural identity.

Because there is an expertise that is given by the local people who are also now well versed with the material. There is a good cultural significance when we use vernacular and traditional building materials. Because these reflects the local architectural styles, history and the culture of this place. As you can see.

Any of these buildings will evoke a sense of ethos of that place and just by seeing the building you can clearly tell which part of the country these buildings belong to or sometimes you can even identify which buildings these are. Now let us look at the relevance of these vernacular materials. In recent years there has been a growing public and private concern about the adverse effects of construction operation which has led to push for green or sustainable building initiatives. Since vernacular buildings have adopted some materials, strategies and techniques from vernacular style, green building construction is not completely new or something which we are, for the first time we here in our country are hearing about it. No, it was always there in our tradition to go green, to be respectful to earth.

and things like that. According to some published research it is imperative to re-examine historical experiences, particularly in relation to these traditional constructions, as traditional buildings are authentic representations of sustainable building practices. In the future of construction, these kinds of techniques will be crucial. Since this traditional construction, which we also call as vernacular architecture, it involved the use of vernacular materials, techniques and strategies. The sustainability aspect of it became most problematic if new buildings are constructed without using such vernacular or local materials or local techniques or I will summarize the whole thing as local wisdom.

That becomes very important. Now, what are vernacular building materials? These materials are indigenous to a certain region and can be sourced naturally for the construction of buildings. They are usually climate responsive and tied to the culture and traditions. It is basically the traditional and cultural art which is still practiced in rural areas. It showcases the roots, the cultures and also defines the history of the architecture there.

There is a myth that vernacular buildings are easy to construct but actually it takes a lot of skill. Especially if it is a foreign skill which is trying to imitate it. Locally, yes it is very easy -because they have practiced it over time and they are familiar with the building material. Different regions of the world have different styles of vernacular building designs and which comes from use of that particular building material. Because building design is also an outcome of the building material that you use.

There are definite environmental advantages when we use vernacular materials. As you

can see here that these are the- You can see here that these are the vernacular building materials. We have granite which is a stone, timber, rammed earth and straw. Just look at their embodied energy in comparison to the embodied energy of modern building materials such as steel. Concrete is somewhere in between.

Steel is extremely high in embodied energy. Then you have ceramic tiles. Imagine using red oxide instead of ceramic tiles.

Roof tiles. Thatch. Think of thatch. Thatch will be a carbon negative material because of the amount of carbon sequestration it has. Polystyrene. The point is it is quantified that Traditional building materials are low embodied energy and modern building materials carry high embodied energy. I am not discussing more about concrete because if you look at the amount of concrete that is needed in buildings then the embodied energy, total embodied energy, contribution due to concrete in the building will be skyrocketing.

That is why I am not discussing much of concrete right now. So, this is the amount of embodied energy that the buildings will have, based on the building material choices. The point also is, most of the buildings especially houses, for each of the modern building material- there can be an alternate building material which is vernacular and yet we do not choose it and that is what I say we need to choose. Now, if you look at the cradle-to-grave analysis of some materials, I am looking at the global warming potential. If you look at the global warming potential of these materials, that is also humongously high if you start looking at the modern building materials as compared to vernacular building materials.

So, now some of the cradle to grave analysis of materials that I have selected is -say if we look at earth or adobe, it is few grams of carbon dioxide equivalent per meter cube of the material. Sun dried clay brick has 0.2 to 0.4 kg carbon dioxide equivalent per meter cube and bamboo has half of that.

it is even less. But look at the carbon dioxide equivalent of modern building materials or conventional building materials. Concrete has 1.5 to 2.5 kg carbon dioxide equivalent per meter cube.

Steel has 2.5 to 4 kg carbon dioxide equivalent per meter cube and kiln baked bricks have 0.5 to 1 kg carbon dioxide equivalent per meter cube. So, this is the amount of, for a perspective, this is the amount of global warming potential of traditional building materials vis-a-vis modern building materials. Let us quickly look at the socio-economic advantages of vernacular building materials. The local production of materials is not only economically cheaper because it also enables creating jobs for the unemployed people in

the local area.

migration of people gets reduced. The social advantages also include the passing of knowledge from one generation to another generation and it enables groups of people to work closely together due to common knowledge or due to their occupation familiarity which is specific to the local area and these things must be respected. Now there is a general misconception that vernacular building materials are appropriate to only old structures which is not true. Here I have shown cases where I have just taken an example of stone to show, how stone, as much as a very grandeur building material for or a very majestic building material for old or traditional structures. It depicts a kind of a majesty in terms of scale in every way. But the same building material also has a contemporary application which is equally glorious.

If you look at the styles of architecture, they are completely varied between the right half and the left half and yet it can be comfortably used. It can gel well, - as a contemporary building material as well as a traditional building material. It is only our creativity which is going to bring out the best of that building material. Imagine this application of all the other building materials also. Anyways, during the course of this subject, we will be seeing each of these building materials separately.

Similarly, let us look at mud. Mud can function equally well. I mean you do not have to think of mud only as an old hut or something like that. Traditionally, mud has been used in structures which are vernacular. So, we have this is vernacular and this I consider as a modern structure.

One cannot even make out. Yet, it brings in a certain rusticity, certain very ethnic touch to the buildings. And therefore, in no way are these building material less to any of the contemporary building materials. You can even see the span of the building. So, even structurally, these building materials, which I have shown now, which is stone, mud. And now we will move on to bamboo- They project a very contemporary image also.

So it is only our creativity as architects and designers how far we take these building materials. Let us look at bamboo. Bamboo is predominantly assumed to be used as a hut. But the versatility of bamboo is so much that you can use it for a short span, long span, for a low ceiling, extremely high ceiling building material. It is up to the human ingenuity to use these materials.

I have taken these three materials right now because they also classify as extremely earth friendly materials, durable and very very low embodied energy thus contributing to the environmental repair or rather they do not damage the environment. Bamboo as a

building material also has a lot of carbon sequestered in it and that way it is even a carbon negative material. But if you look at the style of each of these-style in which each of these materials is used, it's very different. The way stone is used is very different from the way mud is used and it's very different from the way bamboo is used and hence use of local skill must be tapped when we start using these building materials. The context remains very intact when we start doing that.

So, in conclusion -Vernacular materials have the potential to evolve and to be adapted to contemporary needs, helping to reduce the embodied energy and environmental impacts. These building materials are sourced largely from a particular area, from a particular locality and hence the transportation cost is completely reduced because of which one aspect of embodied energy gets completely cut. Most of these building materials are renewable building materials and therefore they are extremely low in embodied energy. Bamboo, you have to anyways keep on cutting the culm of bamboo. And therefore, it is very very low embodied energy or rather it is a carbon negative material.

The vernacular materials and techniques have from the sustainability point of view lots of advantages that must be promoted by us. How that can be done is you and I as architects must start incorporating these materials. A lot of research is happening on the contemporary application of these building materials. We need to go and source.

For example, you have IPIRTI for use of bamboo. They have done lot of research on bamboo as a building materials. You have NIRD which works on rural building materials. Rural building materials is what? It is all that we have talked of. Each one is giving a different name tag for these building materials. So, lot of research is done to understand their contemporary application in terms of the material in combination with new technologies.

It is we as architects who have to stretch that hand further and incorporate these into our buildings. Among these, environmental issues stand out most -especially from this course point of view. But there are also social and economic benefits which we should not ignore. So, it is concluded that using locally materials has environmental and socio-economical advantages such as it reduces the embodied energy in buildings.

I will write some of these aspects down. So, reduction of embodied energy is one. Then it also reduces the operational energy in buildings. How? Because these buildings can also be designed to enhance indoor thermal performance and therefore the operational energy can also be reduced. These buildings can also be constructed at a much reduced cost.

First is transportation cost can be cut almost completely. If at all the cost increases it is because of skilled labour. So skilled labour is something which we must encourage also because it boosts the local economy. So it promotes the local economy through local payment of the cost of materials as well as workmanship which is actually not a bad thing at all. In fact it's a very good thing because you are also using the wisdom of the local people and therefore the building materials' complete potential can be brought out if we use the local economy. And therefore, it is our duty to see how we can incorporate vernacular building materials in today's building.

This becomes more prominent and relevant because today's clients are also willing to accept these. Today's clients are willing to accept their houses to be made with stone or mud can be incorporated or bamboo can also be incorporated. So, now is a good ecosystem here for the architects considering that we have clients, we also have technology which is doing a lot of research and bringing out quantifiable data on the use of these building materials. So, With this, I conclude this class and from the next class onwards, we will see the various vernacular building materials before we move on to looking at various alternate materials. So, I will stop today's class with this and we will move on to the next vernacular material in the next class. Thank you.