Lecture – 51
Crashing of Networks- IV

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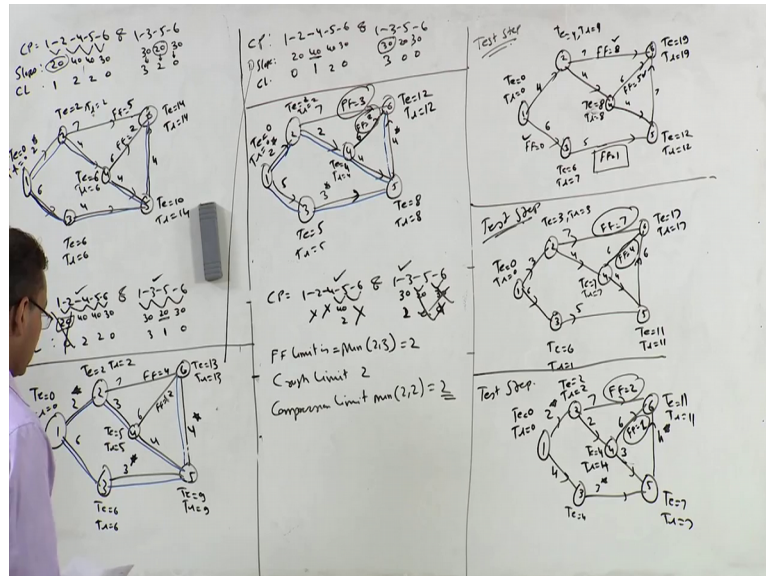
Hello friends, welcome you all in this session. In previous session, we were discussing how to crash a network using free float method and we were solving in this particular question. And so far we have reduce the duration of this project up to 13 days; however, its initial duration was 20 days. So, let us again move further there are two critical paths you have got 1-2, 1-3, let me put it in this way 1-2-4-5-6 first critical path, 1-3-5 and 6 second critical path. So, we have written these two critical paths here as 1-2-4-5-6, 1-3-5-6 and slopes of course, you can easily write by looking at the very first table right for this path also right. And crash limits for 5-6 we have exhausted crash limit and for 3-5. So, let me put it in this way right. So, for 1-2 we cannot reduce it further; 5-6 we cannot reduce it further; and 3-5 right we cannot reduce on these activity further.

Now, we have to take a decision here. What decision we have to take, we have to decide which activities from these two critical paths should be selected for compression. So, if you look at this activity 2-4, its crash limit is 1. And from here, you have got only this activity left 1-3 is not it. So, crash limit here is 1, crash limit is 3, so there is no need of

going for test step you just reduce duration of activity 2-4 by 1 day right. Had it been two you would have gone for test step right.

So, let us reduce a duration of this project by 1 day, so this 1, 2, 3, 4, 5, 6. So, this is 2-4 right we have to reduce 2-4. So, this is two four this is now two this is seven this is three this is four this is four right four star, you cannot crash this per way right similarly for activity 3-5 also. Now, 1-2-3-4-5-6 just check whether we have reduced it by 1 day or not, yes, 2, 6, 7, 2, 3, 6, 4 yeah this is missing right. So, this is 6 right and the directions are like this.

Now, look at all T es and T l; T es at this point is 2. Let me draw a line here because this critical paths slope and C ls are for this network right not for this network. So, T e is equal to 0, T e is equal to 2, T e is equal to 6, T e is equal to 4; 2 plus 2 – 4, and 4 plus 4 – 8, and 6 plus 3 is 9. So, T e is 9 here and this should be now 12. So, why this is 13, in fact, yes, yes, yes we did not reduce 1-3 by also 1 day. So, 1-3 is where 1-3 is this yes, because where we decided to reduce 2-4 and 1-3. So, this is also this would also be reduced. So, this would be 5. So, this is 5, this 0 plus 5 – 5. This is 8, 8 plus 4 is equal to 12, it is common sense since this total duration is 13 we are reducing two activity simultaneously by one day. So, this has to be 12. So, if you know if some if you are not getting 12, it means you have draw you have made some mistake in drawing network right. So, this is 12.

Now, let us look at T l T l here is 12. T l here is 8, T l here is 4, T l here is 5, T l here is 2, T l here is 0. Critical paths are you have got two critical paths 1-2, 2-4, 4-5, 4-6, and 1-3-5 and 6. Let us also calculate free float limits. So, this 12 minus 2 is 10 and 10 minus 7, it is 3 right. So, free float is 3, and free float for this would be what it is 12 minus 4 – 8, 8 minus 6 is 2. So, 3 and 2 are free floats of non-critical activities. Let us move onto next step, so which paths are critical paths here you have got two critical paths 1-2-4-5-6 and 1-3-5-6. So, in fact, let me now try it slope and crash limits for these two because we have done this we are done with this because now crash limit is 0 here. So, you have got only for 4-5, this is 40, and crash limit is 2. For 5-6 this is 0 right you can do for 5-6 also.

And in this path this would be now thirty and crash limit is two this is 20, 30 of course, these are also gone right 3-5 and 5-6 are also gone right. So, you are left with 4-5 and 1-3. Is it necessary to go for test step here should we go for test step? No, we should go for

text step because this crash limits are more than one right. See this crash limits are more than one we will have to go for crash limit sorry test step. And test step we are doing in this in this part of the board right.

So, test step three. So, what is test step reduce duration of activity 4-5 and 1-3 by 1 day right and see what is the effect of on these reduction on free floats of non-critical activities right. So, let us go for test step. So, what we will do we will reduce 4-5 by 1 day and 1-3 right 1-3 by 1 day right.

So, let us draw a network here. So, 1-2-3-4-5 and 6, all these are the directions. So, we have got 1-2 is now fixed right 3-5 is also fixed right 5-6 also fixed right and 1-3 is 5 here now we have to reduce it to 4 right we are doing test step right. So, when we reduce this activity by a 1 day, we will see how this non critical activities floats change right. So, this is 1-3, this 4-5, 4-5 is this. So, this is now 3 right, this is 3. All other values will remain same 7, 2, 6.

Now, calculate T e and T ls right. So, T e here is 0, T e here is this is right. So, T e here is 2, T e here is 4, T e here is 4 right. So, this is 7, this is also 7, this is also is 11, and T l here is 11, T l here is 7. T l at this point is 4, 7 minus 4 is 4. T l here is yeah this is 11, 11 will take this path. So, 4 minus 2 is 2 T l is 0 and which were the non-critical activities, these two right 2-6 and 4-6. Let us calculate their floats now. So, 11 minus 2 is 9, 9 minus 7 is 2. So, there no change in yeah there is a change in free float of this right; earlier it was 3. What about free float of this 11 minus 4 − 7, 7 minus 6 is 1, yeah this also got changed. So, earlier 3 and 2, now 2 and 1.

So, what is free float limit. So, free float limit is minimum of these two right minimum of 2 and 3 right which is 2. And crash limit is what is crash limit, it is also 2. So, compression limit, compression limit is minimum of free float limit and crash limit, so minimum of 2 and 2 is 2. So, we can compress activity 1-3 and 4-5 by 2 days; we can compress activity 1-3 and 4-5 by 2 days. So, what decision we have to take we have to we have taken what decision we have taken you have decided to compress activity1-3 and 4-5 by 2 days.

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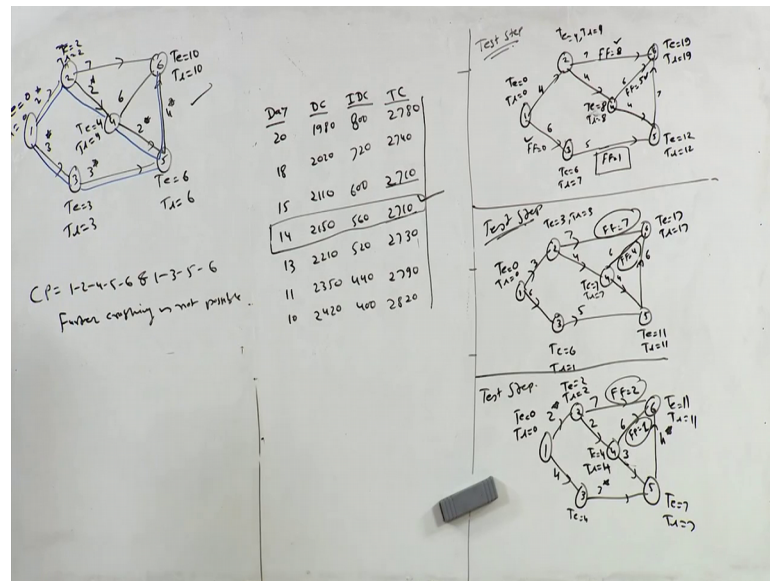
So, this is our final decision right. Let us look at this network now, 1-2-3-4-5 and 6, this is our network and these are the directions and now we will write time durations for all these activities. So, this 2 is fixed, 3 is fixed, 4 is fixed right. And now since we are doing it for activity 1-3 and 4-5, 1-3 where is 1-3, 1-3 is this you have to reduce it by 3 days. So, this is now 2 days. We have to reduce these by 2 days. So, this is now three and which is also now fixed right we cannot reduce it further. The other one is 4-5, where is 4-5, 4-5 is this 2. Now, this also is exhausted. What is left of course, this is 2. So, this is 7 and this is 6. Let us calculate T e and T l values 0; T e is equal to 2, T e is equal to 3m T e is equal to 5, T e is equal to 6, 6-4, this is 10. And T e here is 4 not 5. This 2 plus 2 this 4, so 4 plus 2 – 6 yeah. So, from here also you will have critical path.

So, T l is equal to 10, T l is equal to 6, T l is equal to 3, T l is equal to 4, and T l is equal to 2, here similarly T l is equal to 0 here. Again you have got two critical paths and get this also is exhausted right 2-4 is also exhausted. So, the critical paths are will remain same. So, you have got 1-2 4-5 and 6, 1-3-5 and 6. Now, let us try can you further reduce this network. So, for this just write critical paths here critical paths are 1-2 4-5 and 6, and 1-3-5 and 6. Since, you have got two critical paths, and for which is there any yeah for 4-5 for 4-5 right you have got 4-5.

Now, since you know these two are critical paths right and on all these critical paths, you have exhausted all crash limits. So, further crushing is not possible further crushing is

not possible. Why because you have exhausted all these crush limits right as far as these two activities are concerned, you cannot reduce duration of the project by reducing and duration of non-critical activity. So, with this we complete this question, but let us find out what is the final solution. We have done so much of you know calculations, let us find out what is the exact answer to this question.

So, let us find out total cost. So, for this question the total cost is. In fact, we have done several iterations initially the initially you had 20 days was the answer. Then at that time direct cost was it is 1980 right it is given in this table right. So, 1980 indirect cost indirect cost was 800 why 800 because indirect cost is 40 rupees per day. So, this is 800 right for after that your solution was 18 days then it was 15 days, 14 days, 13 days, 11 days and this is 10 days right last solution.

So, direct cost of course, as I said direct cost will increase. So, 2020, you have got 2110 2150, 2210, 2350 and 2420. Direct costs of course, 720, 900, no, no, no yeah this 720 right 600 is 5 into 40 right, 560 it is 520, 540 then 440, 400 just check this once again. So, 800, 720, 600, 560, 520, 440 and the total cost is this. So, you have got total cost has 2780 just add these two value 2740 right, 2710, 2710 then you have got 2710 for fifteenth day it is 270, for 14th day also 2710, for 13th day 2730, 2790 and 2820.

Now, if you look at the total cost curve carefully, total cost curve is decreasing right here to here it is decreased is decreased. Now, at these two levels, it is constant right and then it is started increasing. So, what is final solution what is the final answer? You should the optimum cost is 2710 and the optimum duration is 14 days. If you further crash it then your cost will increase and it will continue to increase right because your direct cost is increasing your direct cost is increasing you know until this point. In other words, you are in that the decreasing indirect cost is more here up to this point, then direct cost and after this points things will change. The direct cost will increase more and indirect cost will decrease less. So, the optimum solution is 14.

So, with this let me summarize what we did in this session. In this session, in fact, in last three sessions and we did this question and we applied free float method. Free float actually acts as a guard against creation of a critical path, so that is why we always check whenever your crush limits are more than one for and development of critical path using free float. So, with this let me complete here.

Thank you very much.