Sustainable Architecture
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Lecture - 34
Materials and Resources - IV

Good morning, welcome back to this 4th lecture of this week where we are discussing Materials and Resources, efficient use of them as part of this ongoing online course on Sustainable Architecture. So, in the previous lecture we have discussed several properties of the materials to be chosen and we have also looked at various compliance criterias. So, we have discussed about the embodied energy, we have discussed about the building reuse for its structural and non structural components and we have also looked at the material reuse.

In today's lecture we would look at some of the other compliance criteria and the properties associated with the materials and resources as part of sustainable buildings. So, the first very important property for today's lecture which we are taking up is recycled content. Now when we are talking about recycled content in a material, we are talking about presence of some materials which are either they have already been reused once and then they go back into the processing or they are the byproducts of some other product and then they have been recycled put back into recycling.

So, here it is also related to the reprocessing of the materials. So, some of that is related directly to the recycled content.

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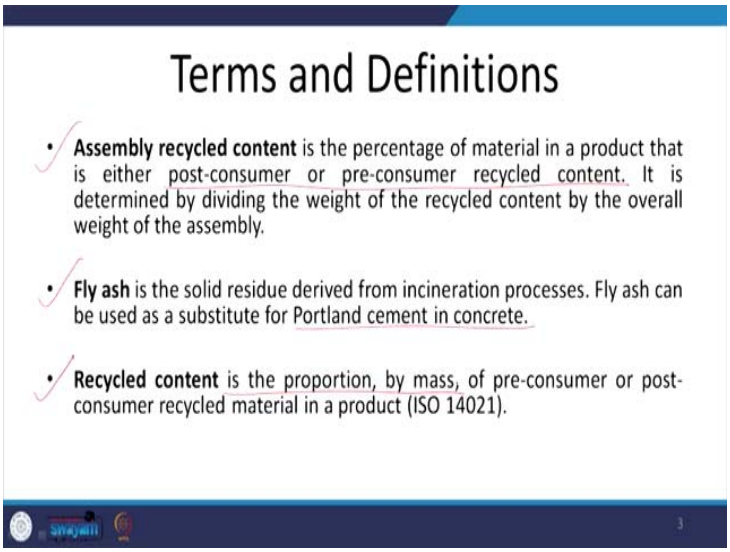

So, when we are talking about the recycled content, we are talking about assembly recycled content which implies that there is a part of the post consumer or pre consumer recycled content in the given material and we will calculate it as a percentage by weight of the overall weight of the assembly.

Then we are talking about fly ash as a material and a lot of materials use fly ash as one of the constituents, one of the ingredients and it also substitutes some of the materials. For example, Portland cement in concrete can be substituted by adding fly ash. So, fly ash is becoming very commonly used material when we are talking about the material optimization. And then we are talking about the recycled content which is the proportion by mass of pre consumer or post consumer recycled material.

So, we talking about the assembly recycled content and we are talking about recycled content both are slightly different. In the first one we are talking about it at an assembly level, here we are talking about it at a material level by mass. So, when we are talking about post consumer recycled content, now post consumer recycled content implies that the product which is added back into the manufacturing process after it has been used by the consumer.

So, for example, let us take the example of glass. Now you already have installed glass in your fenestration windows and after that glass has broken off, you give it back to the glass factory, it is collected and it is sent back to the glass factory and it is mixed with

the new lot that is the post consumer content. So, what percentage of the post consumer content is going back will be calculated for every batch of the product manufacturing.

Then we also have pre consumer recycled content. Now pre consumer is the post industrial content. So, taking the example of glass again. So, when the glass is manufactured if you have ever seen the manufacturing of glass, so, it gets manufactured in terms of huge sheets. Now of those sheets the edges are quite rough, they need to be cut, they need to be cut in a very refined format and when the sheet is cut some portion of it goes back into the manufacturing that is called cullet.

But it has not even gone out of the factory and it has not gone into the hands of consumer. So, that is the post industrial, but pre consumer content. Now this kind of recycled content includes the planar shavings, the sawdust, the bagasse, nut shells, culls, trimmed materials like I was just talking about paper from over issue publications.

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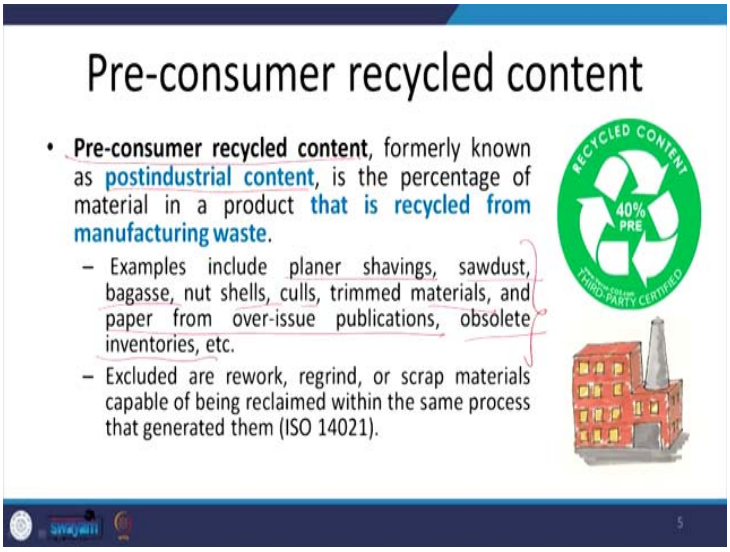

So, if there has been an over issue of a particular publication, that this kind of a paper could go back, obsolete inventories of any material. So, all these would be considered as the post industrial or pre consumer recycled content.

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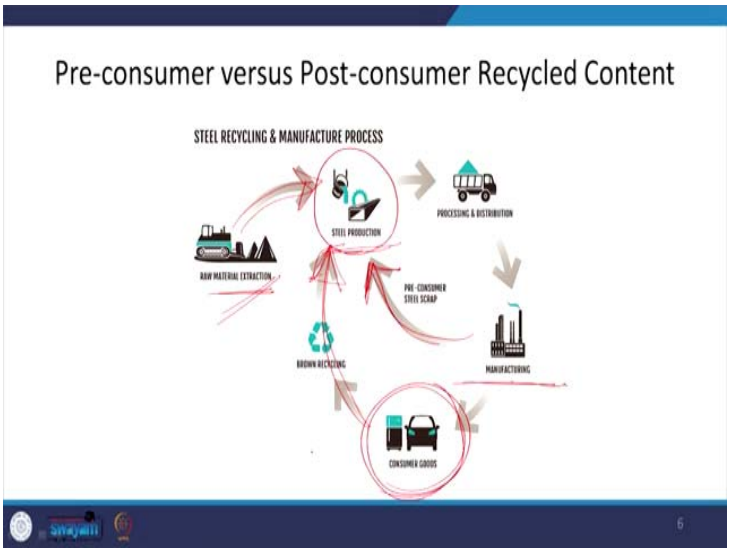

Now, these contents the post consumer and also the pre consumer recycled content would be added back into the manufacturing system. For example, here we're taking an example of the steel production. So, there is raw material which goes into the manufacturing of steel, processing distribution goes into manufacturing and then it is going to the consumers.

Here at the time of manufacturing, the pre consumer steel scrap goes back to the steel production and this is actually offsetting the raw material extraction. Once a major part of the steel which is manufactured goes to the consumers, it goes back into recycling and goes into the steel production again, thereby again offsetting the need for this raw material extraction.

So, in this manner both the pre consumer scrap, the recycled content material and also the post consumer will be put back into the manufacturing system. This is how the recycled content can get back into the processing and the percentages of that will be calculated. Now some materials have very high percentage of this recycled content, for example, steel. Steel is one material which is 100 percent recyclable.

So, 100 percent of the steel which is being used can go back to the recycling and specially this stainless steel 100 percent of it can go back into the manufacturing plant. Large percentage of glass can also go back into the recycling plants into the manufacturing plants. So, any material which has huge recycled content percentage will

be good because that is offsetting the need for raw material extraction, which is our main intent when we are talking about materials and resources.

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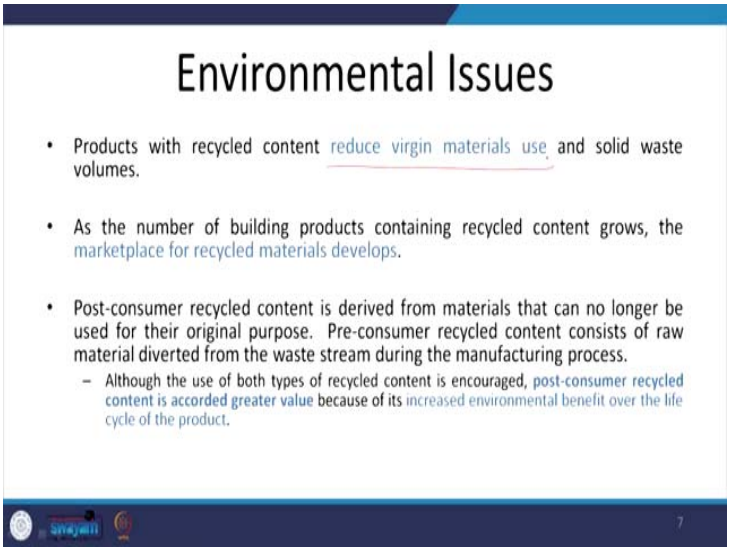

Again if I talk about the environmental benefits because of this intent that we want to reduce the burden on the environment for the virgin materials, it directly reduces the use and extraction of virgin materials and thereby reducing the environmental impact.

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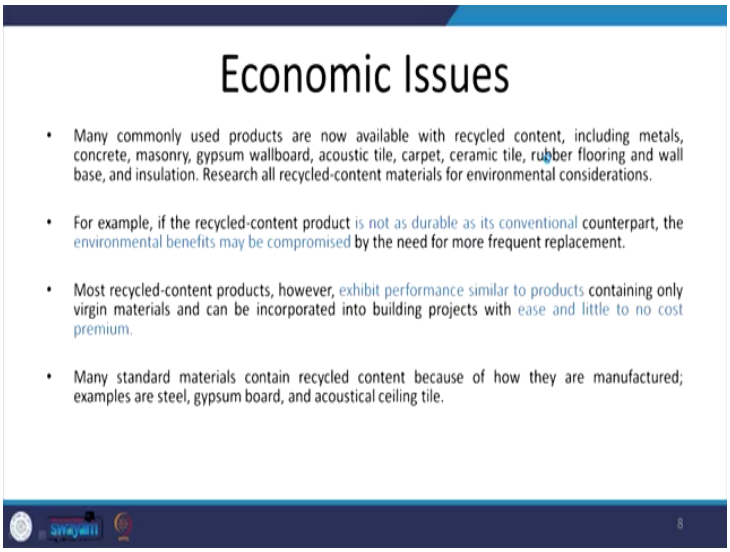

Again, the similar thing is transformed, translated into economic benefits because we will be reducing the amount of raw material extraction.

However, again a word of caution here, sometimes the recycled material in some of the cases might not be as durable or of the same quality as the material which is produced for the first time using virgin raw materials. So, it is not the case with steel or glass, even after recycling you get the same quality out; however, with some of the materials for example, some of the plastics once you recycle them you do not get the same quality of plastic after recycling. So, we have to check, we have to see what is the property of the material which contains the recycled content and while other properties which are then going to be used in your buildings.

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When we are talking about the compliance criteria, it varies from rating system to rating system, but we are talking about almost 10 to 20 percent of the total cost of the materials given in a project, to have the recycled content.

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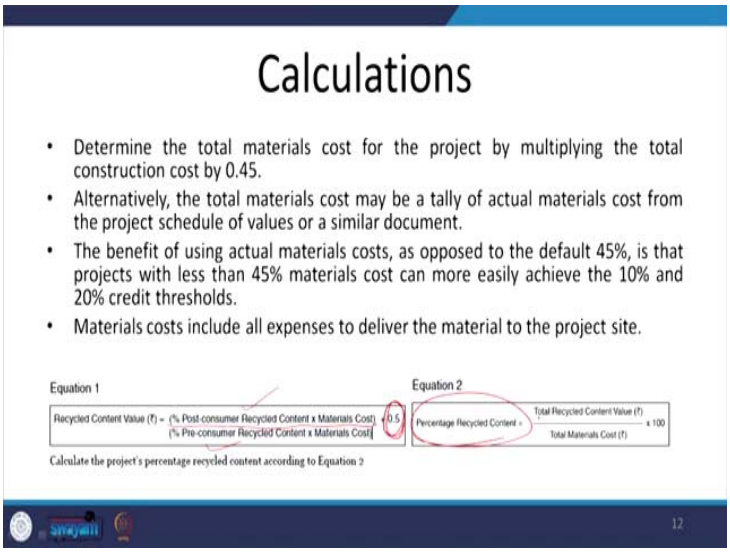

So, that is what we are looking at and if we look at the calculations, we are calculating the post-consumer recycled content. The percentage of post-consumer recycled content multiplied by its material cost; however, if it is a pre consumer recycled content only 50 percent of it is taken into account and then we calculate the total percentage of the recycled content as a percentage.

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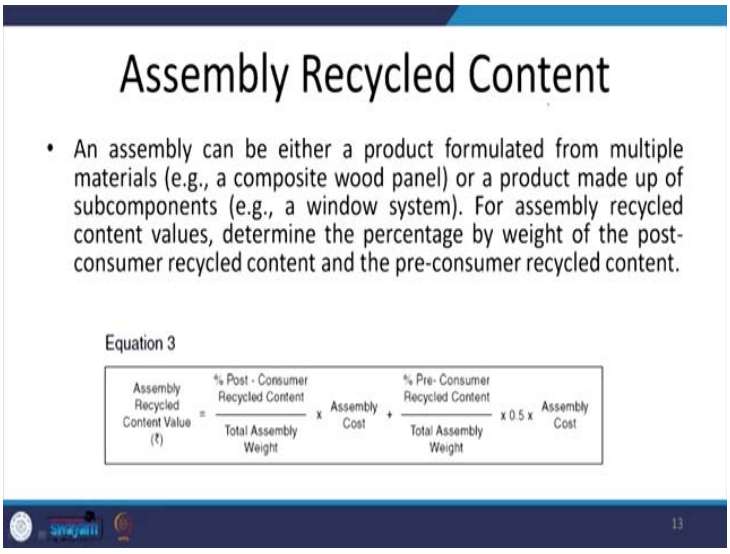

So, the percentage compliance for the compliance criteria, it varies from ~~material to from~~ rating system to rating system, this could be at a material level and then I said it could also be at an assembly level. So, for example, it is a window assembly a UPVC window assembly. So, here we would be talking about the total assembly and not the material.

So, it is not just glass, but it is also the UPVC frame. So, we will be taking into account all these different components that go into an assembly.

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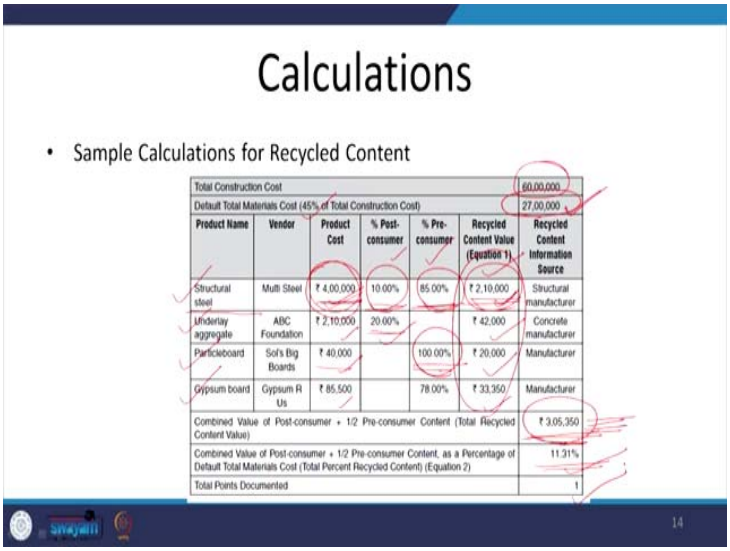

If we have to show the calculations, let us see here what all materials can possibly have the recycled content. So, structural steel has a lot of ~~recycling~~ recycled content, the underlay aggregate, the particle board and gypsum board. So, four of these materials for this particular project under consideration they have the recycled content. So, here the total cost of the material, the product cost will be indicated we will calculate the percentage of post consumer and pre consumer recycled content in this.

So, if we talk about structural steel, 10 percent is the post consumer recycled content and 85 percent is the post industrial pre consumer recycled content. So, the recycled content value will be 50 percent of this, 100 percent of this as part of this total product cost. So, which is coming out to be 2, 10,000 as against 4, 00,000. So, this is the recycled content value. So, of the total material which is worth 4, 00,000 rupees 2, 10,000 is the recycled content value, similarly, for all others.

So, the underlay aggregate 20 percent is the post consumer recycled content. So, 100 percent of it is taken here 42,000; then 100 percent of the particle board is pre consumer that is post industrial recycled content. So, 50 percent of it has been taken and hence this number. The total of all these is indicated here.

Now, of the total recycled content value we calculate that it forms what percentage of the total material cost of the project. So, if the total construction cost is 60 lakhs we calculate it roughly at 45 percent of the total construction cost will be of that of materials. So, 27 lakhs out of which approximately 3 lakhs is the recycled content value. So, we calculate that it is around 10.31 percent of the total material cost.

Now, depending upon the rating program which is taken up 10 to 20 percent of the total material cost should have the recycle should be that of the recycled content value and here we see that it has already crossed 10 percent and hence the credit has been earned. This is how the calculations for the recycled content would be shown.

Now, as I have questioned again and we need to keep that in mind, we have to clearly keep in mind that the recycled content materials may have different maintenance requirements depending upon their properties, depending upon the alteration in their properties, post remanufacturing or addition of the recycled content. So, the overall maintenance and operations they might require different attention altogether.

Here if we talk about steel specifically, steel ias a material as I have already discussed which is 100 percent recyclable. So, though when we saw in the embodied energy that steel is a material which has very high energy intensity. So, the per ton Giga joules is greater than 50, but when it gets recycled the energy intensity of for per ton manufacturing of steel that keeps coming down with every recycle the energy intensity would come down same ias with aluminium or any other material same as with glass.

So, it depends upon how robust the process of collection and recycling is, higher is the percentage of recycled content going into the manufacturing of a material lower will be its energy intensity as compared to the virgin extraction, virgin manufacturing.

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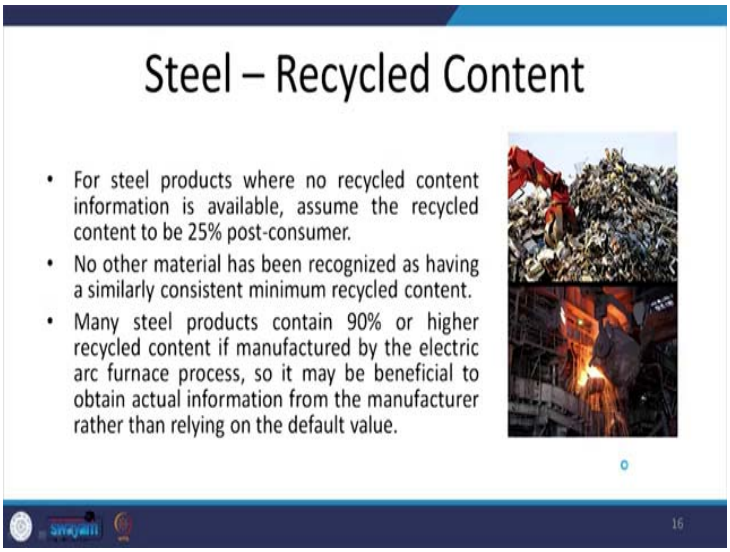

So, still here has a very high amount of recycled content, on an average it can be assumed that any steel which is available has 25 percent post consumer recycled content.

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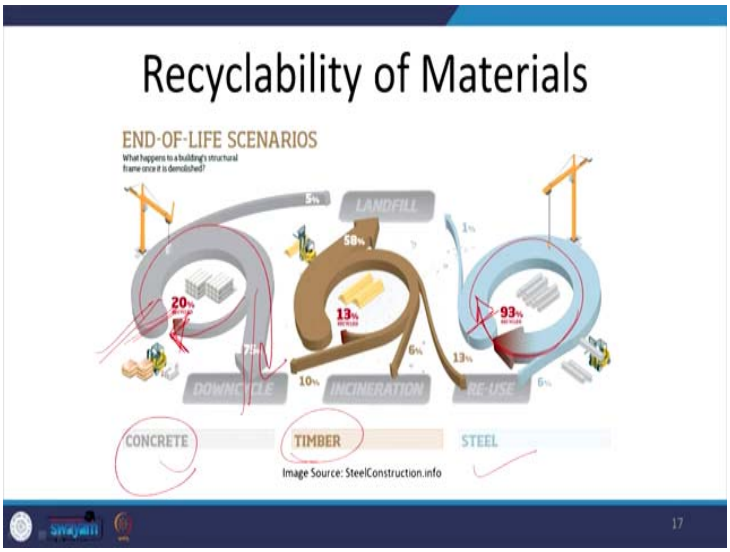

So, if we compare that with also with the end of life scenarios, the wood timber may not go back into the recycling. So, it may only have a cradle to grave kind of ~~recycling~~ lifecycle. While if we are talking about steel it will be cradle to cradle because once it has been manufactured almost 100 percent of it is brought back into the system. So, it is a cradle to cradle life cycle.

If we are looking at the concrete, despite very huge amount of energy which is required to manufacture to manufacture it, it is not going into recycling at all. So, it comes at a very heavy price of energy and it is not going into recycling as much very small percent of it can be recycled. So, from that perspective we have to compare between materials also we have to look at the availability of different materials alongside the function of it the purpose.

So, if we are making a multi storied building which is essential because there is no land available, there are there is a space crunch and we are going to construct a building in and in a very highly dense area in the heart of the city, steel comes out to be one of the best choices because 100 percent of it can be recycled. However, if we are looking for a suburban house in a rural area, where land is available in abundance and wood is also available from managed forests and it is abundantly available a wood house a wooden house would be an appropriate solution of material and not steel.

Because steel wood anyways come at a very high energy cost, energy price though 100 percent of it can be recycled and timber cannot be recycled yet timber would prove to be the most sustainable material. So, when we are talking about recycling, we are talking about processing of a waste item into a usable form.

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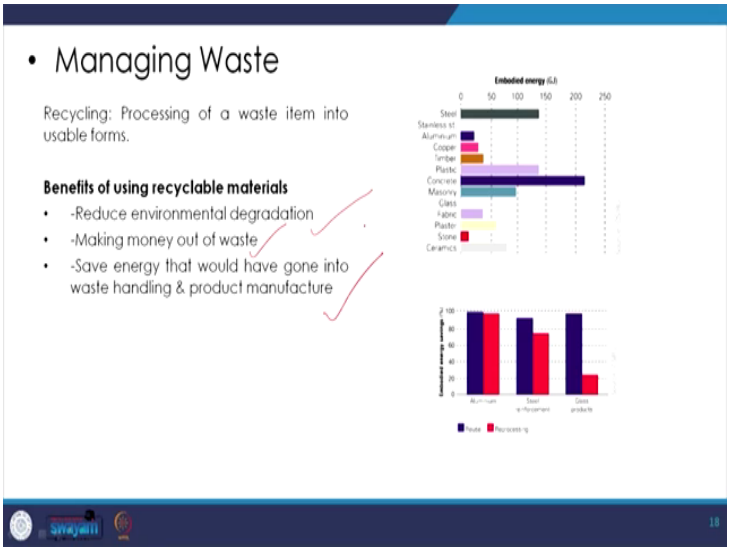

We are reducing the environmental degradation, we are making money out of the waste and we are saving the energy which would have otherwise gone into the manufacturing of the material.

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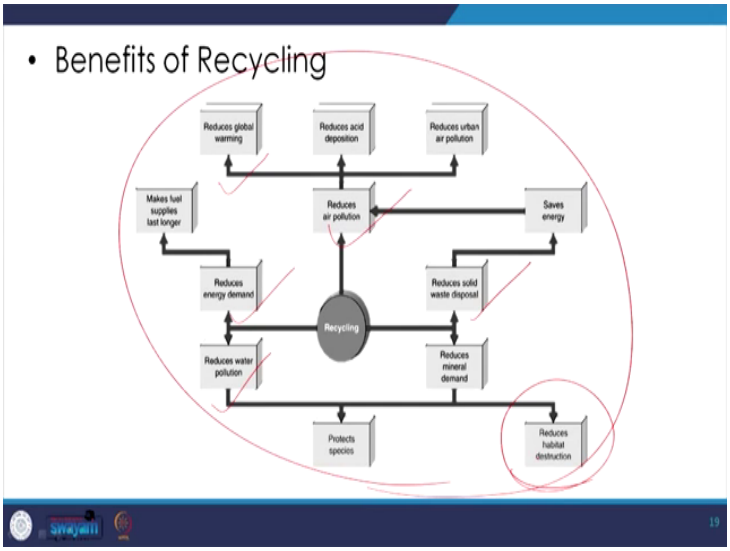

So, recycling on the whole comes with great benefits. We have also seen that in the introductory lecture when we started talking about materials and resources and we saw that any material ~~which~~ where recycling is possible, it must be recycled because it saves a lot on the natural resources. So, it reduces the water pollution, it reduces the demand for energy, it reduces the global warming a lot of larger global phenomena, it reduces the overall air pollution, it reduces the solid waste disposal, it reduces the habitat destruction for animals. So, there are huge benefits which can be accrued from the recycling.

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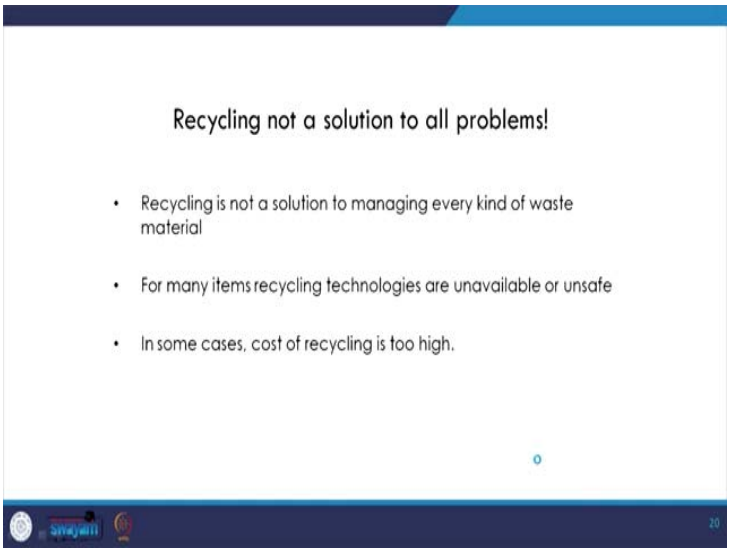

However, recycling is not a solution to all the problems. So, many problems can be solved with the help of recycling yet not all of them can be solved. So, another property which we emphasize on another criteria which we emphasize upon while selecting materials is selection of local materials. So, what are local materials? Local materials are the materials which are extracted and manufactured within the region. Now this definition of a region varies from rating system to rating system.

Some rating systems called 400 kilometer radius as a region, some argue that the local region is just 10 kilometers or 20 kilometers some argue that it is 100 kilometers. So, this definition of region may vary, but in a sense the idea is the intent is to reduce the burden on fuel conventional fuel for transporting a material from a far off place while a substitute for the same material can be procured from in the local vicinity from the local region.

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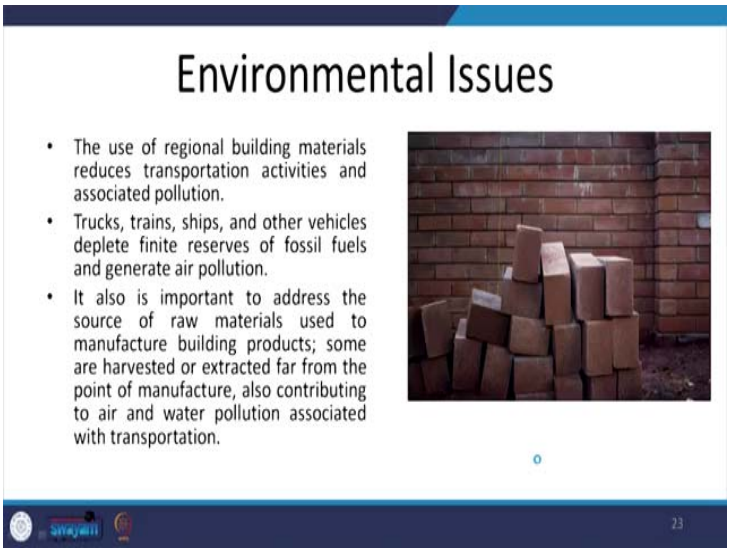

Again when we talk about the environmental benefits, here we are talking about reduction in the use of conventional fuel because the transportation will be reduced that is one. The second thing is over the years people have improvised how to use the locally available material and hence it comes along with a lot of economic benefit and social benefits as well because people know how to use these materials and they have been using it.

So, the ~~se~~skill~~ale~~ set that comes from people the local people, they complement the use of local materials as well. So, there is environmental benefit and there is also socio economic benefit that comes.

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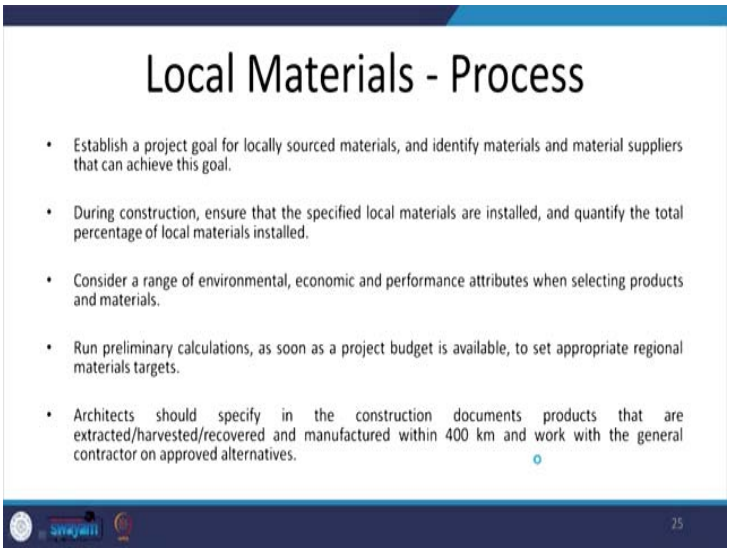

So, when we start to select the local materials we have to first identify the materials which are available in the vicinity and we also identify the users for these material which are available. So, all materials cannot be used for all the purposes. So, some materials can be used for structural purposes, some materials can be used for cladding purposes, some materials can be used for finishing purposes and so, on.

So, we have to identify what are those materials, for what purposes those materials can be used and where are those suppliers. And then we also have to ensure the workmanship that it is available for handling these different types of materials so, that it can be duly constructed with these standard procedures and following these standard protocols. Once we have done that and if we looking at compliance criteria as per one of the rating systems, it is 400 kilometer radius.

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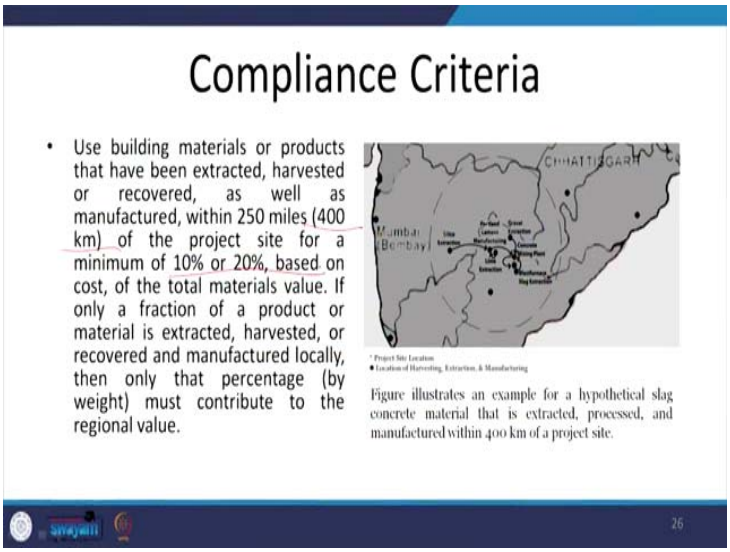

Now, when we are talking about the compliance criteria, we are talking about procurement of these building materials which have either been extracted or harvested or recovered or manufactured within a 400 kilometer radius of the project site. And here again when we are talking about the compliance we are talking about the percentage of the total material value and keeping it at 10 to 20 percent depending upon the different rating programs.

So, 10 to 20 percent of the cost of the total material which is going to be used on the site should be locally procured. Again if we want to show the compliance we have to prepare a calculation sheet. So, this is how it looks like.

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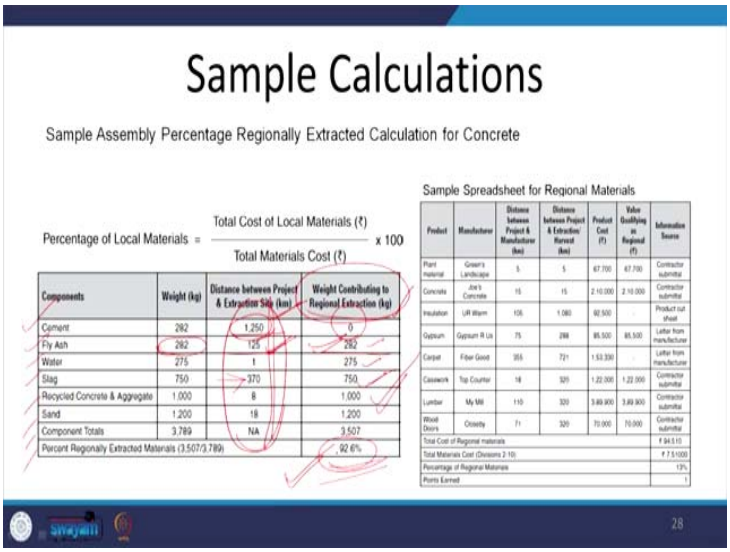

So, if we have different types of materials identified whatever materials are going to be used and then we identify from where these materials are being procured based upon the distance from the site to the extraction site or the manufacturing site.

So, whatever complies within the 400 kilometer radius will be what will be accrued towards the weight contributing to regional extraction. So, here fly ash is procured from a site which is ~~125 from~~ 125 kilometer from the project site. So, 100 percent of this weight will be taken towards the count. However, here we see that cement is brought from a manufacturing plant which is more than 400 kilometers from the project site. So, none of the weight of this is taken into account. So, it is taken as 0.

Slag again is within 400 kilometer. So, 100 percent of it is coming. So, wherever the distance between the project site and the extraction site or manufacturing site is less than 400 kilometer, it will be contributing towards the local material and we calculated as a percentage 92.6 is a high percentage here the minimum requirement was only 10 to 20 percent. So, this criteria would be achieved by showing this kind of a calculation.

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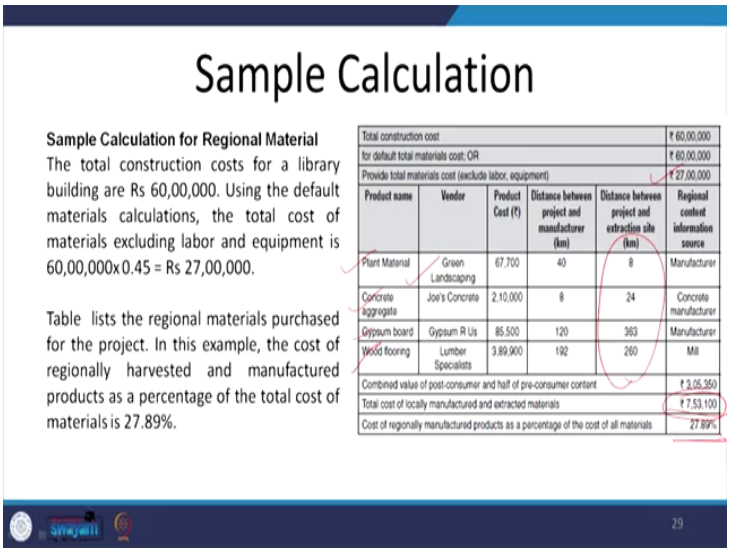

So, besides taking the weight of the material as compared to the total weight of the materials we can also go for the percentage cost which is how most of the calculations are done. So, we can identify the different materials which are going to be procured and then we identify the distance between the project and the extraction site and then we see that how much of this material can be called as a regionally procured or a locally procured material and we calculate the total percentage total cost of this material which is regionally procured as part as a percentage of the total material cost, total material cost for the project and we calculate the percentage of it for showing the compliance.

So, either way whether by a weight by mass or by cost, we can show the compliance we can clearly show the compliance. So, I will stop here again. So, we have covered some of the very important properties and also the compliance mechanisms, in which we can see how the material procurement for a green building, for a sustainable building has to be done. There are few more topics of interest left when we are talking about materials and resources and how to select the materials and how to procure the materials, which we will subsequently take in the next lecture.

-So, see you again for the next lecture till then

Bbye.