Course Name: Building Materials as a Cornerstone to Sustainability

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Lecture 02

Aerated Concrete

Hello everyone. Today we will be looking at yet another alternate building material. In the last class we looked at the efficacy of phosphogypsum as a building material. In today's class we will look at aerated concrete as an alternate building material. Aerated concrete can have a lot of advantages and strengths. Let us look at all of these today.

So, we will today have a look at the manufacturing of aerated concrete in brief, its characteristics, the benefits of using aerated concrete, its limitations, its applications and building examples. So, cement, lime, fly ash or gas former or aluminum powder, they combine to make aerated concrete. It is a very effective heat insulating material that is created by steam curing and molding. Its qualities include sound absorption, thermal insulation and heat preservation.

Aerated concrete has a low apparent density and a thermal conductivity that is even lower than that of a clay brick by several times. As a result, the 24 cm wide aerated concrete wall is superior to the 37 cm wide brick wall. Additionally, the aerated concrete also resists fire very well. Despite its name, aerated concrete isn't conventional concrete but it is a mix of cement, finely crushed sand and water. Aerated concrete, also known as lightweight concrete, is a modern construction material that incorporates air voids for specific density and strength needs.

Unlike traditional concrete, aerated concrete is relatively new in research and commercial use. Now, this concrete should have target a density of 1300 to 1900 kg per meter cube and should have a compressive strength above 20 megapascals. Aerated concrete is created using various pore development methods like air entraining, foaming and combined pore forming techniques. Despite its name, it is not your typical concrete but a blend of water, cement and finely crushed sand. There are various brands of company which produce aerated concrete in India.

Let us look at the characteristics of aerated concrete. So aerated concrete is a lightweight

construction material which is produced by introducing gas during the mixing stage. Its utilization in building construction is attributed to its low density and thermal conductivity. Aerated concrete exhibits a density ranging from 800 to 2000 kg per meter cube- whereas a normal concrete has a density in the range of 2320 to 2400 kg per meter cube and compressive strength varying accordingly.

So aerated concrete becomes a lightweight building material, produced by using gas in the early mixing stage. It is much lighter in weight and has lots of pores in it. And its utilization in building construction is attributed primarily towards low density and thermal conductivity, while maintaining a comfortable temperature inside buildings.

In summary, aerated concrete is a lighter and energy efficient choice for construction. Let us look at the benefits of aerated concrete. Aerated concrete has reduced dead load, because it is lightweight leading to reduced dead load on structures. It has lower haulage cost. Because the material is light in weight it has lower transportation costs.

It has good thermal insulation. So aerated concrete offers a high degree of thermal insulation contributing to energy efficiency. It is a versatile material in its applications as it is suitable for structural, partition, insulation and acoustic purposes. Aerated concrete has reduced environmental impact. Production of aerated concrete typically involves less environmental impact compared to traditional concrete.

It also is easier to work. So a lightweight nature makes aerated concrete easy to handle and work during construction. So aerated concrete brings several benefits because it is lightweight meaning structures bear a lighter load. This not only reduces the burden on buildings but also leads to lower transportation costs due to its weight. Another advantage is its excellent thermal insulation, making structures more energy efficient.

Aerated concrete is versatile and can be used for various purposes like structural elements, partitions, insulation and soundproofing. Moreover, its production is often more environmentally friendly than traditional concrete methods. Lastly, the lightweight nature of aerated concrete makes it easy to work with during construction, simplifying the building process. Overall, aerated concrete offers a range of advantages for different construction needs. This includes the most important aspect being that it is light in weight due to which it has high workability because of which it can be used for faster construction.

Once it is made modular, there is accuracy in size, has a longer life, is extremely environment friendly. Has better sound insulation because of the pores it has. Is fire resistant and is cost effective. These are the benefits of aerated concrete. Let us also look

at the limitations of aerated concrete.

Now, the limitations are it has reduced compressive strength. So aerated concrete tends to have lower compressive strength compared to traditional concrete. It has higher creep and shrinkage. So the porous structure leads to higher creep and shrinkage over time. It has increased reinforcement requirements.

Additional reinforcement is often needed to address deformation challenges. It has cracking potential. So gradual tensile stress from shrinkage and creep can lead to cracking. It has limited load bearing capacity. So aerated concrete may have limitations in heavy load bearing applications.

One must also look at cost considerations and initial cost for aerated concrete products or construction may be higher in some cases. Aerated concrete comes with these limitations. As it is usually, it has lower compressive strength compared to traditional concrete; its porous structure contributes to higher creep and shrinkage over time, which poses challenges. Additional reinforcement is often required to address its deformation issues, increasing the complexity. The potential for cracking exists due to gradual tensile stress from shrinkage and creep.

In heavy load bearing applications, aerated concrete may have limitations. Additionally, initial cost for aerated concrete products or construction can be higher in some cases. Understanding these limitations helps in making informed decisions when considering aerated concrete for construction projects. Let us now look at the applications of aerated concrete. The utilization of aerated concrete extends to various building types encompassing commercial, residential and educational structures.

These blocks find relevance in warehouses and buildings with an industrial focus, leveraging their high insulation capabilities, swift construction, cost effectiveness and the significant advantage of being lightweight. This not only reduces the dead load on the building but also positions aerated concrete as a suitable construction material. Aerated concrete plays a pivotal role in constructing both residences and businesses. Notably, it can be efficiently employed for rapidly crafting kitchen surfaces. One of its distinct advantages lies in its malleability, allowing shaping with saws, files and rasps.

The outstanding insulation properties of aerated concrete make it a preferred choice for external walls in construction projects. Aerated concrete proves to be a viable option for multi-storey buildings, demonstrating feasibility even in the construction of structures with up to five storeys. Aerated concrete finds versatile applications in various building types including commercial, residential and educational structures. It is especially

relevant in warehouses and industrial buildings due to its high insulation capabilities. Besides, its swift construction, cost effectiveness and lightweight nature also make it suitable for industrial buildings.

This not only reduces the overall load on the building but also establishes aerated concrete as a suitable construction material. It plays a crucial role in constructing residences and businesses, offering efficiency in crafting kitchen surfaces. Its notable malleability allows for easy shaping using tools which are simple and easy to handle. Without outstanding insulation properties, aerated concrete is a preferred choice for external walls in many construction projects. Moreover, it proves to be a viable option for high-rise buildings, which showcases that these structures can go up even up to 5 storeys.

So, due to its characteristics, due to its properties, aerated concrete has wide application in the building industry. Let us have a quick glimpse at a base case study which has applications of aerated concrete. So, autoclaved aerated concrete AAC is a versatile building material which is used in both structural and non-structural application as seen from this example given by Barnett. In this figure you can see an AAC residency in Monterrey, Mexico. Which demonstrates is use as both a structural component and building envelope.

Similarly, this building, the AAC Residency in Mexico is an example of a low-rise building made with aerated concrete, whereas the AAC Hotel in Tampico; again in Mexico, is an example of a building which is high rise. So, here AAC is utilized for both structural purpose as well as building envelope. This shows the adaptability of AAC proving its effectiveness in serving dual roles in construction project providing structural strength and enclosing the building in both low rise and high rise buildings. So, from this we can conclude that AAC is an extremely versatile material that can be used for all types of buildings and it is very effective when we look at insulation. I myself have done a small study where I have compared houses made with various building materials and assess their thermal performance.

These building materials all had the same type of roof which was sloping thatch roof and the walling material varied. One house had a reed material for its wall. One house had an AAC material. Another house had a 9 inch thick brick wall and so on. One house had mud wall and another house had a stone wall.

I found that the house which had aerated cement concrete had the least indoor temperature. Whereas the house made with reed had a good thermal performance as a combination of wind movement as well as temperature. But aerated cement concrete performed the best thermally amongst all the four types of walling material. And the fifth

one which was the conventional brick wall. So as a combination, now you know its usefulness becomes more relevant when you look at places which are very hot, which are prone to heat stress and so on.

In these places using aerated concrete for a walling material can actually protect and save the people. Because heat stress is a major issue in places which have poor economy. In rural areas not everybody can afford an air conditioner. So you need to design indoors which are thermally more comfortable. So, even as an environment friendly material by virtue of its insulating properties and also as a material that can be used in houses which cannot afford air conditioners, aerated cement concrete is found to be best in terms of its thermal performance as compared to a conventional 9 inch brick wall, a mud walled house a stone wall house and a reed wall house which I call as a straw bale house.

So this is the versatility of aerated concrete, easy to handle and available too. Let us also use aerated concrete in our projects and it can help the user in terms of thermal insulation which is very important. And we have to-you and me as architects; have to create this awareness. So, I will stop this class with this material which is aerated concrete. And tomorrow we will continue with yet again new material. Thank you.