

**Course Name: Building Materials as a Cornerstone to Sustainability**

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**Week: 03**

**Lecture 03**

Alternate building materials

Hello students, so the last segment we had completed all the traditional building materials or vernacular building materials such as mud, stone, thatch, straw bales, laterite quarry etc. Today we will be looking at an introductory class on alternate building materials. So, we will be looking at what are alternate building materials, how are they classified, some examples along with their properties, the advantages and disadvantages of alternate building materials. What are their limitations? What about their sustainability component? We will look at some case studies, the future trends and summarize. So, this will be the gist of the entire alternate building materials that we will see. Now, in what way does alternate building material differ from traditional building materials?- From conventional building materials such as brick, cement, concrete and steel.

Now these offer solutions for lessening the environmental impact using the resources very efficiently and creating healthier living spaces. In the last class I had reiterated a number of times that in order to go carbon neutral we must look at the combination of traditional knowledge and modern technology. In a sense alternate building materials does that. Construction often harms the environment and depletes the resources, the way in which the extraction of materials happens and also more importantly the way we transport the raw materials and finished goods.

So, alternate materials addresses this by reducing energy use, by minimizing the waste and promoting resource conservation. They keep a low carbon footprint and they support biodiversity by using renewable sources with very minimal ecological impact. Thus, they provide a very eco-friendly approach to construction for a better and sustainable future. These materials will help us reach the carbon neutrality. They compensate for the limitations of the traditional building materials which we saw in our previous segment such as mud or bamboo, straw, etc.

, Now, why must we go for alternate building materials? Why should we do it? The first is that the market for alternate building materials is primarily driven by desire for the

public. Now, public awareness of environmental issues and new government regulations requires the use of sustainable building materials for infrastructure projects. So, once you give an option to people or the client for building with sustainable building materials and with conventional building materials that are energy intensive, the awareness is pretty high especially because of the green labeling system. Now, in comparison to typical building materials, the alternate material has low carbon emissions and it takes less energy for production. That is because most of the time there is a large component in these building materials which are either a waste or which are locally available.

Either ways the end product is a low carbon emitting building material. They are therefore perfect as an alternate building material and they are very environmentally friendly. Further receiving a green certification from certifying bodies also results in significant energy savings. A combination of all this has really created a market for alternate building materials. Now there has also been an increase in environmental awareness around the world due to climate change occurring in the globe which we are facing on a day to day basis.

We see that there is a sudden downpour on cities. the clouds just literally stand over the cities and pour down which is attributed to the urban heat island effect which again is attributed to using urban climate as a heat sink which is again attributed to design of buildings which are not climatically suitable which again bounces back to the envelope building material the walls and the roof and therefore that is there is intense awareness about the building material choices that we have to make because these end up becoming directly related to climate change. Now, in order to conserve natural resources and avoid its adverse effect on climate by using material that emit ozone gases while manufacturing or which are very carbon intensive building materials. So, in order to know conserve these natural resources in addition to alternative building material, we must also consider green materials that are relatively eco-friendly. Also alternative materials such as say recycled plastic which is made from plastic waste, and hence it solves a major issue of dumping these hazardous plastic wastes into landfills.

What happens when it gets dumped into landfills? It pollutes the land. And then when it rains, it percolates in and goes and pollutes the water channel below. And again, it comes back to us as microplastics. So these become very hazardous for us. So in order to avoid this, what is considered as probably a waste, the awareness to recycle it or use it as an alternate building material has risen significantly. Very high. And very good example of this, awareness is affecting us in day to day life is the way we use our lunch bags. You can see that 80 percent of people have shifted to jute lunch bags that itself is an indication that there is great awareness. So, there is a great driving force for people to shift to alternate building materials and there is quite a bit of demand in this segment. Now, the

alternate building material market demand is segmented on the basis of materials, end user, application and region. In general, it can be seen that there is a demand for alternate materials with time and for the reasons that we have already seen.

So, in the construction industry you can see that there is a rise in, there is a projected rise in demand of alternate building materials between the year 2020 and 2030. The furniture segment is also showing a rise in demand. With respect to a particular component we can see that the flooring element is also showing a significant demand in alternate building materials between the year 2020 and 2030. So, we can confidently say that the demand for alternate building material is rising year on year. So, we can confidently say that we established that.

Now, let us look at how these alternate building materials are classified. There are three ways in which we can look at alternate building material. First is natural materials. Now in combination to modern materials natural materials are used as a composite. So it is not just purely mud but it is mud with cement which means it is a combination of a traditional building material and a modern building material. What happens when you do this? When you do this you reduce the limitations of using only natural materials and therefore its limitations which we have already seen in terms of its strength and durability that can be diminished. For example bamboo a versatile and fast growing grass is known for its strength and sustainability. But it has certain other weaknesses say in terms of its durability over time because whatever said and done it is an organic material so its durability. So, we can use modern technology and reduce the impact of the fact that its durability is questionable.

Rammed earth involves compacting natural materials like mud or soil to create sturdy structures. But just using regular rammed earth -instead of that we can have an additive in the form of a modern building material. Straw bales which are used for insulation that it is a renewable byproduct of grain harvesting and therefore it is even you can say carbon neutral or even carbon negative. Timber which is derived from wood is widely used natural building material. Now hemp is a resilient plant that can be processed into various construction materials which we will be seeing all of these we will be looking at.

But using these materials in their natural form may not fulfill the needs of modern buildings. And therefore, we need to look at the combination of these building materials along with the modern building materials. Let us look at the other type. One is using natural building materials and combining it with a modern building material so that we diminish its limitations. Then we look at recycled materials.

For example, fly ash concrete. It incorporates a waste byproduct from coal combustion

and it reduces the environmental impact. Recycled plastic for example. Recycled plastic lumber utilizes discarded plastics for a durable and sustainable construction. We can have salvaged wood which involves repurposing reclaimed timber contributing to resource conservation.

The third type is bio-based materials. For example, mycelium bricks. They utilize the fungus, the roots of the fungus to create a bio-friendly alternative to traditional bricks. A lot of work is to be done in this domain, yet it looks like a promising option. Bioplastics are derived from renewable sources like corn starch and they offer eco-friendly alternatives.

Cellulose insulation which is made from recycled paper provides an energy efficient insulation solution. Let us look at some of the examples. For example, if we look at fly ash concrete, by reducing its reliance on traditional cement, fly ash concrete utilizes waste material which results in lower carbon dioxide emissions. This alternative material helps address environmental concerns in the construction industry. A case to this point is the fly ash concrete building which they have clearly demonstrated can become like a office building.

Mycelium bricks, these are grown from fungal spores and mycelium bricks are biodegradable, fire resistant and they provide natural insulation and there are structures which are made of mycelium bricks. For example, this installation is made out of mycelium bricks and it's only a question of time before we can bring it into mainstream building industry. Now, let us look at the most important aspect that we need to understand and follow, which is carbon neutrality or carbon negativity. What are the characteristics of these alternative building materials? Now, carbon negative building materials are a pioneering innovation in sustainable construction. These materials represent a pivotal shift from traditional counterparts actively capturing and storing more carbon dioxide than they can emit throughout their production and life cycle.

These are sourced from renewable and sustainable resources and these materials minimize the environmental impact by prioritizing low embodied carbon and adhering to circular economy principles, thus emphasizing recycling and minimal waste. The integration of innovative technologies such as carbon capture and utilization further enhances their carbon negative characteristics. Durability is a key focus ensuring that the captured carbon remains sequestered over an extended period. Rigorous life cycle assessments validate their net carbon impact and it provides transparency and accountability. Beyond carbon sequestration, these materials often offer additional environmental benefits contributing to improved air and water quality.

Certification processes validate their carbon negative claims, aligning with global initiatives to actively mitigate climate change by removing the carbon dioxide from the atmosphere. As we explore these advancements, it becomes evident that carbon negative building materials mark a significant stride towards a more sustainable and resilient built environment. Let us look at the advantages of alternate building material. First one is improved health and well-being. Now alternate building materials they offer several advantages.

Firstly they contribute to improved health and well-being as many of these materials are non-toxic and sometimes even breathable. They create healthier indoor environment for the occupants. Secondly, these materials enhance energy efficiency by providing improved thermal insulation, thus reducing the need for excessive heating and cooling energy. Additionally, they open up possibilities for integrating renewable energy sources into construction. Thirdly, alternate materials often exhibit excellent structural and functional properties enhancing the durability and overall performance of buildings.

Lastly, these materials bring unique visual characteristics to construction projects, allowing for innovative and aesthetically pleasing design solutions, more so because they do not follow the regular aesthetics of modern and conventional buildings. Let us also look at the limitations of alternate building materials. Now, while alternate building materials offer numerous benefits, there are some drawbacks to consider also. Firstly, they may incur a higher initial cost as compared to traditional options impacting the project budgets. Because, unless there is great acceptability and manufacture at a mass level- because of its customization, the initial cost can be high.

Additionally, the limited availability of certain materials can lead to delays or restriction in construction projects. That is also primarily because of the less amount of manufacture of these materials. Moreover, construction professionals may need specialized training to work with these new materials, potentially affecting their adoption rate. For example, the binders and the mortars that has to be used may be very custom made for these kind of alternate materials or probably the adhesive has to be somewhat different. All this can have a impact on the building time of a project.

Also, the acceptance and approval processes for some of the materials may still be evolving and it may pose challenges in compliance with existing building codes and regulations. Regular updates and alignment with standards are crucial for the widespread adoption of these innovative construction methods. Having seen the big advantages of alternate building materials which include good IAQ, improved indoor air quality, being energy efficient by improving indoor thermal performance, because of which the energy is conserved and fourth is its durability. Fifth is by virtue of combining what could be a

potential waste. You reduce waste and safeguard the environment.

Also, you are able to recycle and cause less burden on the environment. Also, you can try to I mean it can be an innovative approach for green building certification. And definitely a step towards going carbon neutral. So, these are the advantages of using alternate building materials. While its disadvantages can be the cost, limited availability, lack of expertise to construct these buildings, impingement of building codes and regulations may not be too accepting of something which is very new.

Now, let us look at the environmental aspect of alternate building materials because it is the focus of the course. Now, alternate building materials they play a very crucial role in promoting sustainability in construction. They contribute to reducing the carbon footprint of buildings by having lower embodied energy and showcasing carbon sequestration capabilities. They also support the creation of environmentally sustainable structures. These materials also promote resource efficiency by utilizing recycled content and renewable resources, thus optimizing the use of resources and aligning with eco-friendly construction practices.

Additionally, incorporating salvaged materials and adopting closed loop systems help minimize waste generation, further contributing to a more sustainable and efficient building process. So, in terms of sustainability, the gist is that these building materials help in reducing the carbon footprint of the building. They help in promoting resource efficiency because of the recycled content and they promote minimizing of waste generation because already materials which are dumped as waste are salvaged and brought back into the loop of usage. We will quickly see case studies of alternate building materials in general. Now, the Indian Plywood Industries Research and Training Institute, IPIRTI, it actively promotes bamboo in its construction, emphasizing bamboo lumber as a processed and treated bamboo variant, which is suitable for structural purposes in building of homes.

Additionally, in Hyderabad, a unique initiative involves recycling plastic waste to construct a studio, replacing traditional bricks has been done. This studio stands out for being fire resistant, heat resistant and being waterproof, presenting advantages like reduced noise compared to regular houses. Despite a slightly higher construction cost, this project demonstrates efficiency with a shorter construction time, thus showcasing innovative approaches to sustainable and resilient building practices. So, these two buildings I have taken, the first one being the IPI or TI, where they are tried to combine bamboo with some modern materials also to create even a two-storied structure. And the second one being a plastic waste house in Hyderabad, which is again a green house, which is environmentally sustainable house.

Let us quickly look at the future trends in construction using alternate building materials. Now, future trends in construction showcase very many innovations. Biofabrication explores growing building materials from microorganisms and fungi like how we saw mycelium and introducing sustainable practices. 3D printing as a technology can revolutionize construction by creating intricate structures with minimal waste and increased customization. The so-called ink which is used for printing which is actually a building material is also another area where intense research needs to happen incorporating alternate building materials.

Adaptable and responsive materials pave the way for buildings that can adjust to environmental conditions, enhancing efficiency and sustainability. Smart materials integrated with sensors and actuators bring intelligence to building components, allowing self-monitoring and optimization. So, these trends signify a shift towards a more sustainable, efficient and technologically advanced building practice shaping the future of the construction industry. And to summarize- Alternate building materials such as bamboo, rammed earth and recycled plastic lumber provide sustainable solution by reducing environmental impact and promoting resource conservation.

They offer advantages such as strength, insulation and fire resistance. Despite some challenges like initial costs and limited availability, these materials address traditional construction industry issues also. They contribute to energy efficiency, improved indoor air quality and innovative designs. Real world examples like bamboo framed houses and plastic waste studios demonstrate successful implementations signaling a transformative shift towards a greener and a more resilient construction future. In the next few classes, we will be looking at each alternate building material in detail and what we saw today was a gist or an introduction to alternate building materials.

So, until we meet in the next class, please understand the significance of alternate building materials which is primarily aimed at resource conservation, energy efficiency, reducing impact on the environment, waste recycling and so on. With this we will stop today's class and we meet in the next class with an interesting alternate building material. Thank you.