Project Planning & Control

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Lecture – 40

Precedence Diagramming Method (PDM), Project Monitoring

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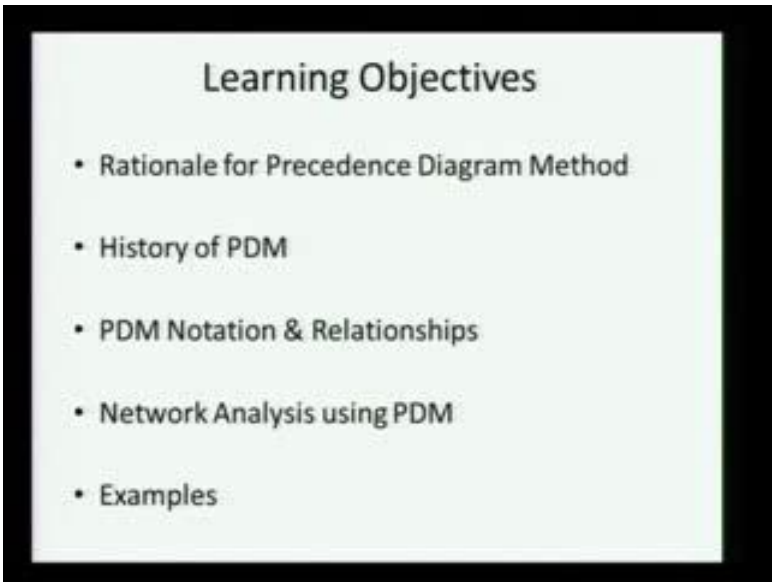

In this lecture, we will cover basically the Precedence Diagramming Method. And this is an alternative to activity on arrow, activity on node and the third method, we call is precedence diagramming. We will cover little bit on the rational, the history, the notation and relationships which are very important, we will do network analysis using the precedence diagramming method and then, we will work out some examples.

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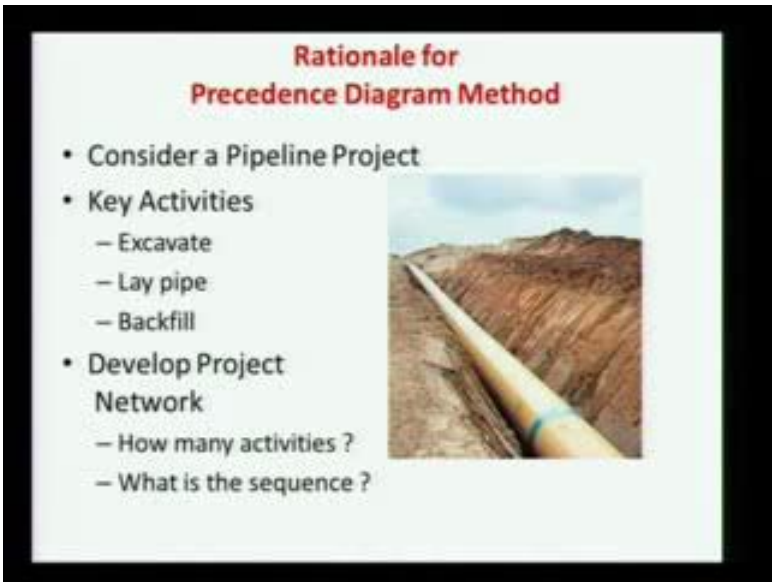

Now, what I would like to start with is, why do we need precedence diagramming? And for this I would like you to do an activity, it is a small activity which requires drawing the network diagram for a pipeline project So, here you can see the image of a pipeline and when in a project like this we know that we need to excavate, we need to lay the pipe, we need to back fill. I am taking it as a very simplistic model of it and if we wanted to develop a network for this using the techniques we know today or we have covered so far, how would you do it?

Can you briefly sketch, what would be the network like? I am only giving you three activities, I do not want you to go to surveying ((Refer Time: 01:33) here. I am only giving you three activities, how would you represent the relationship between the three.

Student: excavation precedes pipe laying.

Right, so you would have an excavation, after excavation finishes, pipeline will start, after pipeline starts back fill start.

Student: Or we can have an excavation to a certain length, pipeline can be laid simultaneously.

Fine, so if we took the first alternative where we have excavation, excavation finishes and then, pipe line starts and then, back filling starts. Is that the way it would be done?

Student: No.

No; obviously, no. Because if it is you know few 10's or 100's of kilometers of pipe line

I am not going to wait till all of it is excavated and then, lay the pipe. And like the second suggestion we are certainly going to excavate the section of the pipe or of the area, lay the pipe. While laying pipe is going on in that area, excavation is going to continue in the in the next area.

So, if you wanted to represent this sequence now, so we know that at certain stage there is going to be excavation on a section, there is going to be pipe laying on a section, there is going to be back filling on a section. So, if you wanted to represent this now, what is your, what are the options.

Student: We need to put some delay, we can go like…

You do not have delay, in your activity on node you only have finish start relationship and you have activities.

Student: We can divide the work, the whole pipe in to sections, then we can excavate, lay pipeline.

Right.

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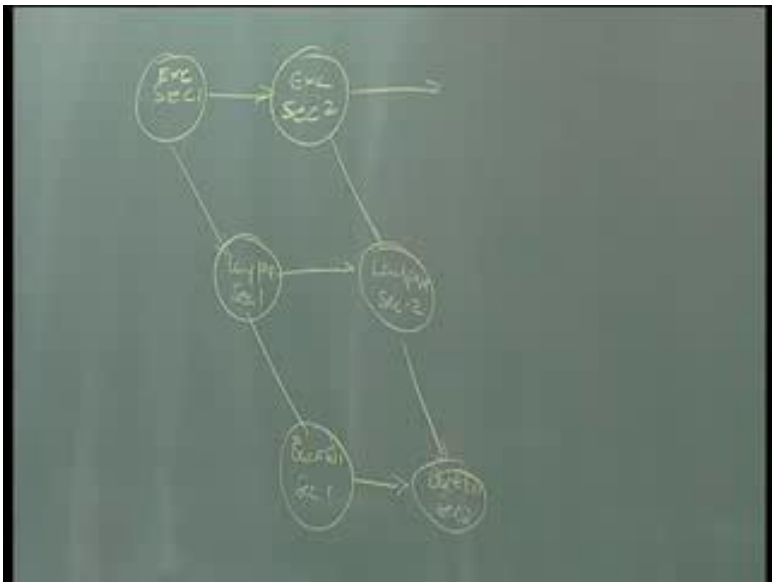

You will have excavate, say section 1 excavate, excavate section 2; this would go on. What would be my next set of activity? So, after I excavate section 1, I can lay pipe for section 1 and then, this would only after exit this, this would be lay pipe section 2 and then, back fill and so on. So, how many activities for just two sections, now we have 6 activities and if it is a very large project, you will have many activities, 100's of activities

for a section.

Now, ((Refer Time: 04:20)) so in order to address problems, so is there any other way you can think? Now, go out of the activity on node, so this is with activity on node or activity on arrow kind of representation, where we have only had finish start relationship, this was the early option.

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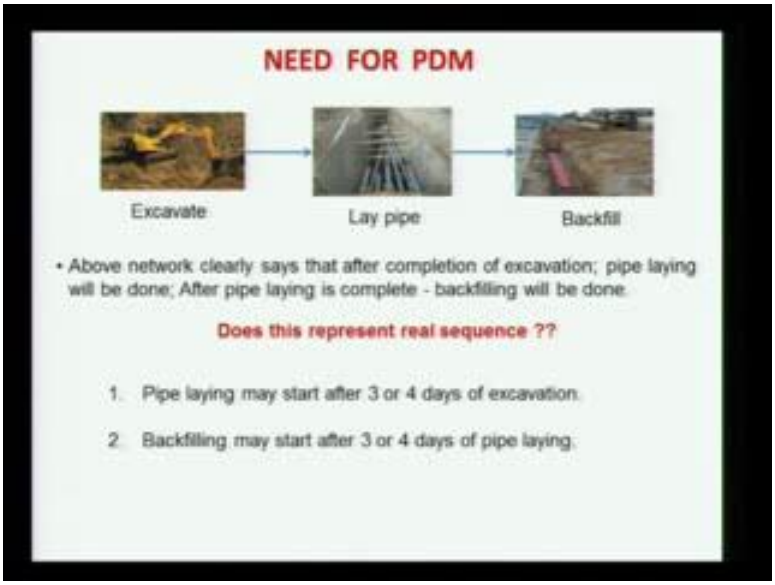

Now, what precedence diagramming does is, it tries to overcome this with different kinds of options. So, let me just go back, this is what we discussed on the board. We know that this does not represent the real sequence you know, so pipe laying may start 3 or 4 days, after excavation or back filling may start 3 or 4 days after pipe laying and what we have shown or what we have worked out on the board is we have split all these into sections. Now, what precedence diagramming tries to do is overcome this with an alternative representation.

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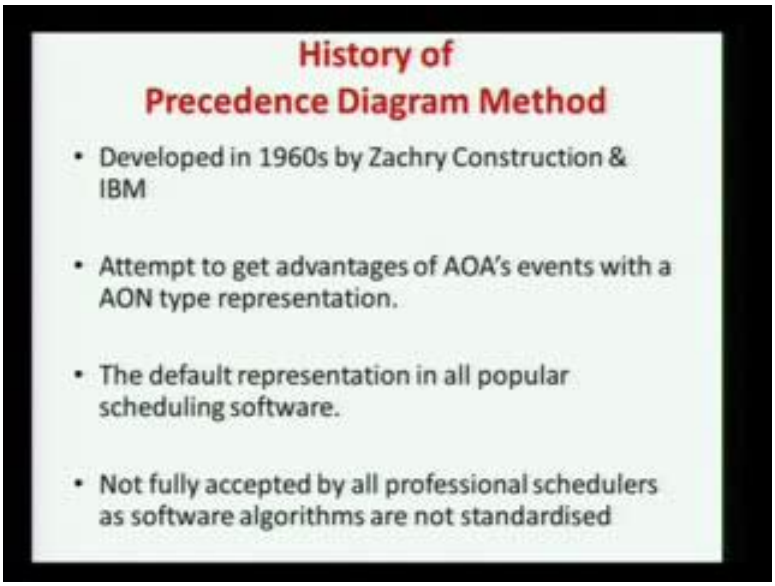

So, it takes large projects like this and tries to reduce the number of activities. And this was actually something that came out of AoN. The activity on node diagram which Fondhal had suggested, it was taken up by a construction company called Zachry in the 60's and along with the IBM they made this precedence diagramming techniques. So, we will come to the details soon.

The attempt was to get the advantage of AoA events with AoN type representation. We briefly touched upon AoA earlier. What did we find as a problem with AoA?

Student: We have to create dummy activities.

We have to create dummy activities; that is number 1, then

Student: During branching on activities.

Right, it is not, you normally have to draw the network, then a kind of redraw it, because it is not that intuitive to do draw it, whereas when you went with AoN we could flow through the network quite easily. But, when you use an AoA you will find that there is a start of an activity. You remember, an AoA required the arrows to be in this form. I mean you had activity on arrow ((Refer Time: 06:21)) and this was start and this was end of the activity and this was the activity, so you had events.

Now, so what the precedence diagramming method tries to do is to get the event based approach of the AoA, but the flow of AoN. And it is the default representation in all popular scheduling software. So, when you open Microsoft project or you know

Primavera or open project, any scheduling software you opened today, which is popular, this is the representation.

Now, you can see the last point, PDM also has these issues. And you will find that in practice there is a lot of discussion of how PDM causes (while it is powerful and flexible and it is representation), a lot of confusion for practical scheduling and software does not use the same algorithm, each software does not use the same algorithm. So, there are again different results from different software, there is no standardization.

So, really professional schedulers have hesitation in using this, but because of software is easily available, a lot of people start tending to throw PDM representations without really representing the project problem. Let us see how this can happen and issues related to this.

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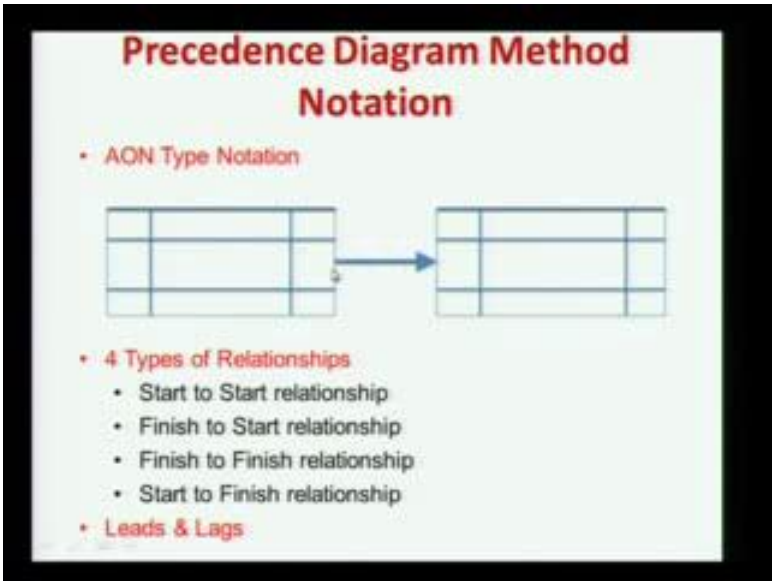

So, when we get into the basics of the precedence diagramming method notation, you basically have the AoN type of notation. You can see there is instead of the circle which we use for AoN, you have a rectangle; you have the rectangle divided into various spaces and these spaces can be filled with things like activity name, early start, early finish, activity number, late start, late finish, floats. Depending on the type of representation, type of nomenclature you want there are different software, different methodologies will use different values in these boxes.

But, I have not put any specific value, because it depends on the kind of tool we use. More interestingly, the PDM represents various types of relationships. So, far we have

been only using a finish-to-start, an activity should finish, so what we have shown there is the finish-to-start. AoA uses three other kinds of relationships, start-to-start, finish-to-finish and start-to-finish. In addition to this, each relationship can be qualified with lead or lag, which says that for example, if this is the finish-to-start relationship, I can say this is a finish-to-start and a two day lag; that means, the next activity will do finish-to-start after two days.

The lag is represented in the relationship. I can have a start-to-start with two day lag, which means the activity which follows can start two days after the first activity starts. We'll get into some of these details. But, this is the main difference; one is the notation is very similar to AoN, so there isn't much to worry about that, but the relationships are significantly different. And these different relationships cause computational differences in analyzing the network.

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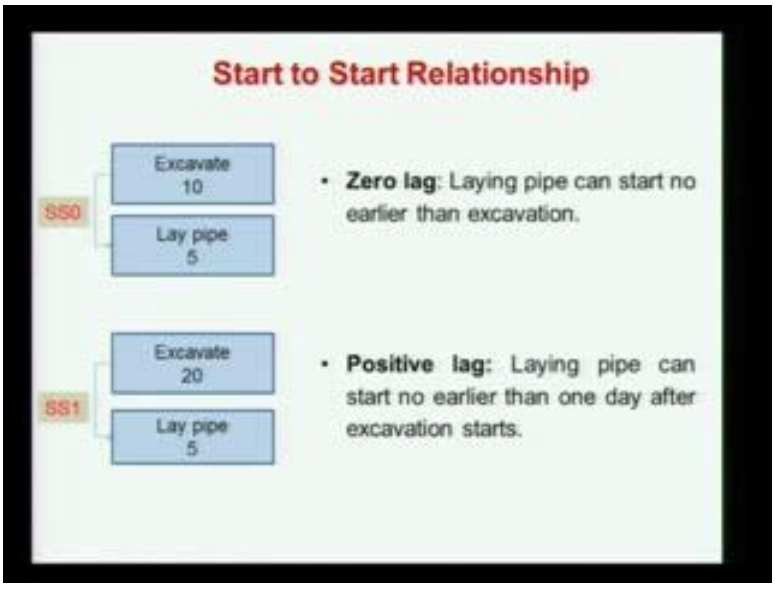

If we take a start-to-start relationship for example, here is a start-to-start with the lead lag of 0; might not be possible, but what it says is laying pipe cannot, so laying pipe. So, this is the successor activity; it cannot start earlier than excavation. That is the constraint. But, is this acceptable? This almost says I can start immediately with the excavation.

Student: It says that you cannot start unless the excavation is finished.

No doesn't say that. Excavation is starting. Here is starting of excavation. So, right now what it says is laying pipe can be as I mean is the constraint is it should not start before excavation; that is all, but I can start after excavation, but it is giving me up to almost

immediately after, which might not be feasible. So, something like this which says, laying pipe can start no earlier than one day after excavation starts. Might be reasonable. You want to have some length of excavation done before you start laying pipe.

So, this gives you lag relationship. Now, I am not covering leads in this, because you will have negative relationships. We'll just use the lag for now, to illustrate the various relationship.

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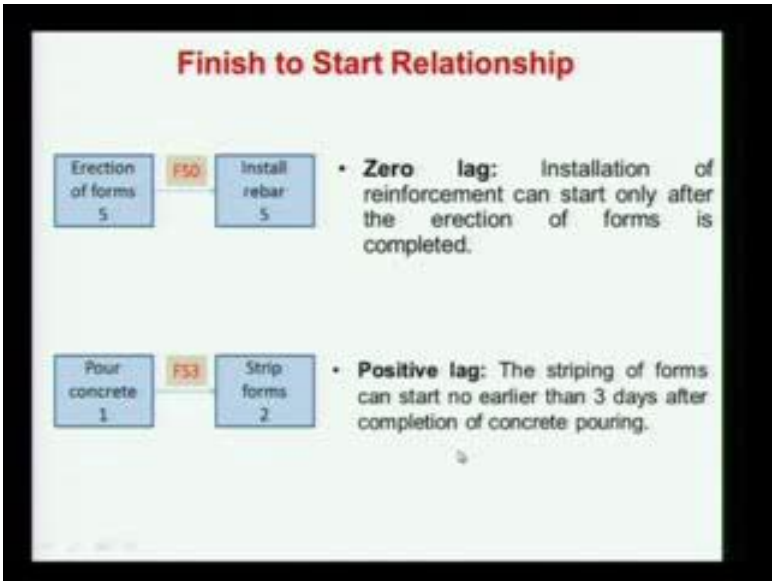

Finish-to-start, we are familiar with this. You can have erection of form, install rebar as an example. So, here it is says insulation of reinforcement can start only after erection of forms is completed. And this is 0 lag. This is what we are used to. We can put an other relationship like this: pouring concrete, complete pouring concrete, wait for 3 days and then, strip forms starts. So, stripping of forms can start no earlier than 3 days after completion of concrete pouring.

Now, a relationship like this, so for example we might decide you want some form of setting or you could have instead of, so what the finish-start relationship with a lag replaces is an other activity. You cannot say pouring concrete and then, I am going to keep an other 4 days for just pouring concrete; it will not be representative. But, at the same time when I put a lag, I do not know what the lag is for. The activity for which the lag is represented is not clearly represented in the network.

So, that can cause some kind of, sometimes a little bit of uncertainly as to why did the planner put the lag there. But from an activity perspective, it reduces the number of

activities in the network.

Finish-finish relationship.

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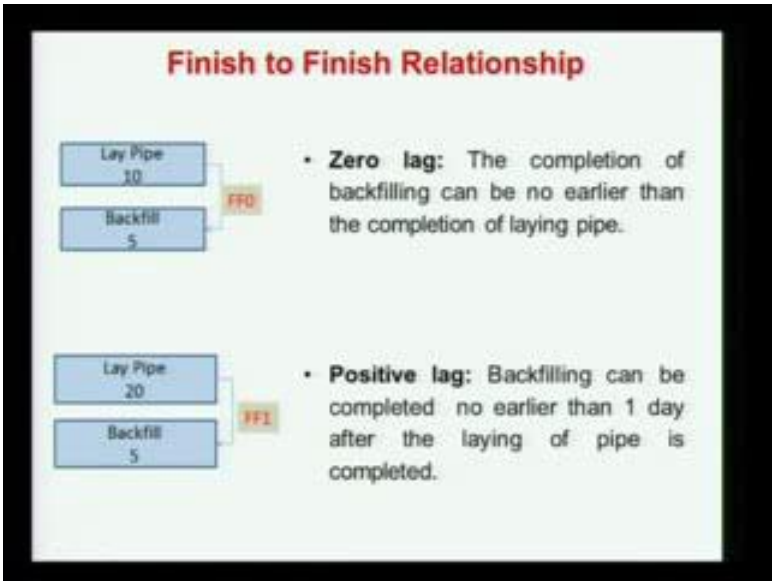

So, for example, the back filling cannot be completed until the laying pipe is ((Refer Time: 13:01)). So, here we have said no earlier than completion of laying pipe or we can say back filling can be completed no earlier than one day after laying of pipe is completed. So, you have got the idea of these, at least the two new relationships we have discussed, so far start-start and finish-finish.

Now, we come to kind of unusual relationship, which is start-to-finish relationship. So far we talked about finish-to-start. So this relationship actually is not used frequently. It is not a finish-to-start relationship, it is a start-to-finish relationship.

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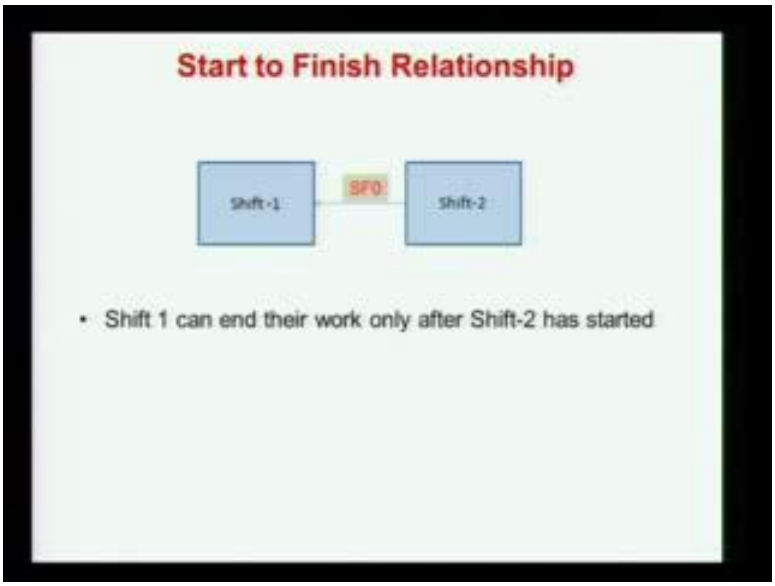

So, here is an example and it is quite, I mean you do not come an across the kind of situations where you need to you start-finish frequently. So, here is an example: let say you have two shifts. So, we can discuss this a little, in terms of: I want to represent that shift 2 will start before shift 1 ends. Is that the way I am trying to a represent? No, what I am trying to represent?

Student: Shift 1 can only start finish before shift 2 as start.

Right, it is not that shift 2 can start when shift 1 is ended, it is that shift 1 can end only after shift 2 starts; that is the people on shift 2 have to come in,

Student: only when shift 1 start.

No.

Student: Shift 1 people can leave only after shift 2 people have come.

Shift 1 people can leave only after shift 2 people have come. So, again you can see that this is, I mean I have not come across many situations, where this is used in the construction schedule. So, it is not common relationship, it is not rarely used. You might not see it in practical applications, but when you have to do calculations with it, it is just applying the same kind of rules in different way.