Course on Integrated Waste for a Smart City
Professor Brajesh Kumar Dubey
Department of Civil Engineering
Indian Institute of Technology Kharagpur
Module 10
Lecture No 49
Construction and Demolition Waste Management (Contd.)

Okay so welcome back so yesterday sorry in the previous module we talked about this C & D waste management rules and today we will I will kind of go over some of basics of what is a C & D waste. So although we talked about that as part of the rules as well so I will go little bit more in detail in terms of what are the different types of C & D waste in fact what are the different components of C & D waste, how they are managed, what are how they are being managed globally and we will talk about in Indian context as well.

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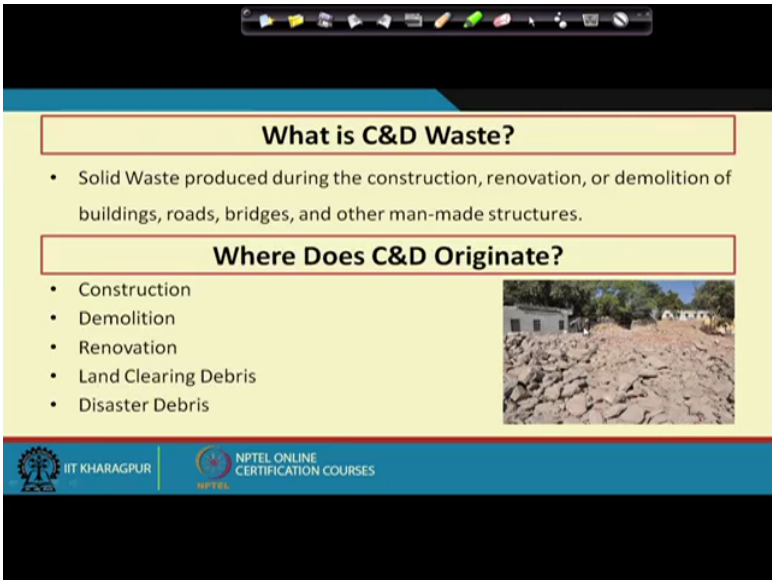

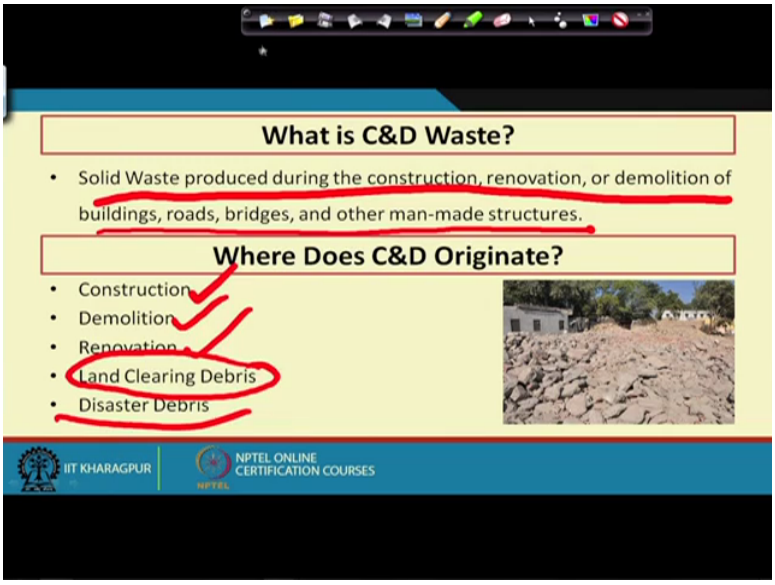

So let us get started, so in terms of C & D waste management, C & D waste is solid waste produced during construction, renovation or demolition of buildings, it could be buildings, roads, bridges or any man-made structures. So as listed here it is a any waste that is produced during construction, renovation and demolition of buildings, roads, bridges and other man-made structures. So any structure that we made so when it is undergoes some sort of during the construct also we produce some waste, during renovation if you are doing a renovation of a building you will produce waste.

Demolition and sometime during natural disaster, say recently we have had flood situation in several cities in the country in this particular last monsoon was very severe monsoon we had even in Bombay after 2005 we had a biggest rainfall this year. So and several like few building collapsed we had some structures being damaged, so those are all becomes like a disaster waste, it is a natural disaster waste but it is a disaster waste. Few years back if you remember the thing that happening in Uttarakhand in like in Hrishikesh and the area above Hrishikesh so those that we have lot of disaster debris.

So those are again part of construction and C & D, C & D is construction, demolition and disaster debris, so it is all three together and the disaster debris is the most nastiest one then is the demolition, demolition since there are lot of things mixed up, construction waste would be the most easy to handle because you can keep it clean, when I say you can keep it clean means you can we have better control on the construction waste, we can put concrete separately, we can put drywall, we can put the wood if you are using the drywall,, bricks, masonry, so all these different materials can potentially be kept separate and that can be used at the construction site itself or may be some other application.

Demolition we since you have say now the building is already made there could be certain things on the building which cannot be removed. For example, you had like a lead-based paint, painted on the wall, so now you cannot remove the lead-based paint from the wall you can but you have to scrap it through but even then you will have some little bit of traces of lead left.

So that becomes more difficult to do in terms of demolition, demolition will be little may have some contamination as well, because you cannot really avoid those contamination, because certain type of chemicals are used in certain product which are used in houses and which is already becomes integral part of the house, like the wall paint or even you do something on the ceiling or you do some flooring stuff which have certain chemicals those mosaics and other stuffs, so there could be certain things could be there which can have presence in demolition waste.

But when you go to the disaster debris, whether it is a natural disaster or a man-made disaster it is a most nastiest material, because that then you have even the furniture from the houses, electrical fittings from the houses and electrical appliances from the from that building, so all those and there could be lot of other things in there so all these things are now mixed up. So disaster debris recycling of disaster debris is the most difficult in terms of if you think of construction waste, demolition waste and disaster debris. So if you think in 3 broad categories, construction waste would be easier to handle than demolition waste and then the disaster debris will be the toughest to handle in part of these 3 streams.

So but in terms of how what are the different how they are generated, so we have that in the construction sites, we get construction C & D waste, demolition sites, renovation, you may have some land clearing debris where you are doing some clean up after disaster and the disaster debris, so those are and also several pictures of hurricane Katrina and I think Haiti disaster as well but after the Haiti earthquake few years back, almost like 10 years back now we had a chance to go there. So I will show you some pictures from there as well and hurricane Katrina which was one of the biggest hurricanes right now actually this year also hurricane season in US they are getting some big hurricanes coming up.

But in 2004 if I remember correctly or in early in 2005 either of those 2 years we had this it is a very active hurricane season and hurricane Katrina came and actually basically damage lot of properties especially in Luciano and new Orleans was one of the worst hit area and we had

a chance to visit that area and do some research in that area so we will I will show some of the data from there.

So in terms of C & D waste, any waste coming from construction, renovation, demolition, buildings, roads, bridges or any man-made structures. So sources, either from the construction site, demolition site, renovation site, land clearing debris, so you have debris from before disaster debris so those are what they are in a C & D waste.

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So with that let us keep go to the next slide where it says what are the major components now. So I already told you what are the major sources, so from the sources if you can just think about those sources when we say construction or demolition or disaster off course the concrete would be there, brick will be there. Asphalt; asphalt is in Indian context we do not use that much asphalt in our houses if you go and even if you look at the pictures of houses from say North America certain parts of Europe and other places you see the roofs are in a slant slanted roof and they use the tiles and those are the asphalt tiles, especially the individual houses.

Office building maybe now the flat roof but most of the individual houses is you will see the roof is something like this like in a what you see in if you go to a like Himachal Pradesh or Uttarakhand and those area they also we have something in this sort or in Jammu Kashmir most of the houses you will see those old houses as well like many like in a typical hut shape that we use to like a triangle shape roof.

Why it is triangle shape roof? Because when it in North America when you have the rainfall or if it is a too much of rain or too much of snow, it can just go down it is does not have to stay otherwise if it is like this you have lot of build-up the snow and the weight of water is a lot so weight of that is actually increases deadweight of structure and that like a load on the structure I would say and that leads some of the structural failure also happened, like couple of years back in in New York State in in the area of Buffalo some of these big buildings because they had this roof is flat they had there is a snow build-up of around they are talking about maybe around 3 to 4 feet.

So with this snow build-up of three to four feet this building had like too much of load on the slab and the slab collapsed and it is almost equivalent to having so many cars loaded up there. So that is why the roof is like this so that the water the snow will keep on moving down and that is it gives the roof safe. So there you will see those black coloured tiles, and that black coloured tiles are the asphalt and that is called asphalt shingles, so that is what this is called shingles is all about.

And then in the pavement we also use asphalt in our pavement here that is very common throughout the world. Drywall, again this is the partition wall in Indian individual houses in India we still use brick wall but many of these office buildings now you start saying that drywall is coming up as well, so drywall used for the office building. Plastic source is everywhere these days, you may have some cardboard, you will have wood, wood you may have some Darrel lumber, lumber is means the real wood, and the then you may have some you may have some engineered wood as well.

Engineered wood is where the particleboard which is compressed particleboard, these days many furniture are coming like you see some of these like a we have some of these furniture like beds or cupboards they are all made of these particle board compressed wood, we call it compressed wood you look I am trying to remember name of those companies like Zuari or there are some other companies out there that is I am not getting name of that, but there are lot of companies out there. Those are branded furniture but if you look at their wood it is not really the real wood it is compressed wood it is mostly saw dust and they are compressed together so that is it is what it is used for.

Then you will have metals, you may have some copper from the copper wire, iron, aluminium and there could be some other sources. So these are the major components and as you can see if we can separate these into different fraction as if we can separate the metal in

terms of copper and ferrous, aluminium and lumber, engineered wood plastic, cardboard each one of this can be easily recycled. So as long as we do the separation and either on-site or take it to a C & D processing facility where we separate this the each of this have some market.

Concrete can be used to make a concrete, concrete can be used to crush concrete can be used as a filler material, brick again can be broken down and can be used as a filling material, asphalt shingles and asphalt pavements can be recycled back. Drywall again there is again you can recycle back as a drywall, drywall essential component there is calcium sulphate with two molecules of water which is gypsum and so that it could be used back , recycled drywall is also used as amendment so that is also there so those are those things are used.

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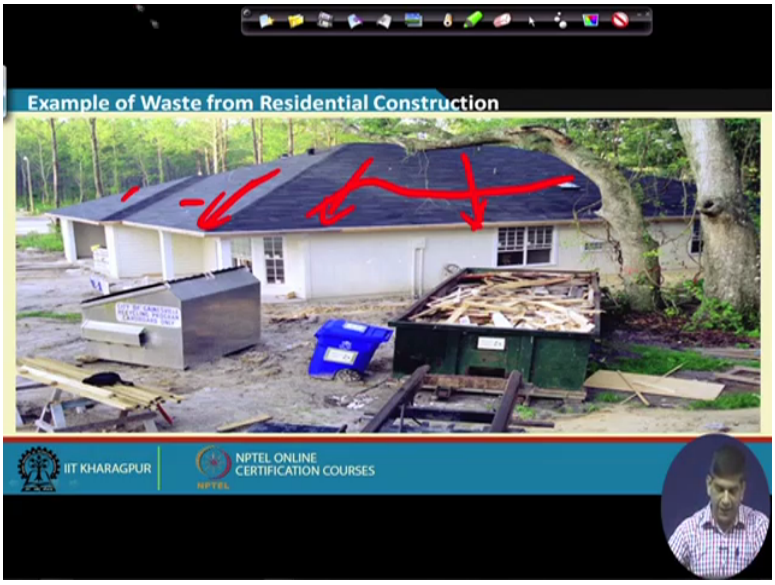

Okay so in terms of example of waste, if you look at some of the waste example from residential building again as this is the as you can see over here these are the asphalt shingles that I was referring to slightly ago, this is your asphalt shingles on top, so that these are all asphalt shingles which you see that is the and the roof is slanted. So that if heavy rain or snow and just will come down, so that is why the roof is slanted over there.

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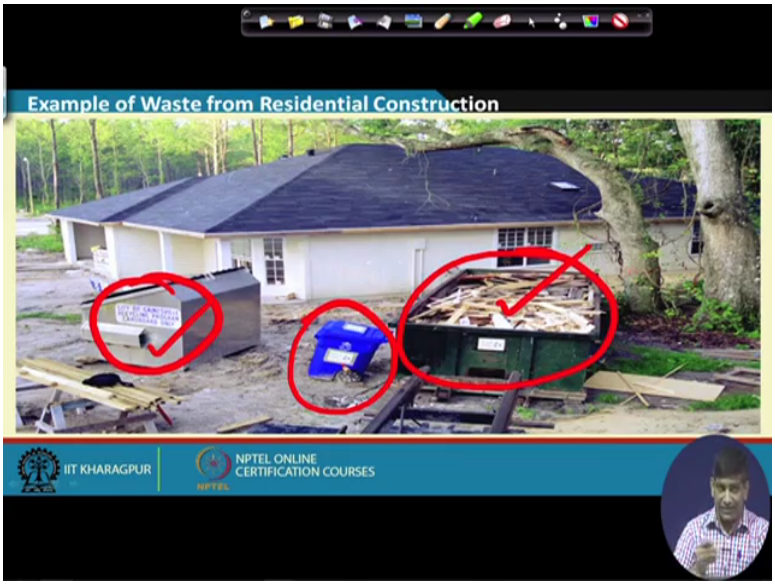

And so here in terms of the construction site this is for the wood, this is for cardboard only as you can see here they have got it from the city of Gainesville recycling program cardboard only. This seems to be only a wood and similar this is another trash can here for some other type of waste. So you can have various trash can where things you can separate them. So this wood can be easily recycle, looks like very clean wood then cardboard can be easily recycled and again here whatever is the material can be easily recycled.

So those things if you keep the things separate, so again whether you are talking about Indian context, whether we are talking about global context the separation is the key, if we can keep our wastes different components of the waste stream nice and clean see it is kind of sometimes seems like we are talking about waste and at the same time saying nice and clean which does not really sound very good together, but I am talking waste is also a material, so if you think and when you are going to recycle it is actually recycled as a new material, so it is a recovered material.

So if you can keep these material coming from the waste stream as a separate material so if you here as I done over here wood was wood is separate and we have cardboard separate and this another material separate so this can be easily send to the wood recycler, this can be easily going to cardboard recycler and you can make some market out of you can make some money out of that. So as part of the new C & D waste management rules as we discussed in the previous module you also saw that the government is now trying to promote recycling.

So even the constructions companies are being asked to use some of these recycle material within their construction site or at somewhere place somewhere else let us recycle these material. So that is and if we can do something like this where we can keep this different stream separate our recycling becomes much easier. We it is a good quality material, you can get good money out of that so that is always is helpful in that regard.

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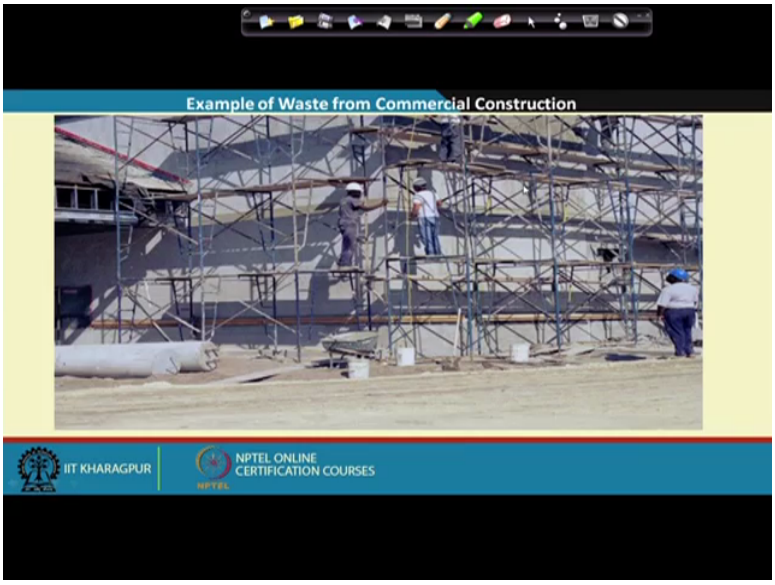

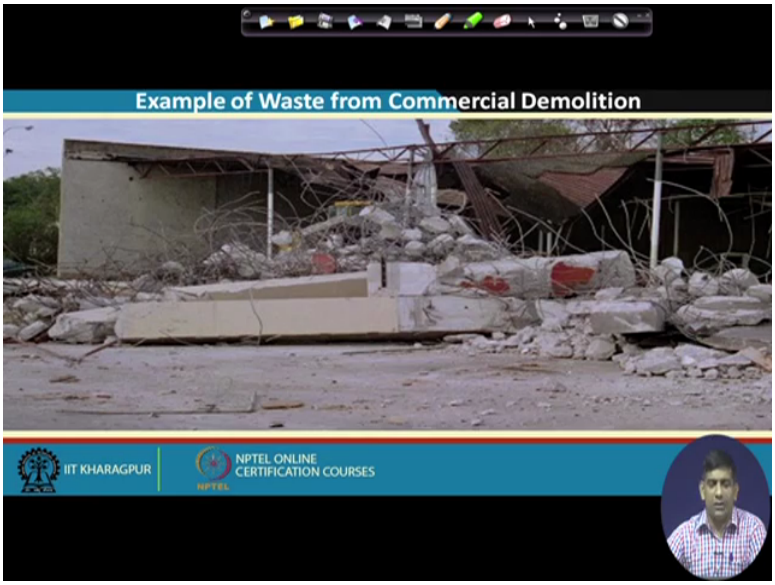

So another from this is another picture from the commercial site, as you can see the commercials which construction is going on so you can again it will generate different types of waste and that needs to be collected and needs to be treated. Example of waste from commercial demolition as you can see over here in the demolition you have some of this

concrete, you have lot lots of rebar's, so if the rebar's can be taken out and that is the rebar are your reinforcement bars so if that can be taken out that will be used it can be recycle for as a ferrous. Concrete can be used to make the new concrete out of this. Concrete can be crushed and used as a filling material, so all those different types of applications can be done for that.

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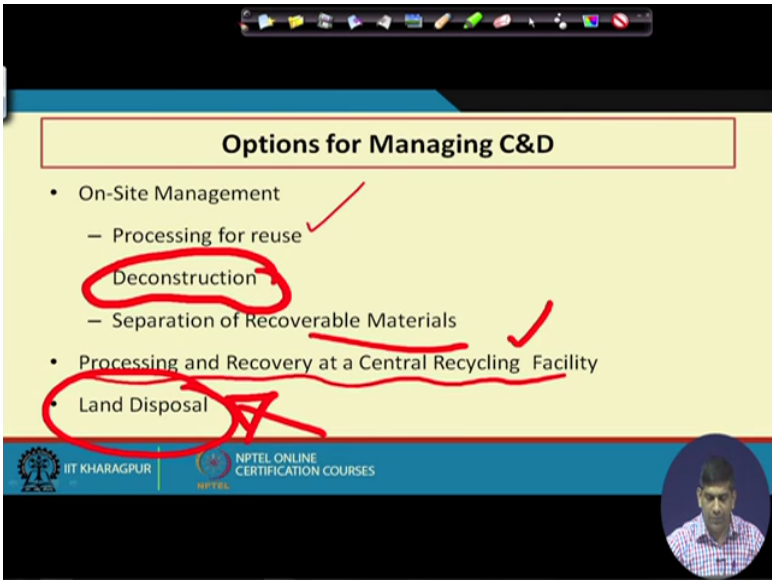

Then options for managing C & D but how we can do it, so if we have this construction and demolition material we can one of the option is you do it on-site value process it or for its reuse. So you do it on-site where or you do like a deconstruction, deconstruction is a new word which is not that use that much, deconstruction is basically you are not really doing a demolition.

So you have an old house and you have to get the house down and build a new house on top of that, so if possible the concept nowadays is let us deconstruct that house, deconstruct means you take one part at a time, that is more common say for in the western world still they use lot of wood, they have this asphalt shingles, they have wooden frames on which the asphalt shingle is there, so with the wood only you what you have to take out is the nails and other stuff, nails and screws and other things if you can take out we can start deconstructing.

But when we are talking about concrete building with a slab and all those which is kind of integrated together you really cannot that much of a deconstruction but still you can try to take actually is okay you can take the slab out so let us bring down the building in such a way so that we can salvage some of the material, we can salvage some of the material which can

be useful potential like a future buildings or future so if certain components can be used in the new building let us salvage and keep it and use it over there.

So the deconstruction term is rather than demolition you are actually taking one part at a time, you are taking one rather than bulldozing the whole building, you are not you actually taking a roof off, taking the asphalt shingles off, taking all those frames out, taking the roof off, so that we can keep all these material separate and that becomes easy for its recycle as well. Then you can separate the recoverable material then other option is to processing and recovery at C & D materials Central recycling facility you can put it in a landfill.

So after recycling if there is certain thing left, which cannot be recycled, that can go to a C & D waste landfill. And C & D waste landfill in many places the world does not require to have liner. So which is again there is lot of debate on that, so we really need a liner in C & D landfill. With the nature of the houses also are getting lots of heavy lots of different types of organics and inorganics chemicals now so we have to think about whether we should have liner or not in a C & D landfill, but as of today many areas does not required to have liner.

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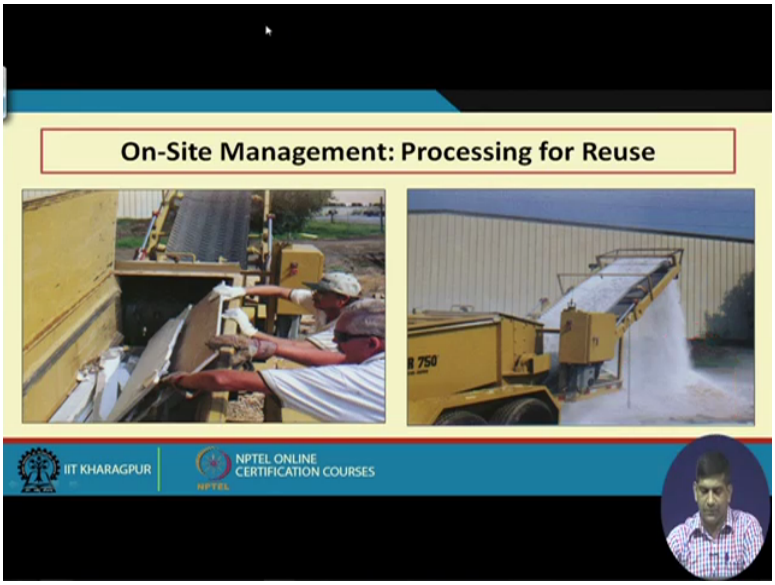

So here this is one example where on-site management processing for reuse, so here the drywall is been recycled. So drywall is being recycled, crushed and made into a powder which could be used for certain application, so it is can be used as a soil amendment in the agricultural application, because it helps maintain alkaline pH and that is it is good for certain types of plant especially peanuts and other stuff it is used for those plants.

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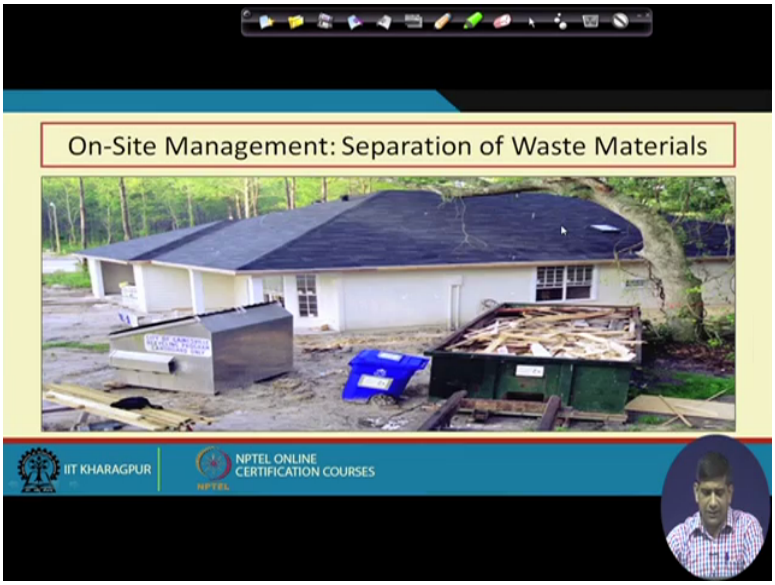

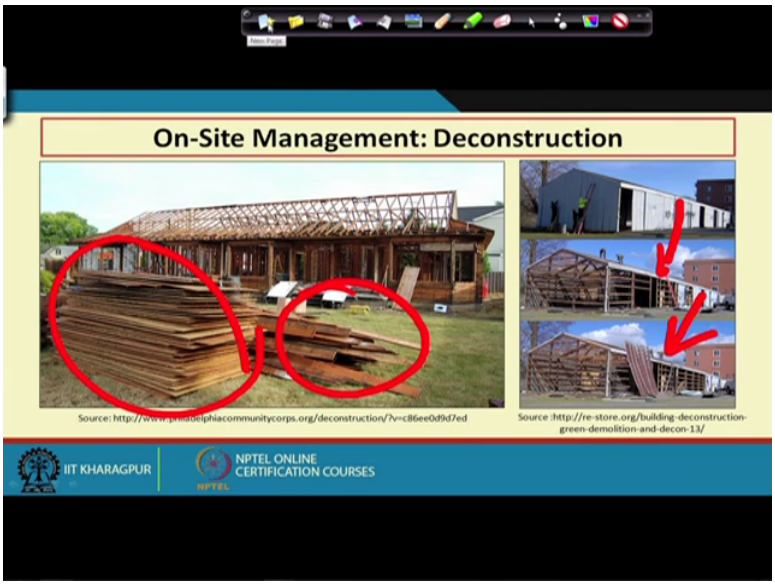

So that then you can have we already saw on-site management, separation of this material, this example you have already saw, if you separate material that can be reused. Then you can have a deconstruction where this building is actually not being demolished, it is being deconstructed as you can see from this picture to this picture to this picture, so if you watch it from this is this was the building earlier then they sorry this was the building earlier, from here they went into this and from there here they went to this one, so as you can see from part by part they are taking the building down.

On closer you we can see that the frames are there and that all materials that have been taken out of the building they almost look like very nicely separated. So it is a can be recycled, can be used and as a construction material off course you need to test the strength of that and that

our structural engineering friends will be able to help with that part of that, but we can do like a use many of these material on-site or for some other project.

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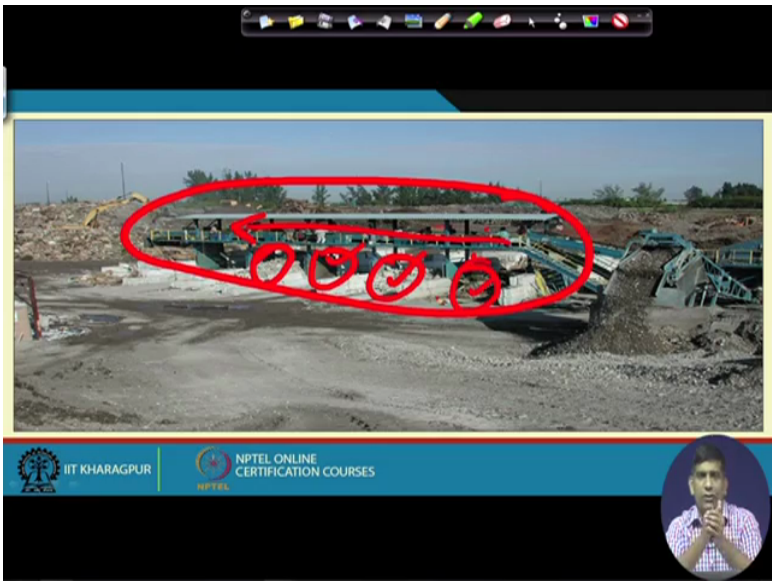

And processing and recovery at a Central recycling facility, so you are building everything at a C & D recycling facility where you are putting it through a recycling system where people will go through the material and try to separate it out. So here we can see some practice where there is lined and if you watch if you look at this pictures very carefully you will see a lot of people actually, there are a lot of excuse me there is lot of manual labour involved, so there is a manual labour here which they are going through this picking line.

So things getting loaded up on a conveyor belt, passes through this conveyor belt and as it is going through the conveyor belt there are people both sides looking at the material and they

are dropping it off into those bunker right here which have different types of material being collected. So this is how it works it is a but C & D this is how the municipal solid waste management system recycling also works. So murf which we talked about earlier module, so in terms of murf things are little bit in a not that heavy as it will happen in a C & D landfill.

So for C & D recycling facility getting sometimes labour is always a problem. So one area of research right now or one area of like I would say fascinating work is going on right now is how to can we use robots can we use robots who can do our help us in C & D cycling facility. For a country like India we still have lot of labour like we have an unemployment issue, so probably we will and we can find labour, off course it is a highly labour-intensive, this requires lot of effort to do things, but as you can see this big like concrete, drywall, wood and all those materials are heavy materials, concrete being the I think the heaviest one, but still you may find workers who will ready to working in that particular situation but they will have some ergonomic issues, their health issues like lifting all those heavy things .

But at the same time if we somehow specially in countries where labour is not that easily available and so there is always a question of can we use robots, can be trained robots to do these things for us and they can once they are trained they should be able to do it for us. So there is some issues associated with that for one example I will give you, if you have two materials mixed together, so you have a wooden be which is nailed in a concrete piece, now in terms of as a human we will look at the wooden piece and the concrete piece and probably what we may decide that okay let us keep this piece aside for now and then we will take this nail out and then put this wooden in the wooden pile on the concrete in the concrete pile.

But as a robot they may not be that much intelligent and they will look at it whatever they see at the first if the concrete piece is on top and the wooden is at the bottom cannot be seen from the top they may just put the concrete into that concrete pile or the vice a versa if it is the wooden things on top then it will put in the wooden pile. So the thing is that there is research is needed in terms of, how to trained these robots, how to trained these robots to do proper job in a C & D recycling facility.

So if you go on you Tube when you start looking at use of robots in waste recycling, especially C & D waste recycling you will see some examples already out there, there are some robots already developed in terms of how to make those robots intelligent. So some of you who in like unfortunately in today's in Indian scenario today civil engineering program it

is among the young crowd it is not that popular it is not that kind of so much I would say one of the cool department like as per the are young friends they call in their language.

So but there are lot of things in civil engineering, there are lot of things in environmental engineering which is really cool and this is one of the coolest stuff where you can use get the robots and come and do this, so how to train this robots? So that is we need to off course with the friends from different discipline to help us in terms of robotics and other stuff, but as a environmental engineer we have a role as well, how to train them better and then at the same time there are other like robots are also used for sewer line.

Say once one site just recently in like couple just in month of July in August there have been lot of in this year there have been lot of discussion on use of man in sewer cleaning. So remember still today people are going down that manhole and trying to clean those sewer lines by and so they are actually going into the sewers. So thing about all the nasty water that you are flushing down the toilet, somebody has to go down in the sewer line to clean it for you and the clean so that the city sewerage system works properly, that looks really it should not happen in today's world where when we are talking about so much going to moon, going to mars and all that but at the same time we people are in going there.

So many developed countries what they do there, they are using robots for that. So they are if they have to send somebody in to the sewerage line the robots are going there and you can talk to robot, you can give instruction to robots what to do and the robots will do it for you. So those are a thing which is applications of very fancy technology, even laser technology another thing in the recycling stream both for C & D waste and more for municipal solid waste is to use this laser technology in terms of sorting. When we are trying to sort different types of materials can we use this laser technology?

Laser is being used right now the Tietic one company Tietic is very popular in terms of separating different types of plastic and other stuff maybe based on colour, based on weight even we are using different type of techniques out there, but there are a lot of applications of all this so-called cool technology in area of waste management. So if you are in interested in those cool technologies I will encourage you to at least look at how they are and we apply in a waste management scenario and you can help create something new which will be helpful in terms of our objective to meet in in waste management area.

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So finally if we cannot do the landfill if we cannot do the recycling, so whatever the material is left which cannot be recycled, recycling either sometimes what happened is in certain parts of the world landfilling is cheaper so recycling is costlier so and then still the material is available, the material cost is not that high compared to in terms of that economy that we are talking about. So waste is going to the landfill which is unfortunate part of this specially C & D, C & D waste most of it could be easily recycled but they do end up in landfill.

So if they go to the landfill that has to be managed in a particular way, so you have to again to the compaction as you can see over here. Looks very similar to a municipal solid waste landfill but here you do not have food waste and other stuff, you should not have food waste and other stuff. So mostly it is concrete, drywall, wood, bricks, some of these iron steel and all that, so you will have those material showing up and then some cardboard and other things out there. So you compact it using this compactor and you kind of take it to the like a just managed it as a landfill.

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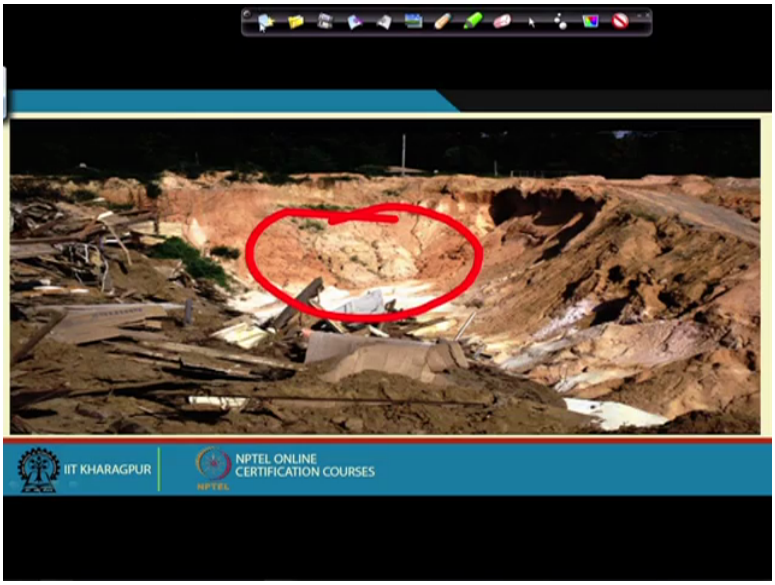

So this is another picture of landfill where you see this quarry, this is all clay you can see from the colour this is all clay material right there. So clay is good as a liner, so if you do not have to put a HDPE synthetic liner on top of that. C & D landfill as I said many parts of the world does not require a liner system but if we try to have a try to use a area which has good amount of clay, so because if any leakage of like leakage of leachate is there it should get prevented by this clay liner or the clay barrier.

So this and you do their waste in here do the compaction, one of the problem in a C & D landfill specially in the developed countries is because of the use of gypsum drywall and the H2S hydrogen sulphide in anaerobic condition gets produced and hydrogen sulphide is always a it is a nasty gas, it creates lot of nuisance around this landfill site.

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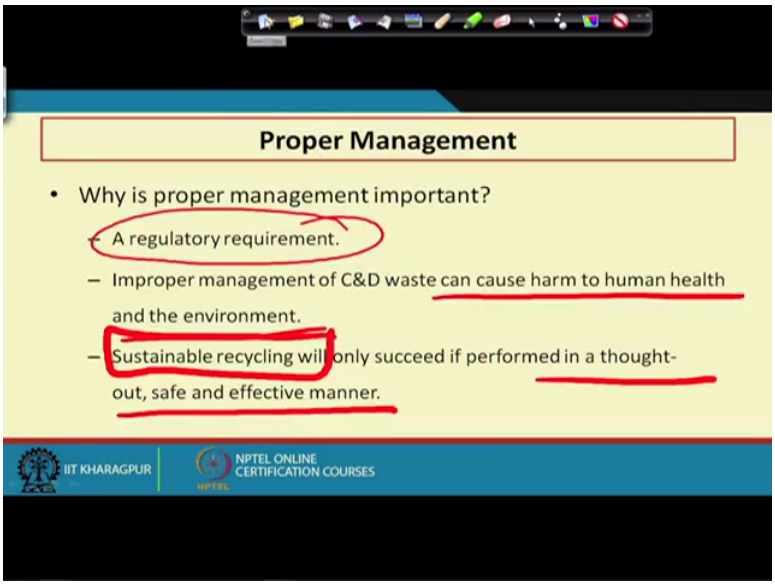

So and you can use the land disposal of a clean inert fills, so many times you can use this inert material we used as a land we can inert filling is done of that material as well in low-lying area. So proper management is important, proper management has a regulatory requirement, we talked about the regulatory requirement in the previous video, we talked regulatory requirement is there. Improper management can cause human health and environment issues, so you already know that. Sustainable recycling will only succeed if performed in a thoughtful thought out safe and effective manner.

So in terms of having a sustainable recycling one of the important things is economic has to work. I do not know how many times I have already said this, that but economics has to work, if the economy does not works nothings things does not you cannot have subsidy going

on a program for a long period of time. So even for a C & D recycling when you are recycling those materials, there should be good amount of market for it, you should be able to some money out of it so that you are at least self-sufficient if you are not making a lot of money should be at least self-sufficient. So that is it is very-very critical in terms of having a proper recycling of the C & D waste.

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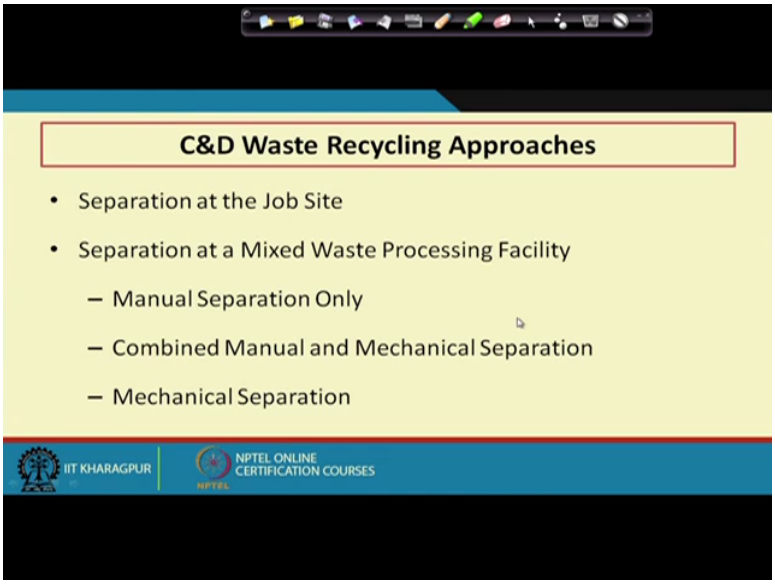

So in terms of recycling approaches you can do the separation at the jobsite very similar to MSW management, what we said separation at source, so here also separation at jobsite that is one possibility. If that is a problem because the jobsite is very small, you do not have space to keep different types of trash cans over there. The next thing is you can do is the separation at a mixed waste processing facility, so you take it to a mixed waste processing facility you separated over there. There it could be a manual separation it could be in combination of manual and mechanical separation it could be just mechanical separation.

Depending on the how much money you have what is the availability the local labour, so you can go for more mechanised system, more the mechanised system more costly it is in terms of building it up but in the long run you require less labour. So if you require less labour you are saving in terms of operation and maintenance cost, so you have to look at the trade off in terms of how much more you are it is causing to go for a fully automated system and versus having some manual system or a combination of both.

Many places you will see essentially combination of both, because machines still sometimes requires human help, because otherwise it is again I as I said earlier, if you have a concrete

piece and wooden piece nailed together, so machine we will look either at wooden piece or the concrete piece because whatever wherever that sensor whatever sensor type of sensor you use so once it says concrete it will put it in the concrete pile but actually there is a big wooden piece behind it or vice versa. So for that human eye human eyes are always needed, so usually you will see the combination of mechanisation and the human labour.

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Market for C & D debris for each one of them Portland cement concrete, asphalt concrete which is like asphalt wood, drywall, asphalt roofing shingles, there are markets out there markets is out there. Asphalt concrete can be used back in the asphalt, wood can be used as a boiler fuel, drywall recycled to make new drywall, drywall can go for soil amendment, asphalt roofing tingles again you can melt that asphalt can be used as a road construction and can you even make a new asphalt roofing shingles out of that, so those things are there.

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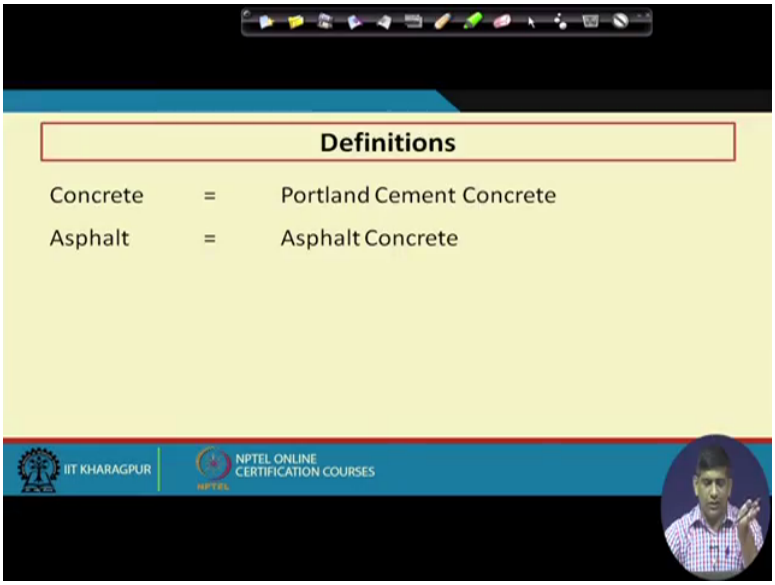

So in terms of concrete we use Portland cement concrete that is the concrete is called Portland cement concrete and asphalt is called as asphalt concrete. So this is again this definition is from the western world you in Indian context many times we say asphalt actually we are also here we use the word bitumen too. So bitumen is also a part of so asphalt concrete is actually bitumen, so that is what sorry asphalt cement we use there is a term used in the US or Canada that asphalt cement. Asphalt cement is actually bitumen, so with bitumen with all the other materials together is becomes a asphalt.

So let us kind of with we will continue discussion in the next module, so with let us know close this module this particular point and then we will continue will go in little bit more detail in terms of different components of C & D waste and what is the what Portland cement concrete, what is asphalt and what are the different component we will talk about that so give you more idea on this one.

So again I hope you are enjoying the course we are kind of very close to the end of week 10, I think one more video and the week 10 will be over and so it is then we have 2 more weeks and we have to talk about C & D waste and have to talk about electronic waste so those are the two areas. So C & D waste will we will finish it up and then we will go into electronic waste.

So keep the discussion board working and as part of the electronic waste if you remember earlier in one of the previous week we gave you an assignment which was kind of we wanted to know how the waste is being managed in your area, so your responses is has been received

and we are working on the responses so we will actually share the results with you towards the end of 12th week. I may have extra video over there, half an hour extra video, where will talk about the two surveys will do in this course which one survey which you already got in terms of which many of you have responded if you have not please go ahead and respond now.

It is basically to find out since there are so many people registered for this course we are talking about the waste management, we want to know how the waste is managed in your locality and it will be really nice for all the people in this class to know that how the waste is being managed throughout India. So since the people in this course are from different parts of country it will be really nice to know how the what is the waste management situation in the country as of today and only you can help us to find that, because so if you have not answered this question please go ahead and answer it, it is a very simple Google form and if you answer those questions and we will be compile all that and share that data with you.

So it is basically you will see that what you have put give the information in of terms of a whole country how waste management changes from parts of one part of the other part how the situation is in the different part, that is a very important information and that is a good thing to learn as kind of towards the end of this course.

Same thing you will do on electronic waste that is certain different type of like a question here very simple but you will get the question here on the electronic waste as well, you have not got it yet but you will get one on the electronic waste, we have talked about that and then I will require system both for municipal solid waste and for electronic waste I will have this last one half an hour extra video we will summarise that information and so you inform of a bar chart and those kind of stuff, like whatever information you provided to us. So with that again thank you and looking forward to see you again in the next video.