Project Controls Expo
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DELAY AND FORENSIC ANALYSIS

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Introduction

Delay in Construction Contracts:

- On-going phenomenon
- Introduction of Critical Path Method (‘CPM’)
- Prospective or retrospective analysis
- Observational or modelled
- Dynamic or Static
- Common Methodologies

Classification of analysis

Some distinctions:

Prospective v Retrospective

- 'Prospective' - performed near the time when the delay is forecast and is an estimate of the future delay – the 'likely' impact on progress.
- 'Retrospective' - occurs after the delay event and when the actual extent of the impact is known – can be carried out before or after completion.

Observational v Modelled

- 'Observational' – analyses the programme without making any changes to it.
- 'Modelled' – inserts activities representing delay events into the network and compares the before and after results.

Dynamic v Static

- 'Dynamic' – may use schedule updates and may involve network logic that differs from the baseline programme.
- 'Static' – relies on only one programme which is then compared to the as-built state of the same programme.

Classification

AACE – Forensic Schedule Analysis (RP 29R-03)

Taxonomy	1	RETROSPECTIVE														
	2	OBSERVATIONAL							MODELED							
	3	Static Logic			Dynamic Logic				Additive				Subtractive			
	4	3.1 Gross	3.2 Periodic		Contemporaneous Updates (3.3 As-Is or 3.4 Split)		3.5 Modified / Reconstructed Updates		3.6 Single Base[2]		3.7 Multi Base[1]		3.8 Single Simulation		3.9 Multi Simulation[1]	
	5		Fixed Periods	Variable Windows	All Periods	Grouped Periods	Fixed Periods	Variable Windows	Global Insertion	Stepped Insertion	Fixed Periods	Variable Windows or Grouped	Global Extraction	Stepped Extraction	Fixed Periods	Stepped Extraction
Common Names		As-Planned vs As-Built	Window Analysis		Contemporaneous Period Analysis, Time Impact Analysis, Window	Contemporaneous Period Analysis, Time Impact Analysis, Window Analysis	Contemporaneous Period Analysis, Time Impact Analysis	Window Analysis, Time Impact Analysis	Impacted As Planned, What-If	Time Impact Analysis, Impacted As-Planned	Time Impact Analysis	Window Analysis, Impacted As-Planned	Collapsed As-Built	Time Impact Analysis, Collapsed As-Built	Time Impact Analysis, Collapsed As-Built	Time Impact Analysis, Window Analysis, Collapsed As-Built

Classification of analysis

Common methodologies:

- As-Planned Impacted Analysis
- Time Impact Analysis
- Collapsed As-Built/But For Analysis
- Windows/Time Slice Analysis
- As-Planned v As-Built Analysis

As-Planned Impacted

Establishes the hypothetical impact of a delay event(s) on the baseline programme.

Technique:

- Step 1 – Baseline Programme
  - Locate most appropriate programme to use as a baseline
  - Establish reasonableness
  - Ensure ‘networked’ and suitable for dynamic analysis
- Step 2 – Impact Delays
  - Identify delay events
  - Establish the nature & duration of the delay events
  - Introduce delay events into baseline programme in an appropriate manner
  - Recalculate programme to achieve result

As-Planned Impacted

It is simple to understand, easy and inexpensive to prepare.

It does not establish that delay was actually caused by the selected delay events.

It does not even establish that delay was likely to occur.

- Because it ignores the effects of actual progress up to the time the delay event(s) arose

It is widely considered to be unbalanced and unfair.

- Because it typically includes only one party's delay events

This method should only be used:

- If the contract specifically mandates its use
- When the delays being considered all arose at the very outset of the project
- There is no as-built or progress information available

As-Planned Impacted

Requires programme network suitable for dynamic analysis.

Does not require as-built data.

Determines the "*prospective*" impact of delay events on the baseline programme.

Does not take account of the effects of progress.

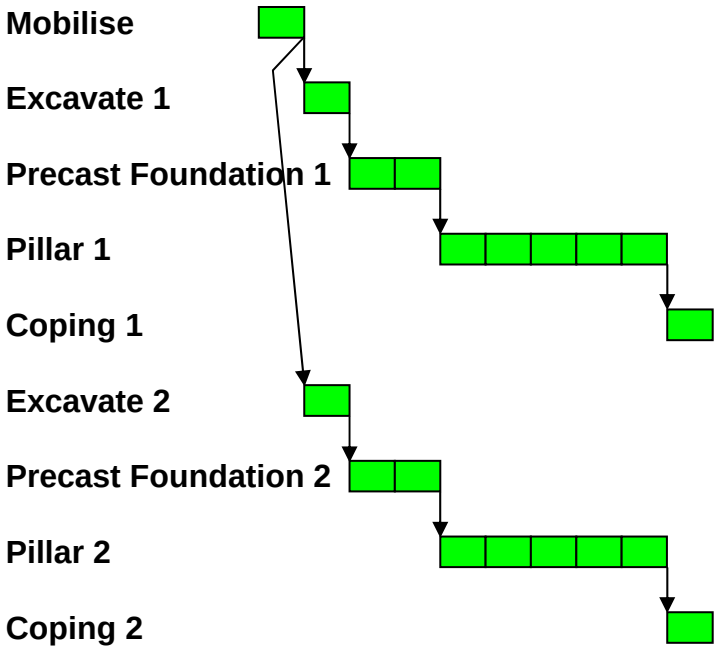
Does not take account of re-sequencing.

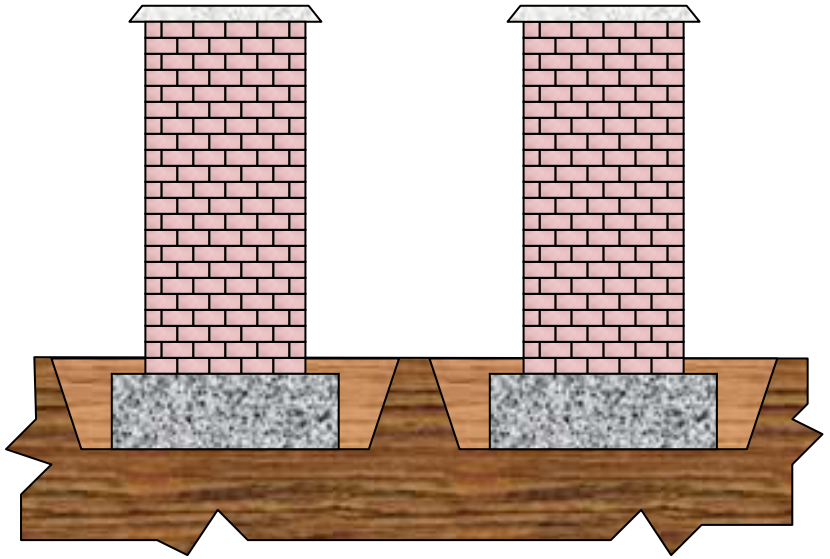
Does not take account of duty to mitigate.

Does not establish the actual effects of the Delay Events.

Can give very different results, depending on whether carried out by Owner, Contractor or Sub-contractor.

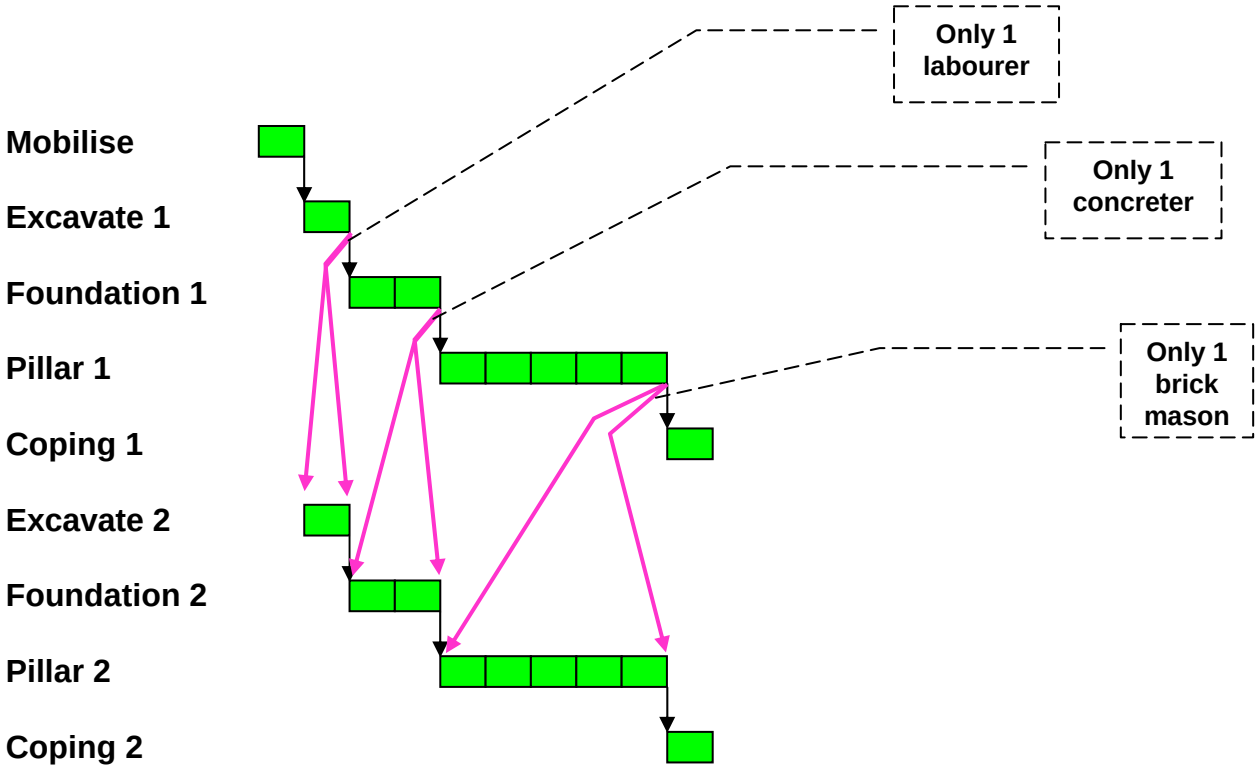
Construction Programme



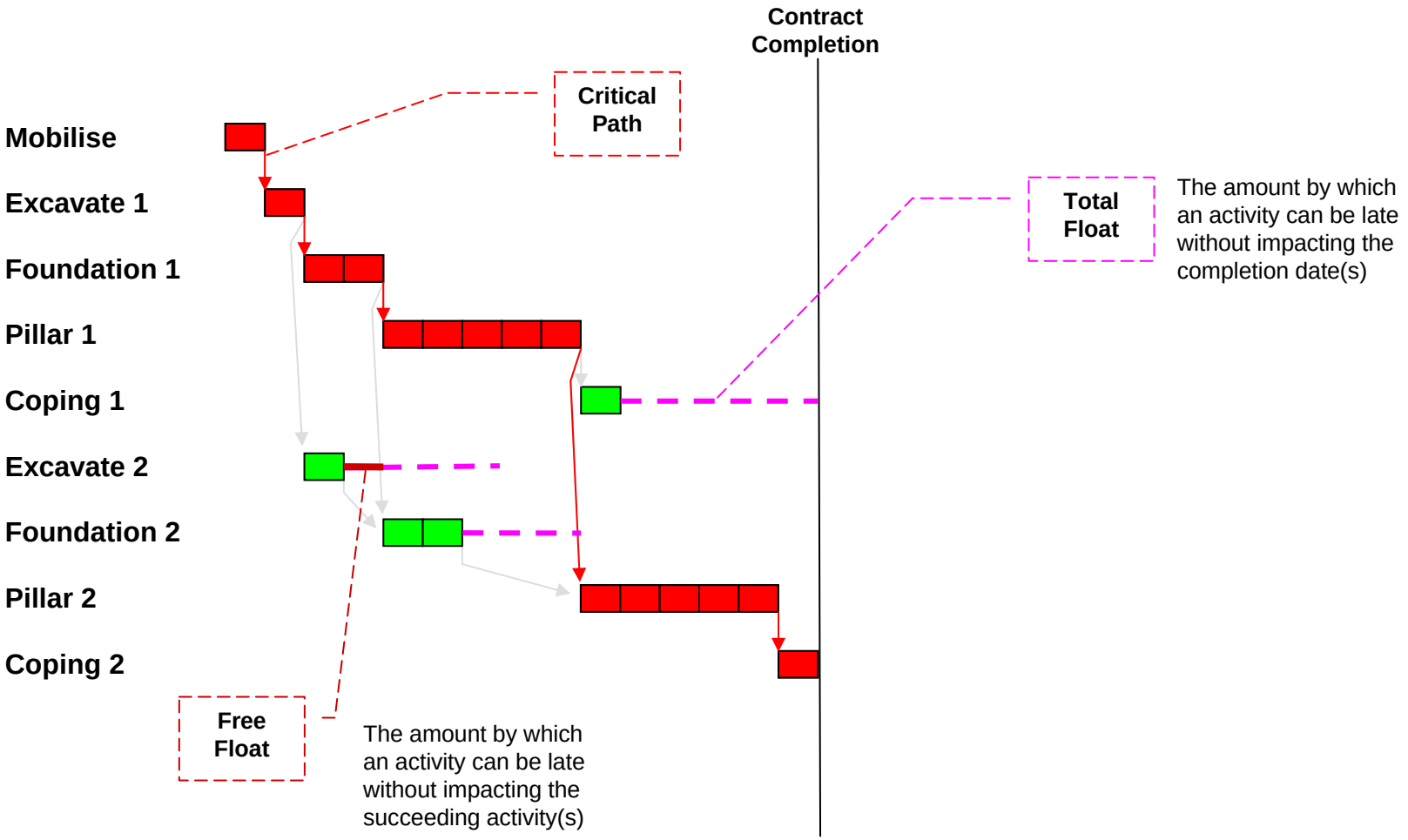


Project – Build two pillars

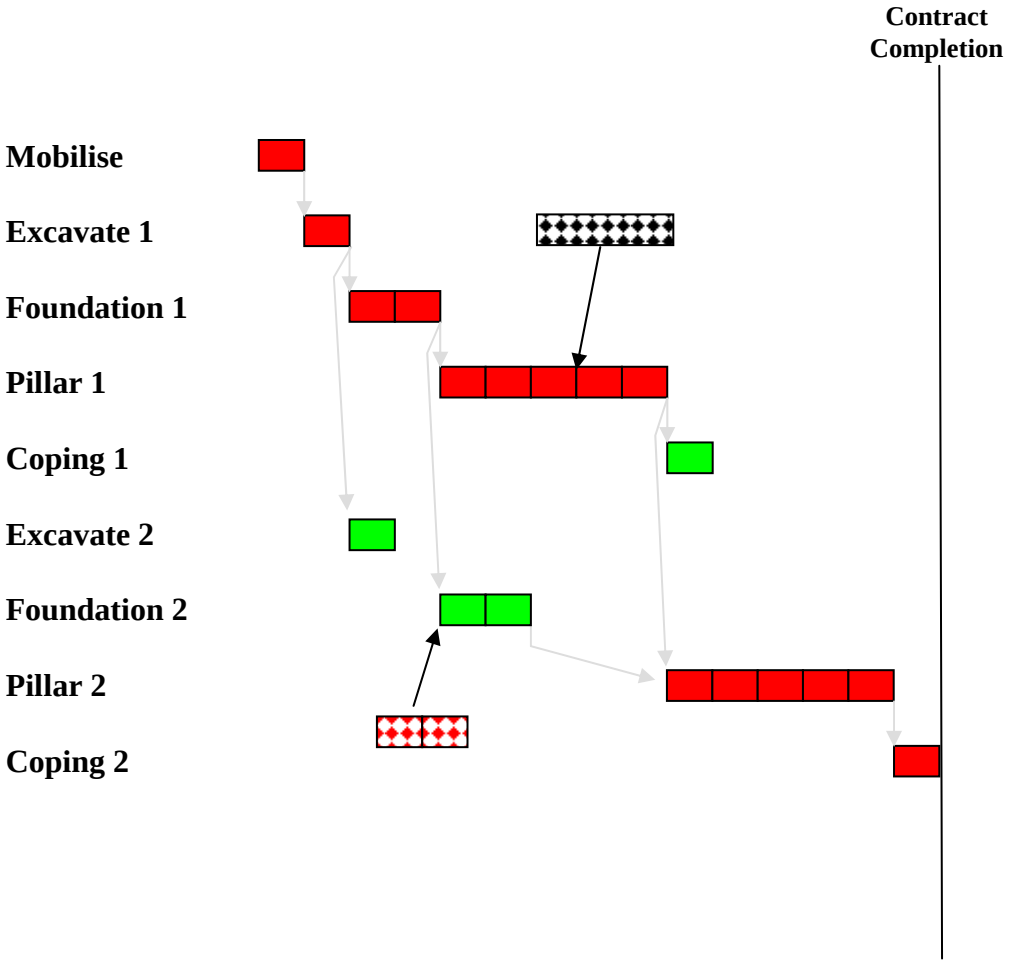
Construction Programme



Construction Programme



As-Planned Impacted



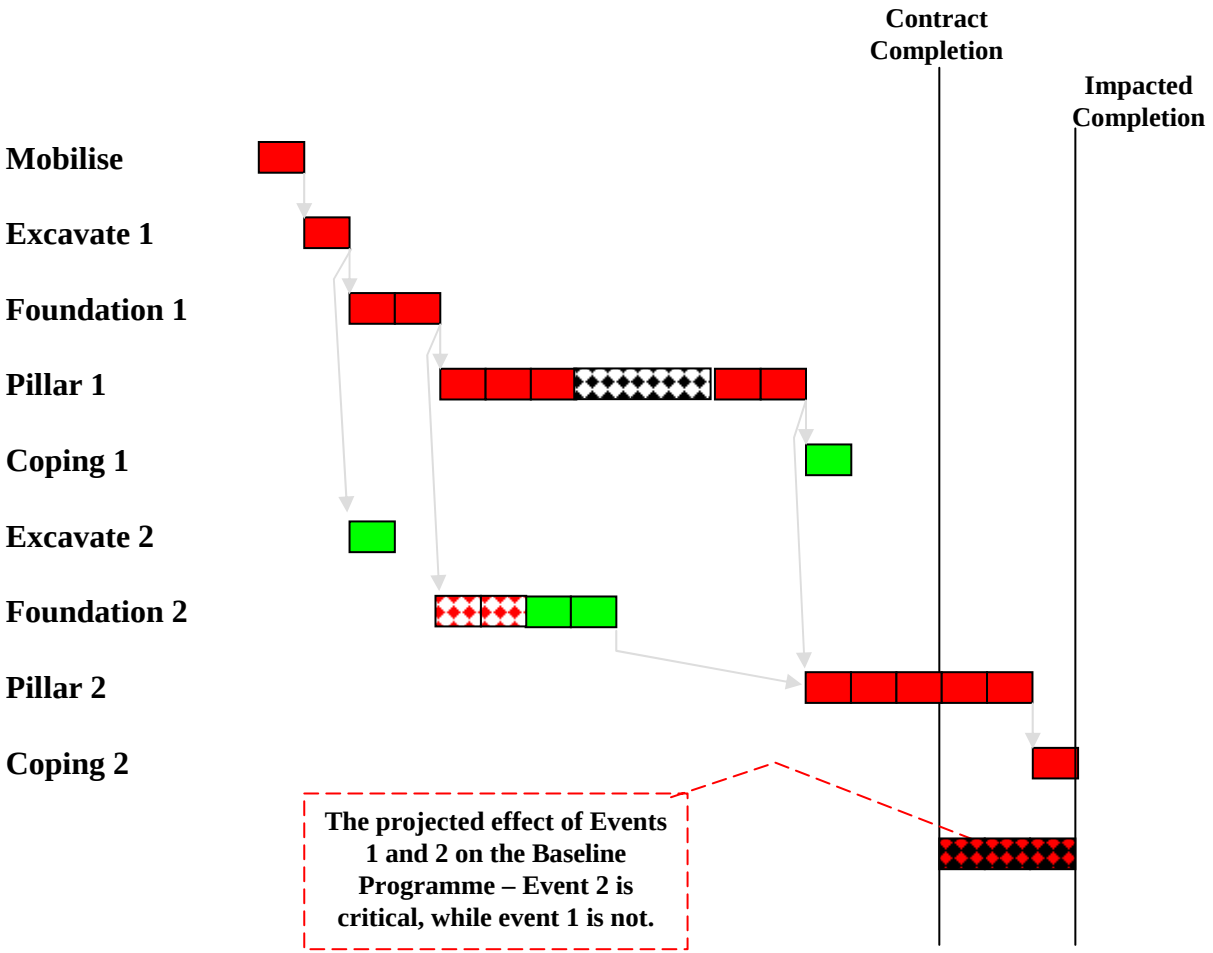
Step 1 Identify Delay Events

Delay Event 1 (Rock Excavation at Pillar 2)

Delay Event 2 (Severe Weather during Brickwork to Pillar 1)

Step 2 Establish relationship of Delay Events to Baseline Programme. Insert Delay Events into Programme

As-Planned Impacted



Step 1 Identify Delay Events

Delay Event 1 (Rock Excavation at Pillar 2)

Delay Event 2 (Severe Weather during Brickwork to Pillar 1)

Step 2 Establish relationship of Delay Events to Baseline Programme. Insert Delay Events into Programme

Step 3 Recalculate Programme

Conclusion The calculated programme overrun is the simulated effect of the inserted delay events

Time Impact Analysis

Establishes the hypothetical impact of a delay event on the programme prevailing at the time the delay event arose.

Technique:

- Step 1 – Baseline Programme

  Locate most appropriate programme to use as a baseline

  Establish reasonableness

  Ensure ‘networked’ and suitable for dynamic analysis

- Step 2 – Update Programme

  Identify delay event and its “manifestation date”

  Update the programme to accurately reflect the status **pre** the delay

  Establish the delay to completion **pre** the delay

Time Impact Analysis

Technique (Cont'd):

- Step 3 – Impact Delays

  Establish the nature and duration of the delay events

  Introduce delay events into the updated baseline programme in an appropriate manner

  Recalculate programme to establish delay to completion (i.e. delay immediately **post**-delay event introduction)

  The difference between the **pre** and **post** update analyses results is determined to be the likely delay of the particular delay event

- Step 'n' – Repeat steps 2 and 3 for every delay event

Time Impact Analysis

Very strong recommendation of its use from the SCL Delay & Disruption Protocol:

> Time Impact Analysis *"is the preferred technique to resolve complex disputes related to delay and compensation for that delay"* - paragraph 4.8.
>
> *"The Protocol recommends that this methodology be used wherever the circumstances permit …"* - paragraph 3.2.11.
>
> *"in deciding entitlement to EOT, the adjudicator, judge or arbitrator should so far as is practicable put him/herself in the position of the Contract Administrator at the time the Employer Risk Event occurred"* - paragraph 4.19

It is considered that Time Impact Analysis:

- Is a totally appropriate method for use contemporaneously during the project
- Is generally not an appropriate method for use in post-contract disputes

Time Impact Analysis

- Time Impact Analysis only establishes ‘likely’ delay. It does not establish ‘actual’ delay.
- Likely delay can only be used to establish a potential entitlement to an extension of time (and therefore a potential relief from LADs).
- Typically cost claims can only be recovered on the basis of ‘actual’ delay.
- Time Impact Analysis is the most expensive type of delay analysis to prepare.

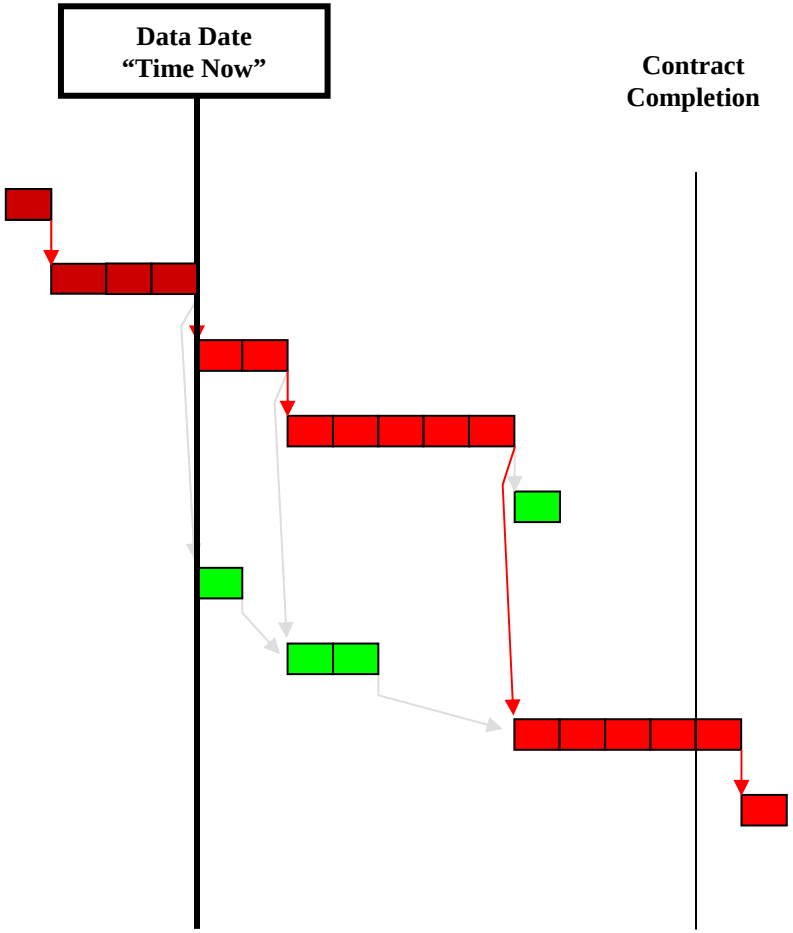
Time Impact Analysis

Criteria for reliable analysis are:

- Baseline programme must be achievable.
- Programme's logic / network must be capable of simulating progress and impact of change appropriately.
- The programme should be updated with detailed and accurate progress / as-built data.
- The remaining planned sequence of the programme for each updated analysis must reflect the Contractor's known future intentions.
- The delay events to be introduced should be based only upon information known at the date of the time slice.
- All known delay events as of the data date of the time slice (irrespective of liability) should be taken into account.

Time Impact Analysis

	% complete	Days Remaining
Mobilise	100	0
Excavate 1	100	0
Foundation 1	0	2
Pillar 1	0	5
Coping 1	0	1
Excavate 2	0	1
Foundation 2	0	2
Pillar 2	0	5
Coping 2	0	1



Time Impact Conclusions: As at Day 4:

Problems in excavation led to a 2 day prolongation and hence a projected delay to completion

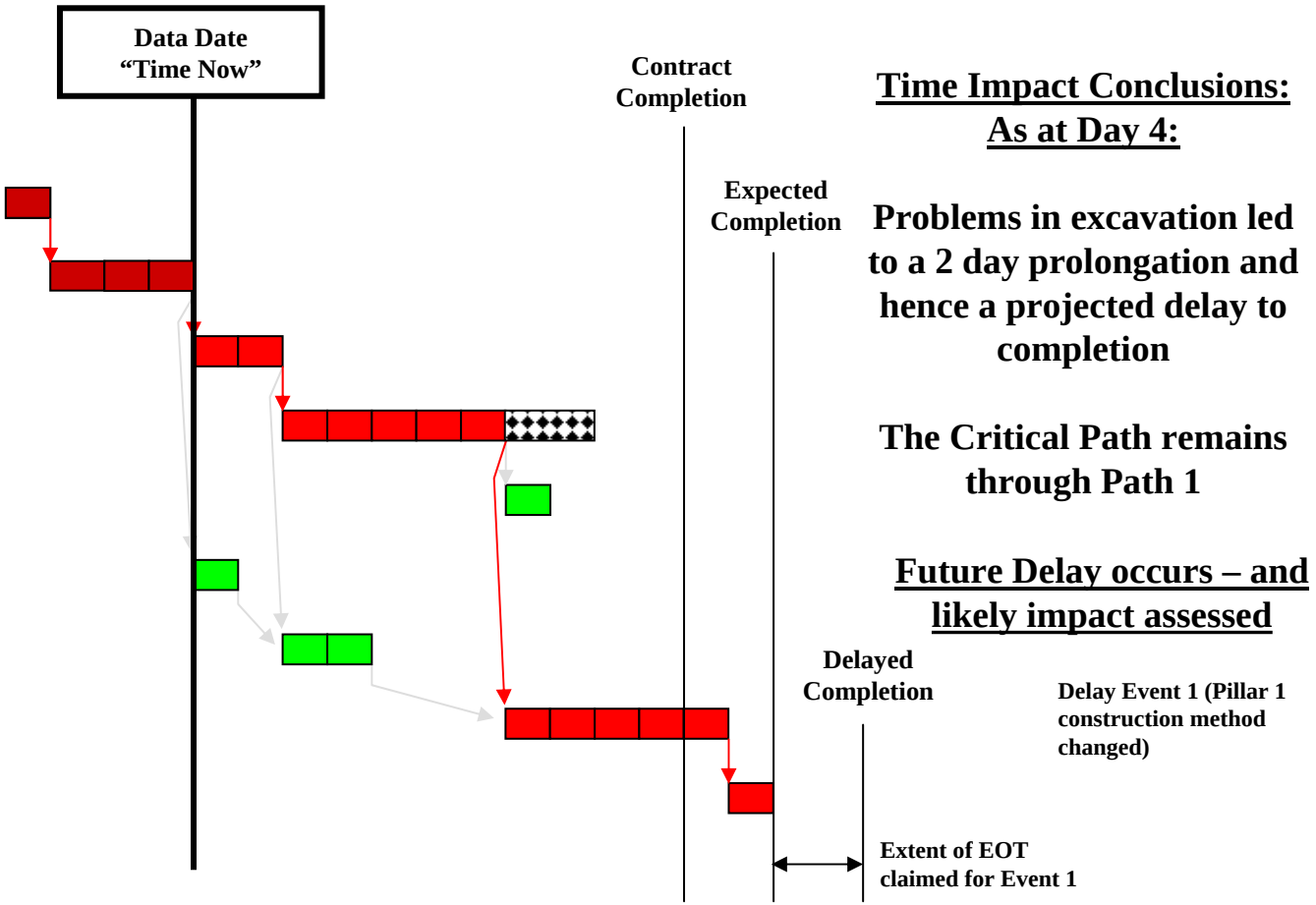
The Critical Path remains through Path 1

Future Delay occurs – and likely impact assessed

Delay Event 1 (Pillar 1 construction method changed)

Time Impact Analysis

	% complete	Days Remaining
Mobilise	100	0
Excavate 1	100	0
Foundation 1	0	2
Pillar 1	0	5
Coping 1	0	1
Excavate 2	0	1
Foundation 2	0	2
Pillar 2	0	5
Coping 2	0	1



Time Impact Conclusions: As at Day 4:

Problems in excavation led to a 2 day prolongation and hence a projected delay to completion

The Critical Path remains through Path 1

Future Delay occurs – and likely impact assessed

Collapsed As-Built/But For Analysis

Establishes the hypothesis of what the completion date would have been if the delay event had not happened.

Technique:

- Step 1 – As-Built Programme

  Compile Detailed As-Built Programme

- Step 2 – Networked As-Built Programme

  Introduce logic links into the As-Built programme so that it can be used dynamically

- Step 3 – Identify Delays

  Identify where delays exist in the as-built programme activities

Collapsed As-Built/But For Analysis

Technique (Cont'd):

- Step 4 – "But For" Delay Analysis

  Adjust programme logic to enable delays to be extracted

  Extract delays

  Recalculate programme to determine whether an earlier completion date could have been achieved absent the delay event(s)

  The improvement in completion date is established to be the net impact of the extracted delay event(s)

Collapsed As-Built/But For Analysis

Factually based – that's good news!

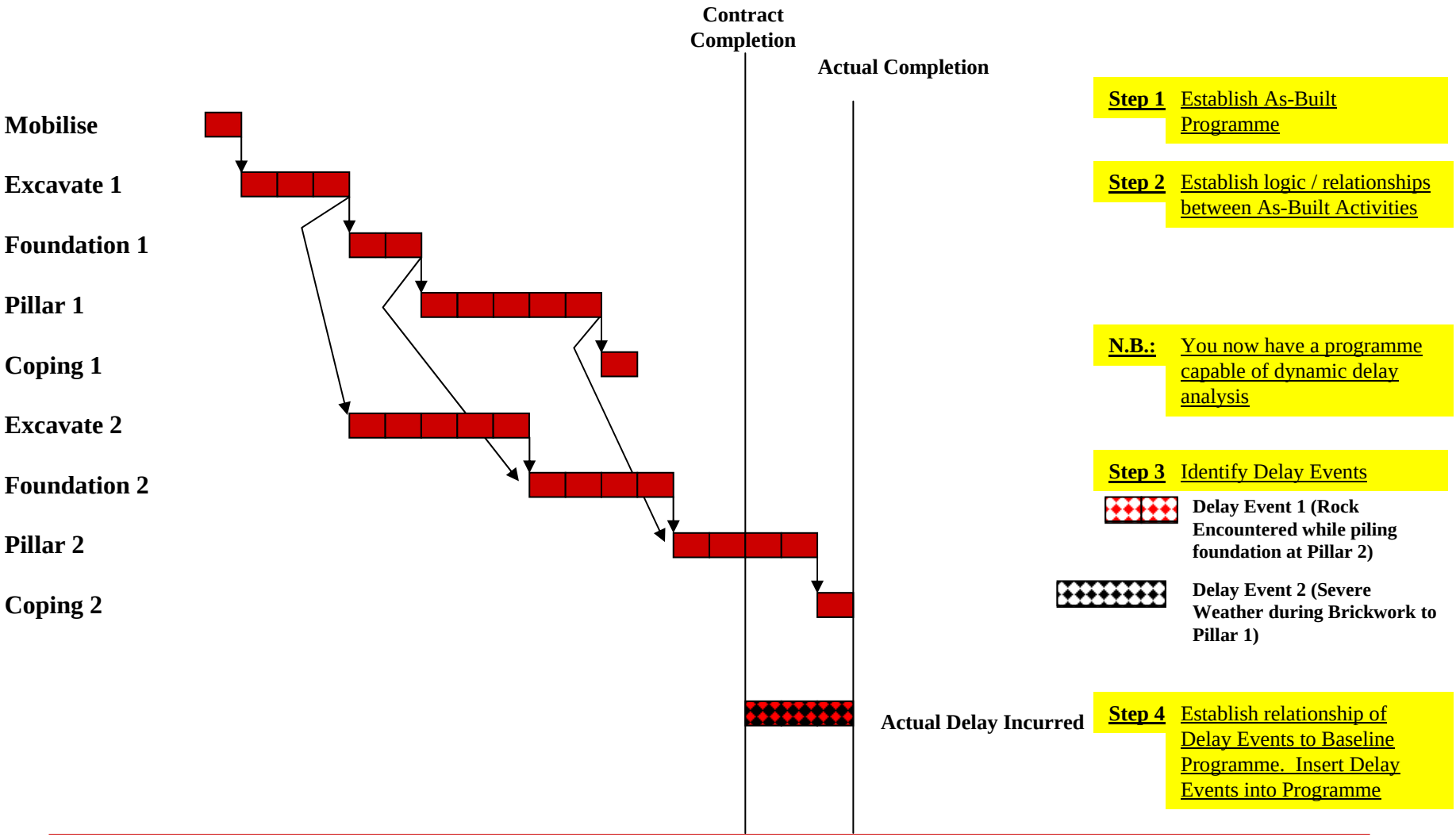
But it must be remembered the result is a hypothesis.

That hypothesis must be checked and challenged before being presented.

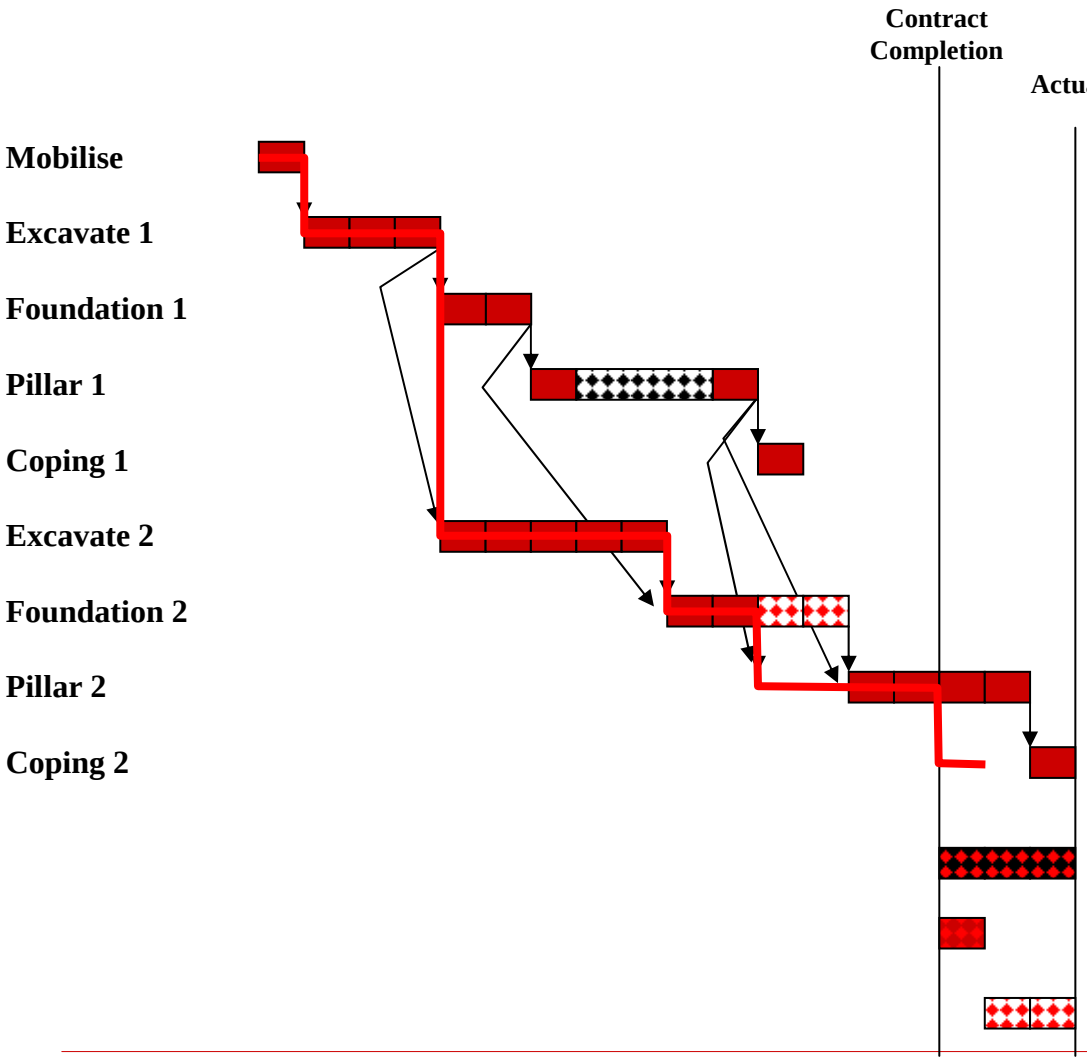
It is extraordinarily difficult to establish a 'networked' As-Built programme.

It is usually a Respondent's analysis – "look you would have been late anyway – therefore the delay event was inconsequential".

Collapsed As-Built/But For Analysis



Collapsed As-Built/But For Analysis



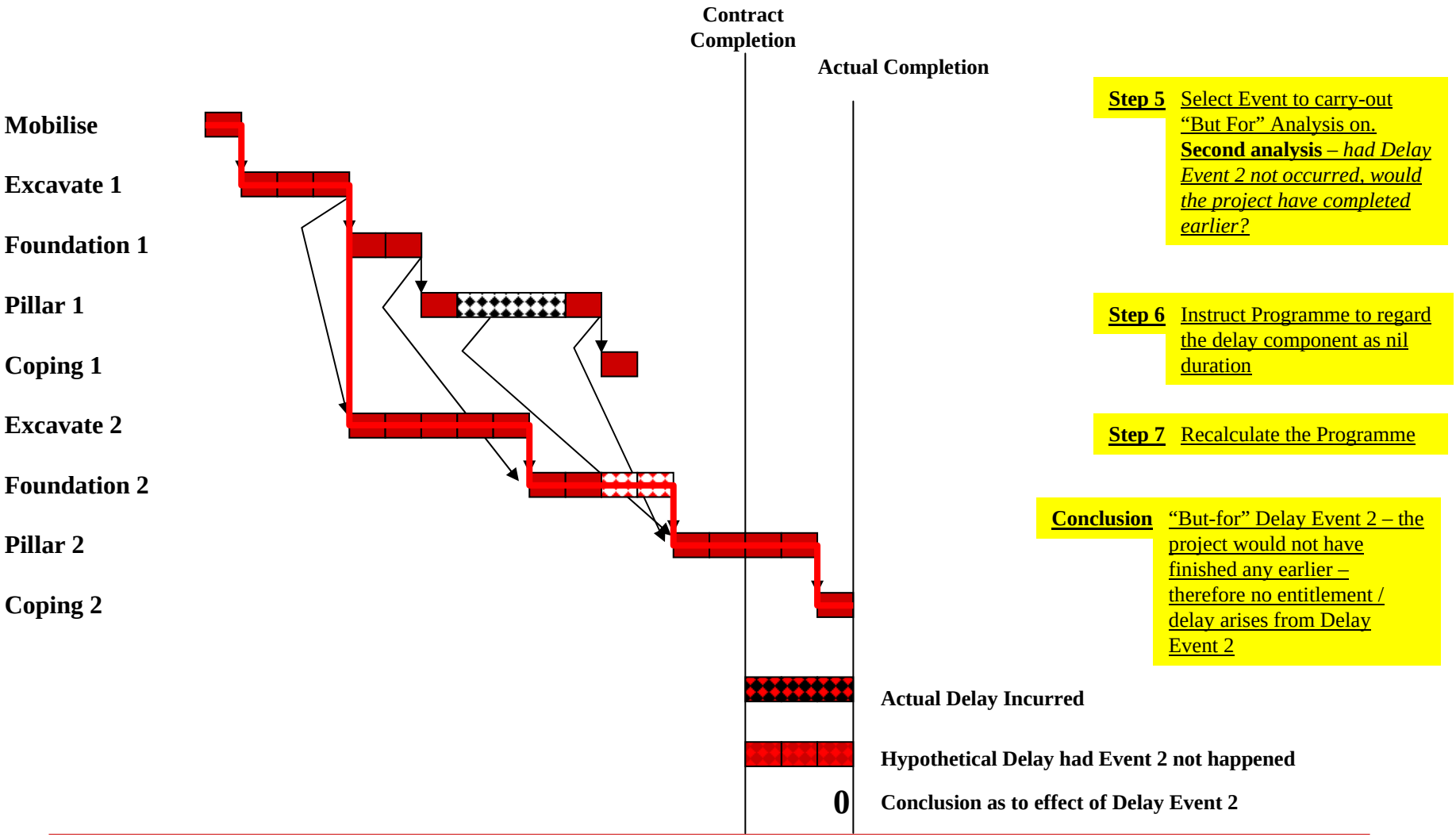
Step 5 Select Event to carry-out "But For" Analysis on.
First analysis – *had Delay Event 1 not occurred, would the project have completed earlier?*

Step 6 Instruct Programme to regard the delay component as nil duration

Step 7 Recalculate the Programme

Conclusion "But-for" Delay Event 1 – the project would have finished 2 days earlier – therefore 2 days entitlement / delay arises from Delay Event 1

Collapsed As-Built/But For Analysis



Step 5 Select Event to carry-out "But For" Analysis on.
Second analysis – *had Delay Event 2 not occurred, would the project have completed earlier?*

Step 6 Instruct Programme to regard the delay component as nil duration

Step 7 Recalculate the Programme

Conclusion "But-for" Delay Event 2 – the project would not have finished any earlier – therefore no entitlement / delay arises from Delay Event 2

Collapsed As-Built/But For Analysis

Requires good progress records.

Can be very difficult to establish logic between as-built activities.

Result is hypothetical not actual.

Relationships between delays are generally not considered.

One must check the validity of the hypothesis?

> The hypothesis is based upon what happened minus the event. But would other decisions have been made / other sequences adopted / other initiatives tried / other resource strategies employed, had the delay event not been in existence?

Generally no account taken of intentions.

Little regard given to the route the critical path actually took.

Tends to focus on one party's delays such that concurrency and criticality accrue to the author's benefit.

Windows/Time Slice Analysis

Windows/Time Slice Analysis:

Windows break the project into manageable periods of time, and promote detailed focus and analysis.

This method establishes the actual delay incurred in each Window.

It operates on the principle that critical delays must be located upon the actual critical path.

Technique:

- Step 1 – Baseline Programme
  - Locate most appropriate programme to use as a baseline
  - Establish reasonableness
  - Ensure ‘networked’ and suitable for dynamic analysis
- Step 2 – Update Programme at regular intervals (usually monthly)
  - Using the available detailed and regular progress data

Windows/Time Slice Analysis

Technique (Cont'd):

- Step 3 – Determine Critical Path and Extent of Delay in each Window

  Each programme update will identify which path / sequence of activities is most critical

  Each programme update will identify what the projected completion date is (and therefore the delay to completion when measured against the contract)

- Step 4 – Investigate critical path to determine the causes of delay

  Detailed forensic investigation of the contemporaneous records pertaining to the critical path in each Window where delay was incurred

  Report findings

Windows/Time Slice Analysis

Involves updating the programme to establish delay status and critical path at regular intervals throughout the project.

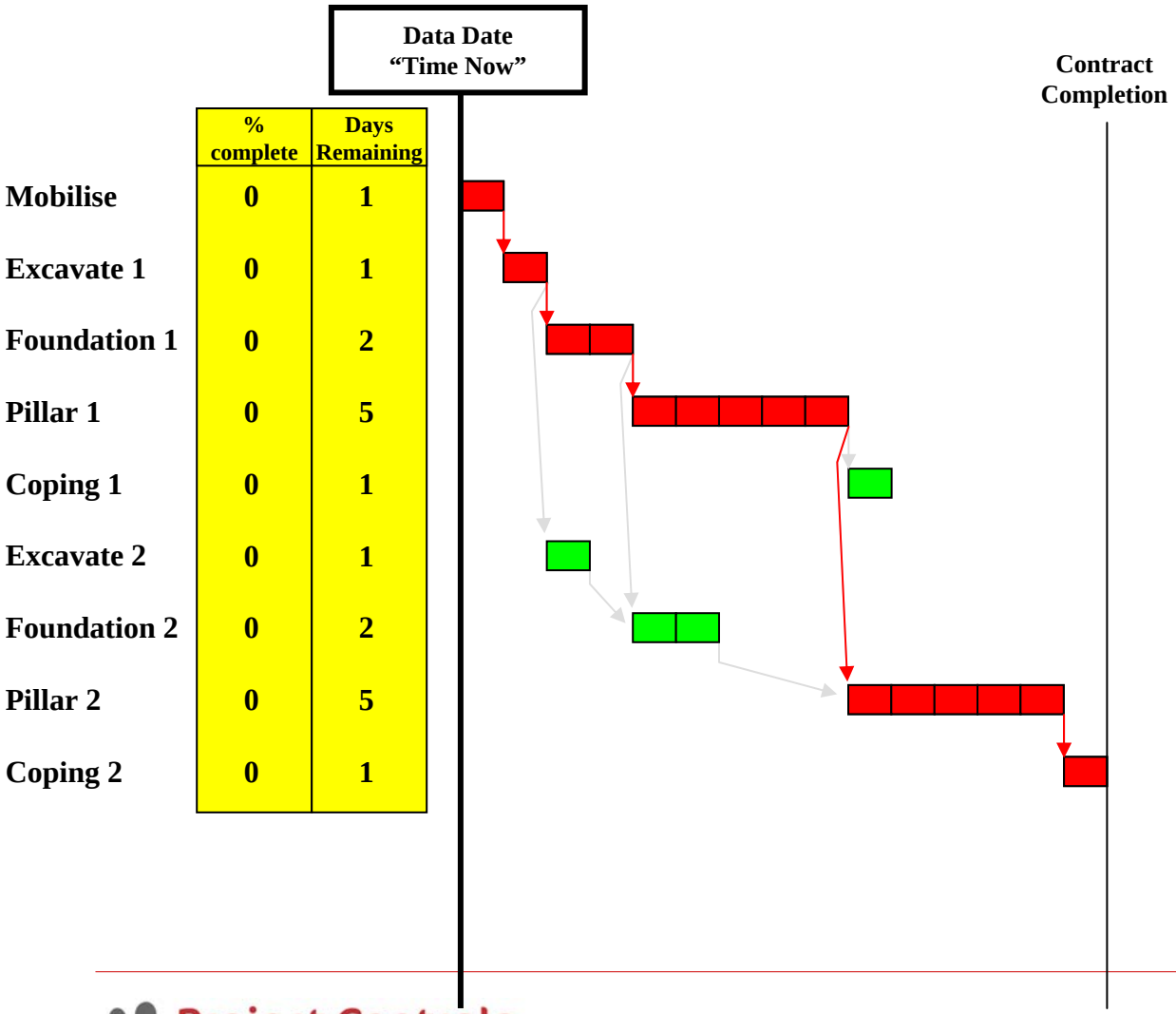
Can be a very reliable and effective method of delay analysis.

Changes to the critical path from one Window to another raises the question of when exactly the critical path switched.

If this method is to be reliable then:

- Baseline programme must be achievable, ‘networked’, and detailed
- The logic within the programme must be suitable for updating
- Regular, detailed and accurate progress data must be available for updating
- The future element of each updated programme must accurately and reasonably represent the status of the works at that time and the contractors intentions

Windows/Time Slice Analysis



	% complete	Days Remaining
Mobilise	0	1
Excavate 1	0	1
Foundation 1	0	2
Pillar 1	0	5
Coping 1	0	1
Excavate 2	0	1
Foundation 2	0	2
Pillar 2	0	5
Coping 2	0	1

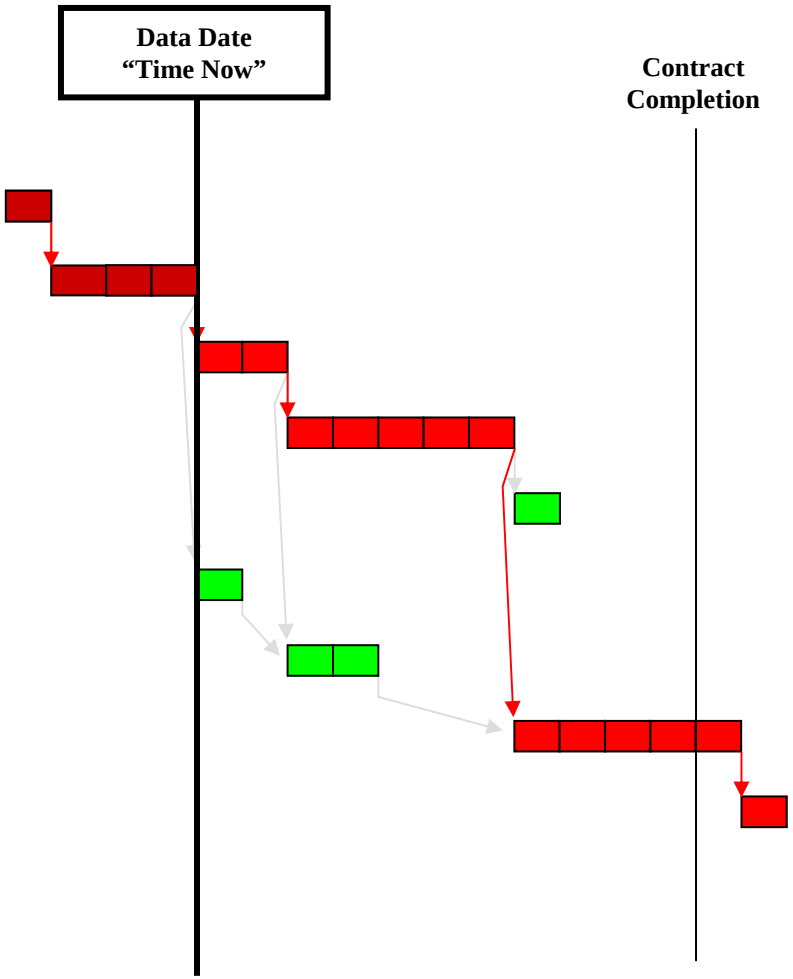
Conclusions:
As at Day 0:

There is no projected delay to completion

The Critical Path runs through Path 1

Windows/Time Slice Analysis

	% complete	Day Remaining
Mobilise	100	0
Excavate 1	100	0
Foundation 1	0	2
Pillar 1	0	5
Coping 1	0	1
Excavate 2	0	1
Foundation 2	0	2
Pillar 2	0	5
Coping 2	0	1



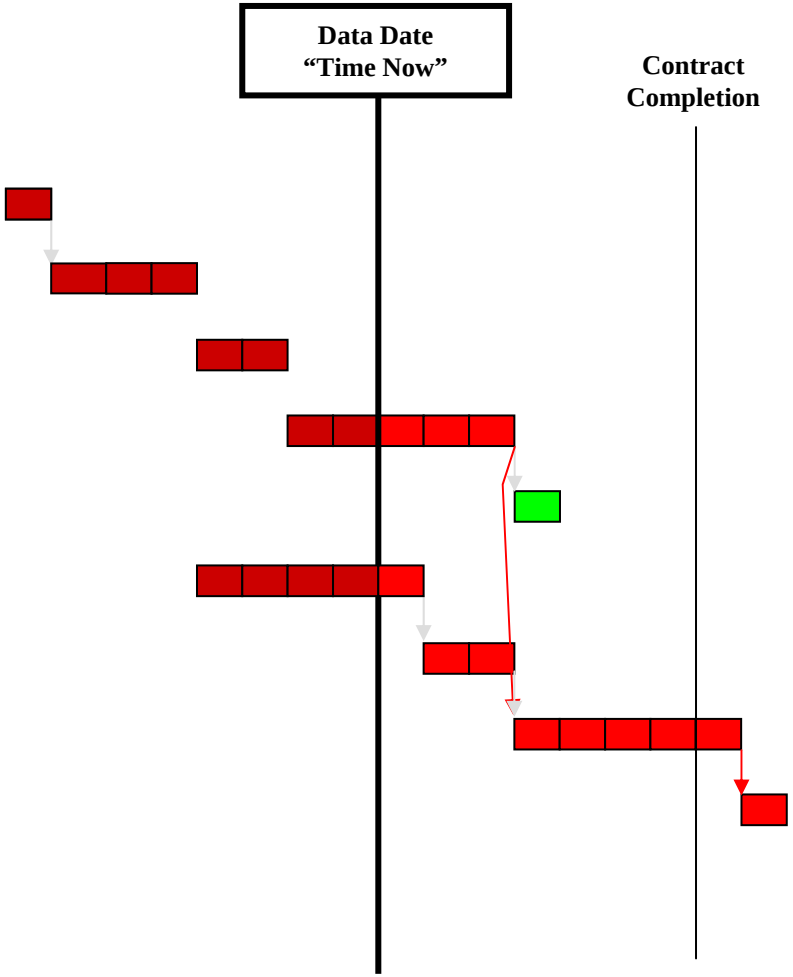
Conclusions:
As at Day 4:

Problems in excavation led to a 2 day prolongation and hence a projected delay to completion

The Critical Path remains through Path 1

Windows/Time Slice Analysis

	% complete	Days Remaining
Mobilise	100	0
Excavate 1	100	0
Foundation 1	100	0
Pillar 1	40	3
Coping 1	0	1
Excavate 2	80	1
Foundation 2	0	2
Pillar 2	0	5
Coping 2	0	1

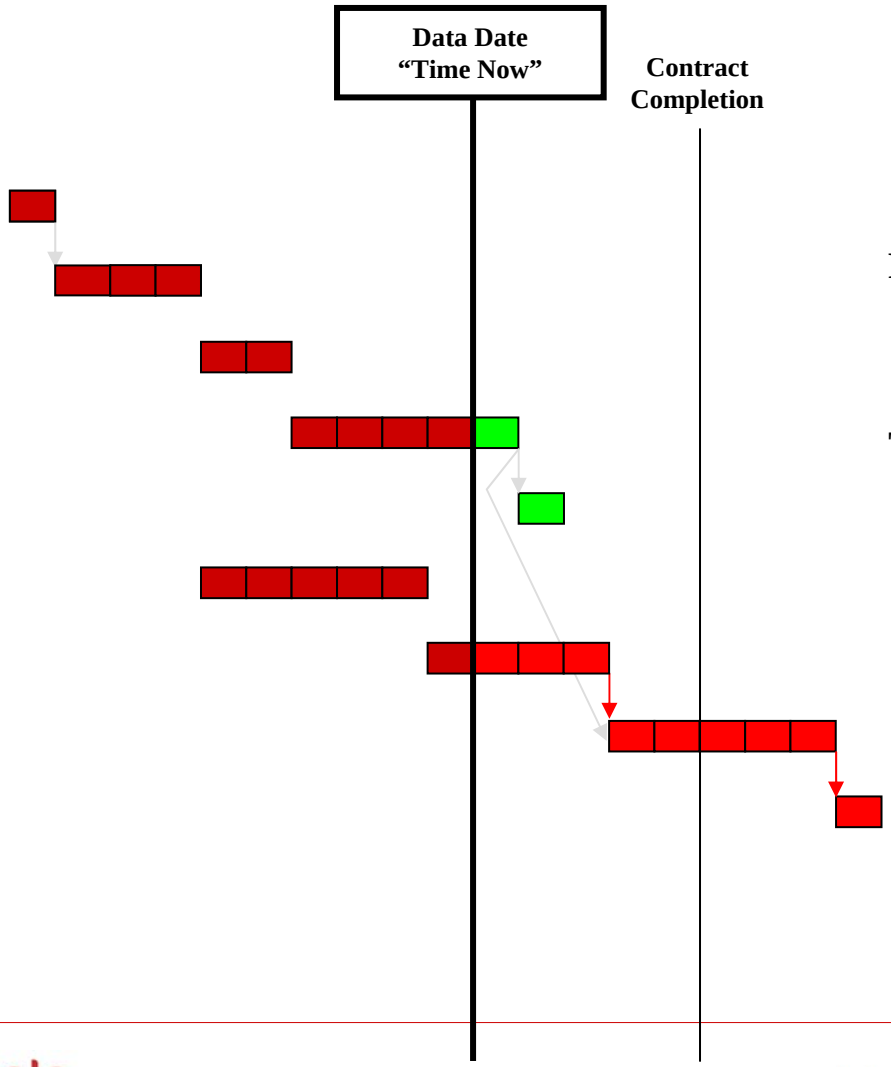


Conclusions:
As at Day 8:

Pillar 2 excavation is also prolonged. However, there remains a 2 day projected delay to completion
But
Now the Critical Path runs through BOTH Paths 1 & 2

Windows/Time Slice Analysis

	% complete	Days Remaining
Mobilise	100	0
Excavate 1	100	0
Foundation 1	100	0
Pillar 1	80	1
Coping 1	0	1
Excavate 2	100	0
Foundation 2	25	3
Pillar 2	0	5
Coping 2	0	1

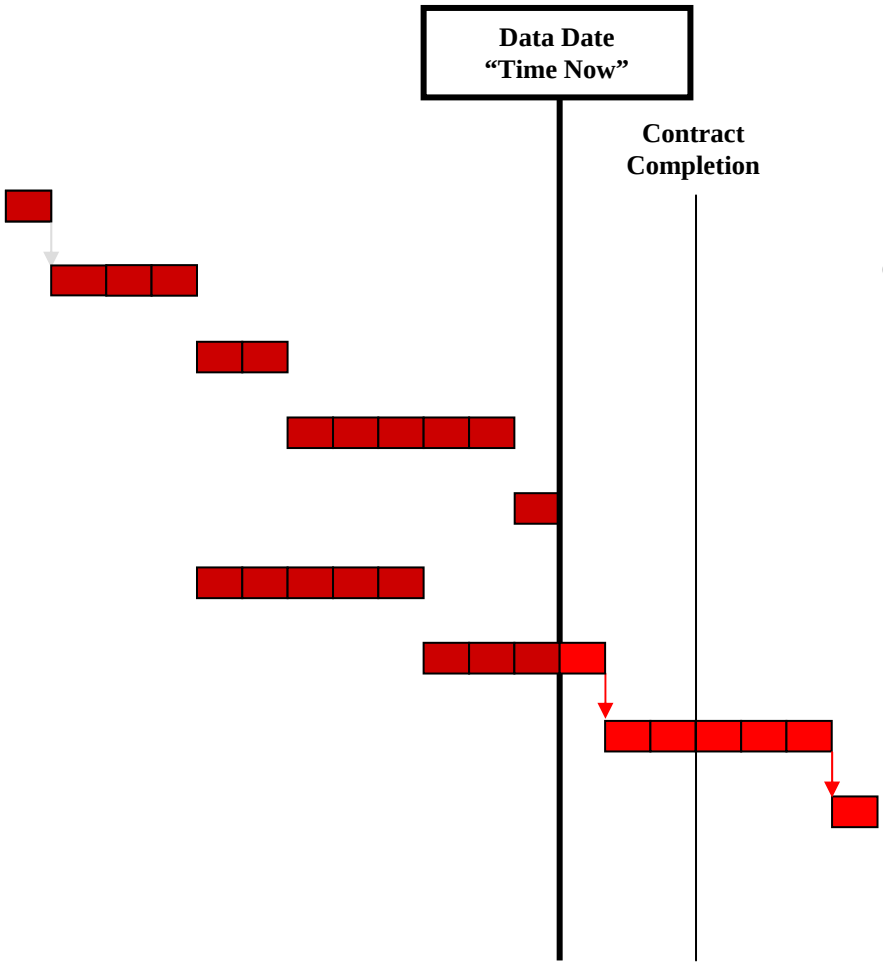


Conclusions:
As at Day 10:

An additional delay to Foundation 2 has increased the projected delay to completion to 4 days
&
The Critical Path now runs only through Path 2

Windows/Time Slice Analysis

	% complete	Days Remaining
Mobilise	100	0
Excavate 1	100	0
Foundation 1	100	0
Pillar 1	100	0
Coping 1	100	0
Excavate 2	100	0
Foundation 2	75	1
Pillar 2	0	5
Coping 2	0	1

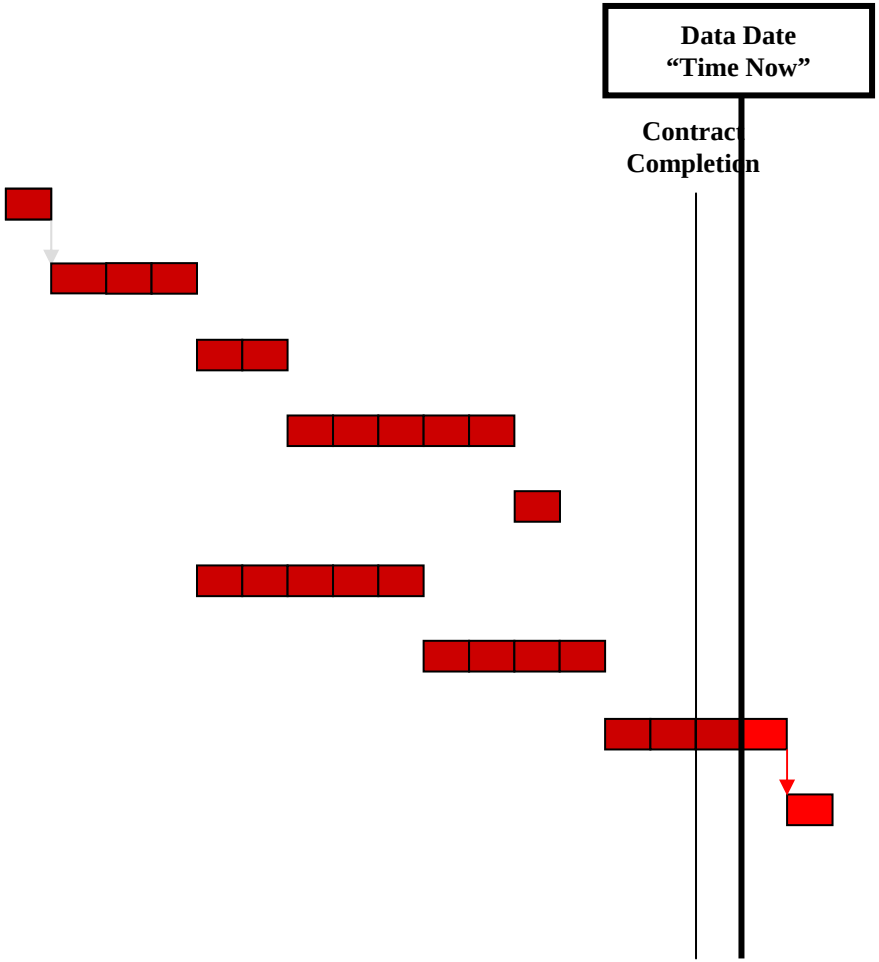


Conclusions:
As at Day 12:

The projected delay to completion has increased to 4 days
&
The Critical Path runs through Path 2

Windows/Time Slice Analysis

	% complete	Days Remaining
Mobilise	100	0
Excavate 1	100	0
Foundation 1	100	0
Pillar 1	100	0
Coping 1	100	0
Excavate 2	100	0
Foundation 2	100	0
Pillar 2	75	1
Coping 2	0	1



Conclusions:

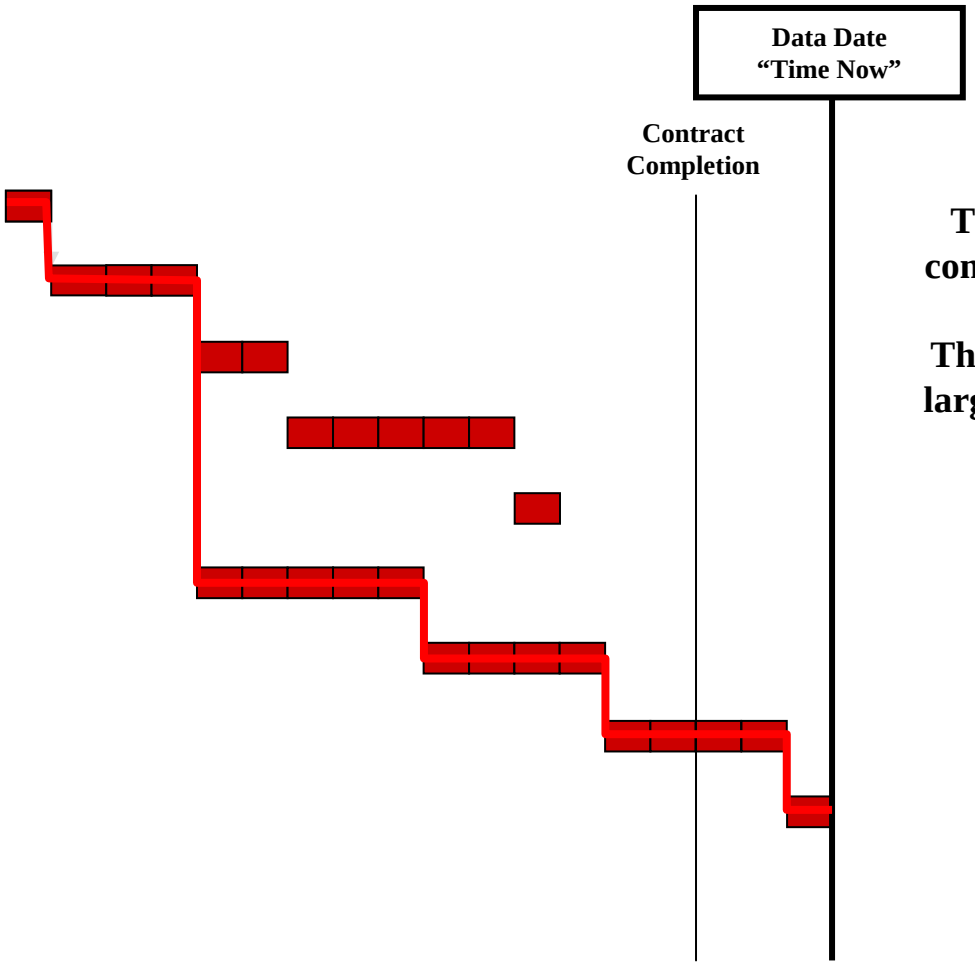
As at Day 16:

Increased resources has led to a reduced time to complete pillar 2, reducing the projected delay to completion to 3 days

The Critical Path remains through path 2

Windows/Time Slice Analysis

	% complete	Days Remaining
Mobilise	100	0
Excavate 1	100	0
Foundation 1	100	0
Pillar 1	100	0
Coping 1	100	0
Excavate 2	100	0
Foundation 2	100	0
Pillar 2	100	0
Coping 2	100	0



Conclusions:
As at Day 18:

The actual delay to completion was 3 days

The Critical Path ran largely through path 2

As-Planned v As-Built

Windows break the project into manageable periods of time, and promote detailed focus and analysis

This method establishes the actual delay incurred in each Window

It operates on the principle that critical delays must be located upon the actual critical path

Technique:

- Step 1 – Establish a comprehensive understanding of the following:

  The scope of work

  The Baseline Programme

  The As-Built Programme

  The progress of the works and development of issues as evidenced by the contemporaneous records

As-Planned v As-Built

Technique (Cont'd):

- Step 2 – Establish the Actual Critical Path activities in each Window using the following progressive analyses:

  Common Sense

  Practical planning and project management experience

  Discrete programme calculations – use sparingly and with great care

- Step 3 – Determine Incidence and Extent of Delay in each Window

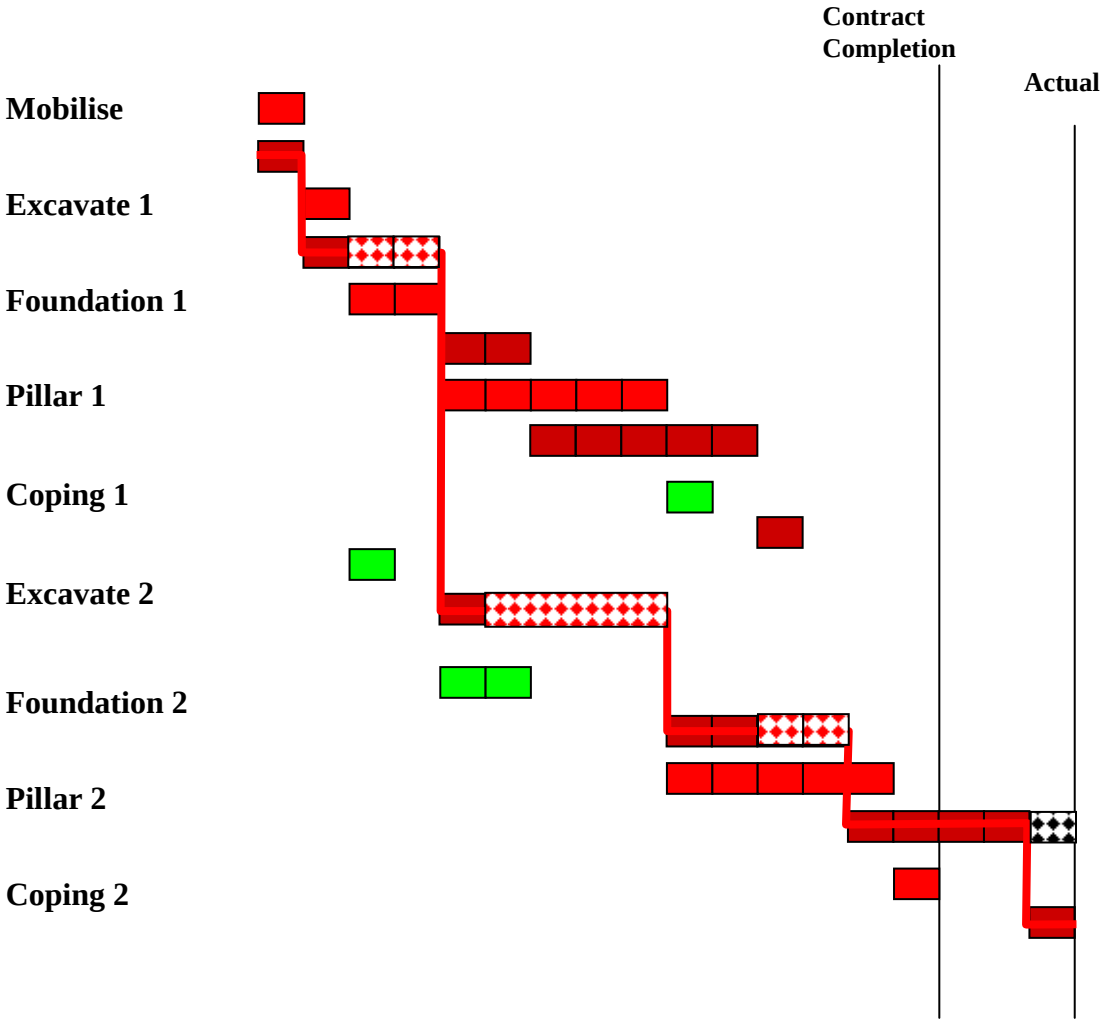
  Compare As-Built data from the critical path to the related as-planned data to determine delays

- Step 4 – Investigate critical path to determine the causes of delay

  Detailed forensic investigation of the contemporaneous records pertaining to the critical path in each Window where delay was incurred

  Report findings

As-Planned v As-Built

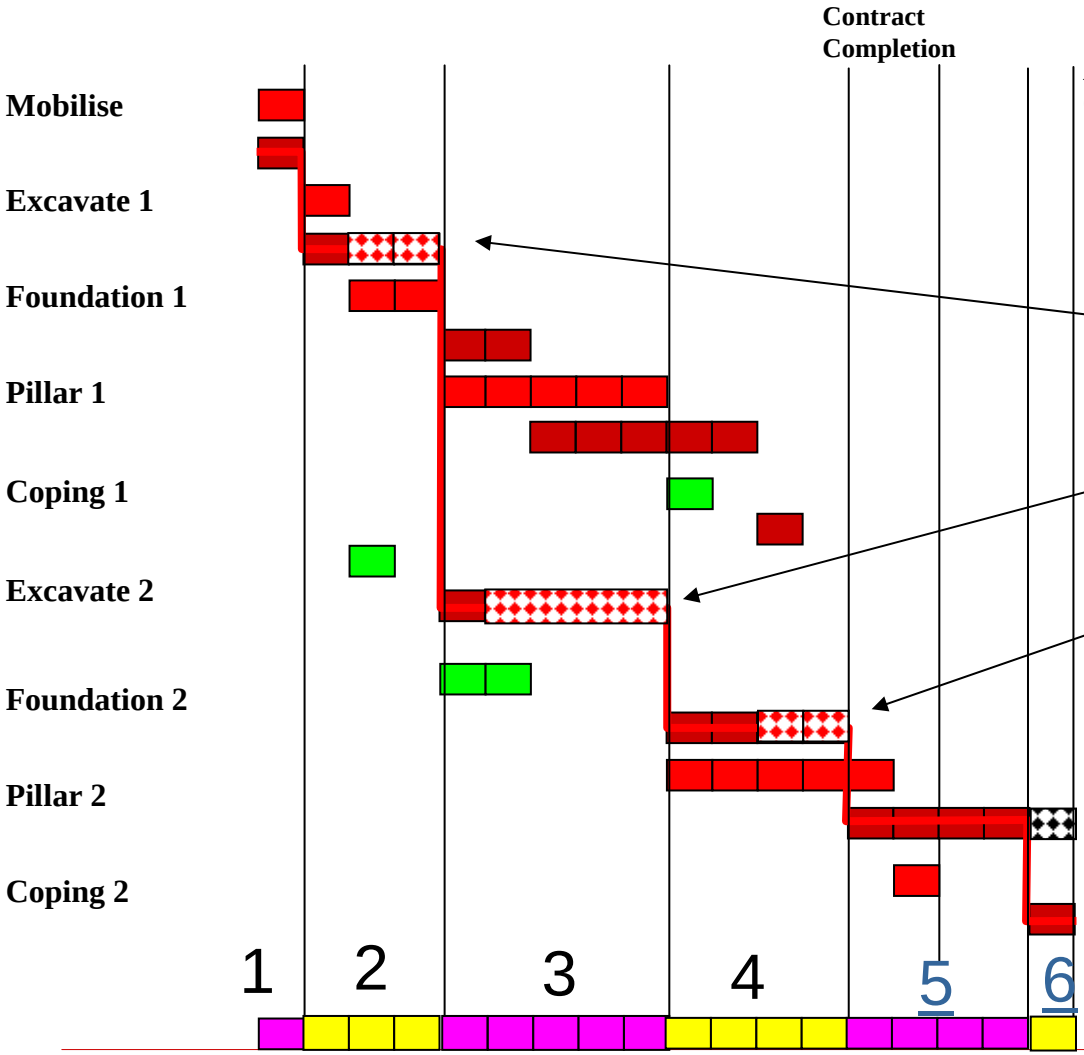


Step 1 Consider both As-Built and as-planned Programmes

Step 2 Identify, from the factual matrix and the as-built programme, the critical path

Step 3 Compare programmes to identify areas of delay and recovery

As-Planned v As-Built



Step 4 Identify "Delay windows"

Step 5 Identify reason / explanation for delays encountered

Delay 1 – Rock at excavation – 2 days critical delay

Delay 2 – Severe Rock at excavation – 4 days delay – but not critical (this activity had 4 days float)

Delay 3 – Problems with foundation concrete – 2 days critical delay – investigate cause– could be Event 1

Recovery 1 – Additional resources reduced pillar construction – 1 day critical recovery

Step 6 Consider responsibility, and hence EOT due, for critical delays. Non-critical delays may be deserving of Loss and Expense payment, but no EOT.

As-Planned v As-Built

Easy to apply

The analysis is investigation / record-based, so results should accord well with the facts

Performed carefully, this method is robust, considers all difficult areas of delay, and stands up to scrutiny

A reliable and effective method of delay analysis

If done properly, the conclusions from this analysis should:

Be entirely consistent with the facts

Meet common sense

Make practical (planning & project management) sense

Be easy to convey and difficult to undermine

But most of all – be right!

Which Method?

Main Criteria for selection:

- What does the Contract require?
- Which approach is appropriate, correct, sustainable?
- Does a lack of information preclude the use of any of the approaches?
- Do time/cost constraints eliminate certain options?
- ABOVE ALL, KEEP IT SIMPLE, WELL PRESENTED AND GROUNDED IN THE FACTS!