Sustainable Architecture
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Lecture – 35
Materials and Resources – V

Good morning. Welcome back to this last lecture of this week where we are discussing about Materials and Resources as part of this ongoing online course on Sustainable Architecture. And, I am your instructor Dr. Avlokita Agarwal, Assistant Professor at Department of Architecture and Planning, IIT, Roorkee.

So, in today's lecture we will discuss about some more properties to be considered while selecting the construction materials, building materials for sustainable buildings and we will also summarize what all goes into selecting the right material for a green building or a sustainable building. So, the next property which we take into account or consider is rapidly renewable materials and their use.

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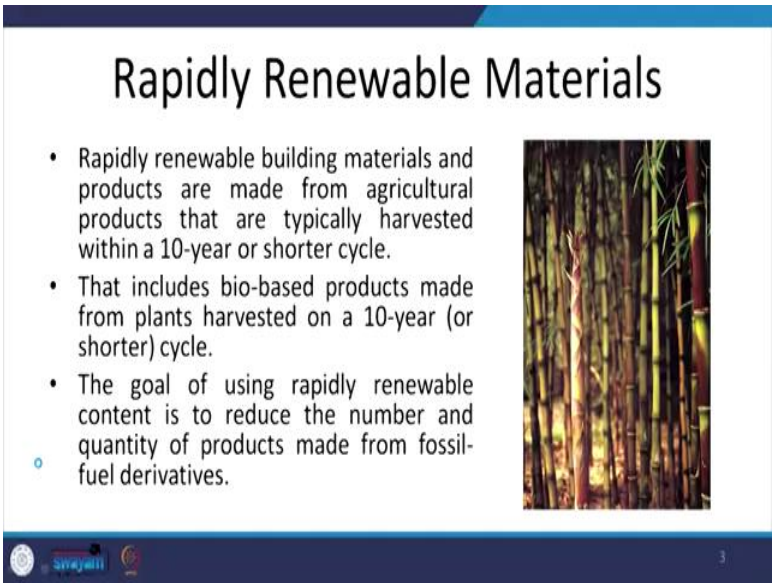

So, what is a rapidly renewable material? It is a building material which is made from agricultural products that are typically harvested within a 10 year or shorter cycle. So, wood which is produced from hard grown timber which takes around 20 to 25 years to fully grow does not come into rapidly renewable material though it is renewable, but it is not rapidly renewable.

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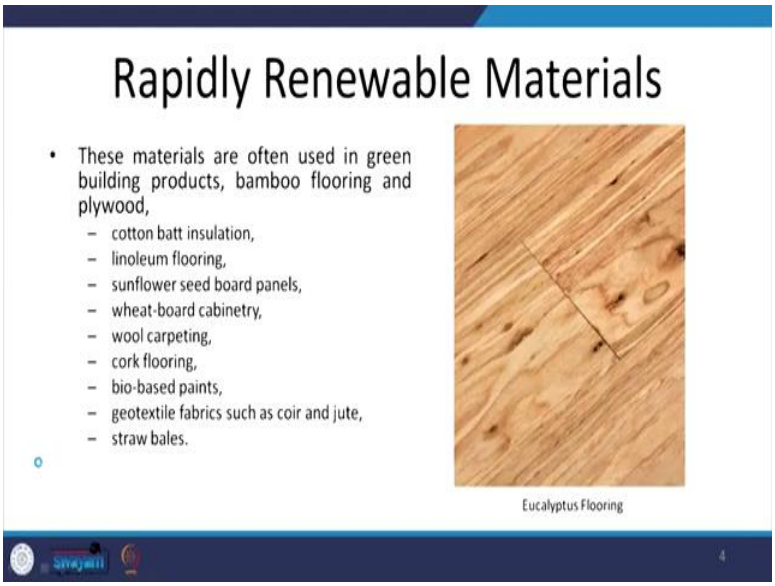

So, the kind of materials that we are looking at here they include some of these like cotton batt insulation, linoleum flooring, sunflower seed base panels, wheat board cabinetry, wool carpeting, cork flooring. So, if we look at all these materials of course, bamboo and straw bales are commonly used rapidly renewable materials.

So, all these materials they can be grown in a very fast manner plus since they can be grown very fast we require less amount of land to actually grow them. Now, that has several environmental benefits – it has economic benefits, social benefits as well, but largely the intent here is to reduce the amount of natural resource which can be derived from nature and cannot be replenished back to the environment.

So, it comes with a lot of environmental benefits. If we are not using rapidly renewable materials, then there is huge amount of resource which has to be put in which includes land resources, it includes water resources because a lot of water would be required for nurturing the product, for its processes, for cleaning and all those and in addition to these resources natural resources we also require a lot of capital. So, the products the materials are often capital intensive.

While if we are looking at the rapidly renewable material since they grow very fast automatically their related associated economic costs it comes down. Also, if we look at all these materials which we have just discussed we can see that some of these materials

can be produced from agricultural by product or waste which will if not used properly utilized properly will go towards the solid waste, organic solid waste.

So, it comes with a lot of benefits because then we have a lot of land available, we have a lot of water and all other natural resources available, the economic cost the financial implication is less. In addition to that it has a lot of social benefit because it provides employment for people to produce and also market such products and earn. So, it is a means of economy.

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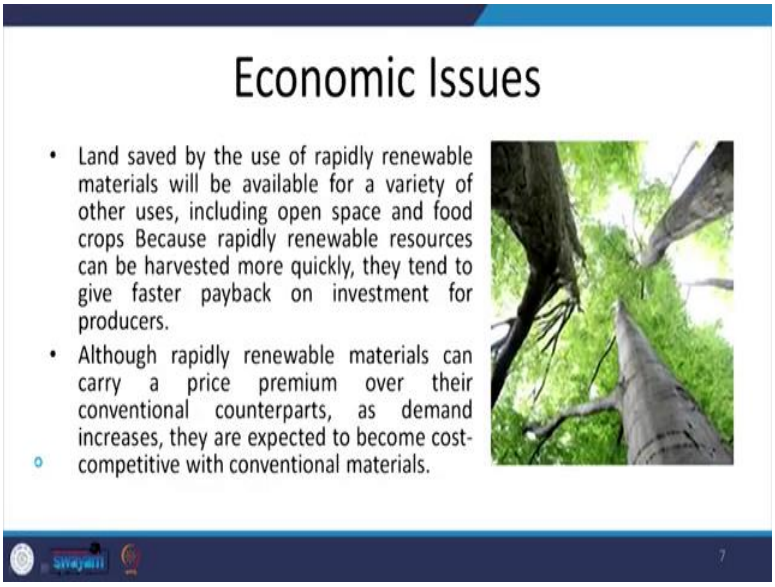

So, besides these environmental benefits we can see that it comes with a lot of economic benefits.

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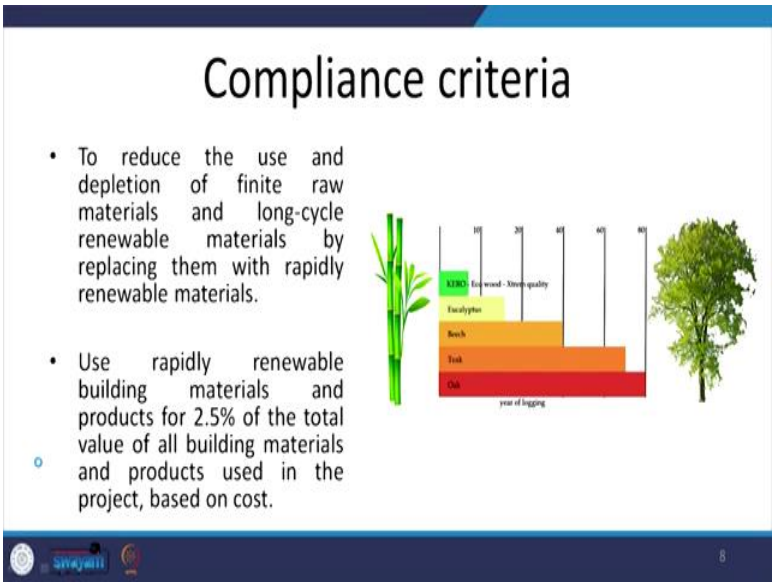

If we talk about the rating programs different rating programs they have different compliance criteria, but the intent of this particular criteria is to reduce the use and depletion of finite raw materials and long cycle renewable materials by replacing them with rapidly renewable materials. For this we have already seen the environmental and economic benefits that come along.

If we talk in proper quantified manner, we can see that for this compliance criteria we have to use rapidly renewable materials such that the total value of all the rapidly renewable materials building materials is at least 2.5 percent of the total value of all the building materials and products used in the project and that is based upon costs. We can also look at it as percentage of weight for each individual material as well.

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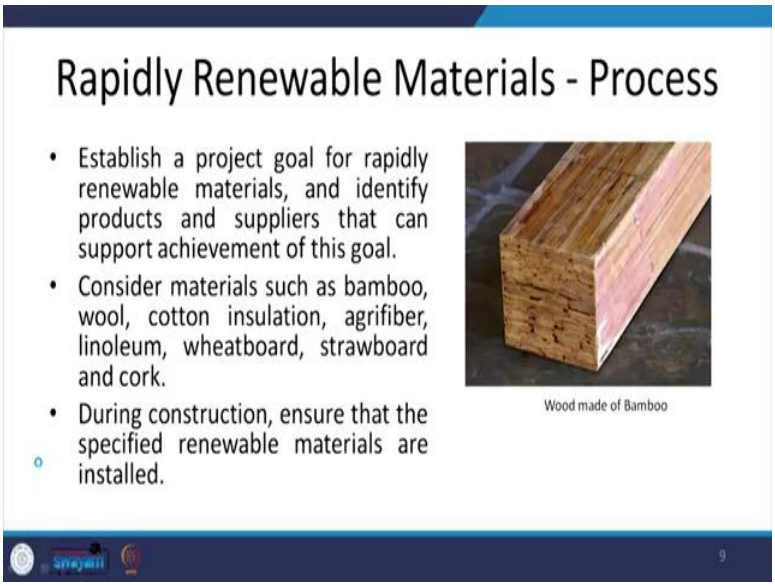

So, when we are looking at incorporating using rapidly renewable materials in any product, in any project again a due process methodology has to be followed. Just like we have seen for the renewable materials, the recyclability, the recyclable content of the materials the same process has to be followed here for adding rapidly renewable materials into our specifications.

So, the first step is to identify what all rapidly renewable materials are available in the locality, in the region and then identify the products and suppliers that can support supply of such materials and support the achievement of this goal. Now, once we have already identified, we will first take up the design which is finalized and do the preliminary calculations to establish what is the total project costs cost tentatively. And, once we know what is the tentative project cost, we will know what is that 2.5 percent threshold for the cost which we have to meet through rapidly renewable materials.

Now, that is the minimum threshold we can go on replacing our conventional materials using through these rapidly renewable materials and there is no upper limit to that. But, for minimum 2.5 percent threshold we will calculate the total value of the rapidly renewable material which needs to be procured. So, once we have that we will identify we have already identified the availability and the cost of these rapidly renewable materials from the identified vendors and suppliers.

Then we make a choice where can these rapidly renewable materials be used; whether we are replacing our structural members using these rapidly renewable materials or the interior partitions or the finishers or some additions that we will have to identify and then calculate the total quantities of these rapidly renewable materials which will be required in the project.

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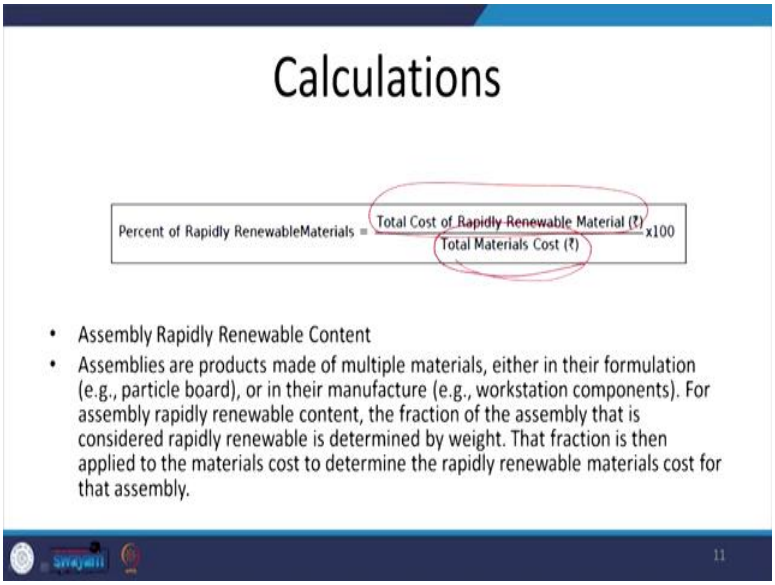

So, if we look at the compliance calculations we can see that we have to calculate the percentage based upon the total cost of these rapidly renewable materials. So, we calculate the percentage of this cost of rapidly renewable material as that of total material cost, like we have done for the other recycled content and renewable products.

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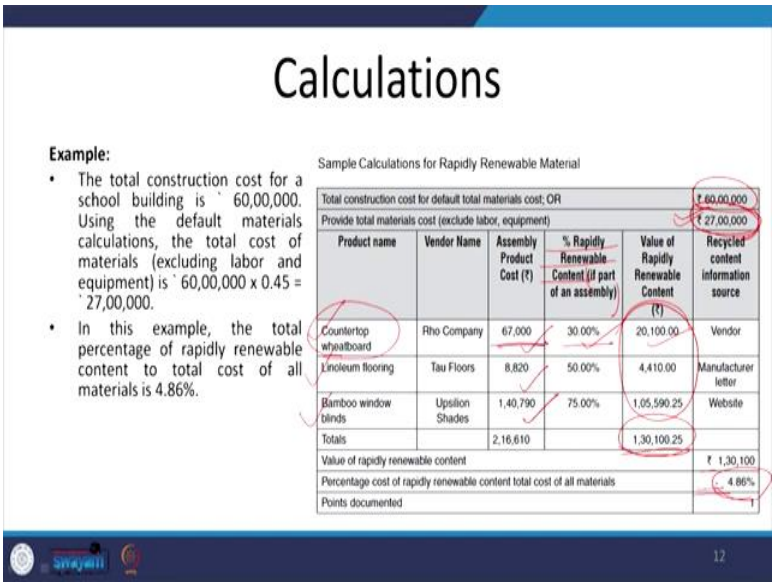

So, if we look at these sample calculations which is very similar to what we have seen and it is the same project where we are doing all these calculations for. So, if you remember the total project cost was around 60 lakhs of which we assumed that 45 percent cost is that of materials. So, around 27 lakhs is the cost for the total building materials.

Now, if we identify that what are these different rapidly renewable materials which will which can be used in the project and where can they be used. So, we will calculate the quantities of these and we will also calculate the total cost of each of these materials. If which is an assembly right now I was talking about only material, but suppose it is an assembly for example, window where there is also some part which is made out of rapidly renewable material for example bamboo and some other part which is say steel which is for reinforcement or some other assembly combination.

So, we will only be calculating the rapidly renewable content as part of the assembly. So, if it is like 30 percent is rapidly renewable content out of the countertop wheat board, the total value will be 30 percent of this value of material assembly and hence this. So, we will calculate the total value of rapidly renewable material and this total value what percentage is it of the total material cost will be calculated here. So, we have to achieve a minimum of 2.5 percent of this total material cost as the value of rapidly renewable content and here we see that it is 4.86 percent thereby we can comply we are able to comply with this criteria of using rapidly renewable material.

However, rapidly renewable materials must be used with caution. Since most of these rapidly renewable materials are agriculture based material they have specific operations and maintenance requirements. For example, bamboo and cork which is a rapidly renewable material. They should not be exposed to excessive moisture from damp mopping or other common janitorial or maintenance activities.

So, if we are using a bamboo floor if you are using bamboo in flooring, we should not be using damp mopping on the floor. If you are using straw bales we have to ensure that there is no driving grain falling on the straw bales and so on. So, the operations and maintenance considerations for these rapidly renewable materials need to be identified, understood and proper maintenance practice should be ensured.

The next category of consideration when we are talking about materials is certified wood. So, we can use wood in itself is a renewable material, but not all the wood is rapidly renewable. So, we may not be having rapidly renewable material, but we can still use wood if it is properly managed. This is what we are going to address here as part of this certified wood. Now, before I go on to explain the concept of certified wood, let us quickly look at couple of these terms and definitions.

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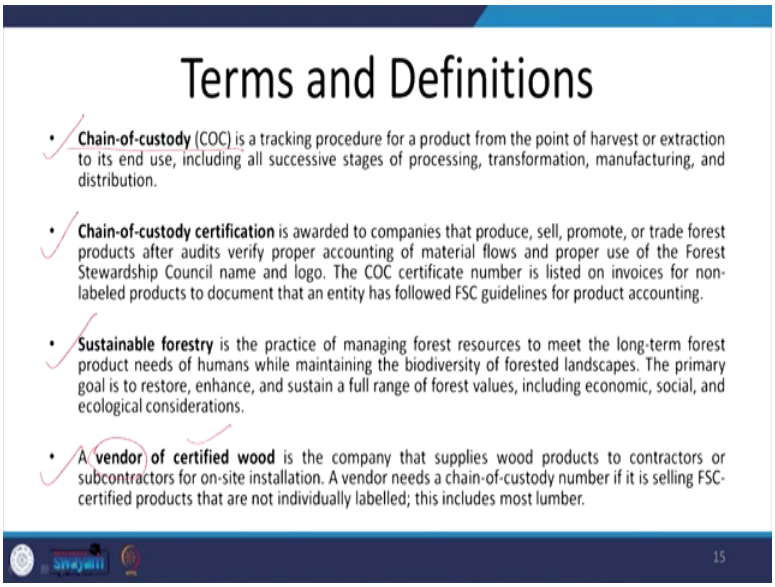

The first one is chain of custody. Now, chain of custody it is a tracking procedure for a product from the point of harvest or extraction to its end use. So, it is for the entire life cycle of the product, but at each successive stage that is from extraction to processing

transformation, manufacturing and distribution we will identify the point of contact, the chain of custody – the custody under whom this material is being processed or transformed and we establish a chain of custody.

Now, the second term is chain of custody certification. So, each point within this chain of custody a certification is awarded to the companies that produce, sell, promote or trade forest products after proper audits and in such a manner that they comply with the rules of Forest Stewardship Council. And, they manage there is a proper accounting of material flows and proper use of the FSC council name and logo.

So, this chain of custody certification and this is given to each level, each stage of this chain of custody and when we are talking about procurement of FSC certified Forest Stewardship Council certified wood products, forest products; the chain of custody certification should be available with each point of this chain of custody. So, it is not that we can procure a wood product or forest based product through a chain of custody where some of the vendors do not have the chain of custody certification.

The next term is sustainable forestry which is actually the practice of managing forest resources to meet the long-term forest product needs of humans while maintaining the biodiversity of forested landscape. The basic intent of sustainable forestry is to maintain the same amount of land cover while at the same time deriving forest products out of that for human use. So, at any point of time the overall land cover under the forest should not decrease beyond a threshold, beyond a given limit. Most part of the forest in Europe is under sustainable forestry practices which is certified by Forest Stewardship Council, FSC.

Next is a vendor of certified wood. It is a company that supplies wood products to contractors or subcontractors for onsite installation who has a chain of custody number if he is selling an FSC certified product. So, at each point of this chain of custody, there will be a vendor coming into picture and this vendor will be a vendor of certified wood.

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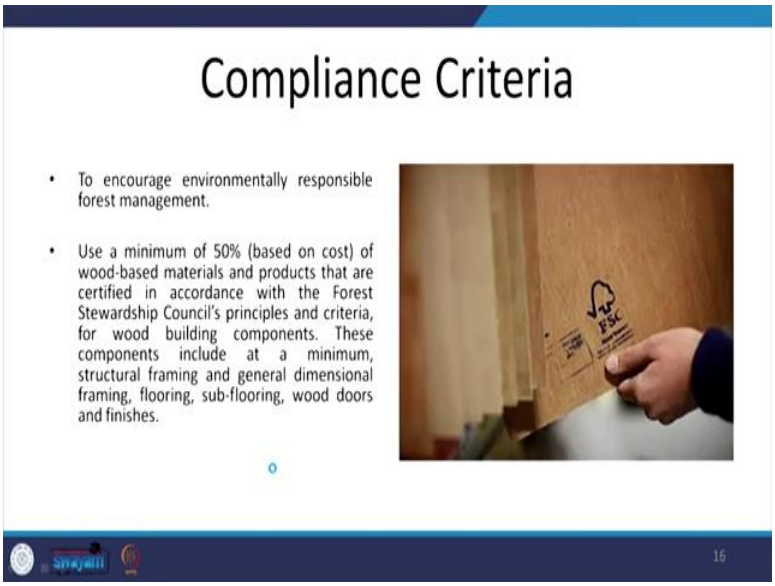

Now, if we talk about the compliance criteria for using the certified wood, the intent is to encourage environmentally responsible forest management and the compliance criteria in quantitative terms is to use a minimum of 50 percent of the wood products based upon the cost again of the total wood based material on this site that our FSC certified. So, out of 100 percent of the wood product forest based materials which are going to be used on the project, at least 50 percent should be procured as FSC certified products.

Now, when we are talking about procuring FSC certified wood products, we are promoting the environmental causes. Unfortunately to supply for our needs and specially building needs because a lot of furniture, wood, doors, windows are made out of wood. In certain parts of the world even the entire buildings are made out of wood. Now, unfortunately we have for a long period of time we have not really managed our forests to provide us for all these products.

So, we continue to take wood from the forest without even thinking that we have to manage them, we have to replant these trees and that is why we have seen that the forest cover from the entire world has suddenly declined, it has reduced drastically and we can see a lot of environmental changes happening as a result of that. So, in order to manage that in order to reverse the climate change, in order to manage these forests because they are essential FSC was formed. And, the aim of FSC as I have already mentioned is to maintain

the forest reserve in the same number even when we procure wood base products out of these forests.

Now, when we look at the economic side of that there of course, we have already seen that there are huge environmental benefits. So, they may not be local benefits, they may not be very tangible benefits, but in the long run for humanity and earth overall this is hugely beneficial, environmentally. When we are looking at the economic issues, currently the FSC certified wood products are generally costlier than the conventional wood products.

That is because a large part of the forest is still not under the FSC purview and the forests are still not managed sustainably in large parts of the world and thereby the wood is currently being made available at a cheaper price. However, we are not calculating the environmental cost which is associated with the making of availability of these conventionally available wood products. So, though tangibly in present times the FSC certified wood products may seem to be quite costly, but in the long run the FSC certified wood products are going to be hugely beneficial even economically for the entire humanity.

Though it is costlier, green buildings, sustainable buildings still promote the use of FSC certified wood products. Also, if we look at the Indian scenario large part of our forests are not governed by FSC (Forest Stewardship Council). So, we do not have locally available wood products which are FSC certified. So, for any sustainable building project in most of the cases the FSC certified products have to be imported from other nations, outside the country.

Now, that itself sometimes proves to be economically much costlier and also environmentally not a good practice because we are transporting the FSC certified wood product from a very far off distance. In such a case where it is not locally available as an environmentalist, as a thinker I would suggest not to go ahead with the FSC certified wood product and rather use conventional wood product or not use wood product at all because we need our forests to be in place.

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Now, if we are talking about the FSC certification process, FSC accredits and monitors these certification organizations as well and the certifiers are independent, they are third party auditors and they are qualified to annually evaluate the compliance with FSC standards.

Now, this certification is given to each vendor at each point of this chain of custody, right from the vendor who is involved in extraction till the vendor who is involved in assembly of these wood products and selling it into the market. At each level there is a certification process and FSC accredits and monitors these certification organizations as well.

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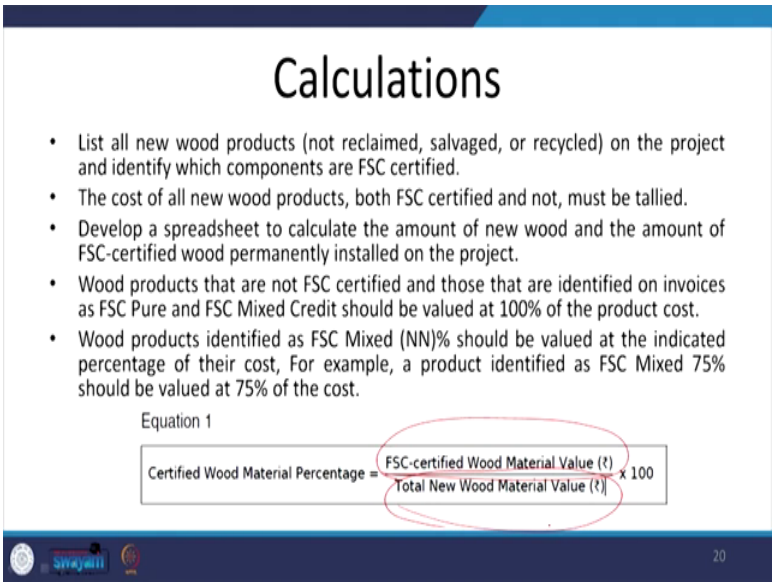

So, when we are talking about the compliance criteria and the calculations which are required, the calculations are very similar as that for the other properties of materials and resources. We are calculating the FSC certified wood material value as the percentage of total wood material value and complying with the minimum 50 percent compliance criteria.

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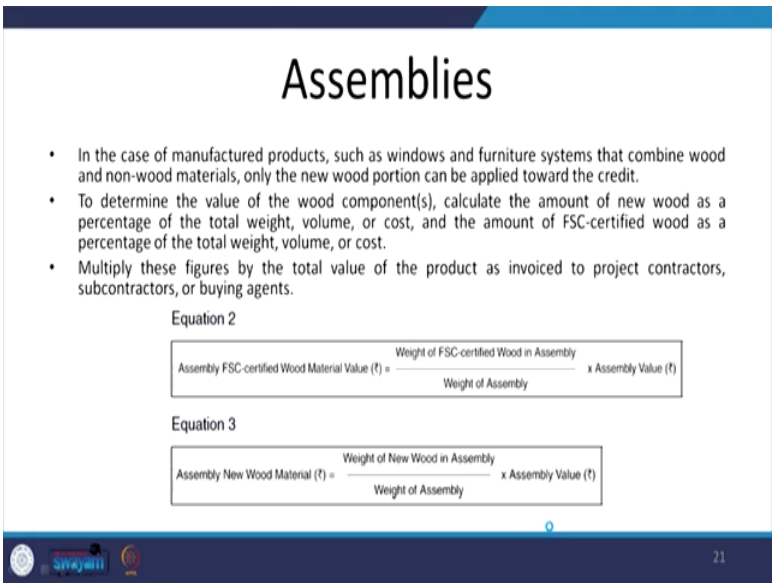

If we are talking about assemblies we will be taking only the part where wood has been used and not calculate the overall value of the assembly. We will only be taking the wood

part of the assembly and then calculating the percentage. So, instead of the total assembly value we will only be calculating the total wood part of the assembly and then calculate the FSC certified wood product as a percentage of this total consumption of wood.

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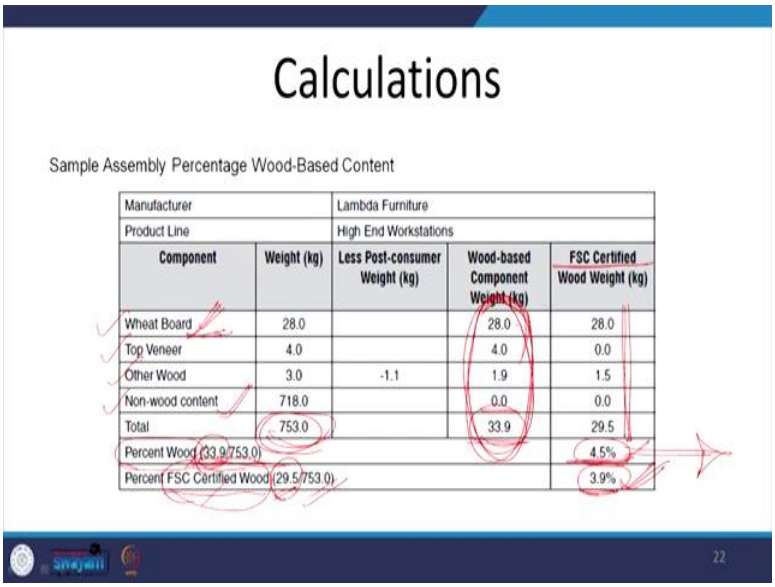

Looking at a sample sheet here again, we can see what are the different types of woods which are used and we see that how much is the wood based component for each one of these materials which are going to be used and out of this wood based component by weight how much is FSC certified.

So, if we see that out of this total wood based component which is going to be used in the project this is the percentage this is the part which is FSC certified and if we calculate the percentage of wood. So, if you look at the total percentage we see that the wood base component we are looking at the weight is around 4.5 percent of the total weight of the products wood based products which are going to be used.

Now, there are there are several like in wheat board. So, there is rapidly renewable material which is coming into picture. In other non-wood components we can see that there is zero wood based component. So, we calculate this as part of the total percentage of wood based components and we further calculate the FSC certified component of the wood. So, this FSC certified component has to be taken as a percentage of this wood component of the product.

So, if we see here that out of the total 33.9 kgs of the wood component, 29.5kgs is procured or is FSC certified wood which is more than 50 percent of this total wood component and hence it qualifies the compliance criteria it complies.

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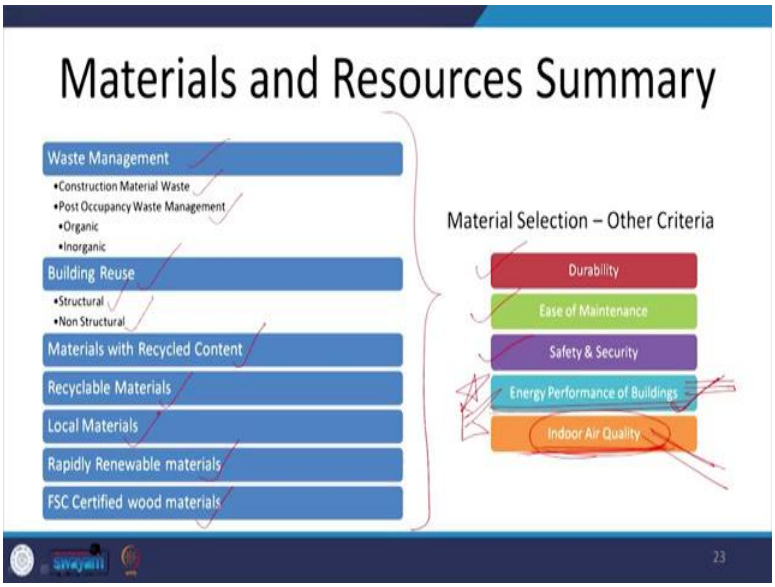

So, to summarize whatever we have discussed in this past week on materials and resources we can quickly club them up under various categories. The first one we talked about waste management where we talked about the construction material waste – how to reduce it, recycle it, reuse it and we also talked about the post occupancy waste management as part of the building design where segregated, dedicated space has to be provided to store, segregate and recycle the solid waste.

Next we talked about building reuse. So, reusing the structural components as well as non-structural components in a building, then we talked about materials with recycled content, we saw how to calculate the percentage as a value based percentage. We talked about recyclable materials not just the recycled content, but we talked about recyclable materials for example, steel and glass.

Then, we talked about the local materials how to prove the compliance based upon the distance from which the material has been sourced. Then, we talked about rapidly renewable materials, what are the different types of materials which qualify as rapidly renewable materials and how to show the compliance and also for the FSC certified wood materials.

Besides these compliance criteria we also should keep in mind couple of other selection criteria. As I have also discussed in between these lectures that durability is one of the very important criteria. We cannot ignore the durability criteria and go for a material which has high on recycled content which is locally available. So, we have to look at durability and strength. We have to look at the ease of maintenance depending upon the type of facility which is being maintained. We also have to look at the safety and security requirement of the building.

Besides these three which are more qualitative in nature we also have to keep in mind the energy performance of buildings for which appropriate materials have to be chosen. Often the energy performance of buildings and the materials which lead towards this energy performance of buildings is often covered as part of the energy and in the subsequent lectures, in the coming week we will be talking about what are the different properties, what are the different parameters for the materials which determine the energy performance of buildings.

Then, we also have to look at the indoor air quality and how materials affect that. So, how the materials should be selected and how they affect indoor air quality this part we will cover as part of our discussion on Indoor Environment Quality. So, what are the different criteria, the VOC value and all other properties which will be discussed along with indoor air quality as part of the indoor environment quality lectures.

I will conclude this discussion for this week on materials and resources here. See you next week where we will be starting our discussion about energy related to sustainable buildings and sustainable architecture. Thank you very much for being with me today.

See you again. Bye, bye.