Project Management for Managers
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Lecture – 45
Slacks and Floats- I

Good morning friends, I welcome you all in this session. As you are aware in previous session, we were discussing about probability issues in networks and we have seen couple of very good examples. Let us move onto a different topic. In this topic, we will be talking about different points like slacks, floats what are these things and where do we apply these things. So, as we have already seen slack is something wherein you can delay a particular event for a particular duration without affecting the duration of the project. So, maximum delay which is possible for an event without delaying the project is slack.

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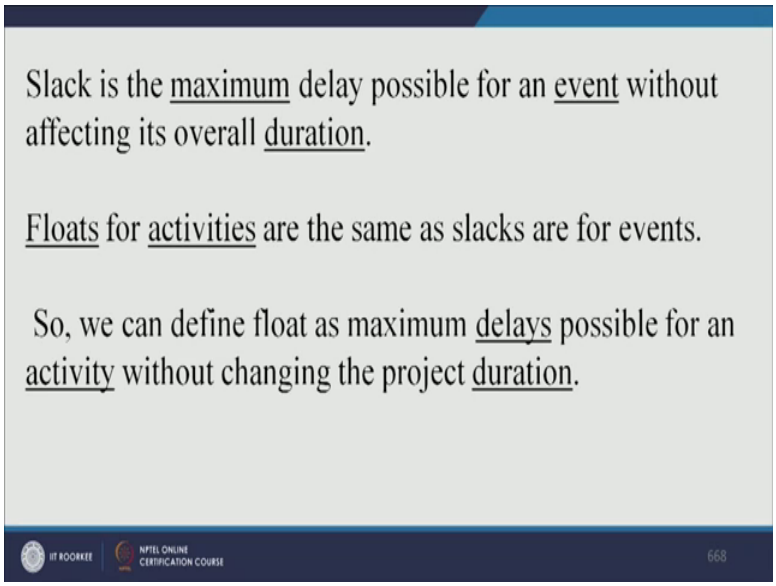

As for as float is concerned it is similar to slack, but we use in terms of you know for activities rather than for events right. So, floats for activities are same as slacks for events. So, either you call it slack or you call float meaning is same, but slack is for events and float is for activities. So, how to define float, float is again just similar to what we have defined in slack. So, the amount by which you can delay an activity without delaying the duration of the project so that is float.

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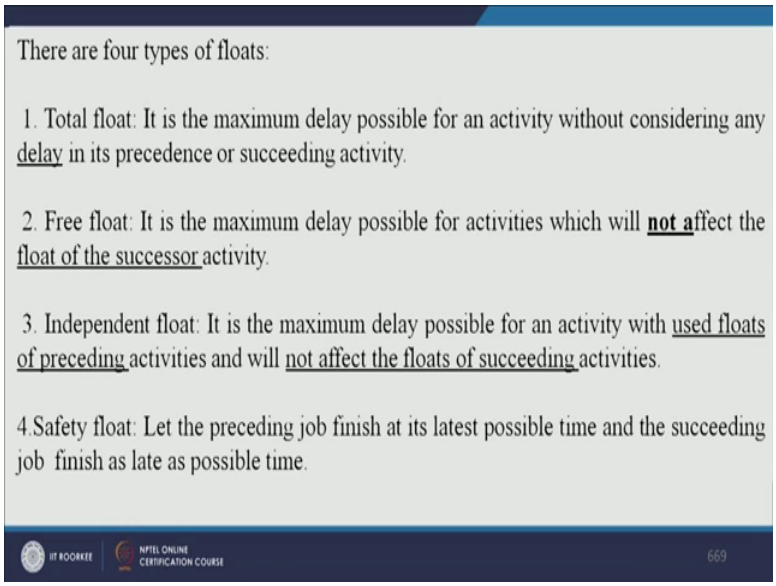

Basically there are four types of floats; in most of the books you will find three types of floats, but actually there are four types of floats. The first is total float. Total float is a float, which has got the highest value amongst all these four types of floats. So, the maximum delay possible for an activity without considering any delay in its precedence or succeeding activity. So, the maximum time available for compression of an activity. So, if you look at let us say there are three activities, and let us say activity a, b and c. So, b is the current activity, a is the you know the preceding activity, and c the succeeding activity. So, the maximum time available for delaying activity b is nothing but that would be called total float.

Free float is the maximum delay possible for activities, which will not affect the float of the successor activity. So, you should delay, you can delay an activity, but without affecting the float of succeeding activity. Now, you have got independent float; it is the maximum delay possible for an activity which used floats of preceding activity, but we will not affect the float of succeeding activity. So, we have already used the float of preceding activity which will not and you are delaying a current activity without affecting the float of succeeding activity.

And the safety float. So, safety float you can calculate when you finish the preceding job as late as possible and succeeding job is finishing as late as possible. So, both the jobs preceding and succeeding and jobs are finishing as let as possible. So, difference

between them minus duration of the activity. So, we will calculate these floats keep in mind that always you will have total float value would be largest amongst these, then free float and then finally, independent float right. So, we have considered only these three, we are not looking at safety float right.

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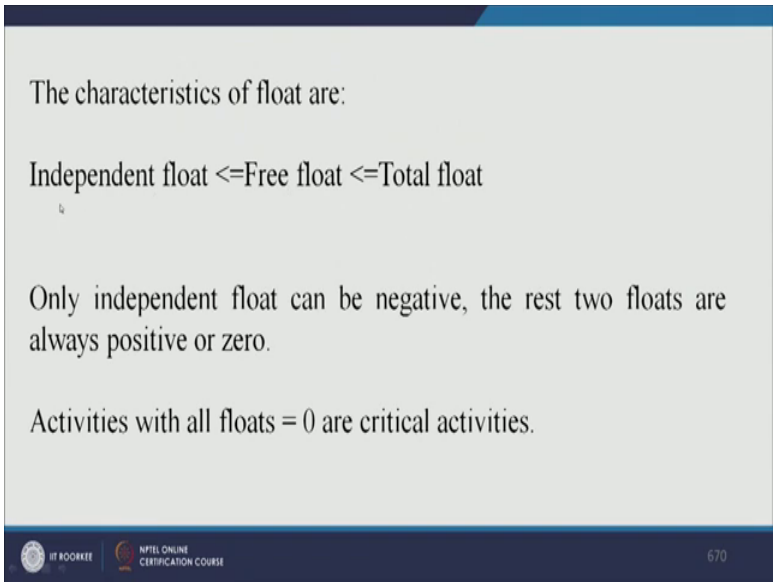

One more important characteristics is that of only independent float can take negative value right; the rest two floats are always either zero or positive right. So, activities which are having all these float 0 would be termed as critical activities. So, this is another way of defining critical activity. What is critical activity? Critical activity is one which has got total float, free float and independent float 0; in other words all the floats are 0 for critical activity.

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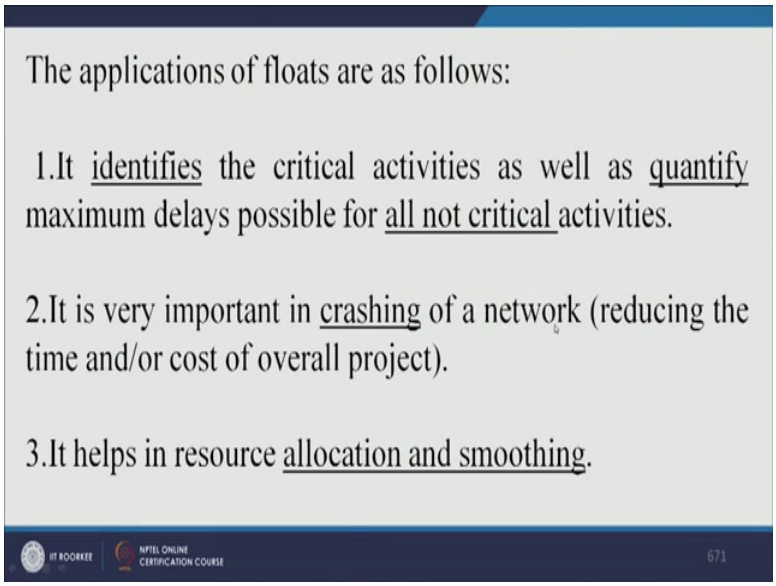

There are a couple of applications of these floats. As I said the first application is that you can delay you can know which are the non-critical activities, which can be delayed. So, it will give you what is up to what value you can delay a non critical activity. it is important in crashing of network. In fact, will be studying shortly what is crashing of network; it is not nothing but the process of reducing duration of the project. So, we will help we will take help of free float when we crash a particular project. And floats are also useful in resource allocation, and resource smoothing. Again because you can delay some of the activities in a projects, so you can delay because you have got certain limited resources. So, it will help in resource allocation and smoothing also right.

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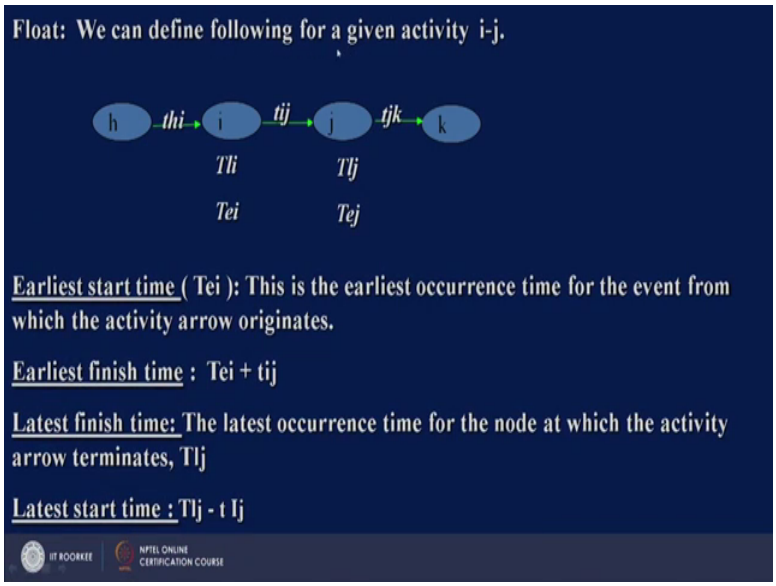

So, let us look at an example. So, we can define float we can define following for a given activity i j. So, actually there are in this network there are three activities h i, i j and j k. So, this t h i is nothing but duration of activity h i; i j is t i j is duration of activity i j; and t j k is nothing but duration of activity j k. Now, at all these nodes you can find out T e and T h. So, let us look at focus on this particular activity which is in between these two activities right. So, you have got T e i earliest start of this particular at this particular node then T l j is a test completion time then you got earliest start time and latest completion time. So, these four time estimates you need to calculate at each node right. So, if there are less a 10 nodes in a network, you just calculate on all those 10 nodes these four time estimates.

And I have already talked about what is T e, T e is earliest start time right. So, the earliest occurrence time for the event for which an activity aero originates right. So, once you know earliest start time earliest finish time can be known just by adding the duration of activity. Similarly, latest finish time as late as possible you can finish an activity right this is latest finish time. So, latest start time can be calculated by subtracting the duration of activity from latest start time. So, these are very simple. So, you can easily calculate these time estimates.

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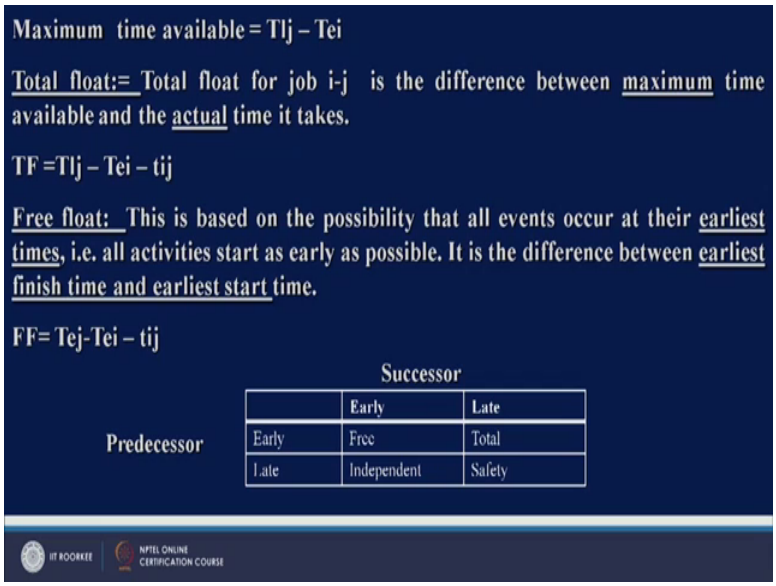

So, let us look at how to find out total float total float for activity i-j is the difference between maximum time available and actual time that activity takes. So, maximum time available is T l j minus T e i. So, I mean you have got maximum time available. Let us say I have to go from Roorkee to Delhi, and the maximum time available with me and let us say 8 hours, but actually the journey takes 5 hours. So, 7 minus 5 would be the total flow. Free float, in fact, if you look at this particular table in this table just look at you got succeeding activity in preceding activity.

If you look at total float here right, so total float is here in this table. So, this equation you can you know formulate from this table. So, what is total float, the successor activities is finishing as late as possible and predecessor activity is starting is finishing as early as possible. So, the succeeding activity finishing as late as possible and preceding activity starting as early as possible minus duration of the activity, you will get total float.

If you look at free float, it is based on the assumption that activities will happen at their earliest times. For example, all activities start as early as possible right. So, it is the difference between earliest finish time and earliest start time. You look at this free float is the difference between earliest finish time and earliest start time of preceding activity. So, earliest finish time of succeeding activity, earliest finish time of preceding activity

right very simple minus duration of the activity, you should always subtract duration of the activity. So, this total float and free float.

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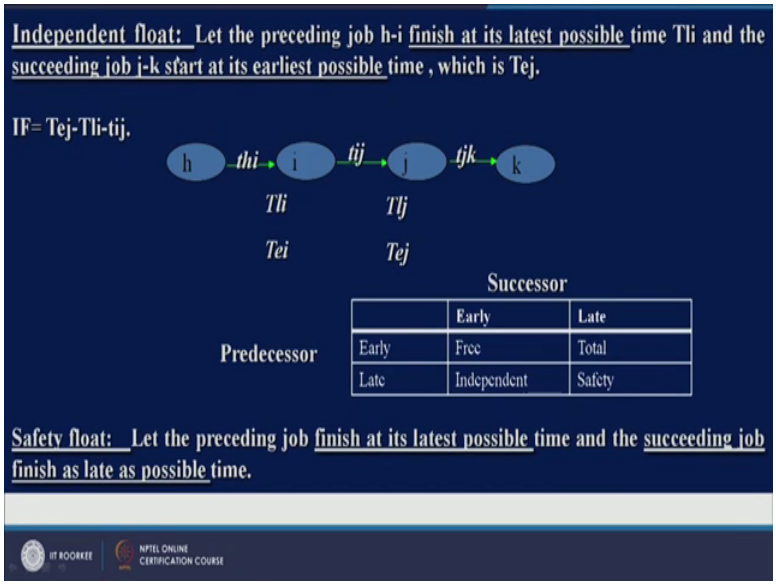

Let us look at independent float. Independent float let the preceding job are preceding activity finish as late as possible and succeeding activity start as early as possible minus duration of the activity just say this independent float this here. So, what is happening here, the preceding activity is finishing as late as possible just see preceding activity as late as possible while succeeding activity starting as early as possible minus duration of the project right. Safety float, let the preceding job finish at its latest possible and succeeding job finish as late as possible. So, this is safety float right. So, both are succeeding activity is you know succeeding activity finishing as late as possible and preceding activity is also finishing as late as possible right.

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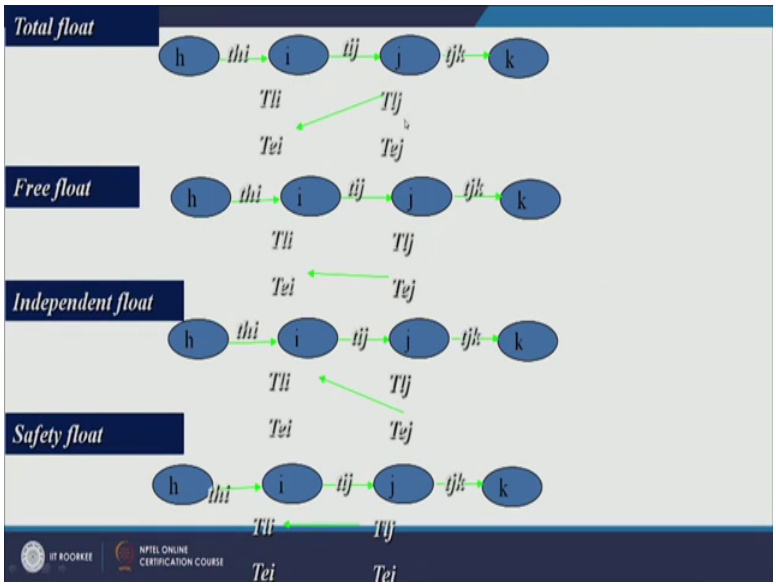

This is a very important slide because in this slide one can calculate all these four floats, total float, free float, independent float and safety float. So, let us look at this network. So, what you have to do is after calculating T es and T ls of for the events. You just if you want to calculate total float then what you should do T lj minus T ei minus duration right you need not remember and this formula. So, you just look at the T l of this event minus T e of this event minus duration you are done free float. T e of this T e of this, you have to took you have to look at only earliest start times. So, T e of this minus T e of this minus duration you will get free float. If you look at independent float T e of this event and T l of this event minus duration of this activity which is t ij right in all these cases the duration of activities tij. And safety float T l j minus T l i minus duration of the activity right. So, this is very simple these are very simple equations you can simply write down.

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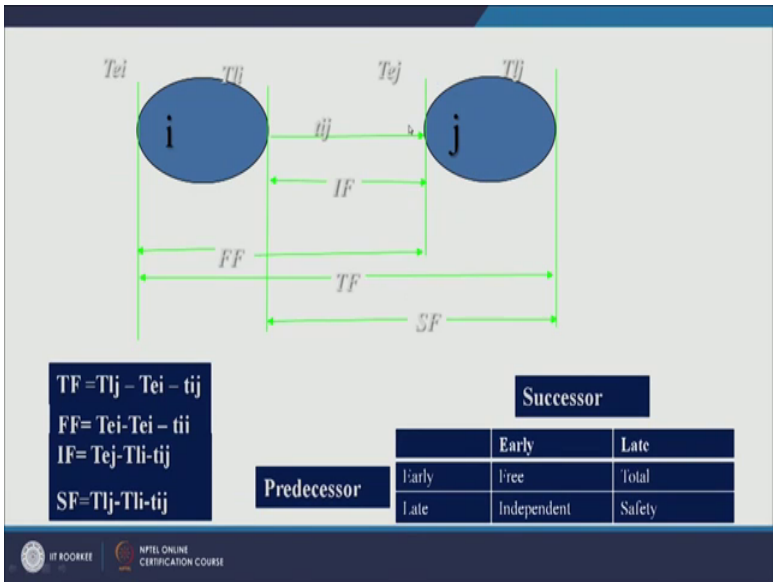

Again jus if you just focus on these two events yes, so event i, event j. So, let us take this is a earliest start time and this is latest completion time. Similarly, earliest start and this end is latest completion and the duration of the activity is t ij. So, what is total float total float as I said is the maximum time available. So, maximum time available is this minus this minus duration of the activity. This is the equation, which we have seen in earlier slides as well. So, maximum time available is for total float. So, look at for this line this point and this point is the maximum time available minus duration of the activity.

Then free float would be smaller than total float right T e j of this minus T e i of this minus duration of the activity. Third is T e j of this, this event and T l i of this event right and minus duration of the activity. And safety float is this right. So, this is how you can calculate all these floats right. So, we will work out couple of examples how to find out floats and we will focus on this particular slide.

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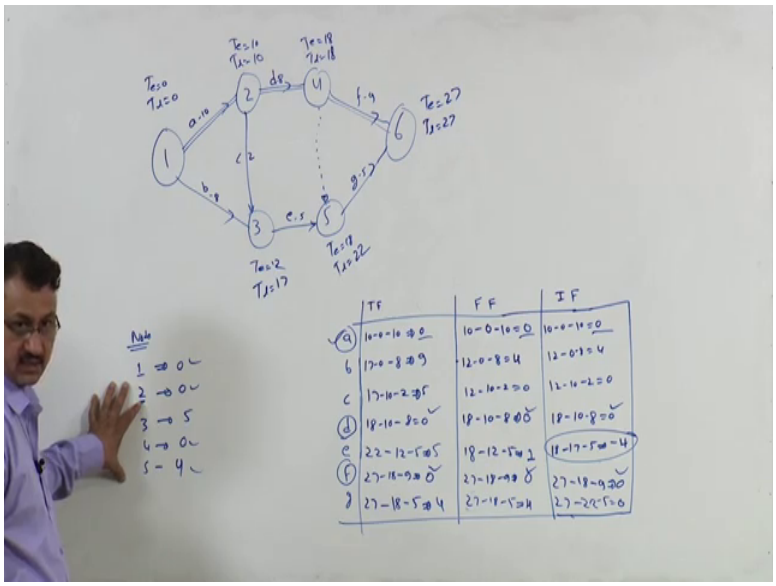

So, let me take a couple of questions and we will solve how to find out floats because floats will help you in knowing which activities are critical activities. 1, 2, 3, 4, 5, and 6. So, these are six events there is one more activity here and there is a dummy activity. So, duration this is activity-a, its duration is 10; activity-b, its duration is 8; activity-c, its duration is 2; activity-d, its duration is 8; activity-e, its duration is 5; e-5, g-5, f-9 and this is of course, dummy activity right. So, we will calculate all these floats.

So, first of all you need to know T e and T l for all these nodes. So, T e at this node is 0, T e at this node is 10, T e at this node is what this 12, 10 plus 2 – 12. T e at this node would be let us calculate at this node it is 18; T e at this node would be it is 17 from this side and 18 from here right T e is 18. Then T e at this node is what it is 18 and 9, it is 27. So, T e at this point is 27 right let us look at what are the values of T ls, T l is 27 at this node, here 27 minus 9, T l is 27 minus 9, so this is 1 and so 7, it is 18. T l at this point would be what T l from here 27 minus 5 would be 22, and T l from here would be 18, because we have to take the least value. Now, T l at because we have to take the T l we can ok, ok, ok, we have to take the from here to here right. So, this is 22 right. And if you look at T l here is 18 minus 8, so this 10 right. Then T l here it would be 17; T l here is 0. So, in this way you can calculate T e and T l values.

Now, if you look at all these nodes, so at node-1 what is the slack is 0; at node-2, slack is 0; node-3 what is slack is 5; at node-4, slack is 0; and node-5 slack is 0. So, 1, 2, 4 and 5

1, 2, 4 and 5; 1, 2, 4 and 5. This is your critical path right. Now, what about float let us we have to calculate floats right. So, let us at node-5 yeah at node-5 yes, yes this is a positive value, so this is 4. And if you look at floats, so you got total float you got free float and you got independent float. So, we will calculate these floats for all these activities. So, for activity a, b, c, d, e, f and g, so we will calculate this float. So, let us calculate total float first. Total float for activity a, so we know that total float is T l minus T e. For activity a, T l minus T e, so 10 minus 0 minus duration of the activity, this is 0. T l minus T e the total float for b, these, these right T l minus T e 17 minus 0 minus 8, this is 9. c T l minus T e 17 minus 10, 17 minus 10 minus 2, this is 5. d what is d T l minus T e 18 minus 10 minus duration 8 0 for e T l minus T e right this is activity e. So, T l 22 minus 12 minus 5, so 17 and this is 5. Now, you got f activity f is here right, so T l minus T e 27 minus 18 minus 9 – 0. For activity g T l is this T e is 18 minus duration is 5 is 4. So, this how you should calculate total float for this network and for all these activities.

Let us calculate free float. What is free float, just remember free float is T e j T e i, you have to take only earliest times right for a T e and T e. So, 10 minus 0 10 minus 0 minus 10 right is 0. So, T e here T e here, so 10 minus 0 minus duration of the activity. Now look at for activity b activity b is here. So, T e minus T e of this, so 12 minus 0 12 minus 0 minus 8, the duration of the activity which is 4. For activity-c, c is this, so T e minus this, so T e is 12 here T e is 10 here minus 2, this is 0. If you look at activity d, d is this one, T e here is 18, T e is 10 minus 8, this is 0. So, for activity-e, e is this right; T e is 18 minus T e is 12 here minus 5 right, so this is 1. Now if you look at activity-f, f is here, so T e is 27 minus 18 minus 9 – 0. For g is this, 27 minus 18, 27 minus 18 minus 18 minus 5, this is 4. So, this is how you can calculate free float right 0, 4, 0, 0, 1, 0, 4.

Now let us calculate independent float. Independent float if you look at this T e j minus T l i. So, T e minus T l, so T e j minus for activity e T e minus T l, so this is 10 minus 0 minus 10 this is 0. For b T e minus T l, so 12 minus 0, 0 minus 8, this is 4. For activity-c, T e minus T l, so 12 minus 10 minus 2, this is 0. For activity-d, T e minus T l, so this 18 minus 10 minus 8, this is 0. For activity-e, T e minus T l, so this 18 minus 17 minus 5, so this is minus 4. For the first time we are getting any float value as negative, and this is minus 4. As I said that it is the only independent flow, which can take negative value. For activity-f, T e minus T l is 27 minus 18 minus 9, this is 0. And finally, g, you got T e

minus T l, 27 minus 22 minus 5, so this is also 0. So, in this way you can calculate all the floats.

Why did we calculate these floats let us look at for which activities you have got all these floats 0. So, if you look at activity-a, this is 0, this is 0, this is 0. For activity-d, this is 0 this is 0, this is 0, right. For activity-f, this is 0, this is 0 and this is 0. So, adf are these are critical activities and this is critical path. So, we have just confirmed our findings of critical path using free float method. So, this is how you can find out floats.

Let us take one more example for finding these floats, but before this let me summarize what we have done today. In today's class, we have looked at floats and slacks. Slack is generally the delaying of an event without affecting duration of the project. Float is nothing but delaying of activity without affecting the project duration. And we have seen there are several applications. The first application is you can know which non-critical activities you can delay right because what happens, when you delay a critical activity you will also be dealing duration of the project. So, you can delay all these activities right which are non critical. So, you know you can delay this activity by 9 minutes, 5 minutes, again 5 minutes and 4 minutes.

And there are other applications you can use a free float method for crashing of project. We will see how to use free float method. And there are other applications like you can go for a resource smoothing and the resource leveling. And as far as the types of floats are concerned, there are four types of floats, you have got total float which is the largest float. The largest this float is basically the maximum time available for doing an activity minus the duration of the activity. So, this is the largest value.

In free float, you have got you consider that the preceding activity we will start as early as possible right and the succeeding activity will also free float if you look at this is based on the possibility that all events occur at their earliest times. So, all activity start as early as possible. It is the difference between earliest finish time and earliest start time. This float would be somewhat less than total float, just see here. In no case free float is more than total float; similarly in no case, independent float is more than free float and total float just here this is this is 9, so it has come down 4. It will all they may be same, but it is not possible it cannot happen that independent float and free float are more than total float right. Similarly, independent float cannot be more than these two floats;

however, they may be they all may be equal right and the only independent float can take negative value.

So, we will we will take up one more question on finding out how to you know calculate total float, free float and independent float. So, with this let me stop here. In the next session, we will be doing two three things after taking one more question on how to find these floats, we will move onto time and cost relationship because that is another very important knowledge area of project management. So, with this let me complete this session here itself.

Thank you very much.