Principles of Construction Management
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Lecture – 02
Interdisciplinary Nature of Modern Construction Projects

[FL]. And welcome back to our lectures on Principles of Construction Management. And today is lecture number 2 where we will talk about the Interdisciplinary Nature of Modern Construction Projects. Traditionally, construction projects were seen to be largely civil engineering projects, now it is not so anymore. And that is what we will see through an illustrative example of metro construction.

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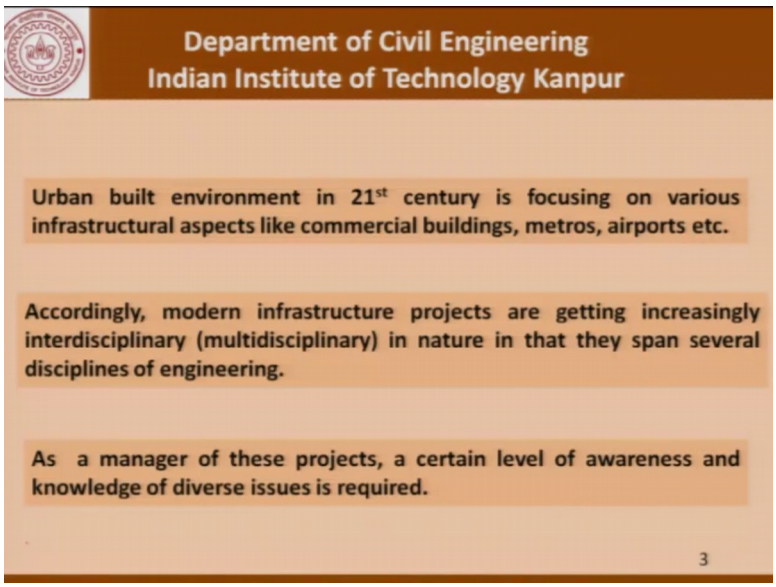

Now, before we get into a discussion on metro construction and the example and the issues involved and so on, let us go over the course once again. Urban built environment in the 21st century is focusing on various infrastructural aspect, such as commercial buildings, malls, metros, airports, roads and rails. And accordingly, modern infrastructure projects are getting increasingly interdisciplinary or multidisciplinary in nature in that they span several disciplines of engineering.

So, most of our treatment here will be with the civil engineering bias, but we will not try to use a lot of knowledge of technical civil engineering or the specific of civil engineering, but of course we will have to borrow from civil engineering issues. As a

manager of these projects, a certain level of awareness and knowledge of diverse issues is required.

Needless to say depending on the stage of construction of a project, the project manager could be from civil engineering- with a civil engineering background or it could be from a mechanical engineering background or an electrical engineering background and so on. It is important to understand that in the construction phase at different points in time different activities are predominating. In the initial parts there is a lot of civil engineering that goes on, as we go along in the project perhaps depending on the nature of the project mechanical engineering and electrical engineering these kinds of issues become more important.

So, organizations tend to change the project manager from time to time depending on the expertise. Similarly, or having said that, even when civil engineering activities are going on and the project manager is a civil engineering background person that person should have a basic understanding of the mechanical and electrical engineering issues and so on. So, that is what is the back drop against which you should try to understand our treatment of construction projects.

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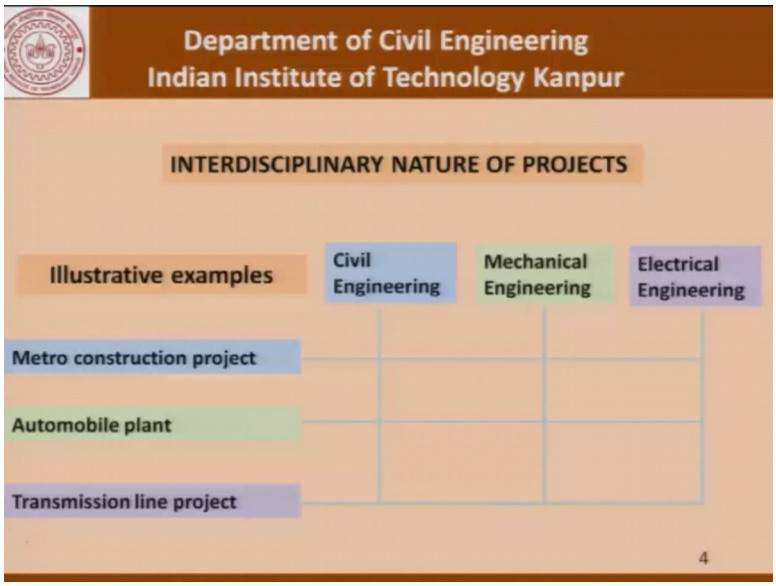

So, now coming to internationally nature of projects lets take some illustrative examples like metro construction or an automobile plant or even a transmission line project. So, if we broadly divide the engineering domains the civil mechanical and electrical of course

there could be other disciplines also involved depending on the nature of the project, depending on the stage in which the project is and so on. If it is a metro construction, there are definitely civil engineering aspects, mechanical engineering aspects, and electrical engineering aspects.

Similarly, in an automobile plant once the plant has been commissioned and is in operation then, it is not necessarily a great civil engineering operation. So, it is a mechanical engineering operation with controls electrical engineering software people, all these people come into play as far as management of that operating plant is concerned, but at the time of construction it is largely a civil engineering activity. In the case of metro construction however, even during operation the civil engineers continue to play a very important and a vital role.

It is not only metros, but in fact if you think about it, if you look at the railways for that matter you will realize that even in the operating phase the civil engineers have a very important role, but the training and the kind of skills required is not necessarily those required at the time of construction,. At the time of operation you require skills in non destructive testing, monitoring, repair and so on. So, the skills required is different, but the background is the same.

Now, if you look at the third example which is sited here the transmission line project. An electrical company can decide to lay a transmission line from point one to point two. There will be electrical engineering issues of course, because what kind of power to be transported, what kind of towers to be used, what height the towers will be and so on, those are issues which need to be resolved in consultation with the regulatory authorities and so on.

But once the electrical part of it is completed, the loads and so on are handed over to civil engineers for structural design and so on. There is a construction part where the towers are erected, and once the towers have been erected civil engineers are obviously not the best people to identify the kind of wires to be used, the kind of fabrications to be done or for that matter the kind of laying of the lines is concerned or substations on the way. The construction of the subways of civil engineering issue, but the equipment that goes into the substation is definitely not civil engineering.

So, the project manager who manages these projects has to have some understanding of all the different facets of the project. Now, getting back to our example which we will deal today is metros.

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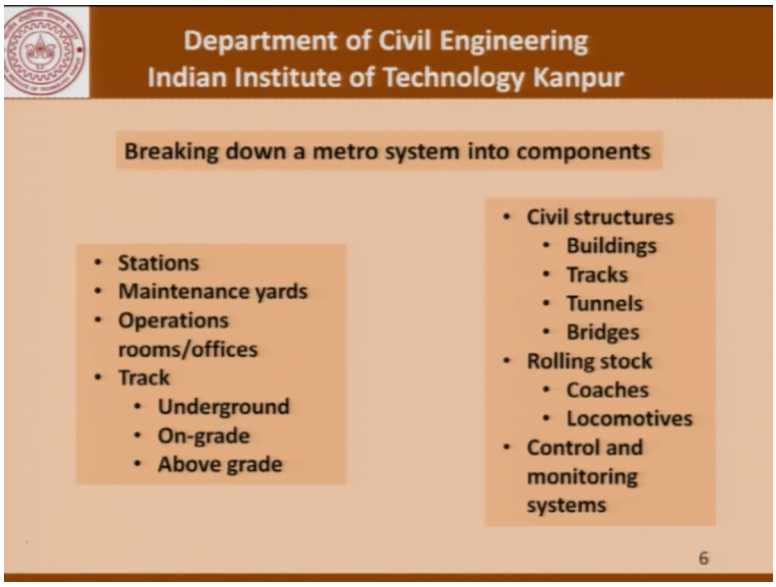

So, now if you look at metros we need to break it down, it would be easier; if we break down a metro system into components and then try to see what kind of expertise would be required to manage or to be able to implement a particular part of the construction.

So, now there are different ways of looking at this breakdown. One is to look at what are the different components in terms of let us say the stations. So, there are stations where the metros or the trains they come, they stay there for a certain amount of time, and therefore the kind of issues that go into the planning of a metro station would include movement of passengers coming in and going out; the movement of trains coming in and going out.

If you look at the planning of stations, primarily the issue is movement of passengers, embarking and disembarking, and how we will transport them from the outside of the metro area. So, if you look at any metro station, you are approaching the metro station from an area which is not really metro. So, first thing is that the passengers will come into the metro area, then, they will come to the platform and take the train.

On the other side, people will disembark from the train, get out of the platform to the station area and then leave the metro area. So, one of the parts of planning and construction of stations is the movement of passengers. Similarly, there is this issue of trains which are coming in and going out. There is the related signaling issues and so on and so forth.

In both these cases there have to be appropriate provisions for safety measures or emergencies that may arise. So, if there is a fire in this station there have to be emergency evacuation systems in place and so on and that goes into the planning and construction of stations.

Moving from there, there are maintenance yards where the coaches and the locomotives are maintained- that is they are overhauled some kind of minor repairs are carried out and. so on. So, again if you look at the movement of trains, so the trains move on tracks which are laid on sleepers and the load is then transferred to the ground. So, apart from the coaches and the engines everything is basically a civil engineering domain. Story: whether it is the tracks, whether it is a sleepers, whether it is the palace or whatever goes on in transferring the load to the ground.

So, as far as the maintenance yard is concerned depending on where the maintenance yard is somebody will tell you that ok, this is the length of the trains which need to be parked so that they can be cleaned. But, the layout and the civil engineering infrastructure that goes water supply, their removal of waste water from there and so on that remains a civil engineering domain issue.

Similarly, if you look at operations rooms and offices; so there is the need for having operations rooms, offices where different people associated with the metro operations will work from and that has to be again planned. Continuing with the story, there could be tracks. And now if you just pause to think about some of the metro systems that you may have seen you would realize that the tracks could be underground or they could be on grade or above grade.

Now, depending on whether the tracks are underground or on grade or above grade, different aspects come into play. And as engineers we need to understand the issues so that we are able to handle them as they come during design or during construction. A proper understanding of all these things helps us plan the system better and ensures that

as we go along in a construction project or in the project of metro construction we do not have to make sudden changes.

Another way of looking at some of these systems would be; let us try to divide them into civil structures. Now, if you look at similar structures there could be buildings, operations rooms, and stations can all qualify as buildings. Similarly, they would be tracks, there would be tunnels, if the track is underground will have make tunnels. There would be bridges; now, bridges can have two functions here. One would be crossing a river or any other obstacle; the other way of looking at a bridge would be all kinds of track which are above grade, they could also be looked upon as bridges in one form or the other. So, depending on the what view we take these are basically inclusive of all kinds of above grade structures which are designed to carry the metro above ground.

Then there is rolling stock which is definitely not a civil engineering story and that consists of coaches and the locomotives. And besides that there are controls and monitoring systems, there is an entire power network which has to be laid down and so on. So, depending on which way we break down a particular system, we will have a better understanding as to what is the kind of expertise which is required for executing a project.

Now, execution of the project does not necessarily mean only on site operations, if it comes to rolling stock for example, these coaches and locomotives have to be procured. When it comes to buildings or tunnels, we need to decide what kind of material we will use and that decision is also an engineering decision and needs to be taken with proper planning and technical issues being kept in mind.

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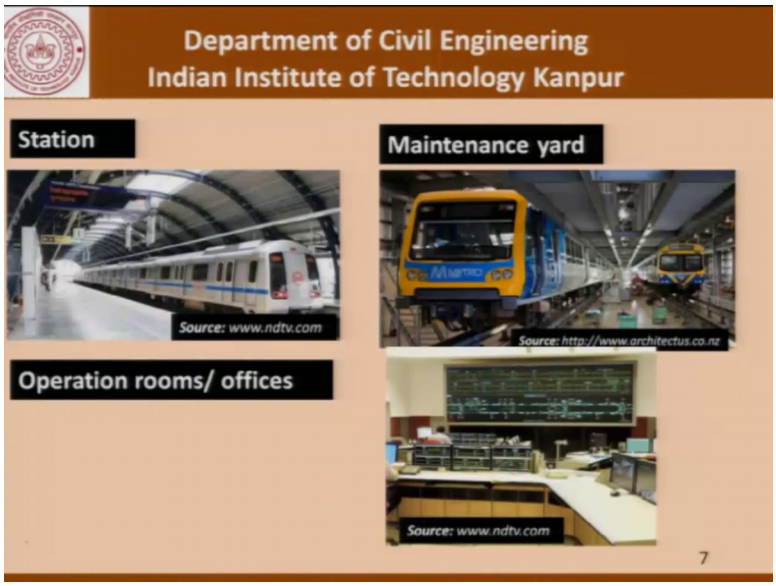

Now, here is an example of a station and you can see that apart from the train and the platform there are so many other things which are a part of the station. There are signages which tell people which way to move in case of an emergency, which ways the exit. There are signages to tell people how much more time to the next train, there could be signages relating to whether a train will stop at that station or not, what is the next stop for that particular train coming the coming into the station and so on.

So, all these things need to be properly planned, included in a drawing which is used for communicating among engineers from different walks of life. Similarly, if you look at a maintenance yard here, is a place where you need a lot of water supply, a lot of systems to make sure that certain amount of testing can be carried out. So, now, here is a maintenance yard where you had need facilities which are required to maintain the coaches and the locomotives, that could include water, that could include some amount of power there, that would definitely need some amount of lighting depending on where that yard is, and so on and so forth. In operations rooms and offices of course you need different setup and that needs to be planned.

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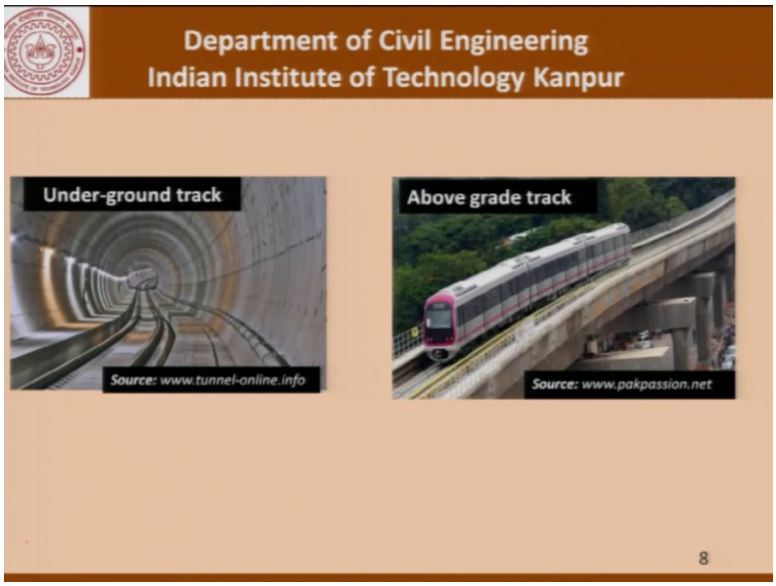

When it comes to an underground track which is essentially a tunnel we have to understand; what are the issues that go into the planning design and construction of a tunnel. That would include things like lighting, ventilation, emergency communication, the kind of slopes that you have to have you have to make sure that there is no leakage of water from outside into the tunnel, what are the kind of emergency evacuation plans from the tunnel and so on

In fact, it is sometimes important and required that along with the tunnel, we run what is called a service tunnel which serves as a parking space or which serves as a place where people who may have to evacuate from a train in the case of an emergency can leave the tunnel and assemble in a service tunnel. The service tunnel also serves as a area through which service lines such as water and power run in addition to this space within this tunnels.

When it comes to an above grade track of course, the situation is more or less similar to that of a bridge and you can see that we have the standard bridge piers and the slab and so on which is designed for the kind of loads that is to be carried by the structure.

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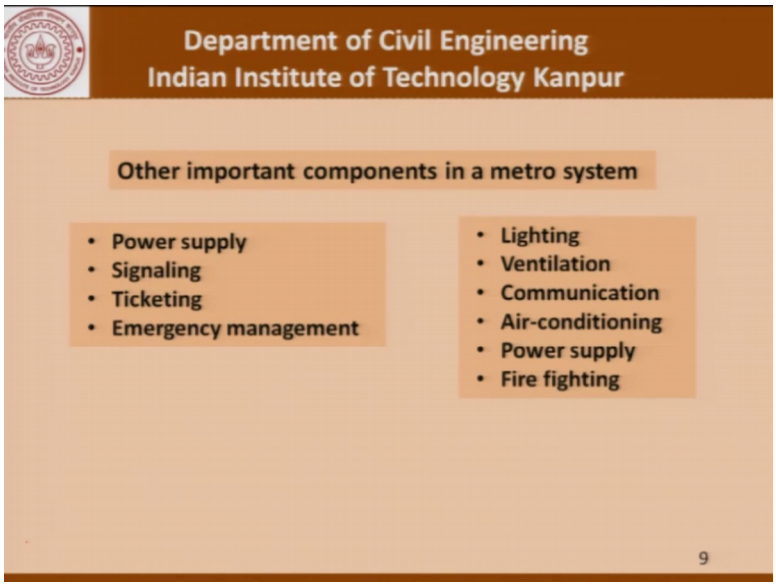

So, now other components in a metro system would include power supply, signaling, ticketing. We have to make sure that there is no rush of people at ticket counters and at places where there are wickets to check the tickets when the passengers are coming in and the passengers are going out.

Then, there is a very important component of emergency management. It could arise on account of power failures, it could arise on account of a terrorist threat and any kind of an unforeseen event. It could arise on account of an accident, where a derailment has occurred or where the trains have collided and so on and so forth. Apart from these; now once we are talking of these things like I mentioned there are issues related to lighting, ventilation, communication, air conditioning and power supply besides fire fighting. All these plans have to be put in place so that the metro system can be designed.

Now, it is no single engineers cup of tea, to be able to put together or have all the knowledge that is required for lighting and air conditioning, communication systems and so on. So, different people come together, form a team and carry out this exercise of planning and designing a metro system; it could be stations, it could be the track, it could be the control room, it could be at the maintenance yard and so on.

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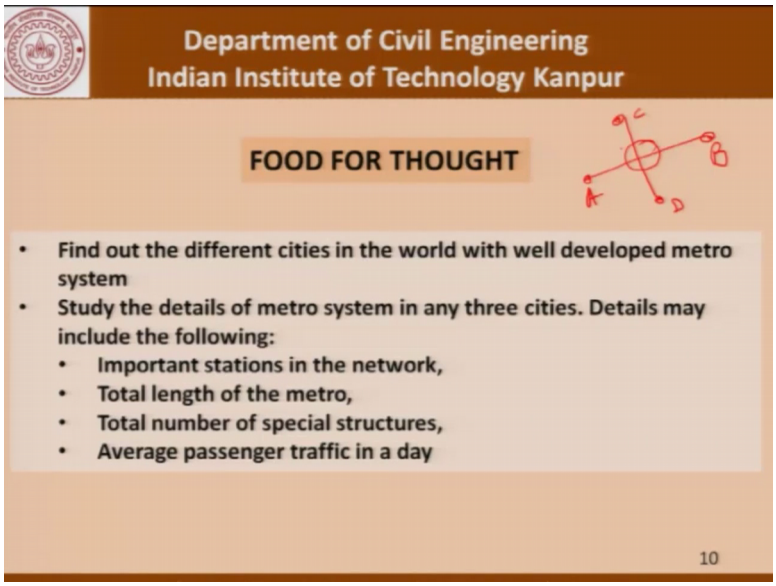

Now, coming to the food for thought, this is a type two assignment as I said we will probably not give you a solution because there is no solution to it. Find out the different cities in the world with well developed metro systems. Now, in this day and age where information is not really at a premium you can get information from a lot of sources, it is easier to find information. The more important issue or the trickier part is analyzing that information and using it to understand the subject matter of the system better.

So, if we look at places like Tokyo or New York, London, Moscow which have well developed metro systems; now of course we can include Delhi in that list. If we try to understand look into the history and find out when were these systems built, what was the kind of technical issues addressed and how that will make us understand the rules of different engineers better.

The second question that I want to leave for you: is study the details the metro system in any three cities which could include important stations in the network. Delhi may have a certain number of stations, if you look at the Tokyo metro network you will find certain number of stations, if you look at the New York metro system will have a different number of stations; and the more the number of stations, the more the number of lines- the more complex the system becomes. And that makes the planning that much harder.

Have you ever thought that when we change lines at a particular platform, how do those lines go? So, for example, if you are talking of a line which connects point A to point B

and the line which connects point C to point D, how do these lines actually go as far as their layout is concerned? This here, as far as the roads are concerned we can easily have a crossing, we can have traffic signals to control, whether the traffic is moving between A and B or the traffics moving C and D and whether the left turns are allowed right turns are loud and so on and so forth.

When it comes to metros those kinds of degrees of freedom if you want to call them do not exist, but how do the lines cross. The lines will cross means that there have to be tunnels or it will be a grade separated system. And if it is a grade separation what should be the minimum clearance. So, these are the kind of things which are technical details we have to keep in mind when we try to do the layout planning of a metro system.

So, I would like you to pay special attention, when you try to study the metro systems in different cities, as to what are the kinds of depths involved in these lines. The thumb rule basically is that if the line is very shallow, the line was probably one of the earlier lines that was built in that system. As we moved in time 10 years later, 15 years later we want to add a line, and obviously we will have to go deeper in the system. And that poses technical challenges which we need to address.

Try to determine the total length of the metro system, try to understand the total number of special structures in that metro system, and try to see what is the average passenger traffic in a day in those metro systems. So, that will give you an idea that ok this system is designed to handle a million people at hundred stations. So, what is the peak demand? So, how is the passenger movement being controlled at different stations in different trains and so on?

Let me assure you that if you do a thorough literature survey on this or if you look at some videos which are available for different metro systems you will be able to make some very interesting observations.

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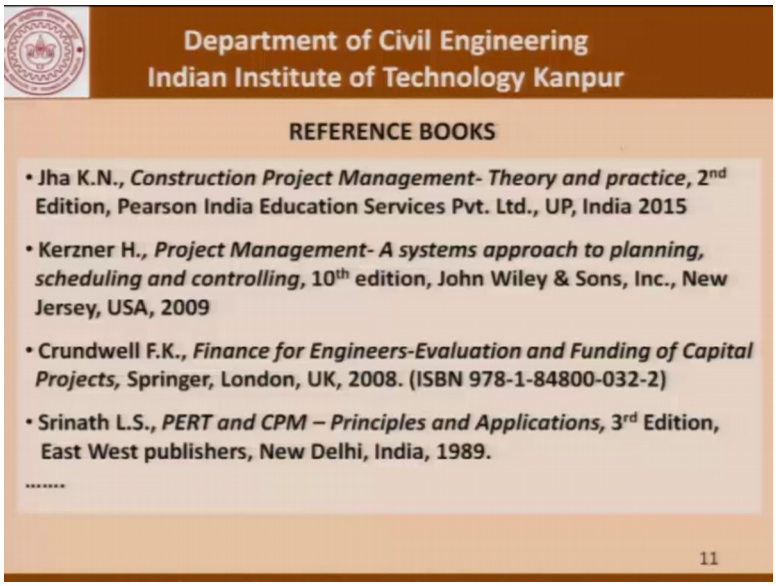

With this I must repeat the reference books, but these reference books are not really centered on metro construction, they are more related to the course on construction management itself. So, In fact, you will probably have to look for some material on your own and try to understand the metro systems better.

Thank you.