Course Name: Building Materials as a Cornerstone to Sustainability

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Week: 08

Lecture 03

Ecobind Tiles

Well, dear students, so we resume our talk with yet another very interesting material, and it is the eco-bind tiles. It's another green building material. Now, we already know that construction industry landfills are a lot of waste that is inert and consumes space in landfills. This is also the reason for polluting the land, and as you know, once land gets polluted, water seeps in through these polluted places in the land, and it pollutes the aquifer below, causing water pollution too. Creating an innovative flooring material from waste products can be a great way to address environmental concerns and also promote sustainability. Eco-bind tile is a tile that is made up of waste materials but is bound for the landfill, which serves as an example of how circularity can be achieved in the construction industry.

What do we mean by circularity? It means that a product, say, for example, a product that comes from a raw material. This is utilized to create a building material, and after the life of the building material, this goes back into waste, which becomes a necessary raw material for either the same original building material or another building material, and therefore this waste becomes the raw material for either the same building material or the next building material, and therefore the circularity gets completed. So eco-bind tile is made up of waste materials that are bound to landfills, and this serves as an example of how circularity can be achieved in the construction industry. These materials include waste from marble and stone processing, broken bricks, glass, ceramic shards, plastic, etc.

So, it can comprise of recycled glass or it could comprise of marble. I could add it here. It could be marble or quarry crush, or it could be stone, broken bricks, or broken stone. So, I will say marble, stone, bricks, etc. And it can comprise of ceramic shards.

So, ceramic shards which come from either the waste ceramic tiles or from any other source, can have plastic waste Along with that, we can also add natural fibers So, natural fibers can be straw, bamboo or any of these natural wastes. So, the floor tiles will be

composed of a very unique blend of waste materials primarily derived from post-consumer and post-industrial sources. Various materials, such as recycled glass, plastic, you name it, that fall into these categories that we have seen, comprise ecobind tiles. So, each material is processed individually and then combined to form the ecobind tile. Suppose we look at recycled glass.

This recycled glass is ground up recycled glass bottles and sometimes even window glass. So, this is collected and processed to form the base material. The glass shall be meticulously cleaned, sorted based on color, and ground into fine particles. If we consider the plastic waste. So, single-use plastics are used as a resilient binding agent with this recycling.

So all the discarded plastic materials, which could comprise single-use plastic bottles, plastic carry bags, and packaging material, can be transformed into a resilient building agent using advanced recycling technology. Then we could have natural plant fibers. So a portion of the material can be enriched with natural plant fibers such as bamboo, straw or hemp. Now these enhance durability and add a touch of natural texture to the tiles. The fourth component is the mineral fillers.

So, mineral fillers are waste material powders from various industries like quarrying and mining. These are incorporated to improve the overall strength and hardness of the material. So, basically eco bind tiles comprises of recycled glass, plastic waste, natural plant fibers and mineral fibers all combined to give a product called ecobind tiles. Let us look at the advantages of using EcoBind tiles. The first advantage is the sustainability, or its environmentally conscious, environmentally sustainable contribution.

By using EcoBind tiles, we are diverting the waste material from landfills to a useful product. which is the tile. Because of this, there is a reduced need for virgin resources and first-hand material. So, what happens is that here itself, your embodied energy of the material gets drastically reduced because upfront embodied energy becomes almost zero. this material promotes sustainability because of reduced upfront embodied carbon.

Besides, this reduces the environmental impact of the waste which would otherwise be dumped as a landfill. Hence, these styles are an example of circular economy because it diverts waste materials from the landfills and reduces the need for virgin resources. They promote sustainability and reduce the environmental impact, unlike other traditional flooring or other conventional flooring materials. The second big advantage is its durability. These materials are highly durable.

They are suitable for residential and commercial purposes. They have good wear and

tear resistance, making them ideal even in high-traffic areas. So they have good wear resistance. The third important advantage or contribution is its customizability. This material is quite versatile.

And the versatility of the recycled glass allows for creative designs that mimic the appearance of natural stone or even unique abstract patterns. So, these are versatile, and they have a variety of designs, as can be seen here. And the amount of plastic that is dumped can be routed to create these eco-bind tiles. The next advantage is that these are very comfortable to use because they sometimes can have a cushioning effect, a soft padded effect due to the natural plant fibers. and these can be used for extended time periods.

So despite their durability, these tiles, which have a slight cushioning effect because of adding natural plant fibers such as bamboo or hemp, make them very comfortable to walk for extended periods. Then the fifth advantage, which is from an environmental point of view, is that these tiles are recyclable. So, at the end of the life cycle, these tiles can be recycled into new tiles or other construction materials, closing the loop on circularity through waste management. The next advantage is that these tiles are very cost-effective. because there is abundant availability of waste material, which is the primary composition and primary resource for these tiles.

So, because of the abundant availability of waste materials used in the composition of these tiles, these tiles are cost competitive compared to any other conventional flooring material. Let us look at a small study that was done on these geopolymeric tiles. So, this study concerns the use of waste from glass bottles, fluorescent lamps, and soda lime window glass, which is used in its entirety as a raw material in the manufacture of tiles by applying the technique of alkaline activation to generate an alkaline cementitious material. Now the reason why this study was taken is that industrial waste glass from numerous application sources is a major source of pollution because only an estimated 30% is reused globally. The methodology that they followed was the intervention involves use of waste from glass bottles, fluorescent lamps and soda lime window glass as a raw material in the manufacture of tiles by applying the technique of alkaline activation to generate an alkaline cementitious material.

This has resulted in the compressive strength of tiles being very good, and the maximum load supported before rupture of tiles was also tested. Sodium hydroxide was used as an activator in a concentration range of about 4 to 10 m. Manually produced tiles exhibit good properties, with a compressive strength of about 178 kg per cm2, and the maximum load supported before rupture was about 1000 N. Another study on recycling waste glass as aggregate in cement-based materials was carried out. Fine aggregate replacement of

waste glass This increases by over 20% and can cause negative effects on the mechanical properties.

So, it is found that 20% of cement can be replaced with waste glass of no 20 nanometers without detrimental effect on the mechanical properties. Another study was on the investigation of the influence of various industrial waste materials containing rice husk ash, waste glass, and sediment soil for eco-friendly production of non-fired tiles. This study shows utilizing waste materials such as rice husk ash, brown glass gullet, and sediment soil for producing non-fired tiles over a duration of 7 to 28 days produced very good quality tiles and can be used effectively. Another study showed that from waste glass to building materials, an innovative sustainable solution for waste glass. In this study, mixing waste glass powder with resin as a binder and hot pressing the mixture under pressure could produce polymeric glass composites in the intervention.

That is mixing waste glass powder with resin as a binder and hot pressing the mixture under pressure to produce polymeric glass composite as an intervention produced excellent results and the optimum PGC achieved a flexural strength of 48 MPa. Its water absorption, its density and compressive strength had minimum scratch wear and UV degradation behavior and it could be used as an alternative to regular building material. Next study shows the effect of waste glass and waste foundry sand additions on reclaimed tiles containing sewage sludge ash. In this study, multiple materials, including waste glass and waste foundry sand, were added in an attempt to improve the physical and mechanical properties of reclaimed tiles. The test showed that the waste glass had positive effect on the bending strength, water absorption and weight loss on ignition.

This waste foundry sand contributed the most in reducing shrinkage but could decrease the tile bending strength when a large amount was added at a high kiln temperature. So here we have seen studies being conducted to create eco-bind tiles. But the composition in all these four studies are very different and these are experimental. This gives us options for us to be more creative in how we can use waste materials to create eco-binding tiles. waste materials such as glass, recycled plastic, foundry waste, agro-waste, etc.

By doing this, we complete the circularity of the building material and ensure that no material ends up as a landfill or as waste. Hence we conclude that eco-bind tiles represent an innovative and sustainable approach to flooring materials. They address waste management issues while providing consumers with a durable and aesthetically pleasing option for the spaces. So, first is eco-bind tiles are very sustainable. Eco-bind tiles are very sustainable primarily because They are made from so-called waste.

And if these are not used, this raw material, which is a waste, if it is not used in the ecobind tiles, will end up in the landfill. further causing pollution of land as well as water. Therefore, this is a good example of waste management. How can waste be managed? Glass which takes millions, billions of years to degrade and decompose is one of the primary raw material. Plastics which are a huge source of environmental nuisance is another raw material because this plastic can find itself even inside human body as a microplastic.

India being an agrarian country, there is a huge amount of agro-waste such as straw, bamboo, and hemp, and this can be another raw material, and therefore what would otherwise end up as no waste somewhere can be used as a raw material in these eco-bind tiles. Apart from these, these styles can offer a lot of options for being creative in terms of their designs. So you can have a variety of designs that can be customized for the color and texture. Hence, we can conveniently say that this is a good material for a greener future because these raw materials are not exhaustive, as I have written here. This can comprise even furnace slag or any other material that can be used after testing for its appropriate use here along with the other components.

And the most important part of using ecobind tiles is its circularity, which is becoming very important in order to be more environmentally conscious. Thus today we have seen a material called ecobind tiles, and this ecobind tile as a concept contributes a lot to preventing waste from getting dumped. It also showcases the potential of repurposing or reusing materials for a greener future. If India is to meet its net zero energy targets and net carbon reduction targets, it is important for architects, civil engineers, and designers to even know they themselves can promote the use of eco-bind tiles. And the best part of using these tiles is that the composition of the tile and the raw material of the tile can be customized, leading to various options in terms of design and texture.

And this can be done based on the availability of the raw material. So with this, we will stop today's class and we will continue with the next class.