

Project Planning & Control

Resource Scheduling

Week 6

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Lesson 1

What is Resource?, Influence of Resources on Schedule, Two-Span Bridge Example, Resource Decisions; ABCD Example Project; Resource Over-Allocation; Example-2

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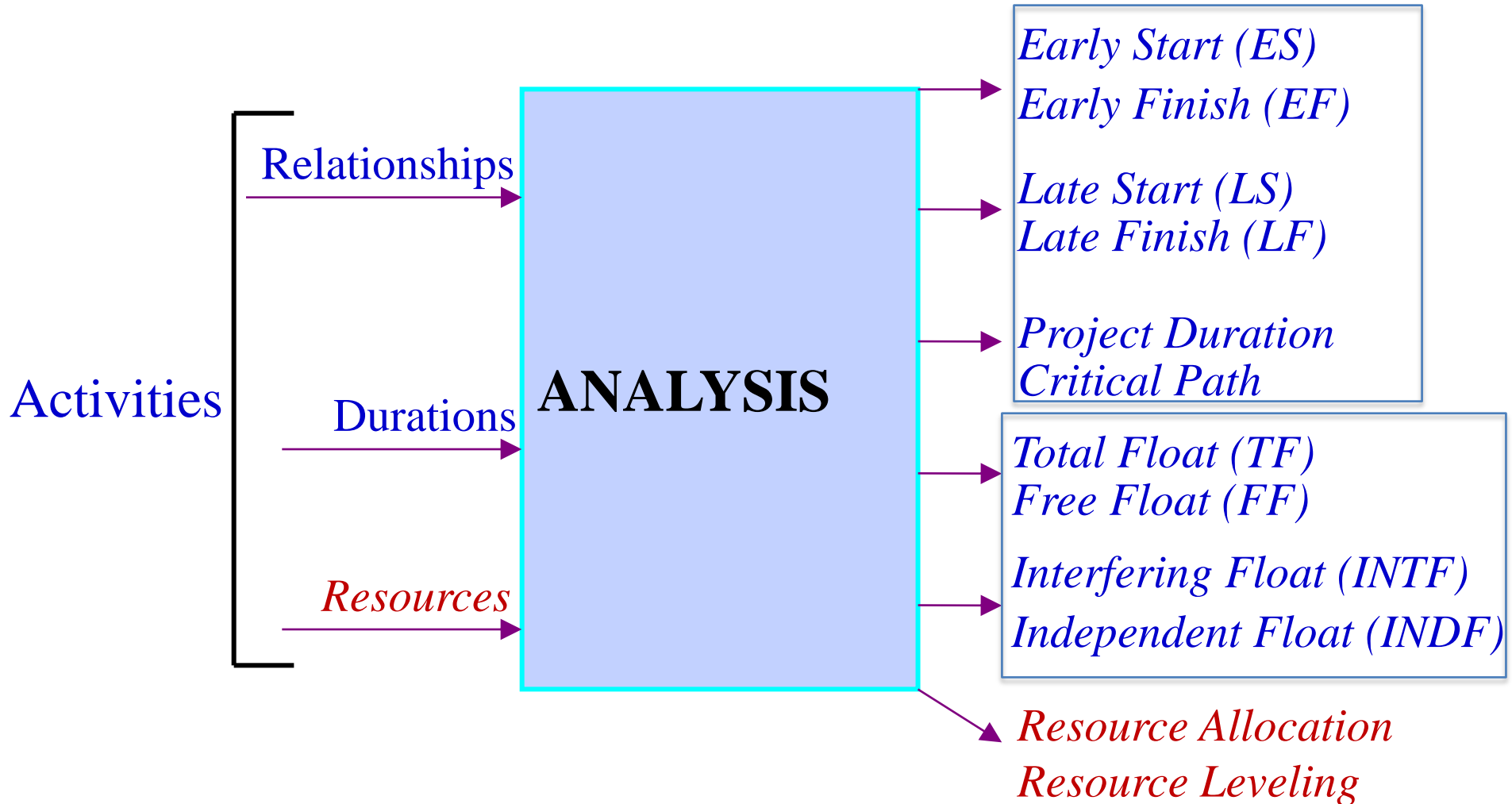
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Networks Analysis



What is a resource?

Material



Manpower



Machine



Money



Consumable

Reusable

Influence of resources on schedule

- Duration of activities are dependent on the usage of resources and their availability.
- Resources are a significant component of the project cost
- Proper scheduling of resources will have positive impact on the time as well as cost of the project.
- Improper scheduling resources will result in cost and time overruns

Two-Span Bridge Example - Cast Beams



Casting Operation



Transport

Two Span Bridge - Cast Beams - Duration

Beams are prefabricated in casting yard set-up on site.
No. Beams required is say *3 for each span- total = 6*

No. beams required = 3 + 3

Operation Sequence:

1.0 Reinforcement Fabrication – 2 days

2.0 Casting Beam

2.1 Formwork Assembly – 1 day

2.2 Concrete pouring – 1 day

2.3 Form removal after – 1 day

2.4 Form removal time- 1 day

Curing before usage – 28 (14) days regular
3 days steam curing

Assume reinforcement fabrication is
done in parallel

Production Rate – based on No. Forms/Beds

No. Sets of forms

1 1 beam in 4 days -> 24 days for 6 beams

2 2 beams in 4 days -> 12 days “

3 3 beams in 4 days -> 8 days “

What production rate is required ?

Assume 3 sets of forms:

Total Duration= 2 +14 (1st set);
Day 6+14 (2nd set)?

What decisions do we need to make
about resources ?

Resource Decisions

- Materials

- Periodic order quantities
- Storage requirements and locations
- Quantity discounts – multiple sites
- Custom equipment ordering & delivery



- Manpower

- Mobilization requirements each period
- Skill requirements during each period
- Work planning during non-availability period



Resource Decisions

- Machinery

- When special equipment is needed on site
- Preparatory works for equipment requirements
- Sharing equipment with other sites



- Money

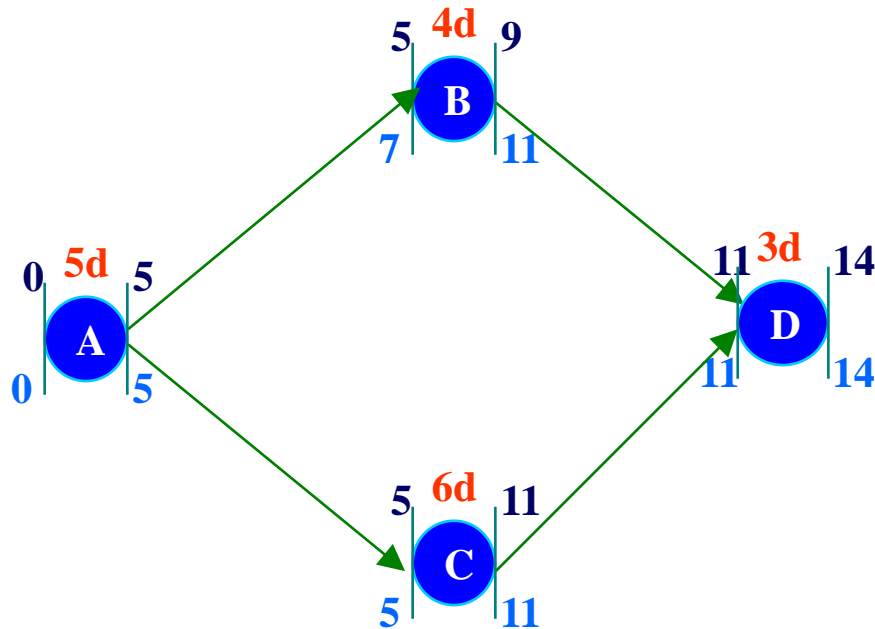
- Cash flow predictions
- Credit planning
- Project Profitability
- Tax planning





EXAMPLE-1 – ABCD Project

FORWARD PASS

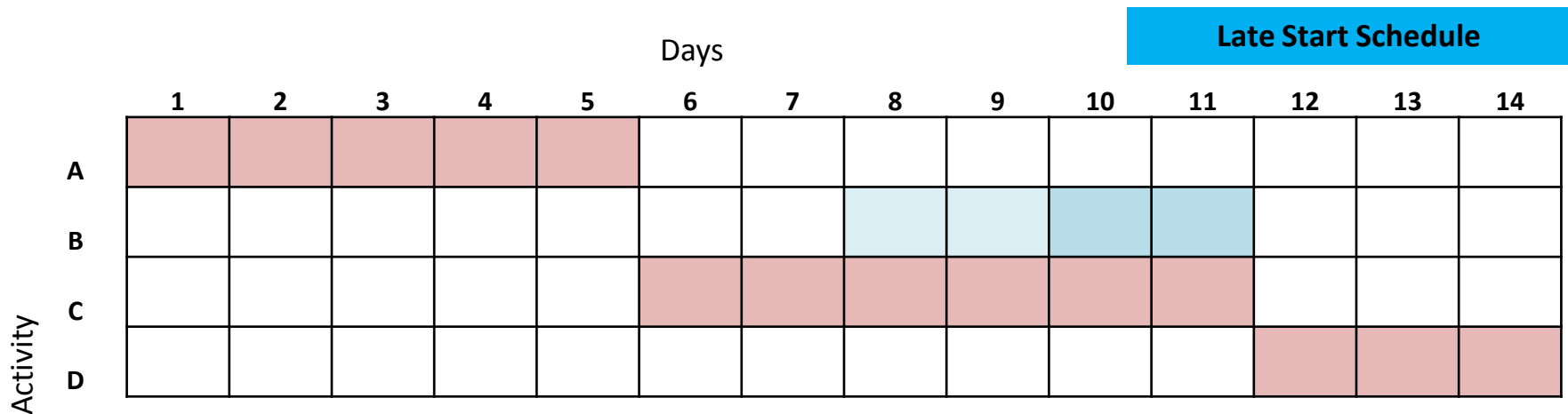
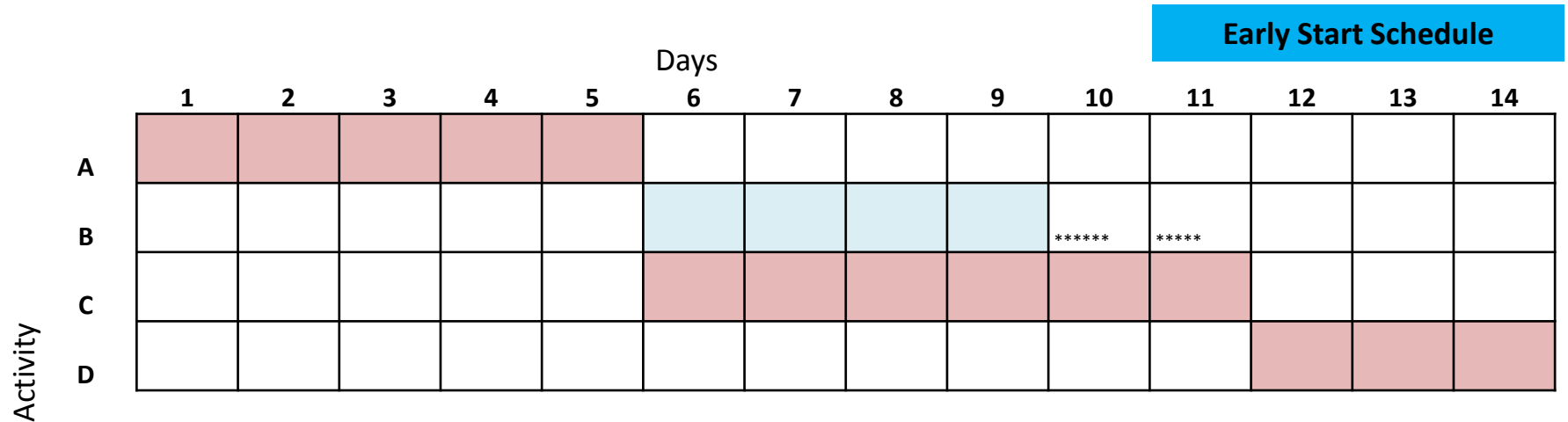


BACKWARD PASS

Activity	Duration	Predecessor
A	5	-
B	4	A
C	6	A
D	3	B,C

ACT	Early Start	Early Finish	Late Start	Late Finish	Critical
A	0	5	0	5	Y
B	5	9	7	11	N
C	5	11	5	11	Y
D	11	14	11	14	Y

Results in Gantt chart



Resource loading

- Assume that 1 manpower resource is required per day for each activity

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	1	1	1	1	1									
B						1	1	1	1					
C						1	1	1	1	1	1			
D												1	1	1

- Each activity is loaded with one manpower resource based on early start

Cumulative Resource Requirement

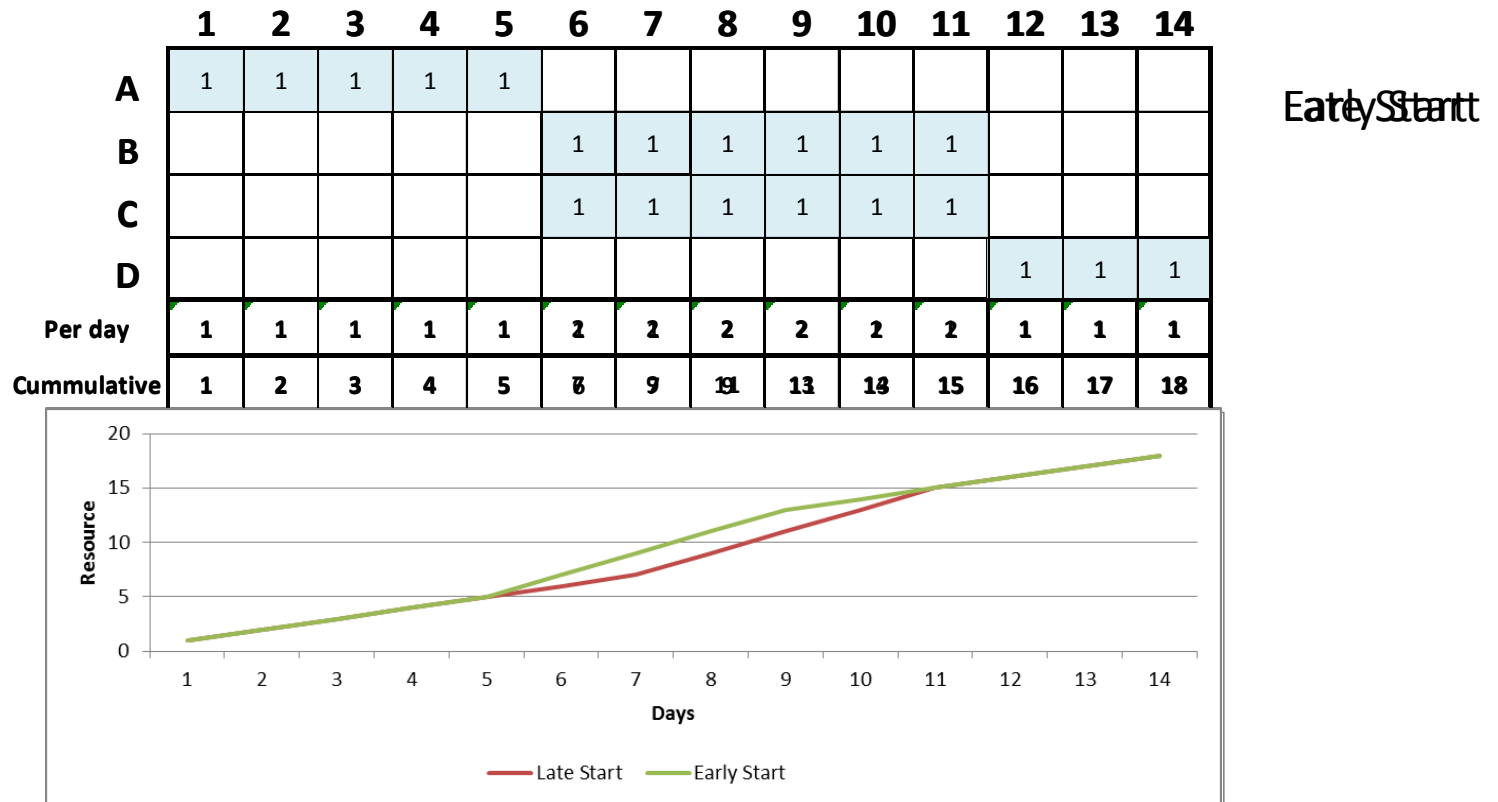
Adding up the resource requirement for each activity for each day a cumulative resource requirement for each day can be derived.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	1	1	1	1	1									
B						1	1	1	1					
C						1	1	1	1	1	1			
D												1	1	1
	1	1	1	1	1	2	2	2	2	1	1	1	1	1

Total resource requirement
for each day

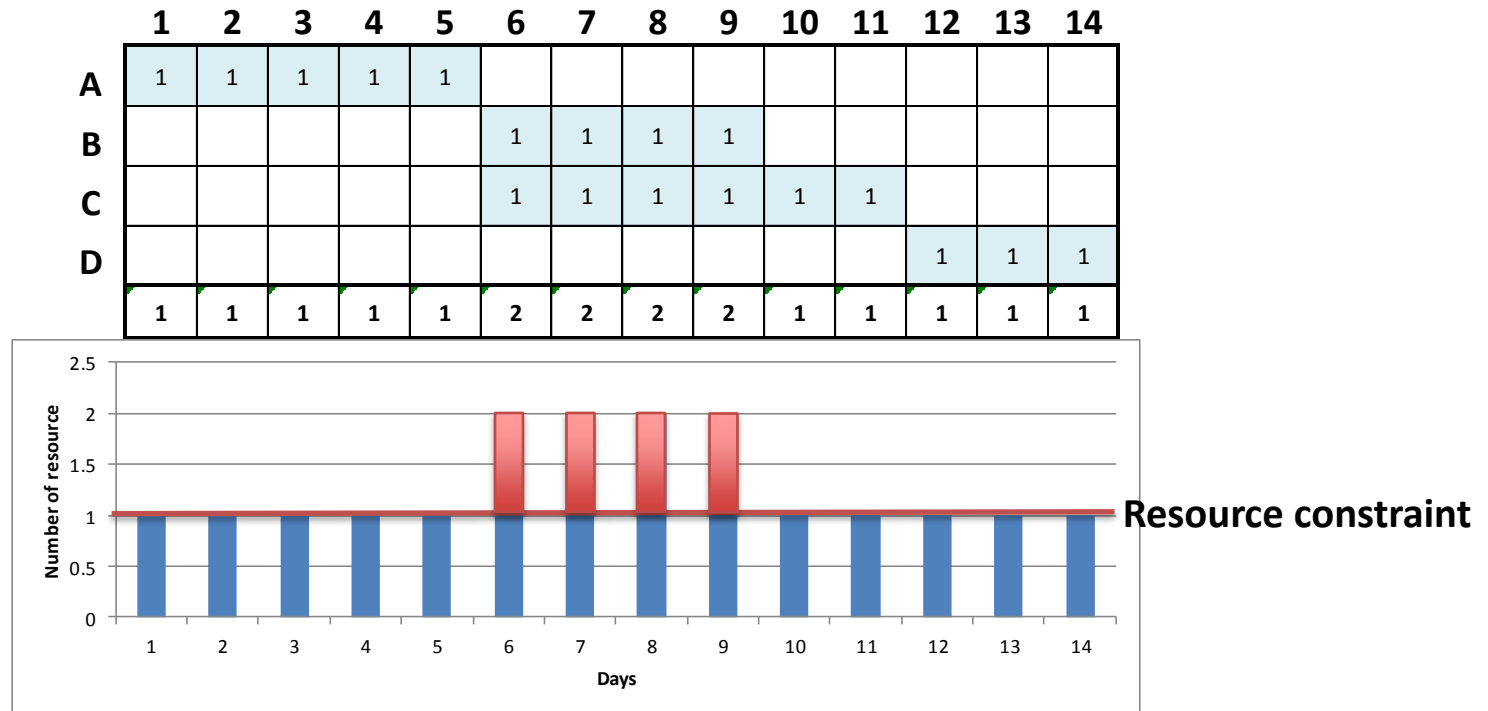
Resource Bar-chart

- Based on the cumulative resource requirement for each day a resource histogram can be plotted.
- This can be used to visually understand the resource requirement over the total length of the project.



Resource over-allocation

If we consider that there is maximum availability of only one manpower resource on any given day.

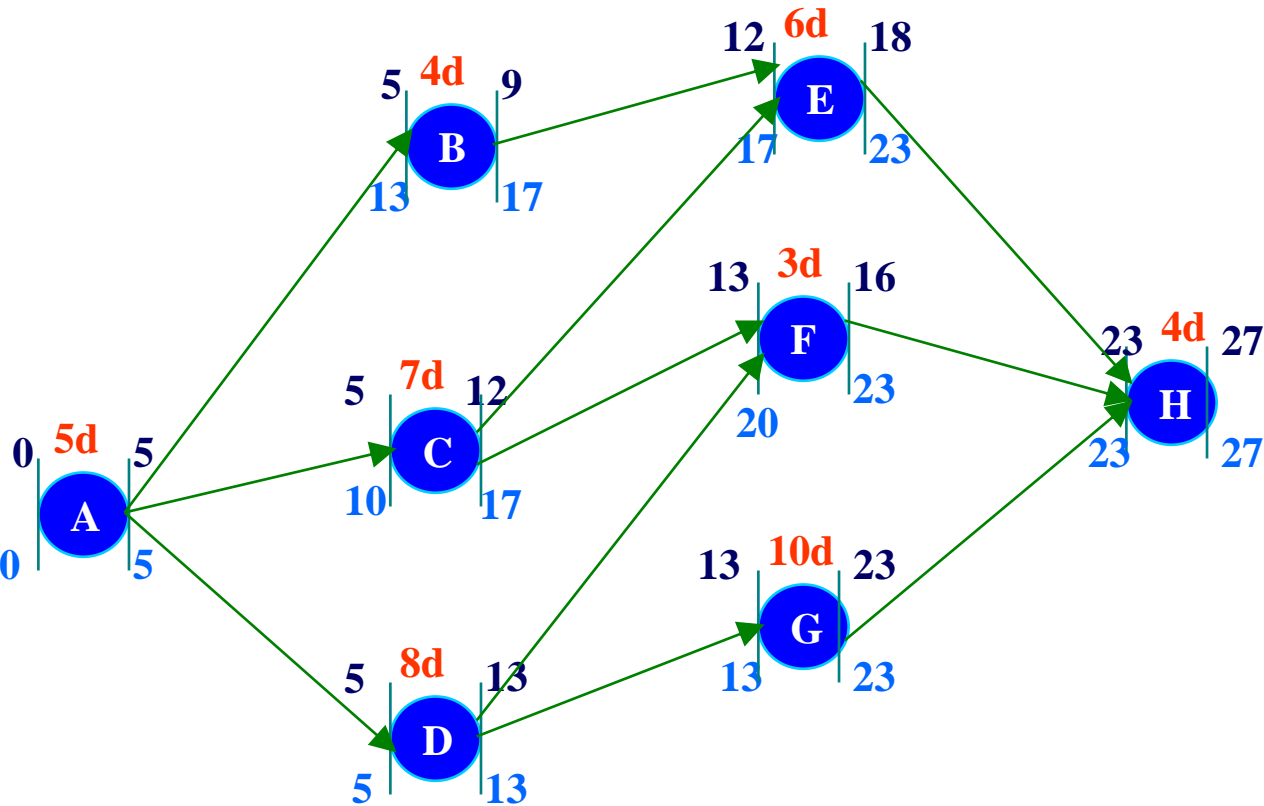


From the histogram we can understand that the resources allotted on day 6,7 & 8 are more than the available limit

NETWORK ANALYSIS

EXAMPLE-2

FORWARD PASS



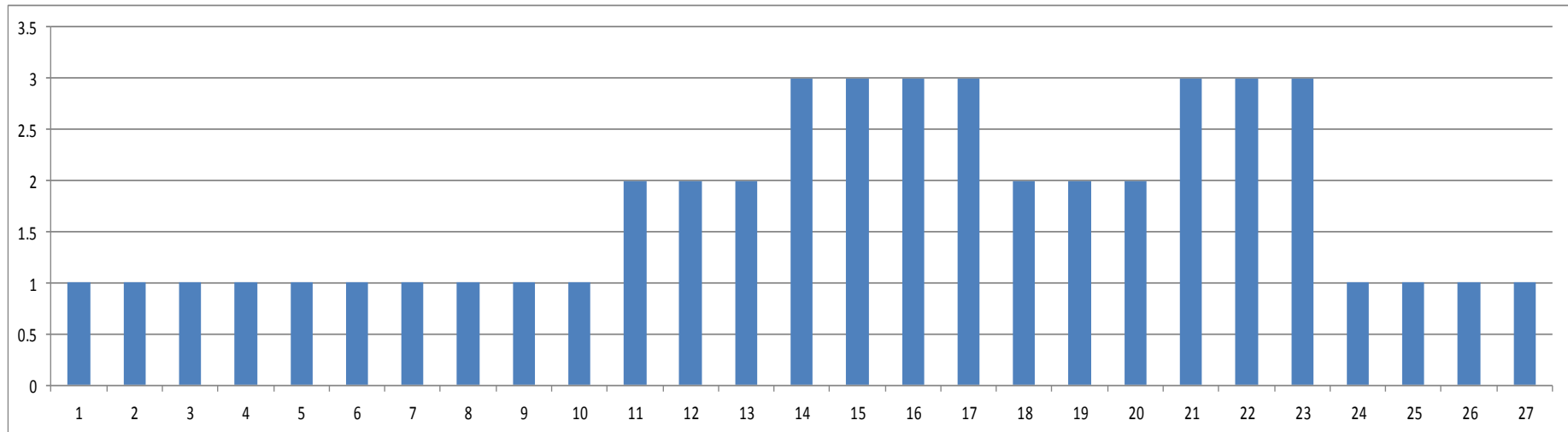
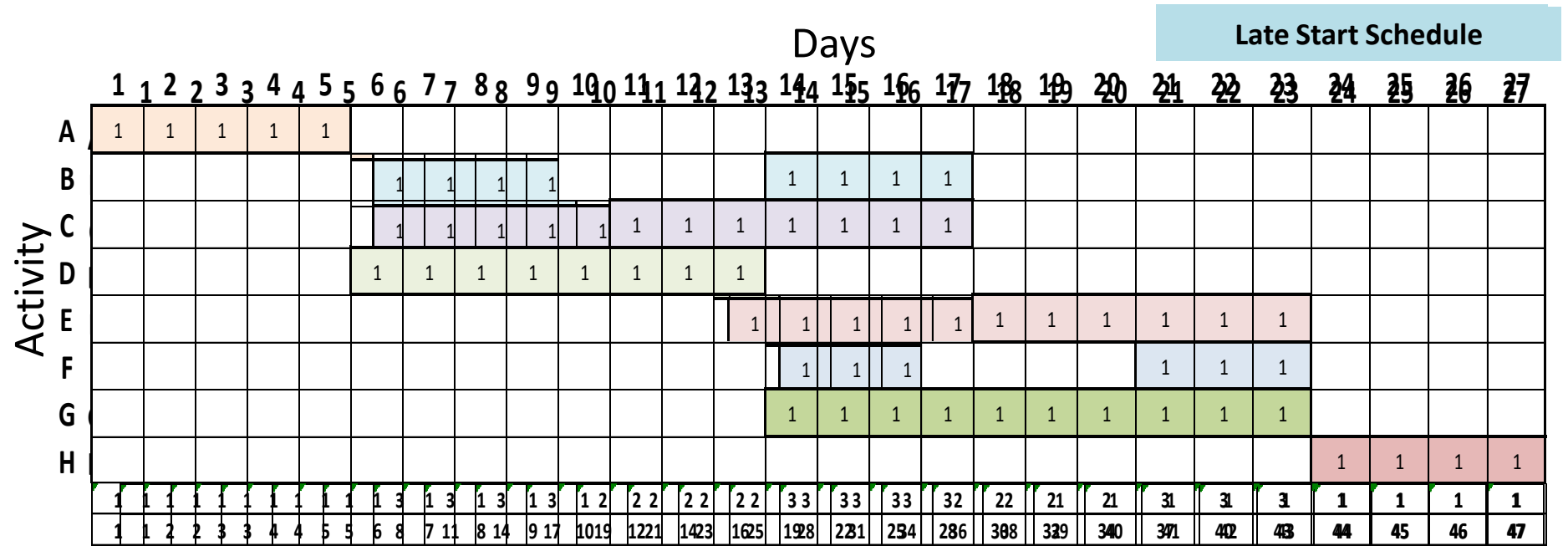
BACKWARD PASS

Activity	Duration	Predecessor
A	5	-
B	4	A
C	7	A
D	8	A
E	6	B,C
F	3	C,D
G	10	D
H	4	E,F,G

- Example -2 Result Summary

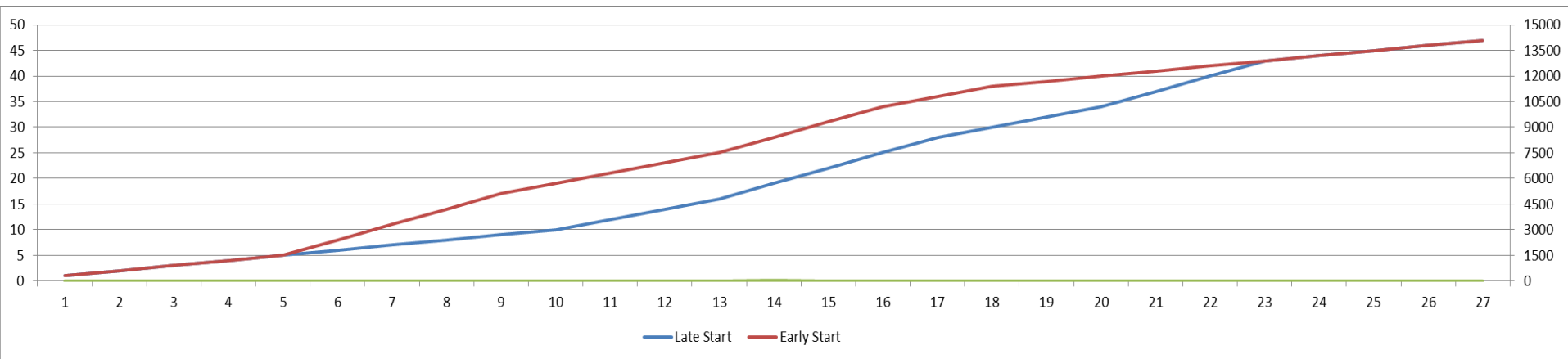
Activity	Duration	Predecessor	Early Start	Early Finish	Late Start	Late Finish	Critical
A	5	-	0	5	0	5	Y
B	4	A	5	9	13	17	N
C	7	A	5	12	10	17	N
D	8	A	5	13	5	13	Y
E	6	B,C	12	18	17	23	N
F	3	C,D	13	16	20	23	N
G	10	D	13	23	13	23	Y
H	4	E,F,G	23	27	23	27	Y

Results in Gantt chart



Cumulative resource graph

- Consider a cost of Rs.250/- per manpower resource per day, a cumulative cost curve can be obtained.
- The cash-flow for the two scenarios can be visualized in the plot below -



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
A	1	1	1	1	1																						
B						1	1	1	1					1	1	1	1										
C						1	1	1	1	1	1	1	1	1	1	1	1										
D						1	1	1	1	1	1	1	1														
E													1	1	1	1	1	1	1	1	1	1	1				
F														1	1	1					1	1	1				
G														1	1	1	1	1	1	1	1	1	1				
H																								1	1	1	1
	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	3	3	2	2	2	3	3	3	1	1	1	1
	1	2	3	4	5	6	7	8	9	10	12	14	16	19	22	25	28	30	32	34	37	40	43	44	45	46	47
	250	500	750	1000	1250	1500	1750	2000	2250	2500	3000	3500	4000	4750	5500	6250	7000	7500	8000	8500	9250	10000	10750	11000	11250	11500	11750