Earliest Start time (E_i)

It is the earliest possible time when an activity can begin assuming that all of the preceding activities have also started at their earliest starting time.

Latest event time (L_j)

This indicates the time by which all activities entering into that event must be completed w/o delaying completion of the project.

Total float

It refers to the amount of time by which the completion of an activity could be delayed beyond the earliest expected completion time w/o affecting the overall project duration time.

Free float

The time by which the completion of an activity can be delayed beyond the earliest finish time w/o affecting the earliest start of a succeeding activity.

Direct cost → It is directly dependent on the amount of resources in the execution of individual activities. The direct cost increases if the activity duration is to be reduced.

Indirect cost → This cost is associated with overhead expenses such as managerial services indirect supplies etc. The indirect cost in counted on a perday perweek or permonth basis.

The indirect cost decreases if the activity duration decreases.

Crashing of two project Network

Activity	Normal time	Crash time	Normal Cost (Rs)	Crash Cost (Rs)
1-2	7	4	700	850
1-3	5	3	500	700
1-4	8	5	600	1200
2-5	9	7	800	1250

Activity	Normal time	Crash time	Normal Cost (Rs)	Crash Cost (Rs)
3-5	5	3	700	1000
3-6	6	5	1100	1300
4-6	7	5	1200	1450
5-7	2	1	400	500
6-7	3	2	500	850

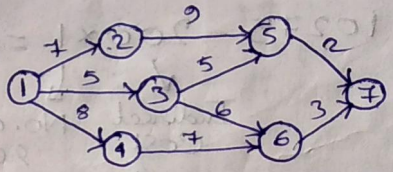
Step 1: Find out Cost slope / slope

$$\text{Slope} = \frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal time} - \text{Crash time}}$$ → Crash limit

Step 2: Draw network diagram

Step 3: Find Critical path

Activity	Slop
1-2	50
1-3	100
1-4	200
2-5	225
3-5	150
3-6	200
4-6	125
5-7	100
6-7	350



1-2-5-7 = 7+9+2 = (18)

1-3-5-7 = 5+5+2 = 12

1-3-6-7 = 5+6+3 = 14

1-4-6-7 = 8+7+3 = (18)

Normal project Completion time = 18 Weeks.

Step 4: Find out the total direct cost

Normal Cost Summation = 6500 (Per Activity Indirect cost given in qs)

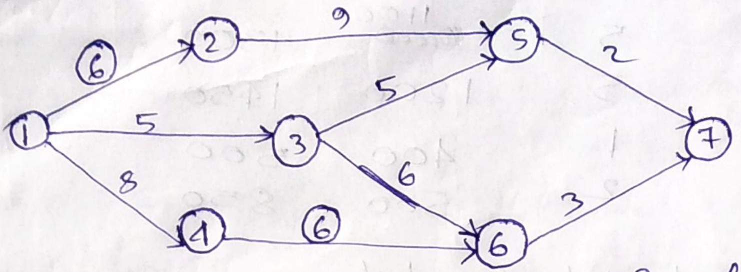
Indirect total cost = 200 × 18 = 3600

Total direct cost = 6500 + 3600 = 10100

Step 5: Crashing of the network :-

Critical Path	Critical activity	Crash limit (Normal time - Crash time)	Cost Slope
1-2-5-7	1-2	3	50 *
	2-5	2	~~100~~ 225
	5-7	1	100
1-4-6-7	1-4	3	~~600~~ 200
	4-6	2	125 ~~250~~ *
	6-7	1	350

2nd Iteration



Normal project completion time after the 2nd iteration will be 17 weeks.

1-2-5-7 = (17)
1-3-~~5~~-7 = 12
1-3-6-7 = 14
1-4-6-7 = (17)

Total direct Cost + Total cost Cost slope

1000 + (50+125) = 10275

10275 - 200×1 = 10075

(200 → Indirect Cost; 1 → No. of weeks reduced)

Critical Path	Critical activity	Crash limit	Cost slope
1-2-5-7	1-2	2	50 *
	2-5	2	225
	5-7	1	100
1-4-6-7	1-4	3	~~600~~ 200
	4-6	1	125 *
	6-7	1	~~300~~ 350

3rd ← Optimum iteration (stopped in 4th)

10075 + 50 + 125 - 200×1

= 10050

1-2-5-7 = (16)
1-3-5-7 = 12
1-3-6-7 = 14
1-4-6-7 = (16)

C Path	C activity	C limit	C slope
1-2-5-7	1-2	1	50 *
	2-5	2	225
	5-7	1	100
1-4-6-7	1-4	3	200 *
	4-6	0	125 *
	6-7	1	350

→ Zero হলে ক্রাশ করবে না।

4th 10050 + 50 + 200 − 200×1
= 10100

1-2-5-7 = 15 1-3-6-7=14
1-3-5-7 = 12 1-4-6-7=15

Since the value in the 4th Iteration is > the 3rd Iteration the optimal Solution

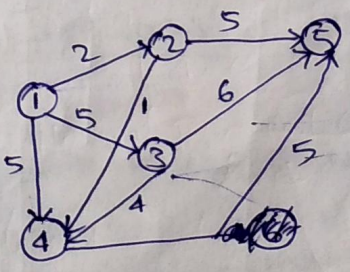
(i) Project Duration = 16 weeks

(ii) Project Path ~~=~~ 1-2-5-7, 1-4-6-7.

Activity	Normal time	Crash time	N cost	C cost
1-2	2	1	800	1400
1-3	5	2	1000	2000
1-4	5	3	1000	1800
2-4	1	1	500	500
2-5	5	3	1500	2100
3-4	4	3	2000	3000
3-5	6	4	1200	1600
4-5	5	3	900	1600
			8900	

Indirect Cost = 350/week.

Activity	Slope
1-2	600
1-3	333.33
1-4	400
2-4	—
2-5	300
3-4	1000
3-5	200
4-5	350



1-2-5 = 7
1-3-5 = 11
1-4-5 = 10
1-3-4-5 = (14)
1-2-4-5 = 8

Normal Cost Summation = 8900

Indirect total Cost = 350×14
= 4900

Total direct Cost = 8900 + 4900 = 13800

1st Iteration

Critical Path	Critical activity	Crash limit	Cost slope
1-3-4-5	1-3	3	333.33*
	3-4	1	1000
	4-5	2	350