



STRN 322 – Construction Planning & Scheduling

Lecture 10 – Evaluation of Work Changes and Delays

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Topics for this week

- Construction delays
- Types of delays
- Reasons for delays
- Calculating delays based on type and time of occurrence



Construction Delays

- An event or condition that results in finishing the project later than stipulated in the contract
- In some cases, a delay can also refer to starting or finishing an activity later than planned

Construction Claims

- A request from one contracting party (usually the contractor) to another party for:
 - Additional monetary compensation, or
 - A time extension, or
 - Both

Delay Claim

Construction Delays

- When delays occur, an examination is made into the party (or parties) that caused the delay
 - Owner caused (o): They are called compensable delays. Contractor is entitled to time extension and possibly monetary compensation
 - Contractor caused (c): They are called non-excusable delays. The contractor is not entitled to any sort of compensation or time extension.
 - Neither caused (n): They are called excusable delays. The contractor is entitled to time extension only.




Compensable Delay (o)

- Faulty design
- Incomplete drawings and specifications
- Changes in scope by the owner
- Suspension of work by the owner
- Differing site conditions
- Design errors or omissions
- Changes in owner requirements
- Unusual weather conditions
- Late delivery of owner-supplied material

** Note is some cases the contract may transfer some of these risks to the contractor.....*

Non-excusable Delays (c)

- Does not entitle the contractor to a time extension nor a monetary compensation. This can be for:
 - Delay caused by the contractor
 - Delay that should have been expected by the contractor
- 
- Weather conditions
 - Soil conditions
 - Low labor productivity
 - Lead time to obtain government approvals
- If the project is delayed the contractor will pay delay penalties according to the contract



Examples of Non-excusable delays (c)

- Slow mobilization
- Cash flow problems
- Unexpected site conditions that should have been anticipated by the contractor
- Poor labor productivity
- Frequent equipment breakdowns
- Failure by sub-contractors to finish on time
- Poor quality (as per specs) resulting in rework



Examples of Excusable Delays (n)

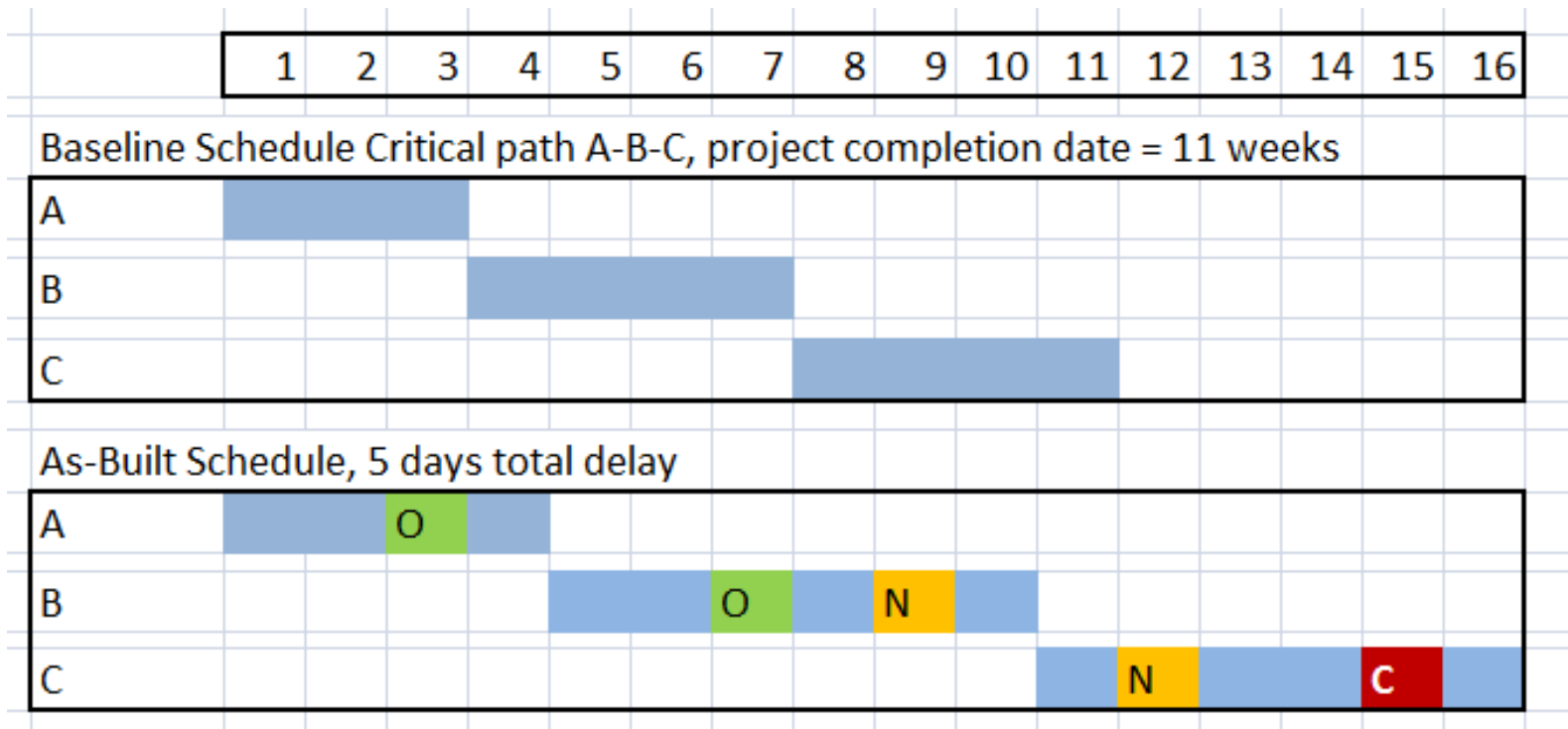
- Natural catastrophes
- Labor strikes



Evaluating the impact of a delay

- When a delay (or series of delays) occur contract administrators are required to evaluate the contractor's entitlement to
 - Time
 - Compensation
 - Both
- This process is called '***Delay Analysis***'

Delay Analysis Example



Time Extension = o + n

Contractor compensation = o

Time Extension = o + n = 4

→ New project completion date = 15 weeks

→ Contractor pays 1 week delay penalty

Contractor compensation = o = 2

→ Contractor entitled to financial compensation of 2 weeks



Calculating contractor compensation

The contractor can typically claim the following costs for a compensable delay:

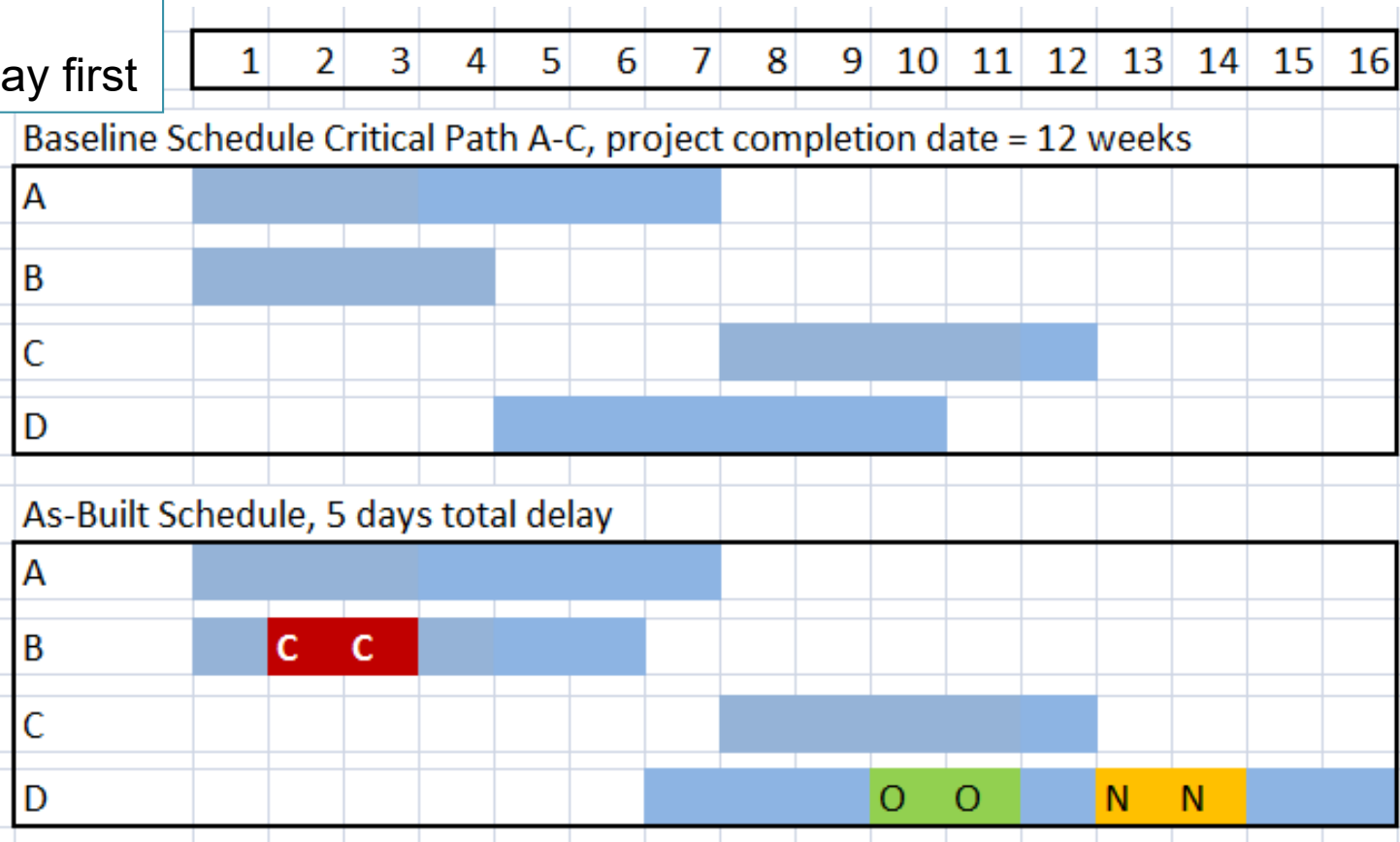
1- Site Overhead Costs: This typically includes staff salaries, fixed equipment, utilities, etc.. Once a compensable delay leads to project delay, the contractor can usually easily claim these amounts.

2- Site disruption costs: This can include any disruption to site works caused by the delay regardless of whether or not a project delay occurs (e.g. owner delays steel delivery and crane is left idle for one week). In this case, the contractor needs to prove that the compensable delay resulted in a direct loss

Consideration of float in delay analysis

- What if delays occurred on a non-critical path and after the delay this path became critical?

Case 1: Non-excusable delay first



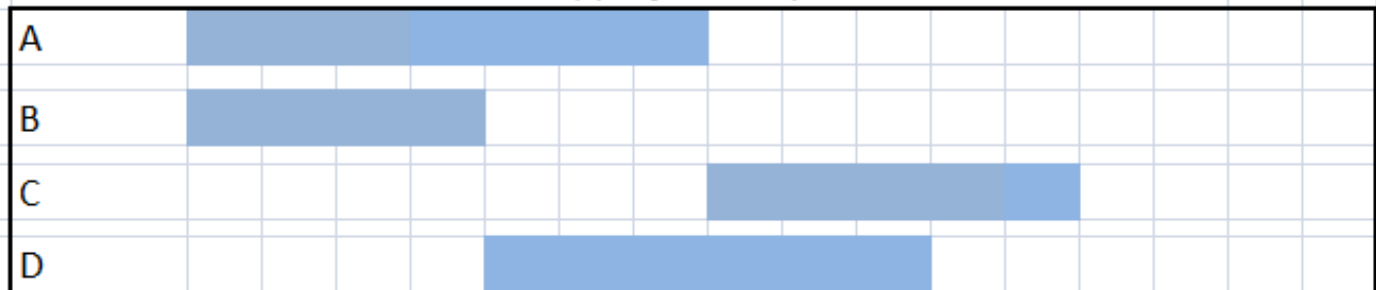
Consideration of float in delay analysis

- What if delays occurred on a non-critical path and after the delay this path became critical?

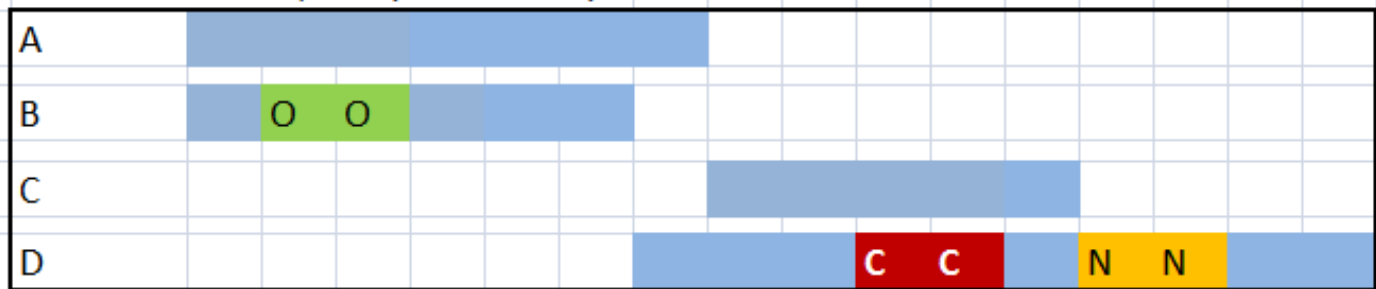
Case 2: Compensable
delay first

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
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Baseline Schedule Critical Path A-C, project completion date = 12 weeks



As-Built Schedule, 5 days total delay



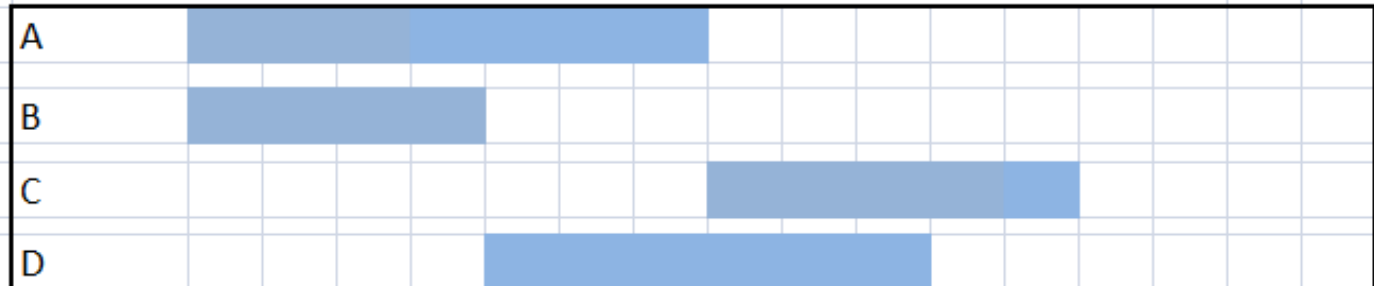
Consideration of float in delay analysis

- What if delays occurred on a non-critical path and after the delay this path became critical?

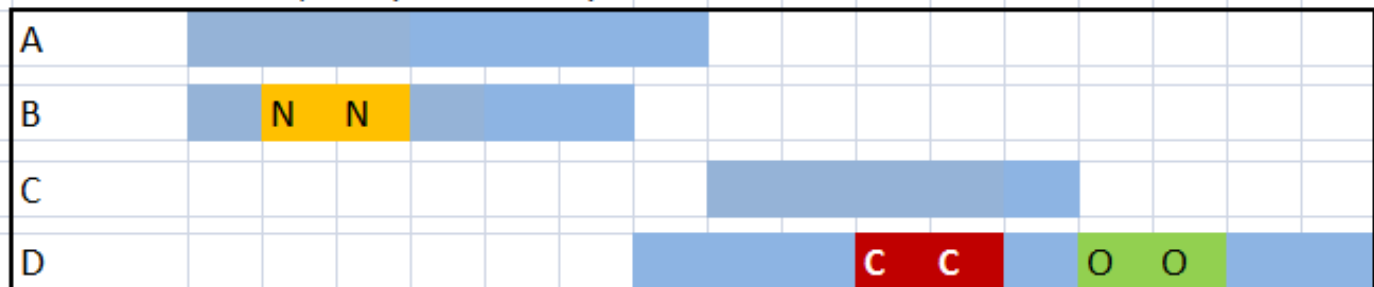
Case 3: Excusable
delay first

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
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Baseline Schedule Critical Path A-C, project completion date = 12 weeks



As-Built Schedule, 5 days total delay





Consideration of float in delay analysis

- If a delay occurs on a path that initially has float, then the delay can be considered to be consuming float.
- Once a non-critical path becomes critical we can calculate time extension and compensation as:

Time Extension = o + n Contractor compensation = o

- Before becoming critical, delays on the non-critical path are using up a valuable project resource “**Float**”.
- This raises a very important question....

Who Owns Float?



Float Ownership

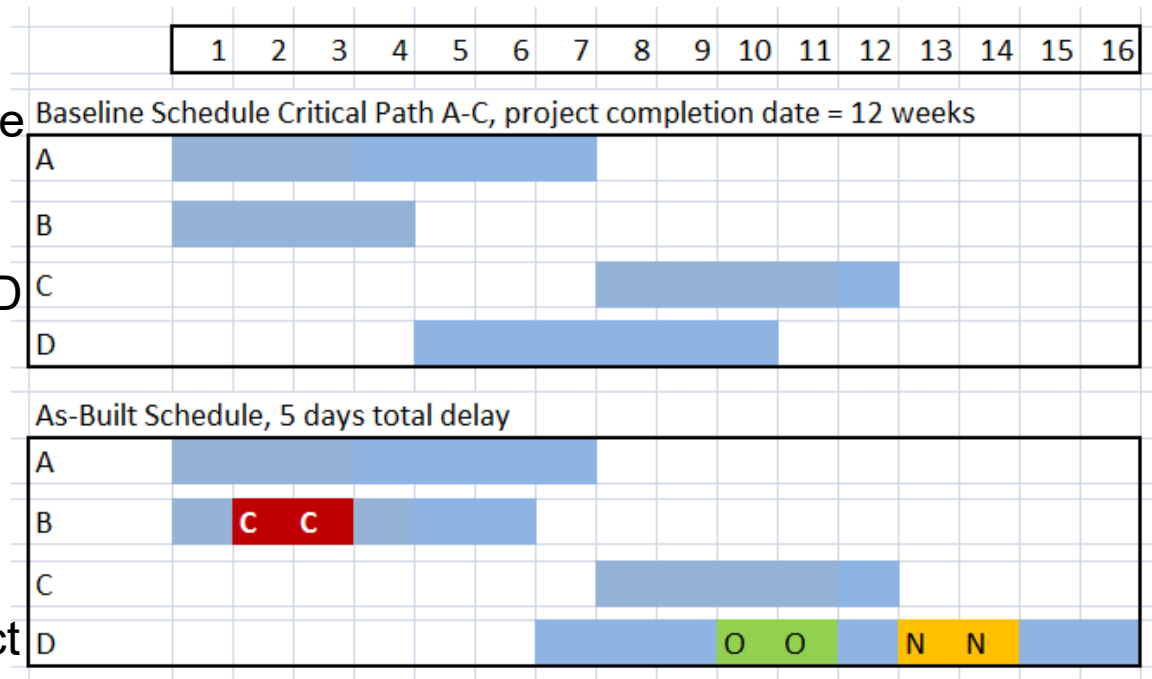
- Float ownership can be assumed to take one of the following five cases:
 - Exclusively owned by the contractor. Any delays caused by the owner will automatically entitle the contractor to a time extension. The contractor is allowed to delay any activities without penalty as long as $\text{delay} < \text{total float}$
 - Exclusively owned by the owner. Any delays caused by the contractor will automatically result in delay penalties if project completion is delayed.
 - Owned by the project: Float is consumed by the party that uses it first (first come first serve).

Case I: Non-excusable delay first

In this case the contractor consumed the 2 weeks of float.

After this delay activity D becomes critical

If the owner owns the float, contractor's delay will be considered to have delayed the project even if no direct project delay will occur



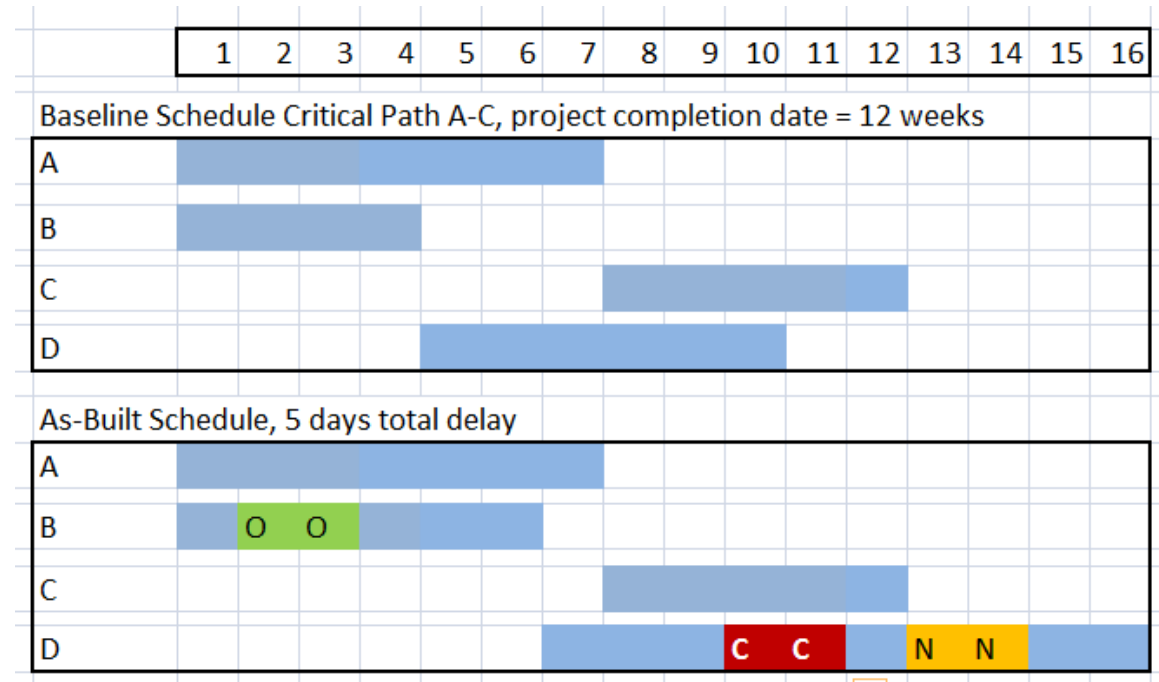
Float Ownership	Time Extension	Compensation	Delay Penalties
Contractor	4	2	0
Owner	2	2	2
Project (FCFS)	4	2	0

Case 2: Compensable delay first

In this case the owner consumed the 2 weeks of float.

After this delay activity D becomes critical

If the contractor owns the float, owner's delay will be considered to have delayed the project even if no direct project delay will occur



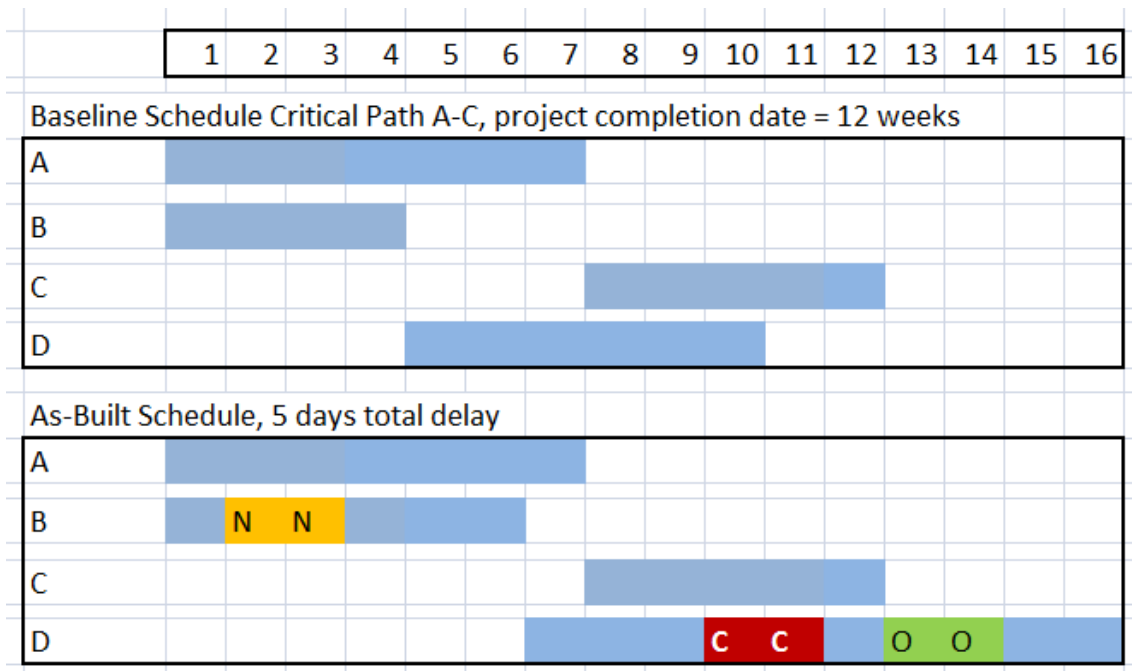
Float Ownership	Time Extension	Compensation	Delay Penalties
Contractor	4	2	0
Owner	2	2	2
Project (FCFS)	2	2	2

Case 3: Excusable delay first

In this case the 2 weeks of float were consumed by a third party

After this delay activity D becomes critical

The excusable delays (n) have no impact on calculating time exemptions or delay penalties and float ownership is irrelevant



Float Ownership	Time Extension	Compensation	Delay Penalties
Contractor	2	2	2
Owner	2	2	2
Project (FCFS)	2	2	2

Solved Example

Activity	IPA	TF	1	2	3	4	5	6	7	8	9	10	11	12
A	None	0	■	■	■	■								
B	None	3	■	■	■									
C	A	0				■	■	■	■	■	■			
D	B	4				■	■	■	■					
E	A,B	2				■	■	■	■	■	■	■		
F	C	0									■	■	■	■
G	D	4							■	■				

Month	Event
2	Contractor delay in material delivery leads to a 1 month delay in activity B
3	Labor strike leads to 1 month delay in activity A
5	Delay in approval of shop drawings leads to 1 month delay in activity D. Low labor productivity leads to one month delay in activity A
7	Hurricane leads to one month delay in all activities taking place in month 7

Assume float is owned by the project (FCFS)

Month 2

Contractor delay in material delivery leads to a 1 month delay in activity B

Activity	IPA	TF	1	2	3	4	5	6	7	8	9	10	11	12
A	None	0												
B	None	3												
C	A	0												
D	B	3												
E	A,B	2												
F	C	0												
G	D	3												

No Impact on schedule yet. Contractor is consuming project float.

Month 3

Labor strike leads to 1 month delay in activity A

Activity	IPA	TF	1	2	3	4	5	6	7	8	9	10	11	12	13
A	None	0			N										
B	None	3		C											
C	A	0													
D	B	4													
E	A,B	2													
F	C	0													
G	D	4													

- Contractor entitled to time extension of one month. New project completion date is 13 months.
- Notice the increase in TF of activities D and G
- Contractor will have to bear the extra indirect cost of one month

Month 5

- Delay in approval of shop drawings leads to 1 month delay in activity D.
- Low labor productivity leads to one month delay in activity A

Activity	IPA	TF	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	None	-1			N		C									
B	None	3		C												
C	A	-1														
D	B	3					O									
E	A,B	1														
F	C	-1														
G	D	3														

- 1- Two different delays types happening at the same time are called concurrent delays.
- 2- A non excusable delay (c) on a critical path activity means that the project will be delayed by one month but the contractor is not entitled to a time extension.
- 3- We now have -ve float on critical activities.
- 4- Compensable delay (O) on non-critical activity. Contractor is not entitled to a time extension. Contractor may be entitled to monetary compensation if he can prove that owner delay caused loss to contractor.

Month 7

Hurricane leads to one month delay in all activities taking place in month 7

Activity	IPA	TF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	None	-1			N		C										
B	None	3		C													
C	A	-1							N								
D	B	3					O		N								
E	A,B	1							N								
F	C	-1															
G	D	3															

Excusable delay on all activities taking place in month 7. Contractor entitled to one month time extension.

Result

Activity	IPA	TF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	None	-1			N		C										
B	None	3		C													
C	A	-1							N								
D	B	3					O		N								
E	A,B	1							N								
F	C	-1															
G	D	3															

- Project completion extended by 2 months due to hurricane in month 7 and labor strike in month 3
- Contractor possibly entitled to 1 month compensation due to delay in shop drawings during month 5
- If progress continues as-planned a 1-month delay penalty will be applied to the contractor