Urban Services Planning
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Lecture 42
Construction and demolition waste management Part - 1

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Welcome back in lecture 42, we will talk about construction and demolition waste management and this is part one of the lecture.

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So, the different concepts that we will cover our construction and demolition waste, and construction and demolition waste generation in India, waste, C and D waste quantification

methods, C and D waste characteristics, and construction and demolition waste management rules, 2016, and C and D waste processing.

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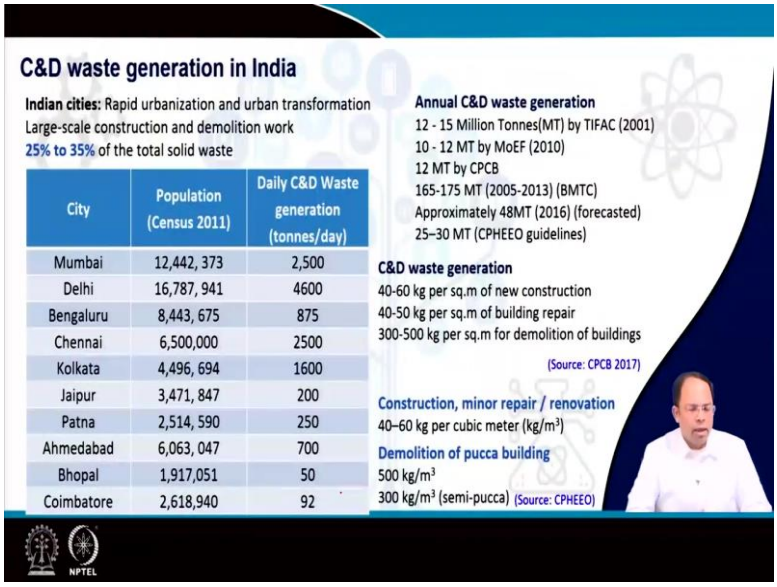

Now, C and D waste refers to construction or demolition waste refers to waste comprising a building materials, debris and rubble resulting from construction, remodeling, repair and demolition of any single structure that is how it is defined in the waste management rules.

Now, from where do this waste is generated, particularly in urban areas, either it is from demolition of existing or old dilapidated structure, renovation of existing buildings, construction of new buildings, excavation reconstruction of as part of concrete roads, so, not only buildings, it is also covered roads, then construction of new flyover bridges under bridges service. So, not only also roads, but also infrastructure over roads such as subways, bridges and so on, renovation installation of new water telephone internet sewer pipeline.

So, that means any kind of digging any kind of laying of pipelines and all that also will require some sort of excavation laying of some bricks soling and all these things that will also lead to certain amount of waste and then present collection and the disposal system as well. So, this is these are the different sources of C and D waste in urban areas. So, the primary point that we will take from this is it is not only masonry, it is not only brick, but a lot of soil lot of silt, because a lot of excavated material also comes from this kind of activities.

So, the waste that we are C and D not only it is not only the waste, that is being generated out of this kind of demolition or this kind of activities, but it also includes this surplus, damaged and temporarily used products, materials during the above activities on site. So, that means,

during the construction process or during the demolition process during different stages, there are excess particularly during construction where excess surplus material, there is some damaged material which also which cannot be reused. So, all these materials are also added as that material that should be generated from that waste from that particular site.

Now, why we are estimating this because, as you understand suppose, I want to estimate the total quantity of waste generated from a particular project site suppose it is a building project. So, how will I decide on that, I will I can take the total square foot of that particular project multiply with the waste generation rate like we can understand that so much amount of concrete, so much amount of all this wood, the steel, all these things that utilize in this project, we can have very little calculations and all that.

So, we know that okay so much amount of waste will be generated from demolition, but during the construction process of this building, suppose we are looking into the construction part and all other things, we kept to also estimate the during the construction process also that we also a lot of losses or other kinds of waste will be generated. So, this also needs to be accounted for. So, it is not only based on the actual size of the volume of the building, but also the process itself or how complicated the building is how much wastage is happening all this thing plays a role.

So, C and D waste construction demolition waste is of course, a very high density and it is a bulky nature. So, because of this nature, when you when people stored this waste outside their own premises in the roads or in the surrounding footpath, of course, that will lead to a lot of traffic congestion in that area, because it will reduce the size of the effective size of the road that will lead to accidents. And usually this will not only lead to accidents and all when you are storing this kind of garbage outside, the drains also get blocked.

So, either this, in the for storing this waste for construction the drains will get blocked, or if it is used for filling up low lying areas, or it is disposed illegally inside municipal bins and storage, or in drains themselves, it will lead to flooding and so on. So, way if you illegally dispose of this waste because of its nature, which is very heavy, bulky, and also it will complicate every stage. For example, if it is put in municipal storage bins, it would be we are not planning our municipal garbage collection system based on this kind of garbage.

So, that would create problems or unnecessarily the weight of the containers would be too high, maybe the skip loader would not be able to lift it that can happen, or if you are putting it

in the drains the drains are getting blocked, then it may lead to flooding of that entire area. So, if you are not properly managing C and D waste, it will lead to lots and lots of problems. So, it mixes with the other kinds of waste municipal waste stream. Of course, not only it increases weight but also it increases reduces the quality of other waste streams.

Because the other waste streams are pretty straightforward, either wet, dry or hazardous. So, wet waste goes to the compost plant. So, if you are putting C and D waste of course, it will contaminate that particular waste. Same goes for the other kinds of waste, which could be recycled. So, all the dry fraction of waste which can be recycled also gets contaminated if C and D waste is mixed with that. So, it is better to keep C and D waste separate from the standard waste streams that we have in our urban area. So, Government of India has now come up with a separate set of rules for C and D waste it is known as construction and demolition waste management rules 2016.

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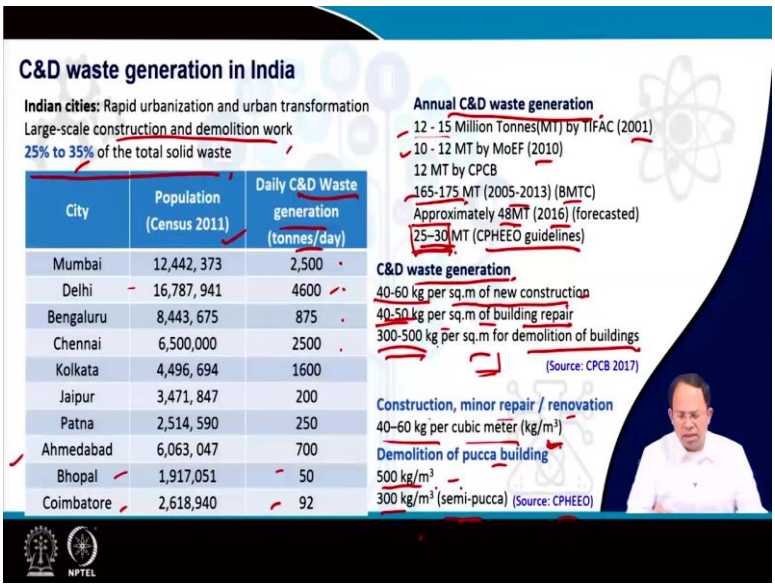

Now looking into waste generation in India, around 25 to 35 percent of the total solid waste generated in India is C and D waste. So, sometimes it is even more particularly in cities which are very, very growing very fast a lot of construction and demolition work is happening. So, in those cities, even this value is ted higher then this particular what we are showing over here.

So, this gives a rough estimate this table shows a rough estimate of the C and D waste for the year 2011 around the population is given for 2011 accordingly, the C and D waste generation is estimated in tons per day, which comes like Mumbai shows Delhi shows the highest 4600.

Whereas, other cities like Coimbatore, Bhopal, these are smaller cities the values are much much less in tones per day.

So, according to the total waste that is generated in each city, we have to determine what sort of facilities for processing, or what sort of what should the capacity of the processing facility, or is it feasible to do processing of the C and D waste and also how much amount of landfill area is would be required. So, based on the total that total annual C and D waste generation in India, starting from we get different figures starting from 2001, 2010, 2013, 2016.

So, it ranges from 12 to some estimates, when say 12 to 15 million tons per year or even some estimates are so high such as 165 to 175 metric tons, which is given by BMTC maybe some of this waste gets reused that means, in India if you live this kind of waste outside it will be taken away by some other people for using for filling up low lying areas and so on. So, in that case also the maybe the variation in how you are estimating it also gets this kind of differences.

Currently CPHEEO guidelines give a figure of around 25 to 30 meters. So, we will go along with that. So, 25 to 30 meters maybe now even 48 meters it seems acceptable assuming that it has improved increased further, so, roughly we can achieve this kind of figures but it is very very difficult to say what is correct, exactly correct. So, C and D waste generation could be also looked at in form of rates of generation of waste, for every square kilometer of new construction 40 to 60 kilograms of waste is generated.

Same goes for repair a building the same 40 to 50 kilograms of waste is generated, why because here the waste generation is a function of wastage or natural excess which happens during the natural rejects that happens during the construction process. So, either it is excess or rejects like when you sweep the sand then some rejects will come out. So, all these things lead to around 40 to 60, 50 kilograms of waste per square meter of building repair or new construction.

Whereas, if the same thing for demolition of building ranges from 300 to 500 kilograms per square meter. Now or you can also in terms of pucca houses and semi pucca houses, the rates given by CPHEEO is around 500 kilograms per meter cube of pucca building whereas 300 kg per meter cube semi pucca building. So, those values are also given, whereas, it is 40 to 60 kg per cubic meter for minor repair renovation and construction. So, the units are also different. So, both the values are given.

So, roughly for so much amount of area of the building more or less, it is the same thing that means, for every square kilometer square meter of space, we can assume that so much amount of weight so much about a kilogram of waste is being produced, but sometimes in spatial buildings we may go with this kind of calculations as well.

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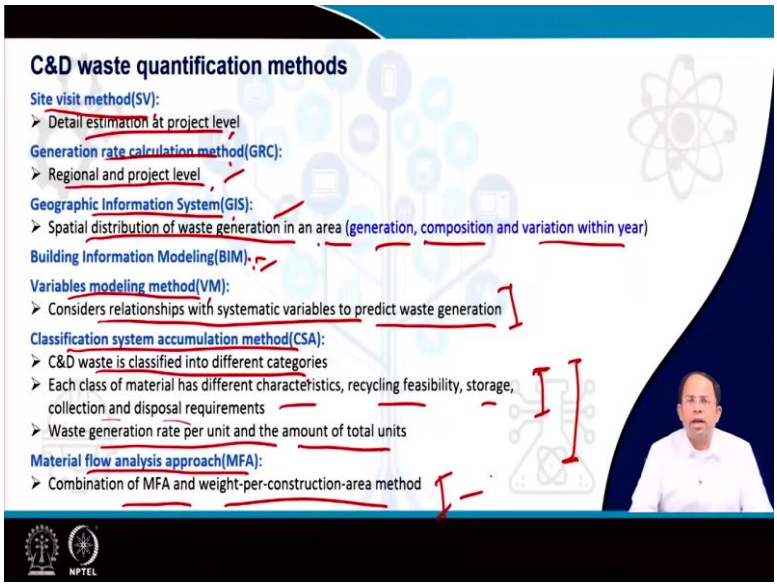

Now, how do we quantify this waste, so, first waste is the detailed site visit method that means, we go to the site measured the amount of waste that has been generated. So, this is detailed estimation at the project level and then the generation rate calculation method so, we have already given you certain rates we multiply the area or the total quantity of waste that is being derived volume of waste from there we can generate it use it.

So, it is at a, so for regional or area broad area level a we can determine that so much square foot of construction has happened. So, what would be the total waste that will be generated from that much amount of construction per year for that particular area. So, from there we can do this kind of calculation, we can use geographical information systems, which gives us spatial distribution of waste generation in an area every area is different.

So, variation how much amount of waste is generated during different times of the year because construction activity varies at different time periods, the composition of waste, generation of waste from different areas, the heterogeneity in the generation in different areas, all these things could be determined via GIS processes. Then Building Information Modelling can be also utilized as this kind of software can give us detailed estimates of what volume of waste is being generated or what volume of concrete what volume of steel, what

all these things are utilized in a particular project from there also we can determine how much amount of waste will be generated.

Now, Variables Modeling Method is a method where we actually say that, like different areas can have different ways. Now, if I develop a model, which says which takes in certain variables or certain parameters, where I say that these four parameters influence the overall waste generation for that particular project or that particular site or for that particular building. So, we can develop relationship between systemic variables and we can predict waste generation.

So, some form of regression models and all these things can be also used for predicting waste generation for other buildings. Now, the Classification System Accumulation Method, this is where C and D waste is classified into different categories, because each class of material has different characteristics recycling, feasibility, storage, collection and disposal requirements. So, all waste categories are treated separately and how much of each of these categories determined and waste generation rate per unit and the total amount of total units are determined based on that we can determine how much total waste to be generated.

Finally, material flow analysis approach where combination of MFA and weight per construction area method could be combined to determine that overall how much material is coming into the site how much material is going out in so in that order, we can determine how much amount of waste is generated.

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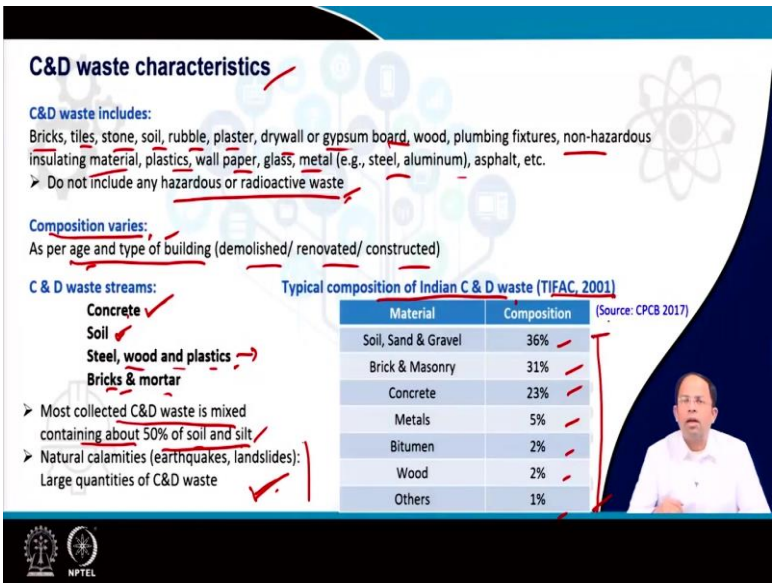

So, the C and D waste characteristics also vary as per because it is not one kind of is there a different items which is there in construction and demolition waste for example, it includes bricks, tiles, stones, soil, rubble, plaster, drywall, drywall or gypsum board, wood plumbing fixture, non hazardous insulating material, plastic, wallpaper, glass metal so on. So, steel, aluminum all these metals are also available.

Now, hazardous or radioactive waste is not considered even though some of them may be present in certain kinds of buildings, but we do not we ignore this kind of waste for normal C and D waste processing collection as well as disposal and treatment. So, the composition will vary, what proportion of all these components should be there in the construction and demolition waste, it varies as per the age of the building because at different times different kinds of material were utilized.

So, that as per age it will varies, the materials deteriorates over time, and the type of building demolished, renovated constructed that also determines what sort of waste to be generated. Now usually when we get C and D waste we categorize into ports municipal streams or port waste streams you can say. So, this is as per the solid the C and D waste management rules.

So, this is concrete, soil, steel, wood and plastic these are taken together and bricks and mortar, why these are separate like this because concrete is crushed to generate smaller particles soil is separated and sold separately, steel wood and plastic could be sent to recycling or in certain cases they could be sent to other kinds of plants for genetic energy also on. Bricks and mortars could be again sold crashed and so on. So, but it is different from concrete that is why these are kept separate.

So, most collected C and D waste is mixed containing about 50 percent soil and said so, as we are talking all these things are mixed together and along with that, there is also soil and silt which is about 50 percent of all waste and particularly during natural calamities and all if the waste that is generated includes a lot of this this kind of waste as well.

So, during in during natural calamities obviously because of destruction lot of this C and D waste is generated, but again the kind of depending on what kind of event it was it we can have if it was a flooding event we can have a lot of silt and soil, if it was something like earthquake then a lot of rubble a lot of bricks mortar would be there. So, roughly as per the TIFAC, 2001 typical composition of Indian C and D waste is given were around Soil, Sand and Gravel is around 36 percent, brick and masonry 31 percent, concrete 23 percent, metal 5

percent, bitumen 2 percent, wood 2 percent and others 1 percent. So, accordingly we can also plan our waste processing systems as well.

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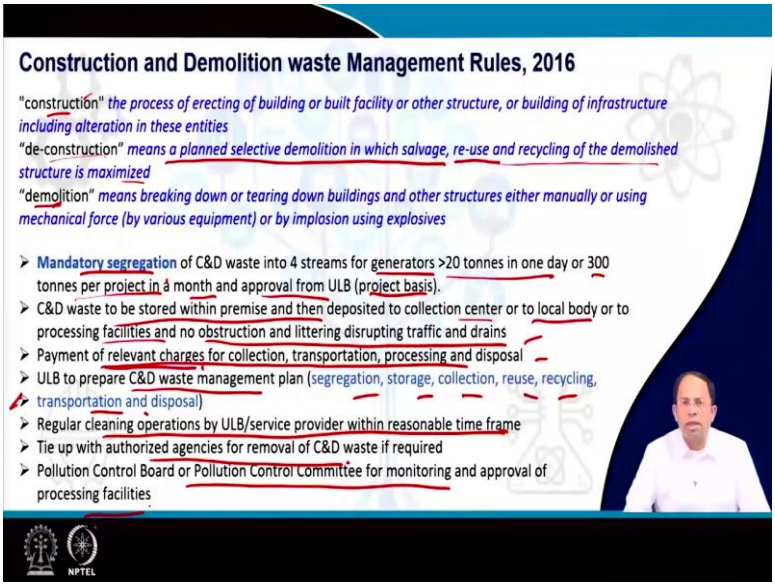

So, coming to the solid way this construction and demolition waste management rules 2016 few definitions. I think more or less these definitions are pretty self-explanatory, I will not going into details. But deconstruction this is the one which is a little bit that may require your attention, which is it means a planned selective demolition in which salvage, reuse and recycling of the demolished structure is maximized.

So, it is a planned way of deconstructing a building. So, that we can generate particular kinds of C and D waste and we are able to use that kind of C and D waste, whereas the other terms construction demolition, it is I think it is fine if you can understand those. So, the rules say that there has to be mandatory segregation of C and D waste and in what categories the earlier four categories that we discussed.

So, and particularly, this has to be done for generators who generate more than 20 tons in one day or 300 tons per project in a month and the approval and for each of these generated you have to take separate approval from the ULB before even you can start operation. So, on project to project basis for every project you have to take separate permissions this kind of permissions has to be taken because you have to have a total C and D plan or in place before you are given any sort of approval.

So, C and D waste has to be stored within premise and then deposited to collection center or to local body or to processing facilities and no obstruction and deterring or disruption of

traffic and drains are allowed. Now, the collection could be done by the local body or could be even the developer of that particular site, they can also take it to that particular processing center or that particular collection center. Then, if you are collecting, transporting, processing disposing the ULB of course, it requires money, it requires some payment.

So, payment has to be given for this kind of activities. That means ULB will charge you money for all this kind of activities. So, ULB needs to prepare a detailed C and D waste management plan including segregation, storage, how much segregation they will do, where they will store, where they how they will do the collection, will they develop a system where they can based on a booking they can go and collect the waste at certain times of the day they have to plan their journeys routes, they have to combine multiple pickups, all these things together.

And for that they can use those traveling salesmen problem, VRP (prob) using VRP and all this they can plan their journeys and the routes for the vehicles, reuse (recyc) in addition reuse, recycling, transportation, disposal, all this thing has to be thought up while preparing the C and D waste management plan.

So, the other thing is that the law states that everything should be clean in a regular time within a reasonable timeframe and mostly it should be regular we cannot keep this kind of waste left on a particular area and there are some for removal of C and D waste that ULB can tie up with some agencies who can do the actual collection and transporting process and pollution control board or pollution control committee committees there for monitoring and approval of different kinds of processing facilities.

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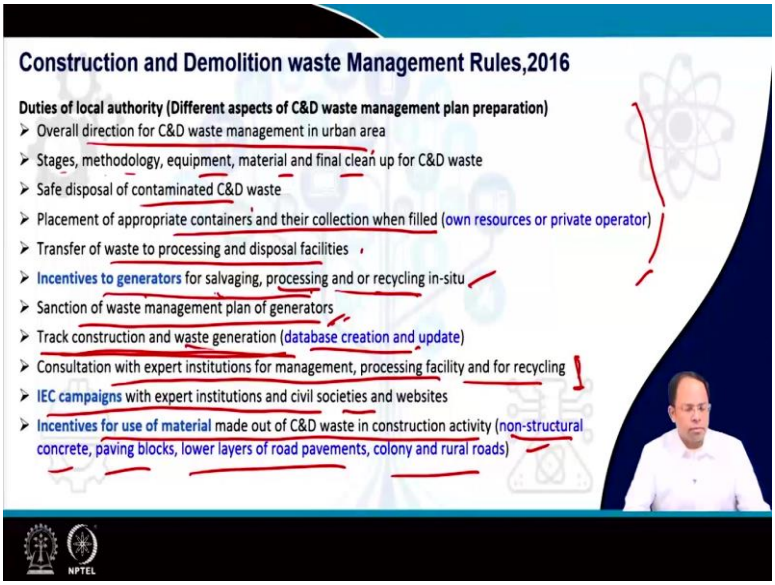

Now, these are some of the duties of local authorities and first of all, the overall direction of seed C and D waste management in an urban area has to be prepared by the Urban local body. There is different stages methodology equipment material and final cleanup for C and D waste has to be prepared this kind of plan as to be prepared. Safe disposal of contaminated C and D waste. Placement of appropriate containers and their collection when filled. Then transfer a waste to processing and disposal facilities. Incentive to generators for salvaging, processing, or recycling in situ.

So, all these are pretty standard this is same as normal waste management. Whereas one thing new is that there has to be incentives given to the generators for both recycling, salvaging or reusing some parts and sending something for recycling, sending it to processing centers and finally, recycling if it is done in situ that means, you do the recycling process in situ for use in the same project. For example, I will show you an example pay letter where after processing of the waste the site it was used in the site itself.

So, that actually will reduce a lot of transportation costs. So, sanction a waste management plan of generators. So, when somebody says that I have this kind of construction activities going on, you have to take permission right. So, ULB as to sanction this plan. So, that is also another activity up the ULB. Then track construction and waste generate, this ULB need to track what kind of construction activities are happening where how much amount of waste is being generated. And also they need to create a database where they have to store all this data and that data has to be updated at certain intervals.

Consultation with expert institutions for management, processing facility and recycling. So, of course, this kind of knowledge is still not that common in ULB and all. So, for capacity building and all they have to consult with educational institutions or expert institutions. Then IEC campaigns with export institutions, civil societies and websites. So, that people are aware of the different processes that has to be followed or they have to be aware of the rules as well and so on.

And finally, they have incentives for user material made up C and D waste in construction activity. So, that means either by other agencies or ULB in their own projects and all they have to utilize all this waste that is process waste that we are generating from C and D waste within their own activities as well. Such as nonstructural concrete, paving blocks, lower layers of road pavements, colony and rural roads this could utilize your process C and D waste or recycle C and D waste for use.

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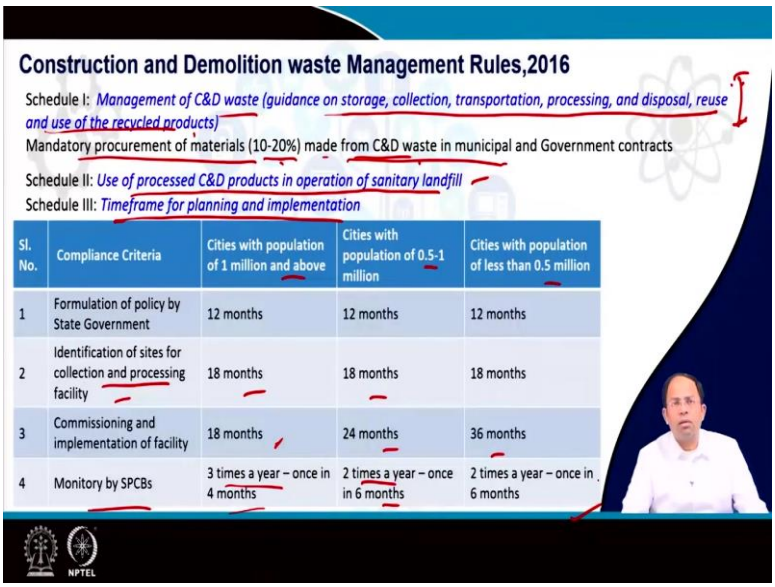

So, 3 additional schedule are given in that rules schedule one is management of C and D waste which is guidance on storage collection, transportation, pricing and disposal reuse and use of the recycled products. Then, there has to be mandatory procurement of material which is 10 to 20 percent made from C and D waste in municipal and government contracts. So, all these activities are more or less same as standard other waste streams of the solid waste management.

So, in solid waste management we have different kinds of waste and we have learned about the other waste how to collect and how to transport and so, on. The same things also apply for

construction and demolition waste as well. The difference is that after this processing, there is mandatory procurement of materials that has to be done to facilitate the recycling process.

Now, schedule 2 talks about use a process C and D products in operation of sanitary landfills. Earlier if you remember we have discussed when the tote that covers for sanitary landfill some amount of materials in the drainage where and all can utilize this kind of C and D waste. So, that is what it talks about. And finally, schedule 3 talks about timeframe project planning and implementation of this kind of plans.

So, for example, for different kinds of cities 1 million, 0.5 to million and less than 0.5 million, you can see that the policies has to be finalized by 12 months. Sites for collection and processing facility has to be set up within 18 months. Commissioning of the facility within 18 months or 24 or 36 as the case maybe, that means this for 1 million plus cities it has to be done within one and a half years and then monitoring of this activities 3 to 3 times a year once in 4 months or 2 times a year once in 6 months accordingly they have given some schedule. So, this is what schedule 3 of the solid this construction and demolition, waste management rules is all about.

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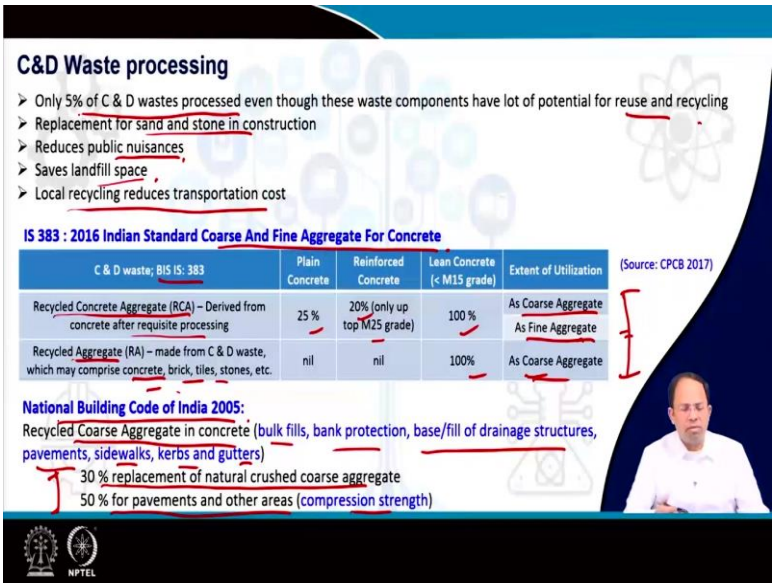

Now, finally, we have to once we collect following the schedule and all we have to design our C and D waste processing and transport plants and all. So, what we find is, after all this we have to actually process the C and D waste. So, in India around only 5 percent of C and D waste is processed, even though because there is lot of a potential for this kind of C and D

waste was for reuse and recycling, but still only 5 percent is processed currently, but we have to improve upon it.

And it is access a replacement for sand and stone in construction. And as you have seen earlier that for structural concrete it is we it is better not use this kind of aggregate, this process aggregate but for nonstructural concrete for lean concrete, it is fine we can use this kind of material. Because we are processing it, if we reduce public nuisances, such as accidents, traffic congestion, drain blocking and all this stuff, it will save landfill space because we are utilizing them and local recycling also reduces low transportation cost for this kind of list.

Now IS standard 383. This is standards for coarse and fine aggregate for concrete. It says that this is BIS IS standards for 383, this is recycled concrete aggregate which is vary from concrete up to requisite processing this is for plain concrete we can use 25 percent for reinforced concrete or on 20 percent. But up to M 25 grade and for lean concrete 100 percent could be this this RCA material could be utilized and for it could be used as a coarse aggregate and also used fine aggregate as well.

Whereas for recycled aggregate, which is not only concrete, but made from concrete brick tile stones, everything crushed together in that case, we can use it only for lean concrete and as coarse aggregate. So, this is the difference. So, if it is coming from concrete it will be used both as a fine and coarse aggregate after of course, making it into smaller pieces and shredding it and making make crushing it and then streaming it and so on.

But other than that, we can use it for your coarse aggregate if it is just for standard mix of bricks, tiles and all this stuff then we can use it as a coarse aggregate for lean concrete. So, the national building code of India also talks about use of recycled coarse aggregate in concrete as bulk fills, bank protection for some channels, base fill of drainage structures, pavements, sidewalks, kerbs and gutters.

And it suggests 30 percent replacement of natural crushed coarse aggregate and 50 percent for pavements and other areas where compress compressive strength is a issue, but other kinds of strength are non-issue. So, that is how this is this kind of material is being promoted in different building codes and different kinds of codes in India that actually will help in further use or recycle of this particular product.

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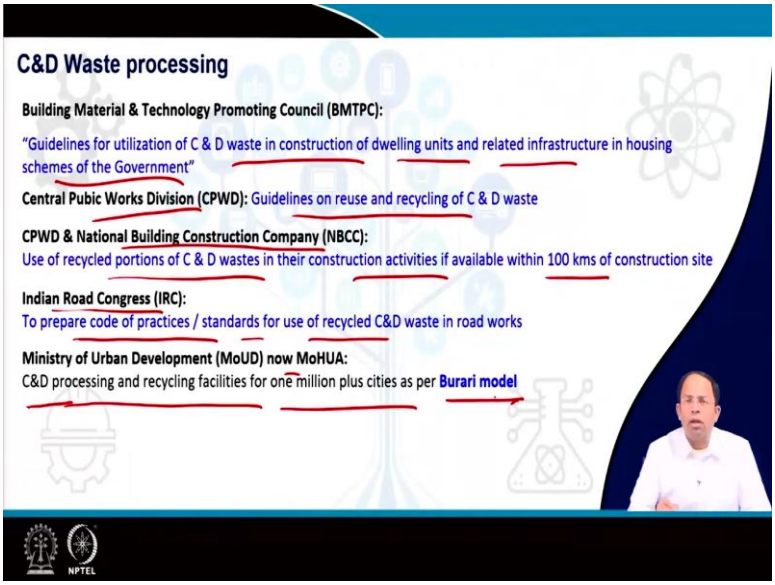

So, Building Material and Technology Promotion Council BMTPC also have given certain guidelines for utilization of C and D waste in construction of dwelling units and related infrastructure in housing schemes of government, and accordingly certain projects have been also taken up. The Central public Works Division CPWD has given guidelines on reuse and recycling of C and D waste, then CPWD and national building construction company they have not only say that they will use recycled portions of C and D waste in the construction activities in buildings, but also they say that up to 100 kilometers of the construction sites, they are willing to come and get this waste for and utilize this kind of waste in that particular projects.

So, that is how NBCC has also tied up with CPWD to use this kind of material. Indian Road Congress is also supposed to prepare codes for practice and standards for use of recycled C and D waste in roadworks. And finally, the ministry of urban development has created a pilot project which is a C and D processing and recycling facility with for 1 million plus cities and this is known as the Burari model and we will discuss this project in the next lecture.