Course Name: Building Materials as a Cornerstone to Sustainability

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Week: 01

Lecture 03

Mud- Traditional Material

Hello everyone. Until the last class we saw, what are the various classifications of building materials? and then we had an introductory class on traditional and vernacular building materials. In today's class we will be seeing the first vernacular or traditional building material which we will be discussing and that is mud. Now, in this class we will have an overview about mud and its use. What is the application of mud in the construction? We will also look at its application. So, in architecture the choice of construction materials becomes very important.

It holds paramount significance. because it actually defines both the structures attributes as well as the application process. Historically, natural building materials like mud, we can call it as earth or soil, stone or wood, these have dominated the construction practices. But as the population has surged and efficiency demands increased, we have transitioned to very energy intensive building materials.

So, we have transitioned to building materials which are no longer eco-friendly as they used to be because these building materials have become energy intensive. But this shift has prompted us to re-look at our choices. We have re-evaluated our choices even scientifically and technically. Mud is an abundantly available resource. It emerges as a transformative material and it deserves to be renewed in the construction industry because it is such a earth friendly building material.

It is renewable. It can be recycled in its original form. A building which is made of mud and it perishes, there is absolutely nothing that happens. The building itself came from earth and has gone to earth. That is the kind of renewable aspect mud as a building material has.

In ancient times, reliance on natural materials was very high. It fostered sustainable building practices also. There was very minimal intervention of something which was not sustainable because there was very little involvement of something which was not local

also. The evolution towards energy intensive materials or energy intensive building construction practices, it was no beneficial in certain areas no doubt. But it led to a lot of environmental harm and concerns.

The abundance of mud as a construction material makes it a compelling choice. You have lots of it. Considering its eco-friendly attributes and the need for sustainable alternatives, mud comes as the first answer. As we confront the environmental impact of our construction practices and choices, a return to something which is less intense in energy, such as mud, is a pivotal step in fostering a balance between modern efficiency and environmental sustainability in the realm of construction. Why mud? Why is it preferred traditional building material? First is its availability.

Mud emerges as a versatile and sustainable construction material with several advantages that make it a very appealing choice for modern building practices. First of all, its widespread availability globally renders it as a cost-effective alternate material compared to traditional materials. especially in situation where transporting construction materials is very challenging. The accessibility of mud contributes to its eco-friendly profile offering an easily available option for construction in various locations. In terms of its energy consumption, in the construction industry, it is a major concern.

The amount of energy a building material consumes is a huge concern, especially in the context of environment. With the manufacturing and transportation of modern materials requiring significant fossil fuel energy, mud addresses this issue by being abundant energy. readily available and requires less energy intensive construction equipment. So, mud becomes important because it is because of its abundance, its ready availability and also it is less energy intensive so requires less energy for processing we could combine it very well with its thermal properties so No, it plays a very crucial role in terms of its thermal properties also. So mud's insulating properties is very impressive.

It surpasses that of steel and concrete structures also in terms of its malleability, in terms of its ability to get into various forms. So you can go for organic designs also. And it has good thermal properties. In embracing local materials and construction techniques, mud serves as a decentralized construction solution. It prevents external heat from penetrating the buildings and maintaining a cool interior environment.

It presents a compelling case of being sustainable, cost-effective and eco-friendly material with driver's application globally. But one of its most standing out feature which makes mud an important material is its recycling ability. So it plays a pivotal role in sustainable construction and mud excels in this aspect. Unlike the very expensive and limited recycling options for modern materials, say like steel or glass, mud can be

recycled without the need for any external sources and this saves time as well as energy. Of course money is also saved.

The post-construction characteristics of recycled mud remains consistent, providing a reusable resource for future construction endeavors. Only thing you have to remember is this mud is normally not to be a topsoil because topsoil is very fertile. Because of all the organic waste that mixes with it, topsoil is very fertile. So, be careful not to use topsoil when you look at mud. Now, the type and process of mud construction differs from one place to another.

It varies as per the climate and the type of soil availability. As for every different type of mud, we use a different construction method. Mud construction techniques are broadly classified into these five types. First is the wattle and daub. Second is rammed earth.

Third is adobe construction. Fourth is a cob wall construction. And fifth is a compressed stabilized earth blocks which we call as CSEB construction. All of these techniques are still used throughout the world for being very pocket friendly that is economical, sustainable and eco-friendly construction. Most of these do not even need very high skilled labour.

Now let us look at what is wattle and daub construction. Now the construction technique of wattle and daub involves weaving a lattice of wooden strips which is called as wattle and this is coated with a mixture of mud with some binders. It can also have little aggregates and the reinforcement there is the daub. So these binders can be clay, lime, dust or limestone, cow dung and these serve to hold the soil together. Aggregates can be earth, sand, crushed stone and crushed chalk and this contributes to the dimensional stability.

That is the mud does not slide and slip down and it gives some kind of a stability and strength. Now that depends on the size of the weave, the wattle design and so on. Here I have shown a very dense wattle design in picture 1 and in picture 2 you can see how over the wattle the mud is plastered and layered one on top like this it just keeps layered and to prevent it slip there is further reinforcement in the form of timber. Now reinforcement materials can be like straw or hay or any fibrous substance. Normally it is straw or hay because that is also locally available and these play a crucial role in preventing shrinkage and providing flexibility to the mud mix.

Now the process of creating this eco-friendly structure begins with constructing a mesh of bamboo cane and straws between the timber framed structure. The mud mix is then applied over this bamboo mesh which we call as vattle performing a plaster that is

subsequently whitewashed so that it is protected from rain also. This whitewash can also be lime whitewash. This sustainable construction method prioritizes stability, rapid construction and environmental friendliness, making it a very ideal choice for those seeking eco-conscious building practices. The process of creating this eco-friendly structure begins with constructing a mesh of bamboo cane and straws between the timber framed structure.

You have a major timber frame structure and then you start constructing the mesh with this reinforcement around it. So, the mud mix is then applied over this bamboo mesh and this forms a plaster that is subsequently whitewashed to enhance resistance to rain. This sustainable construction method prioritizes stability, rapid construction and environmental friendliness and it makes it an ideal choice for those seeking eco-conscious building practices. Here you can see in these pictures how I have just done a case of this where you have this major posts and then you have this reinforcement the form of timber and over that the mud gets daubed like this and it keeps getting daubed until it is completely This is one picture.

This is the second stage. You can see three and fourth is the complete house which is done with wattle and daub. And you can also appreciate the aesthetic appeal this building has got, the earthiness. And in no way is this building aesthetically or in terms of its scale less than a modern or a contemporary building. And all that this building uses is a very vernacular locally available knowledge. Here you can see, so this building is typically it looks more like a village kind of a house, especially because of its roof.

But let us look at this building primarily for its walling. And you can see how local craftsman is enough, sufficient. So most of these houses which can be done with wattle and daub method in villages are constructed by the occupants themselves. So, the use of labor is also negated there. But we have to have a contemporary application for these this building material with this technology which I showed you in the previous case study which is this.

The next one technique we move on to is the rammed earth walls. So, rammed earth walls is a prevalent mud construction technique. And this evolved from the cob wall and it addresses the issue of non-uniform widths. So, this method introduces a framework that ensures consistent width across the buildings. So, the wall dimension does not change at all.

The raw materials consist of clay about 15 to 30 percent along with sand or chalk, lime and gravel. While the compressive strength of concrete of similar thickness surpasses rammed earth, this well-crafted rammed earth structures exhibit remarkable durability

good enough for contemporary living. The construction involves two parallel planks held at a fixed distance and that distance will determine the width of the wall. So, you can see that first you take buckets filled with mud mix then you have two wooden planks, plank 1 and plank 2 at a desirable width and so this desirable width will determine the width of the wall. So, this is one and two plank and this cavity you need to create this cavity in between the two parallel planks inside which the earth is going to be filled.

So, the material mix which you have which is here you have two planks planks it forms the framework and this is built and a layer of moist soil is first fill filled into this. So, this material mixed is placed into this cavity and it is compacted using wooden or metal rod. So, you use a rod to compact it so that there are no air pores and the soil goes and gets compressed or below. Then once a particular section is solidified, here you apply pressure and compress it. Once this gets compressed, you further add more soil, consolidate it and then after that again compress it as shown here and then you start again adding more layer of soil, compress it, more layer of soil and compress it.

So, for subsequent courses these planks keep on elevated, you start adding more planks once you reach a particular height. Although rammed earth walls without reinforcement may struggle in earthquakes in incorporating reinforcement bar wood or bamboo can significantly mitigate the risk associated with seismic activity and storms. Despite the initial limitations carefully constructed rammed earth structures These structures show enduring strength and resilience standing as a testament to the longevity achievable through this mud construction method. Then successive layers as you start adding and pressing gets consolidated like this and you could have either steel reinforcement or bamboo reinforcement or some kind of a structure which would hold this in place during seismic activity. And then this framework is removed and what you see is a wall like this.

One of the beauty, aesthetic beauty of this wall apart from the fact that it is being made with hand and things like that is These layers as they are seen from outside or inside they add a brilliant aesthetic appeal as you will see in the next few slides. So these are the examples of how a rammed earth structure would look and you can clearly see the layers that have been added one on top of the other of the formwork to create a brilliant hue. So, this is a rammed earth house for an artist in Ghana and you can see the various colours. None of these are similar or some of these are similar but they all belong to the same hue because it is the same earth that they have used. You could do it consciously or subconsciously it can happen.

There is a rammed earth house in Canada. which is designed by a firm called Ram Earth Artisan and you can see the clear layers of the rammed earth and the earthiness that it adds. When you look up close, this is the texture of the rammed earth and you can see the

soil and the aggregates on this. Normally rammed earth is not plastered because the beauty of it lies in having to feel the earth, in having to feel the mud and soil of this. So, let us quickly look at the benefits of using mud earth.

So, earth does not catch fire easily. you won't have to really worry about rammed earth walls catching fire or collapsing in the event of a fire threat to the house. So, it's a perfect building material for rural and lush suburbs. The fire resistant rating of a 250 mm rammed earth block wall was attained after 4 hours of testing. The rating for a 150 mm wall was 3 hours 41 minutes. Because they are 300 mm thick and are constructed entirely of blocks rather than in sections, the walls we make are much stronger because there are no weak mortar joints.

The joint is only along the horizontal which is again reinforced. You can always reinforce it with either a steel rod or with bamboo. these are extremely low maintenance another very important factor because there is no point in having a house and having to invest a lot in maintaining it so these are very low maintenance relatively little care is required for the walls you apply a water repellent to the exterior faces of the walls at the final stages of the building process and you incorporate a wall repellent, additional specifically designed for rammed earth. The highly compacted earth's inherent water resistance is strengthened by the use of both of these repellents. One big advantage of rammed wall is also it is breathable.

Even if some moisture creeps in, the moisture will automatically through capillary action rise and it will dry also because it's a porous material. So, these products are very low maintenance that way. They are durable because the mixtures have shown excellent performance in erosion and strength test conducted at well known scientific laboratories. So, the high standard of quality control and vast knowledge in selecting soils because of modern practices. of soil testing can result in very strong, sturdy and long lasting walls.

So, today we have seen the significance of mud as a material and we have also seen two techniques of wall construction using mud and the second one being rammed earth And in our next class we will continue to learn about some other techniques of mud wall construction. Until then see you.