



The Critical Path in Forensic Delay Analysis

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- *“Alan Whaley is a seasoned delay expert with an excellent reputation in the market. Clients say, ‘He is quick to identify issues and appreciates legal and practical considerations as well as complex technical and financial matters.’” **Who’s Who Legal***
- *“I found Alan to be an excellent expert who, in recognition that delay analysis is a subject regarded by most to be of a highly technical nature and of which many arbitrators are unfamiliar with, provided a concise and readable report, which is an art lost on many experts.” **Counsel for Claimant, DIAC Arbitration***
- *“I found Alan to be highly professional and was impressed with his technical knowledge. I was very happy to have him on our team as a Quantum Expert Witness.” **Counsel for Respondent***
- *“I therefore accept Mr Whaley’s analysis of the culpability for the delay. First because I accept his analysis of the critical path and secondly having considered important matters of difference, as between Mr Whaley and Mr [X] as set out above.” **Leading QC***
- *“I do not consider there is any answer to the thrust of Mr Whaley’s observations and criticisms. They are in my view well made”. **Adjudicator***
- *“I have been assisted by Mr Whaley’s analyses, particularly by his second report which reviews the further evidence and [Mr X’s] response to his first report... I have been struck by the examples relied upon by Mr Whaley illustrating the flaws in [Mr X’s] approach” **Leading QC***
- *“I have now had an opportunity to review Alan’s report ...It is clear, succinct and reads extremely well – one of the clearest delay reports I have had the pleasure of reading!” **Counsel for Respondent***

Today

- What is the critical path?
- The critical path in project management
- The critical path in forensic delay analysis
- Questions/Discussion

What is the critical path?

The sequence of activities through a project network from start to finish, the sum of whose durations determines the overall Project duration

BS 6079-2:2000 Project management. Vocabulary. Part 2, 2.41

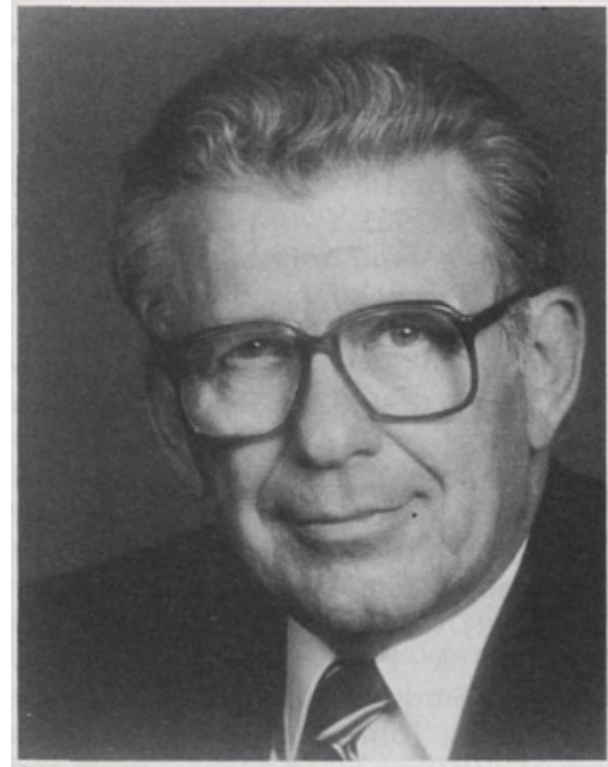
What is the critical path?



Critical path method



JAMES E. KELLEY, JR.

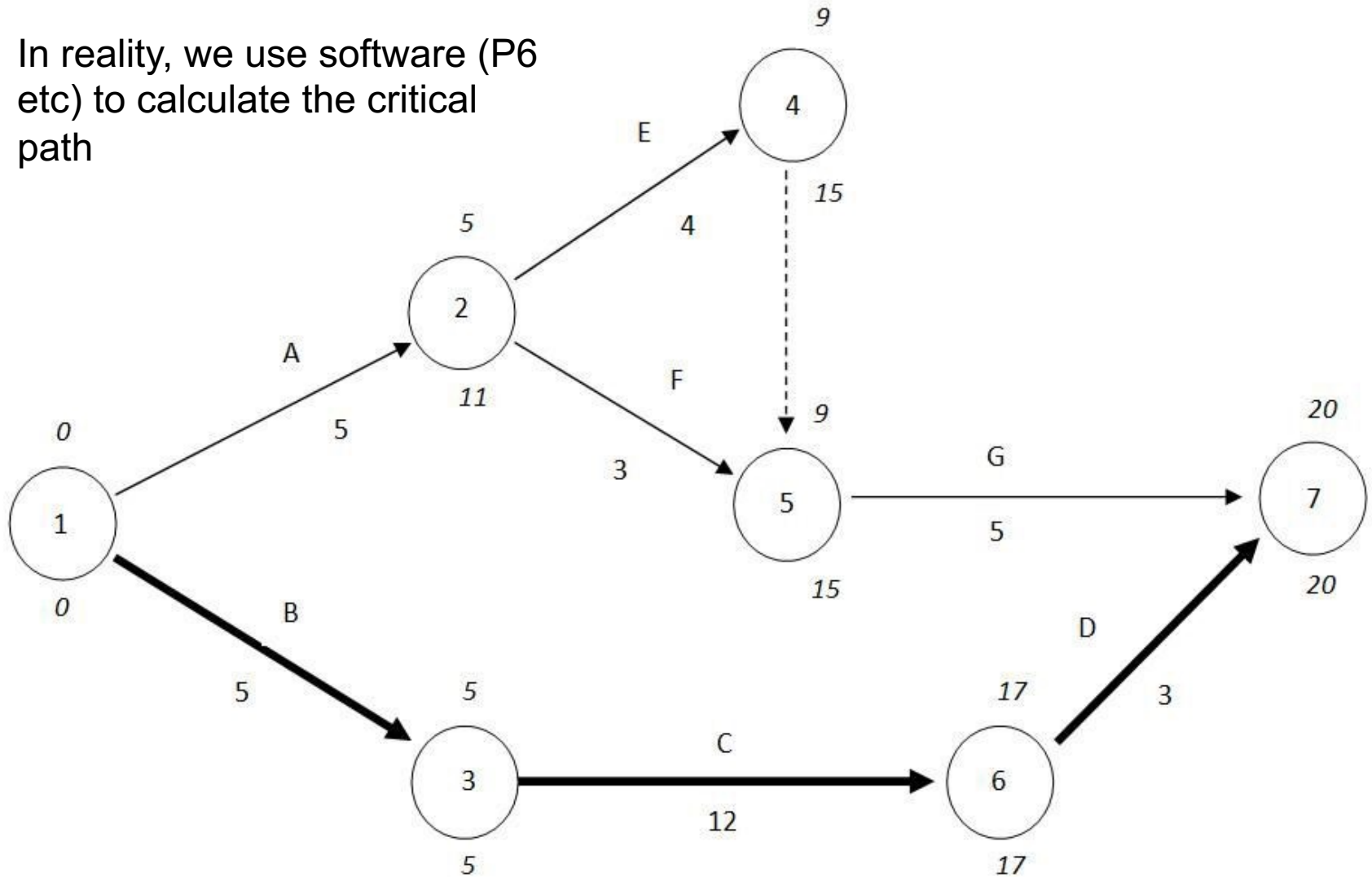


MORGAN R. WALKER

Kelly, J., Walker, R. (1959): Critical-path planning and scheduling, IRE-AIEE-ACM '59 (Eastern): Papers presented at the December 1-3, 1959, eastern joint IRE-AIEE-ACM computer conference December 1959

Critical path method

In reality, we use software (P6 etc) to calculate the critical path



The critical path in project management

*The process of analysing the critical and near critical activities in a CPM programme to **manage progress, balance resource allocations and ascertain delays or acceleration** to the date for completion or the completion date of the works, a section or a milestone.*

The critical path in project management

Used to collect pertinent information to accomplish the following tasks:

- 1) To form a basis for prediction and planning
- 2) To evaluate alternative plans for accomplishing the objective
- 3) To check progress against current plans and objectives, and
- 4) To form a basis for obtaining the facts so that decisions can be made and the job can be done.

Identifying the critical path (and float relative to it) is the time key management tool for complex projects.

So what?

*By now one would have thought that it was well understood that, on a contract of this kind, in order to attack, on the facts, a clause 24 certificate for non-completion (or an extension of time determined under clause 25), **the foundation must be the original programme and its success will similarly depend on the soundness of its revisions on the occurrence of every event**, so as to be able to provide a satisfactory and convincing demonstration of cause and effect.*

A valid critical path (or paths) has to be established both initially and at every later material point since it (or they) will almost certainly change.

Balfour Beatty Construction Ltd v London Borough of Lambeth [2002] EWHC 597 (TCC)

Limitations of critical path method

- CPM estimates tend to be based on what “can” be achieved, not what will likely be achieved.
- Human judgment is generally optimistic due to overconfidence and insufficient consideration of past outcomes (Kahneman & Amos, 1977).
- Statistical evidence shows that unplanned events are often unaccounted for during project planning (Flyberg, 2008).

Limitations of critical path method

- Critical path method does not explicitly consider resource limitations or logistic constraints
- Flexible nature of work often renders computed critical path redundant, as sequence evolves
- Classic CPM is most suited for hard dependencies and vertical construction.
- Much less suited to volume projects and horizontal construction

Vivergo v Redhall

*[A]s is common ground between the experts in this case, **the use of critical path analysis is not really an appropriate way of analysing this type of bulk build project.***

The project... was dependent on resources and each area therefore needed the necessary resources to be committed to it. If any area did not have the necessary resources applied to it or if those resources did not achieve the expected productivity that area would be in delay.

Depending on the amount of delay to one area compared to another area then the delay to a particular area could cause critical delay to the overall completion of Redhall's work.

Common pitfalls: project managers

- Not having a view on the current critical path
- Failing to adjust programme because it is “official”
- Failing to validate or use the programme critical path for management
- Project records not aligned with or contradicting programme
- Delay claims which ignore the critical path (“entitlement”)

Forensic delay analysis?

Why is the critical path important in forensic delay analysis?

- The critical path **is** the link between cause and effect
- Tribunals and experts focus specifically on critical path activities.
- **But**, in forensic analysis, the critical path is a factual issue – not a project management/P6 issue

Walter Lilley v Mackay (2012)

Why focus on the critical path in forensic analysis?

The logic is simply that if there are, say, two outstanding items of work, A and B, and A is always going to take 20 weeks to complete but B is only going to take 10 weeks, it is A which is delaying the work because B is going to finish earlier; overall completion is therefore dictated by the length of time needed for A.

*Put another way, it does not matter if B takes 19 weeks, **it will be the completion of A which has prevented completion.***

*Thus, **if one is seeking to ascertain what is delaying a contractor at any one time, one should generally have regard to the item of work with the longest sequence.***

Mirant v Ove Arup (2007)

Why focus on the critical path in forensic analysis?

Mr Hall, who was adamant in his evidence that the erection of the boiler was and remained on the critical path, wrote to SCC (Mr Smith and Mr Eller) on 8 May 1997 in terms which made it clear that he had expected proposals for resolution of the boiler problem to have been implemented already and that he now expected a speedy resolution of the problem.

His assertion, *without any critical path analysis*, that the boiler was always on the critical path... *is not supported by the Programming Experts.*

Fact not theory...

The question, at this stage, is what was driving completion of the relevant Milestones and overall completion?

That is a **factual** matter which **cannot be overridden** by **contractual or legal issues**.

Leading QC and TCC Judge, Adjudicator's Decision

Forensic delay analysis

- Three key issues:

- 1) Which critical path? (methodology)

- 2) Locating a critical path (method)

- 3) Validating your critical path (evidence)

Which critical path?

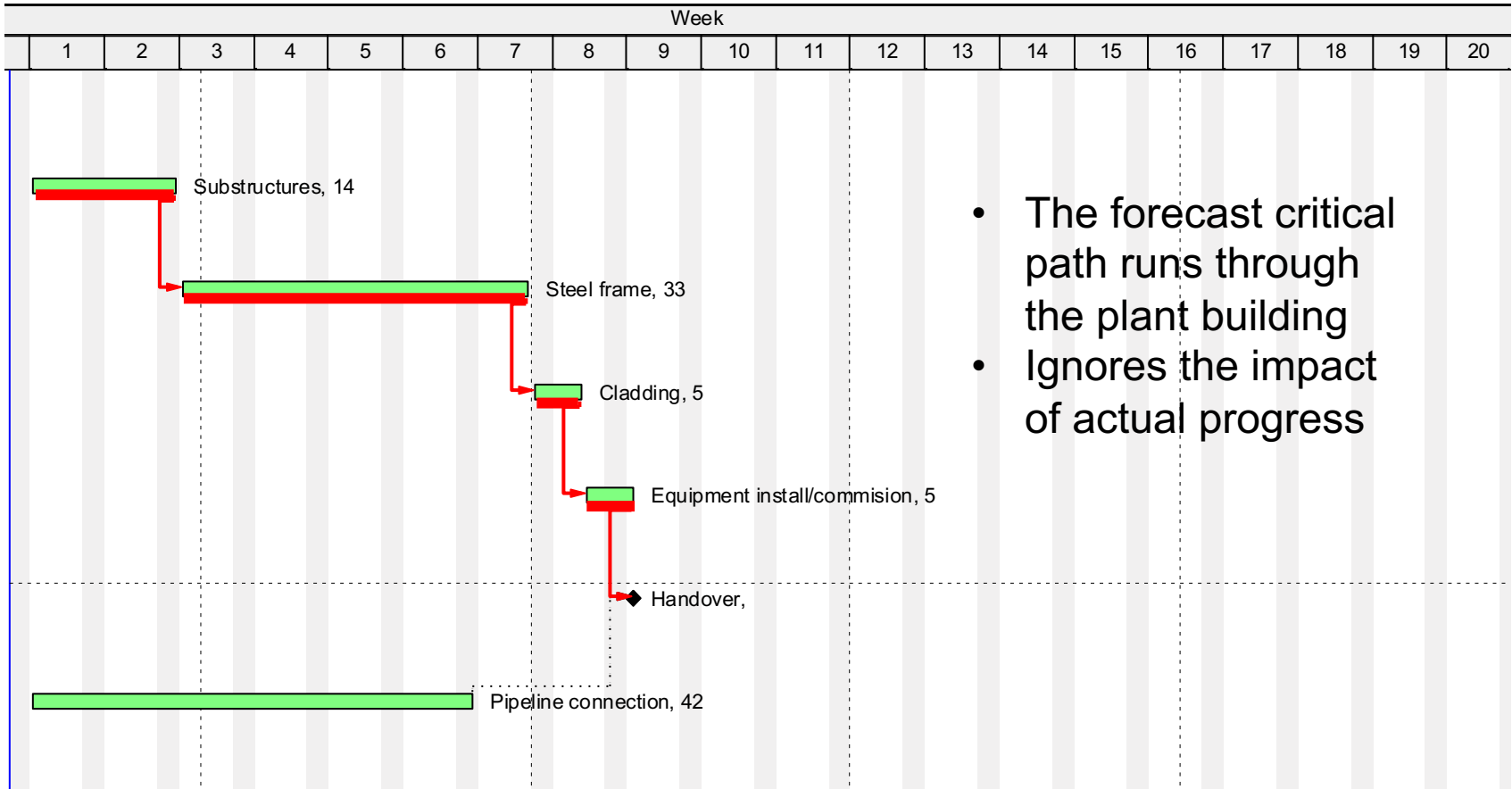
Three choices:

- Planned critical path (prospective)
- Actual critical path (contemporaneous)
- As-built critical path (retrospective)

Planned critical path

Planned Critical Path: Prospective critical path determined at the start of a time period based on contractor's plan. Ignores what actually happened and how the contractor actually constructed the work.

Planned critical path

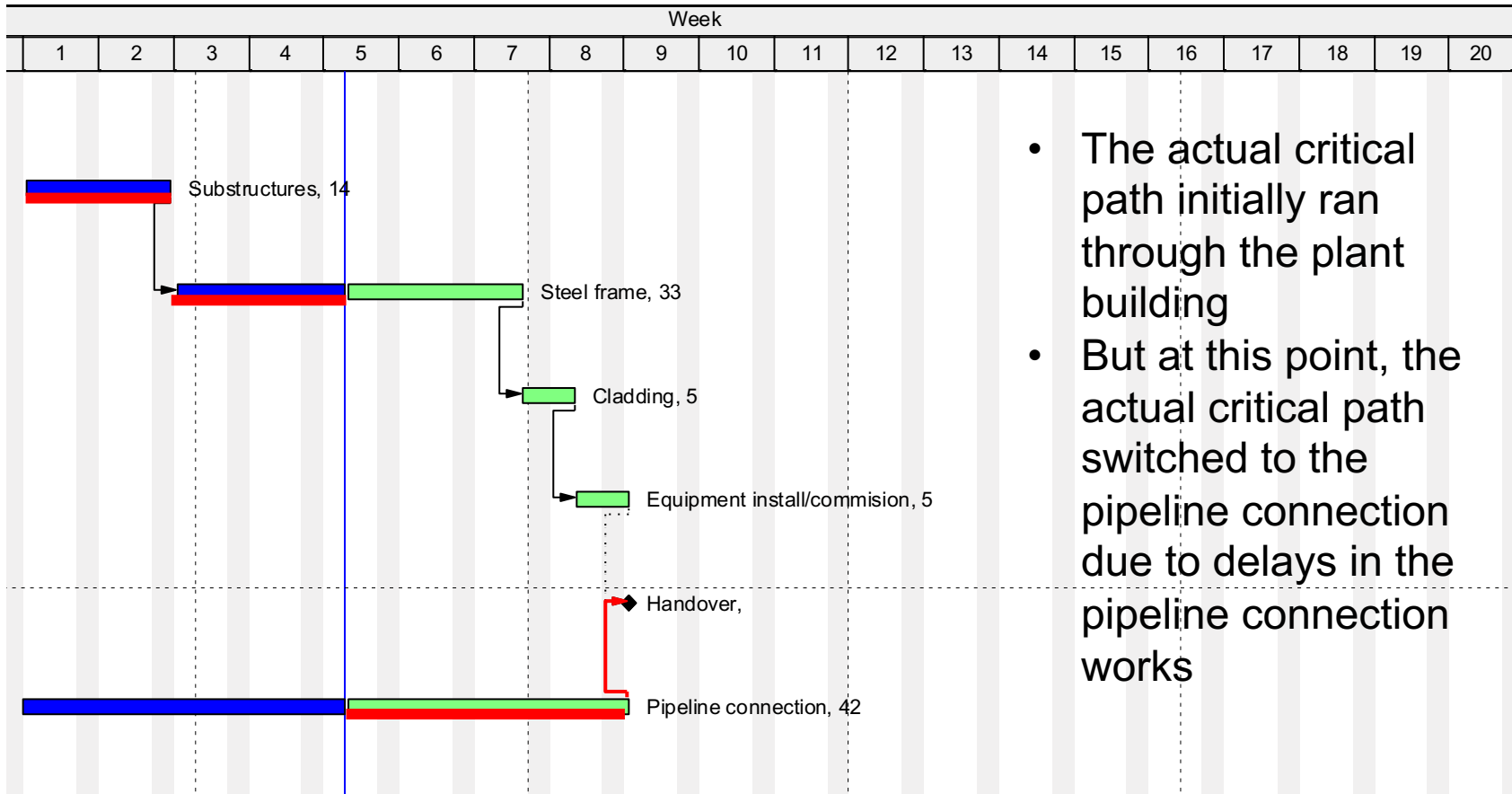


- The forecast critical path runs through the plant building
- Ignores the impact of actual progress

Actual critical path

Actual Critical Path: The contemporaneous critical path for a time period (or Window). Takes account of the actual progress of work and current planned intent. Accepts that critical paths change over time.

Actual critical path

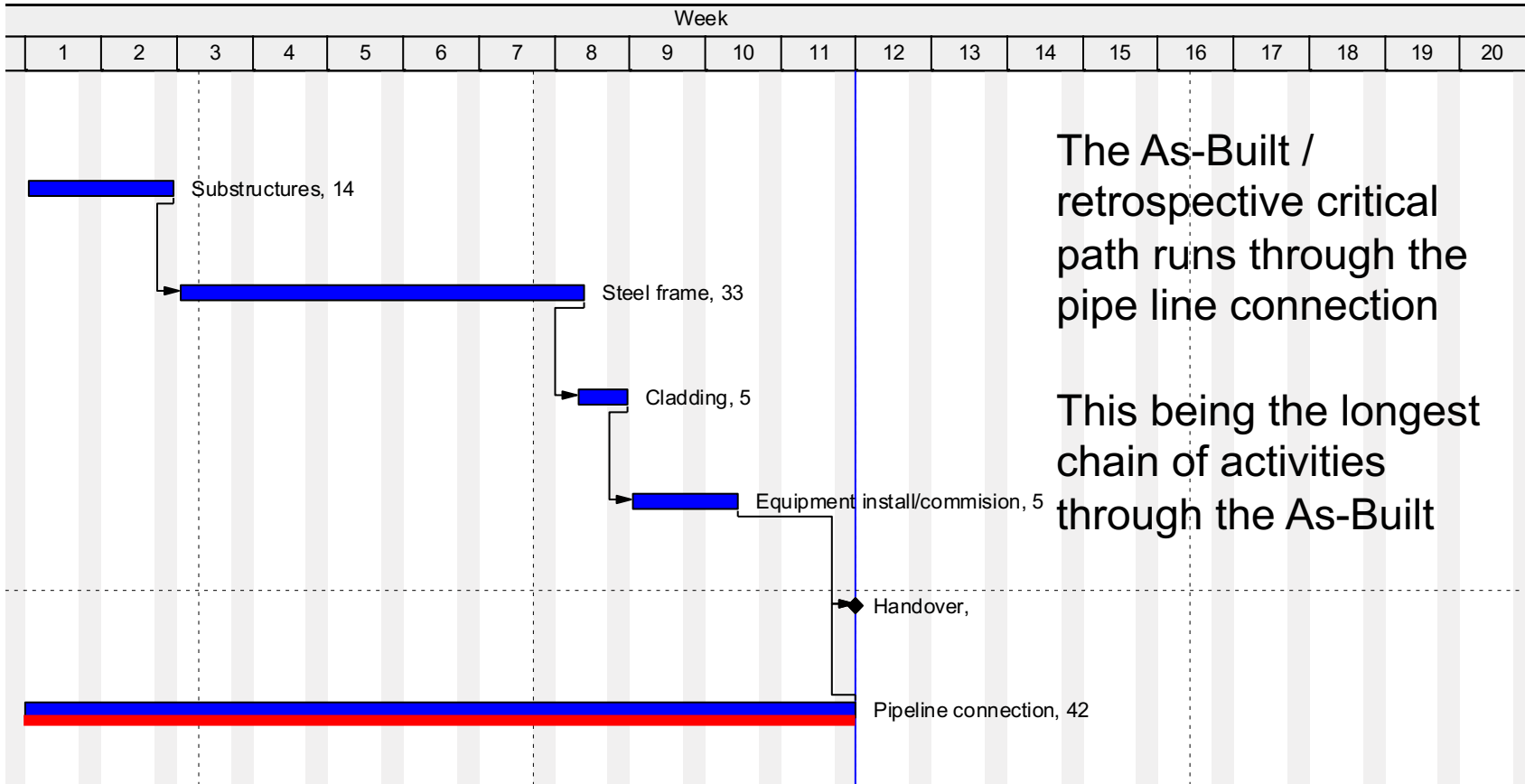


- The actual critical path initially ran through the plant building
- But at this point, the actual critical path switched to the pipeline connection due to delays in the pipeline connection works

As-built critical path

As-Built Critical Path: The retrospective longest path in the as-built programme. Does not consider critical path changes during the project. Assumes all delays exist at the same time.

As-built critical path

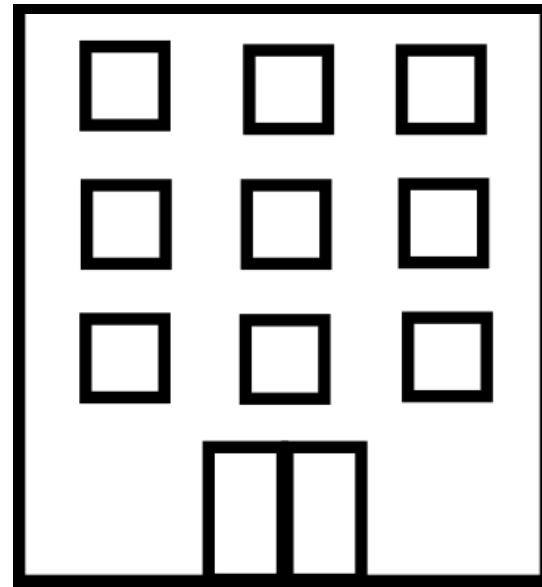
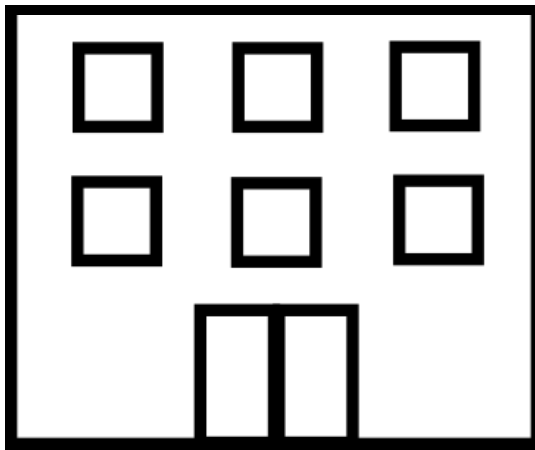


Actual vs. As-built critical path

- Month 1
- Variation to Tower A Level 2 – 1m delay.

Tower A

Tower B

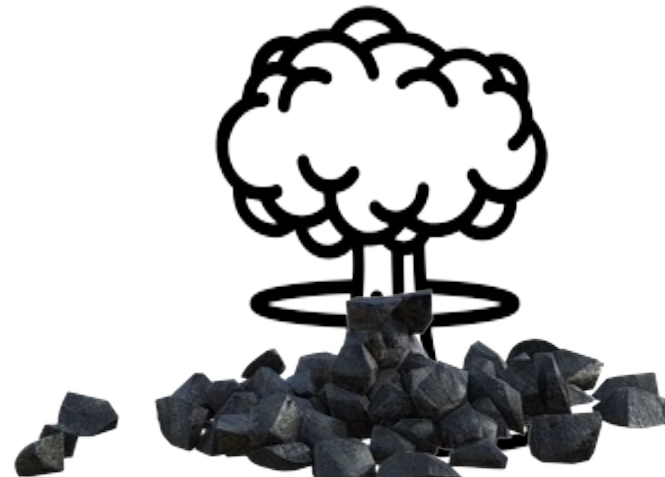
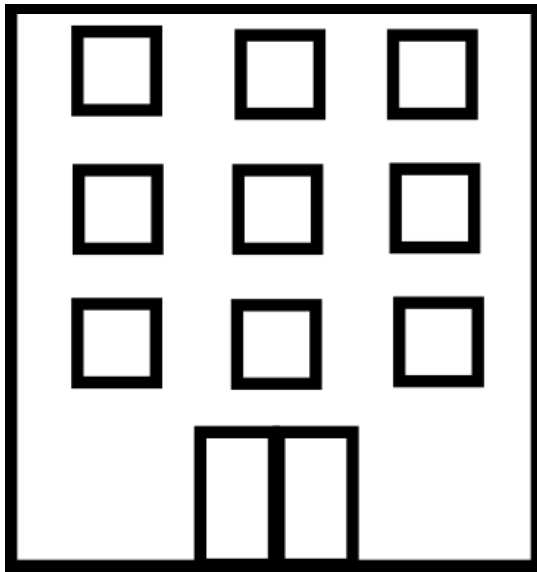


Actual vs. As-built critical path

- Month 3
- Tower B collapses due to major defect.

Tower A

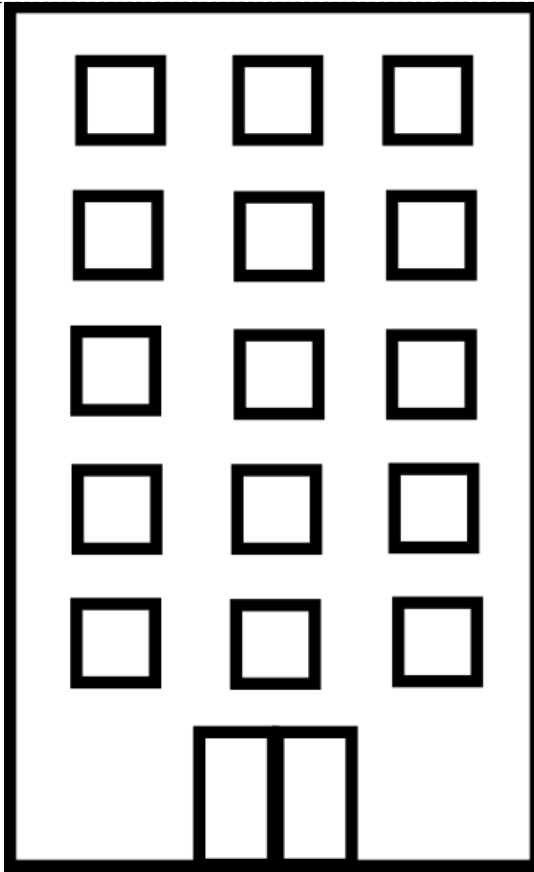
Tower B



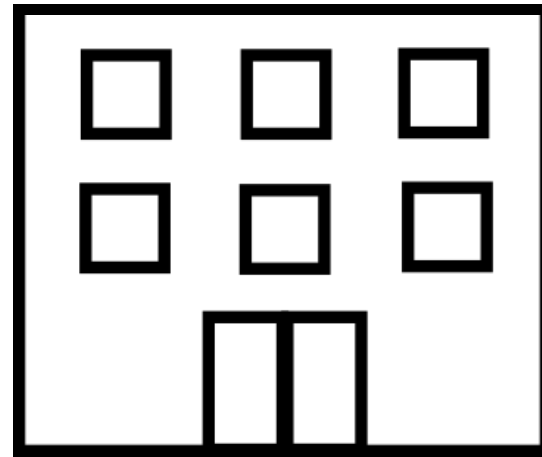
Actual vs. As-built critical path

- Month 5
- Tower A Complete (1m delay)
- Tower B at Level 4 Incomplete (2m delay)

Tower A



Tower B



Actual Critical Path

 Level 0 to 1

Tower A

 Level 1 to 2 (Variation)

 Level 2 to 3

 Level 3 to 4

 Level 0 to 1

 Level 4 to 5

 Level 1 to 2 + Re-build

Tower B

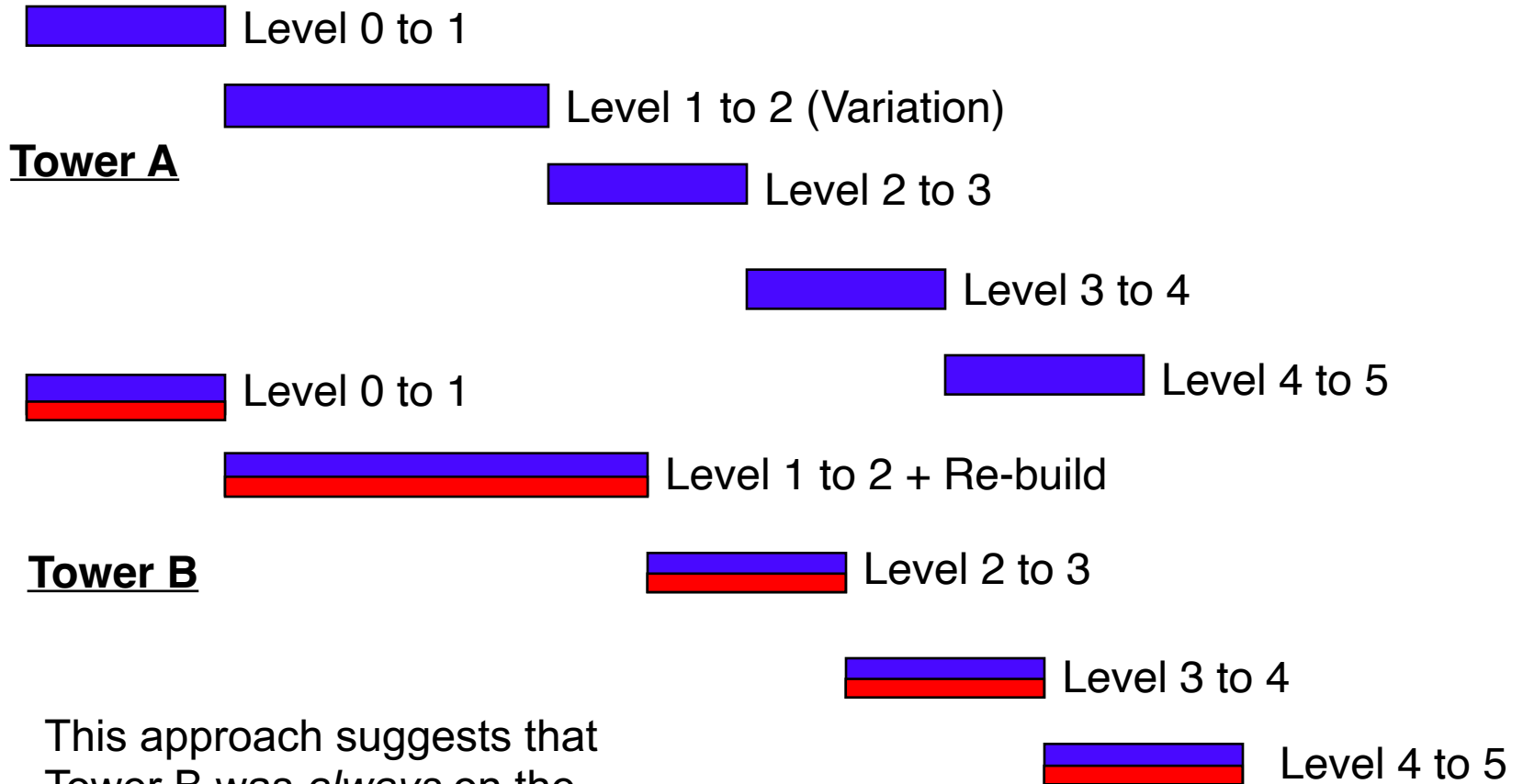
 Level 2 to 3

 Level 3 to 4

 Level 4 to 5

This approach correctly recognises the shift in critical path due to the collapse.

As-Built Critical Path



This approach suggests that Tower B was *always* on the critical path? Is this correct?

ERDC Group v Brunel University (2006)

*Mr Robinson was however cross-examined as to why he had not produced by way of a programme, the as built critical path of all the works. **He explained that he frowned on as-built critical paths since an as-built programme was essentially a record of when things happened and, as such, it did not contain a logic network. In order to create an as-built critical path a logic network would have to be imposed on it but such a programme was not intended to have a logic network imposed upon it. The as-built critical path does not recognise the fact that during the course of a project the critical path will move from time to time.***

In my view that is a perfectly satisfactory explanation, and certainly for this case.

See also City Inn v Shepherd (2010)

Locating the critical path

- Five main methods for locating the **actual** critical path:
 1. Reported critical paths
 2. Critical stages
 3. Accrued delay
 4. Longest remaining duration
 5. Volume of work

Locating the critical path

- Five main methods for locating the **actual** critical path:

1. Reported critical paths

2. Critical stages

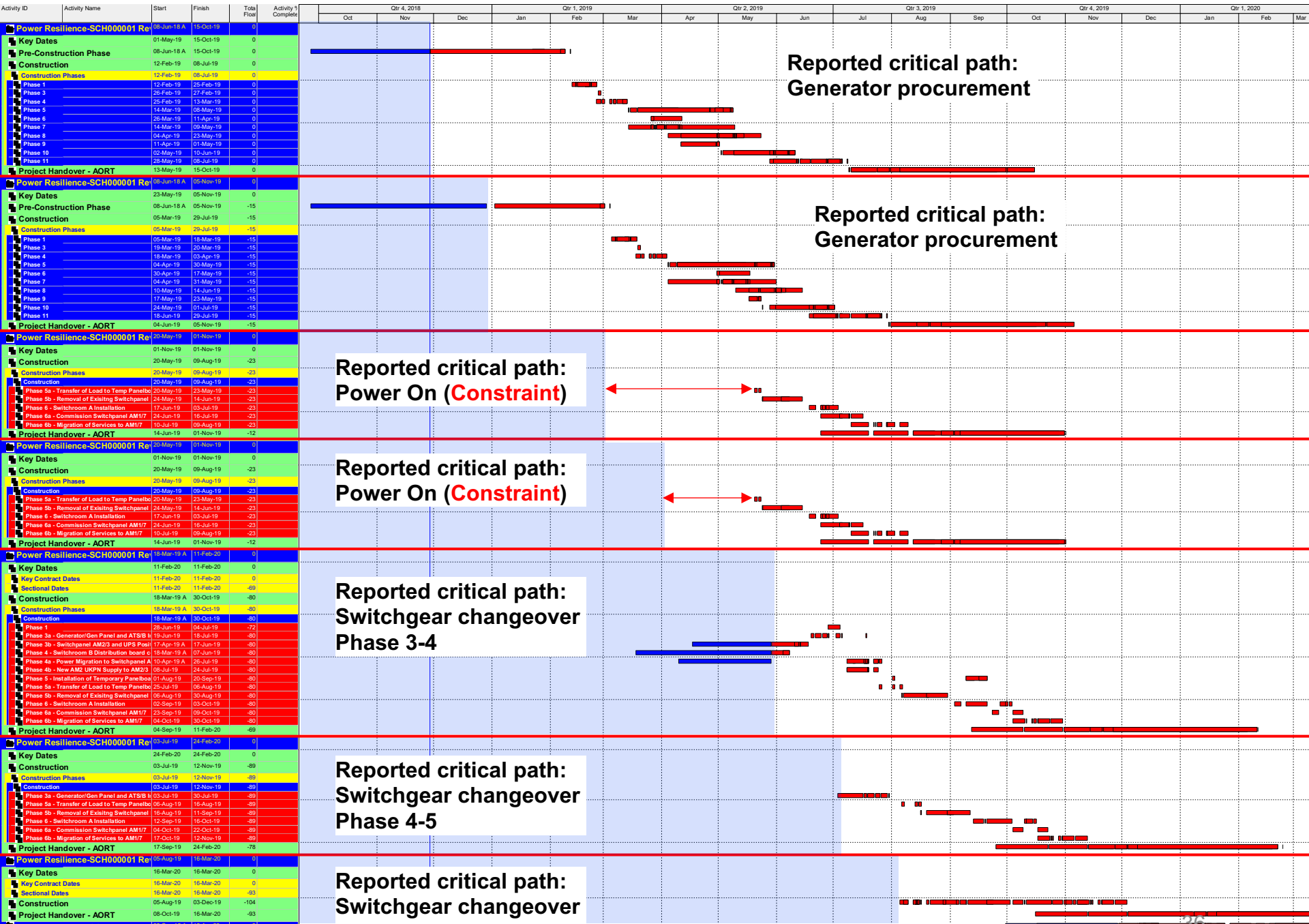
3. Accrued delay

4. Longest remaining duration

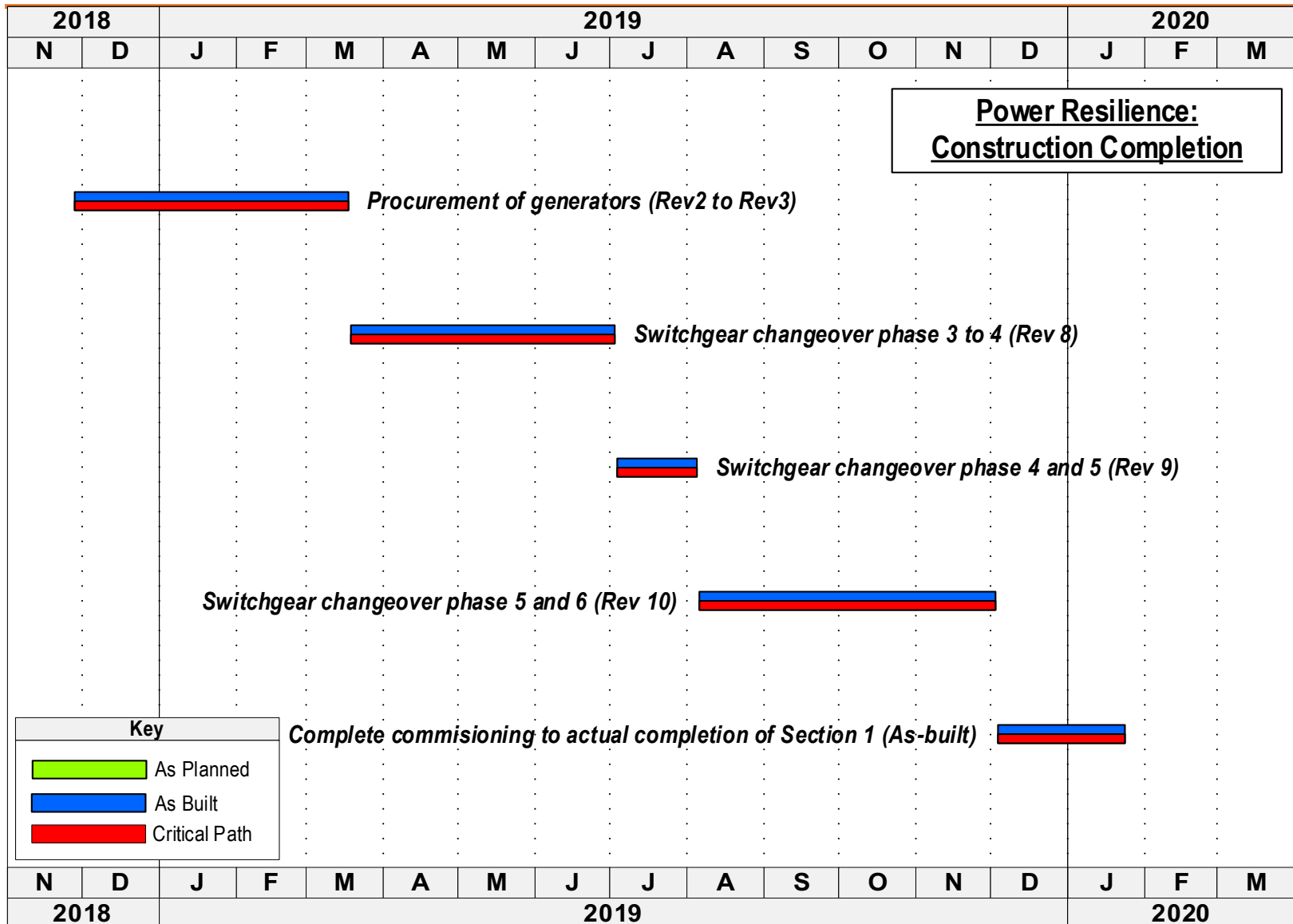
5. Volume of work

Reported critical paths

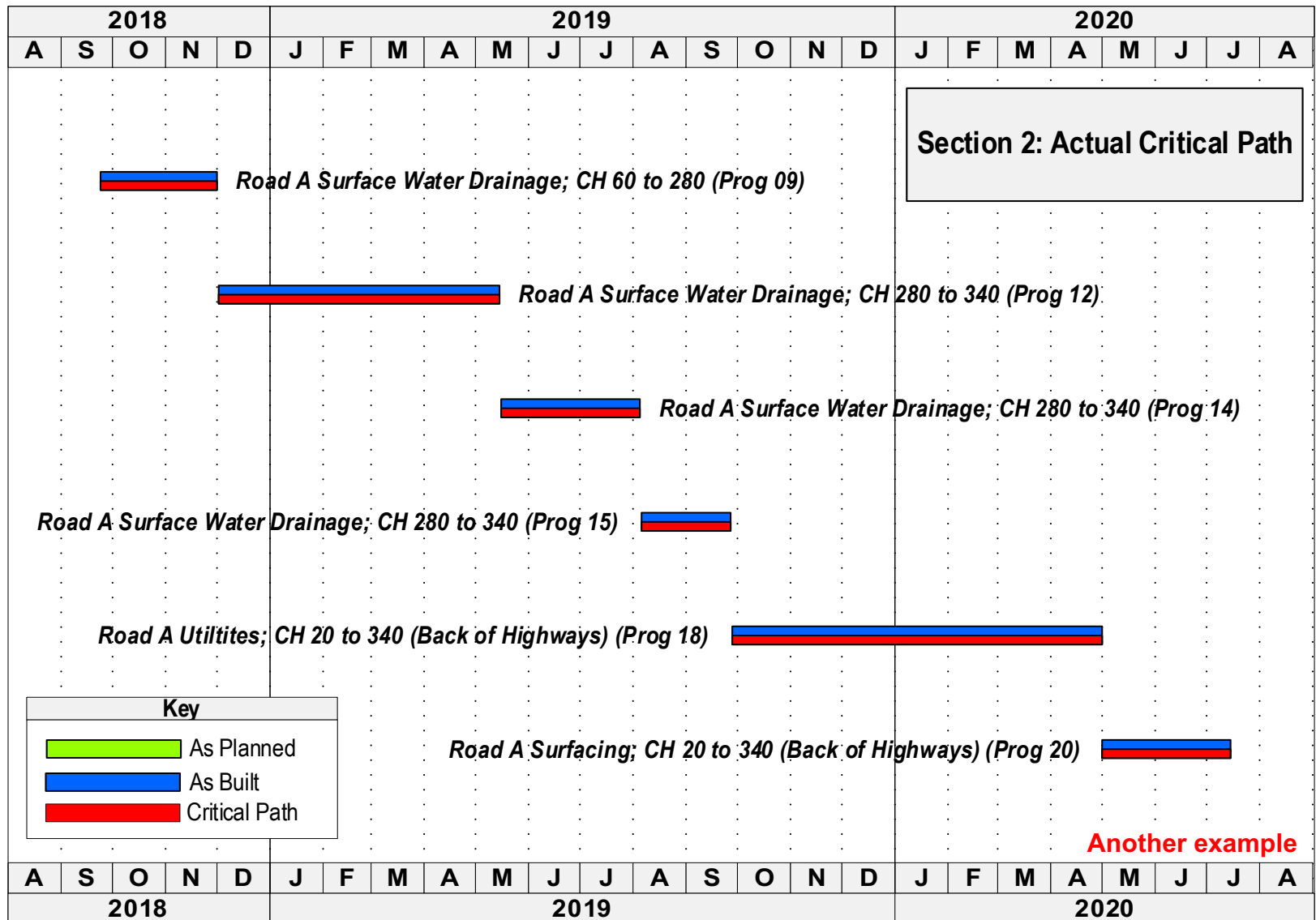
- Method:
 1. Gather updated programmes/records (soft copy if available)
 2. Identify (filter) critical and near-critical paths in each programme, or identify reported critical paths
 3. Check for reasonableness – exclude any critical paths which are unreasonable
 4. Identify periods over which discrete sequences are critical
 5. Identify the actual critical path



Reported critical paths



Reported critical paths



Reported critical paths

*Mr [X] objects to Mr Whaley's use of these other programmes to derive the critical path on the basis that none of them were accepted and, in the case of [], it was provided on a without prejudice basis... **In my view neither of these reasons are good reasons for not adopting these other programmes.***

Leading QC and TCC Judge, Adjudicator's Decision

Reported critical paths

Criticality depends, at least in part, on what the contractor thought at the time was the critical path

Leading QC, Adjudicator's Decision

Reported critical paths

- Pros
 - Straightforward
 - Derived from contemporary evidence
 - Effective if contractor used programmes to construct the project
- Cons
 - Directly dependent on quality of programmes
 - Ineffective if contractor is not using programmes to construct
 - Does not really identify detailed critical path

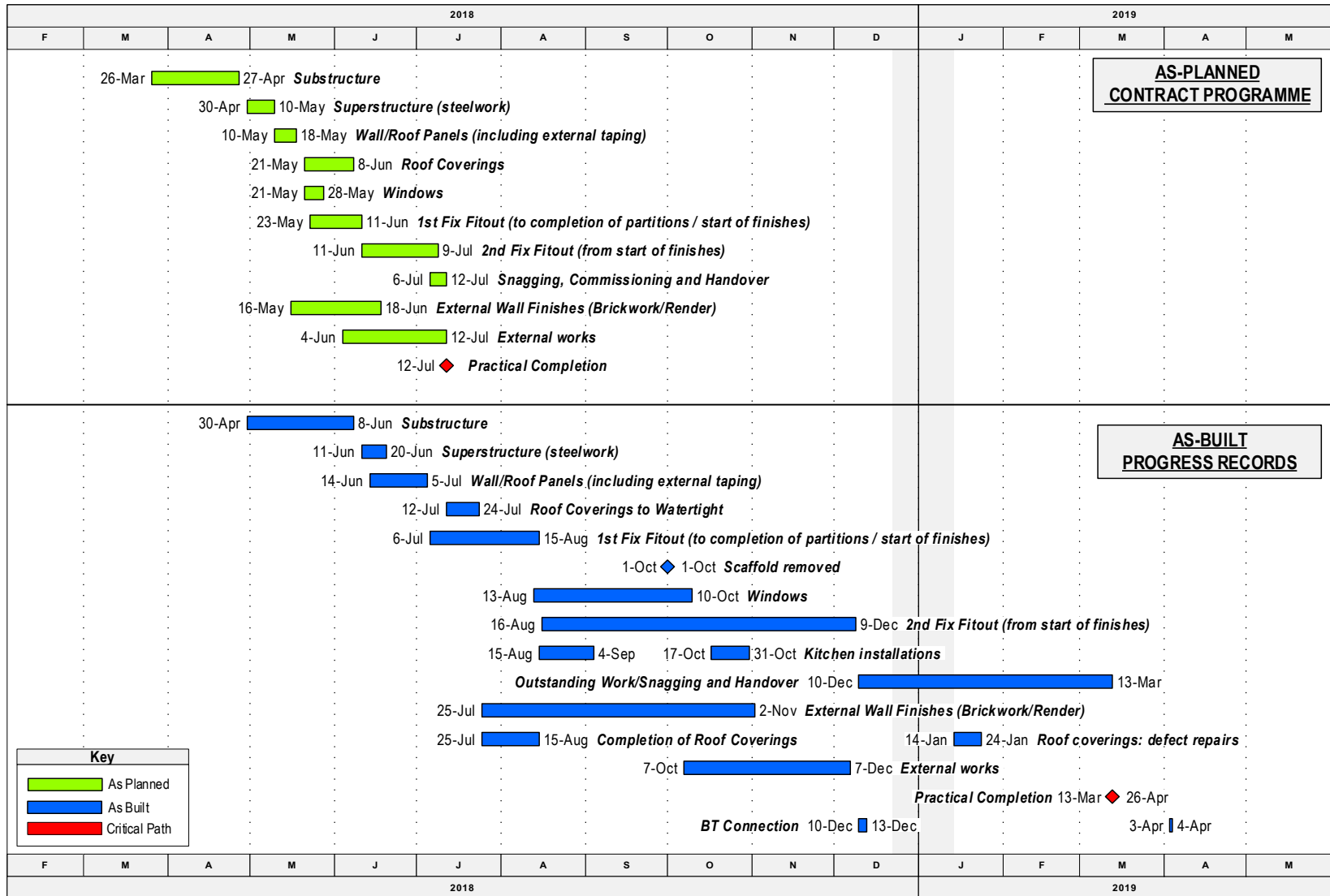
Critical stages

- Method:
 1. Study drawings, planned programme and progress records
 2. Identify 4 to 6 critical stages of work
 3. Construct high-level as-planned vs as-built
 4. Identify planned and as-built period for each stage
 5. Examine as-built records within stages to determine location of actual critical path

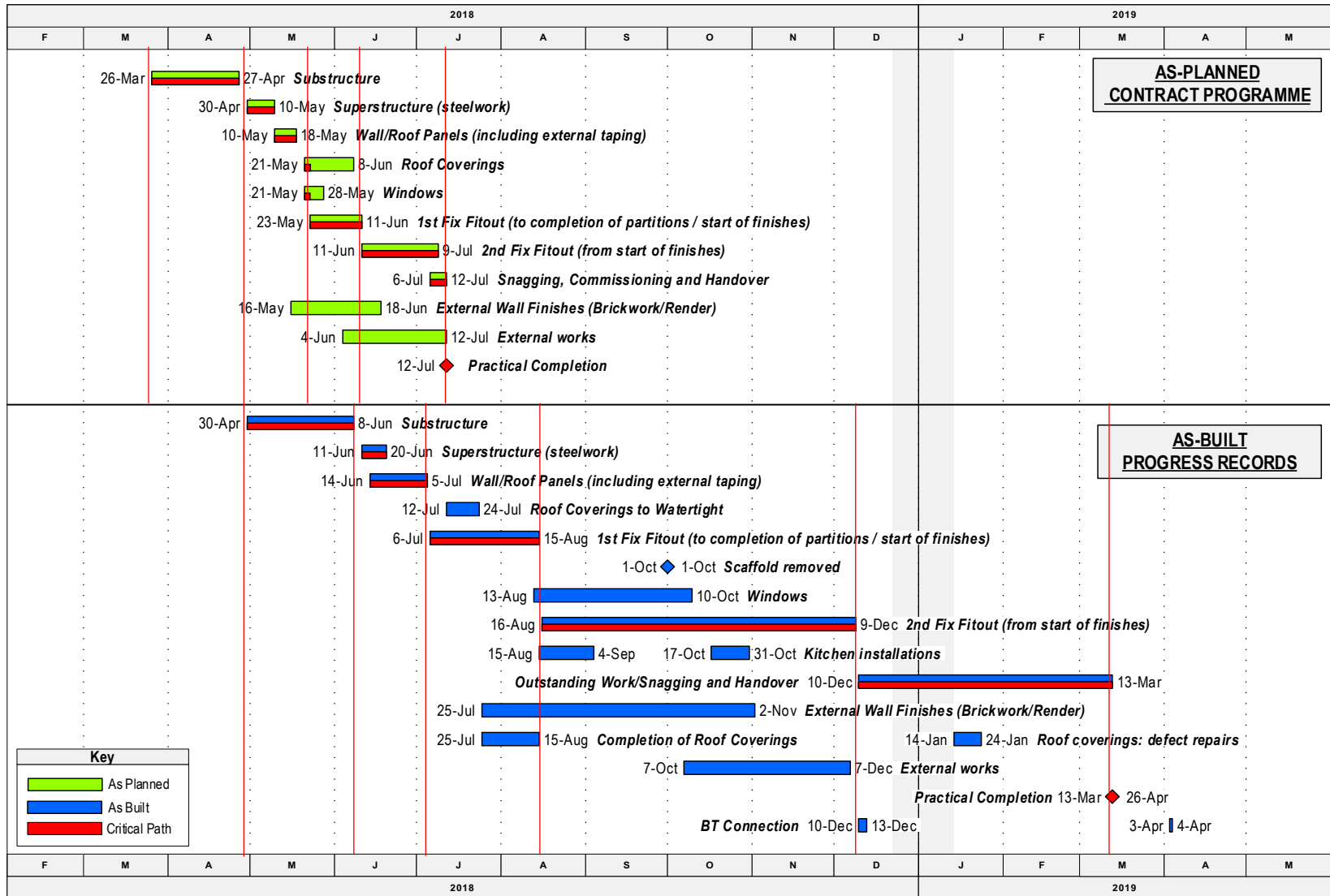
Critical stages

- E.g. A pre-fabricated exhibition space:
 1. Substructures
 2. Superstructure / Envelope
 3. 1st Fix Installations
 4. 2nd Fix Installations
 5. Testing and Commissioning
- The critical path will probably run through these activities. The issue is when, where and for how long?

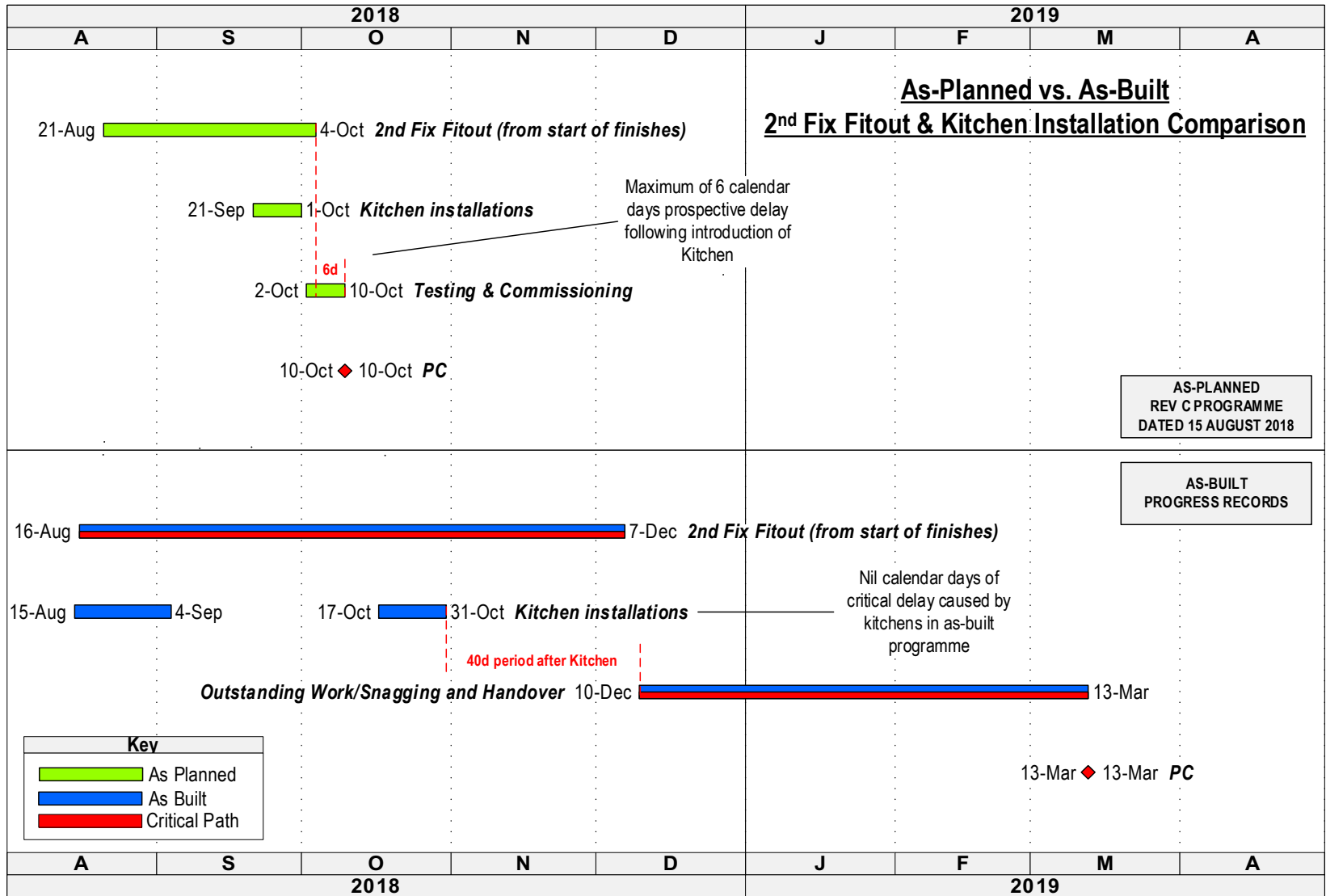
Critical stages



Critical stages



Critical stages



Critical stages

E.g. my opinion:

Window 3: 7 July 2018 to 15 August 2018

(Completion of 1st Fix)

In my opinion, the critical path during Window 3 ran through the progression of the 1st fix mechanical and electrical work, the partitions and the joinery 1st fix until around 15 August 2018 (the end of Window 3), when the critical path shifted to the start of the 2nd fix fit out work

Critical stages

E.g. Adjudicator's Decision:

Window 3: 7 July 2018 to 15 August 2018 (Completion of
1st Fix)

By 15 August [] suggested a delay of 4 to 6 weeks caused by late discharge of planning condition 10 by the planners. This related to the approval of a hard and soft landscaping scheme before groundworks might begin. In my view, the critical path clearly lay through the 1st fix at this point and the cause was simply slow progress against programme by []

Critical stages

- Pros

1. Intuitive and easy to understand
2. Works at any level of analysis
3. Can identify detailed critical path without software

- Cons

1. Cannot identify changes to critical path on its own
2. Difficult to determine competing critical paths on its own
3. Requires repeat steps to identify detailed critical path

Locating the critical path

- In reality, we may use a combination of methods to suit the project / work under analysis:

Type of project	Reported critical paths	Critical stages	Remaining duration	Accrued delay	Volume of work
Residential building project	Suitable	Suitable	May be suitable (near end of project)	May be suitable (competing paths)	May be suitable (nr units complete)
High rise construction project	Suitable	Suitable	May be suitable (near end of project)	May be suitable (competing paths)	May be suitable (e.g. MEP/ finishes)
Heavy/industrial engineering project	Suitable	Suitable	May be suitable (near end of project)	May be suitable (competing paths)	May be suitable (e.g. MEP/ finishes)
Cable pulling/pipe laying project	May be suitable (reliable progs.)	Not usually suitable	May be suitable (near end of project)	Not usually suitable	Suitable
Marine works project	May be suitable (reliable progs.)	Not usually suitable	May be suitable (near end of project)	Not usually suitable	Suitable

Validating your critical path

Key considerations:

- Can you explain, in a straightforward way, why your critical path is correct?
- What evidence exists to support your critical path (or does it contradict evidence)?
- Does it offend common sense?

The importance of records

*...Close consideration and **examination of the actual evidence of what was happening on the ground will reveal if the delay in approving the sewerage design actually played a role in delaying the project and, if so, how and by how much.***

White Constructions v PBS Holdings (2019)

*...there is little indication in the contemporaneous documents, that, at any time, OSR put any great emphasis on these matters, or were claiming they were likely to lead to a doubling of the Contract price. To the extent that the contents of **the contemporaneous documents comprise a credibility test to be applied to the OSR claims**, then I consider that . . . they comprehensively fail the test.*

Van Oord v Allseas (2015)

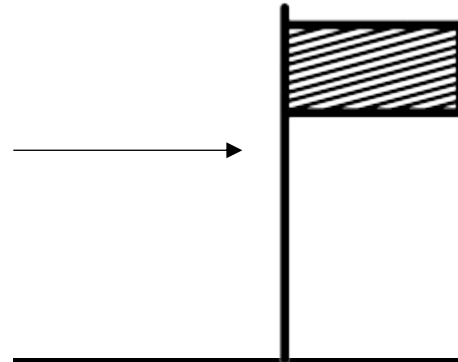
The importance of records

*On 6 October 2008 an internal SCL report identified PFP and insulation as **"on top most critical path"**. SABIC held the same view, which continued through the month. By the end of the month it was Mr Martin's view that application of PFP at current rates would keep PFP on the critical path and delay would result.*

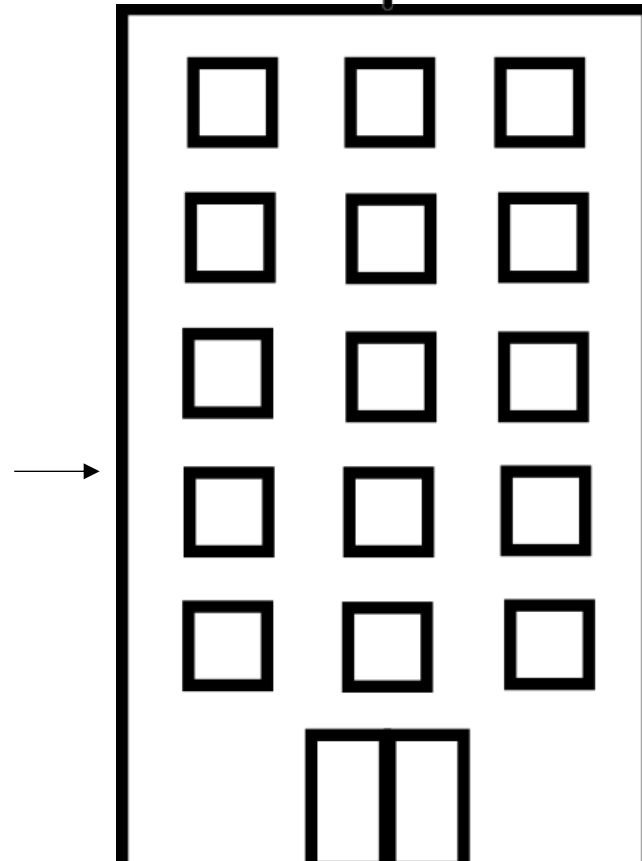
*Mr Crane's retrospective analysis supports the view that PFP was critical. Mr Crossley disagreed but, for reasons given above, **I do not find his evidence on this point persuasive**. On this evidence, **I find that the parties believed PFP to be critical and also that, subject only to the question of the Secondary Compressor (to which I return later) it was critical.***

Finally, common sense?

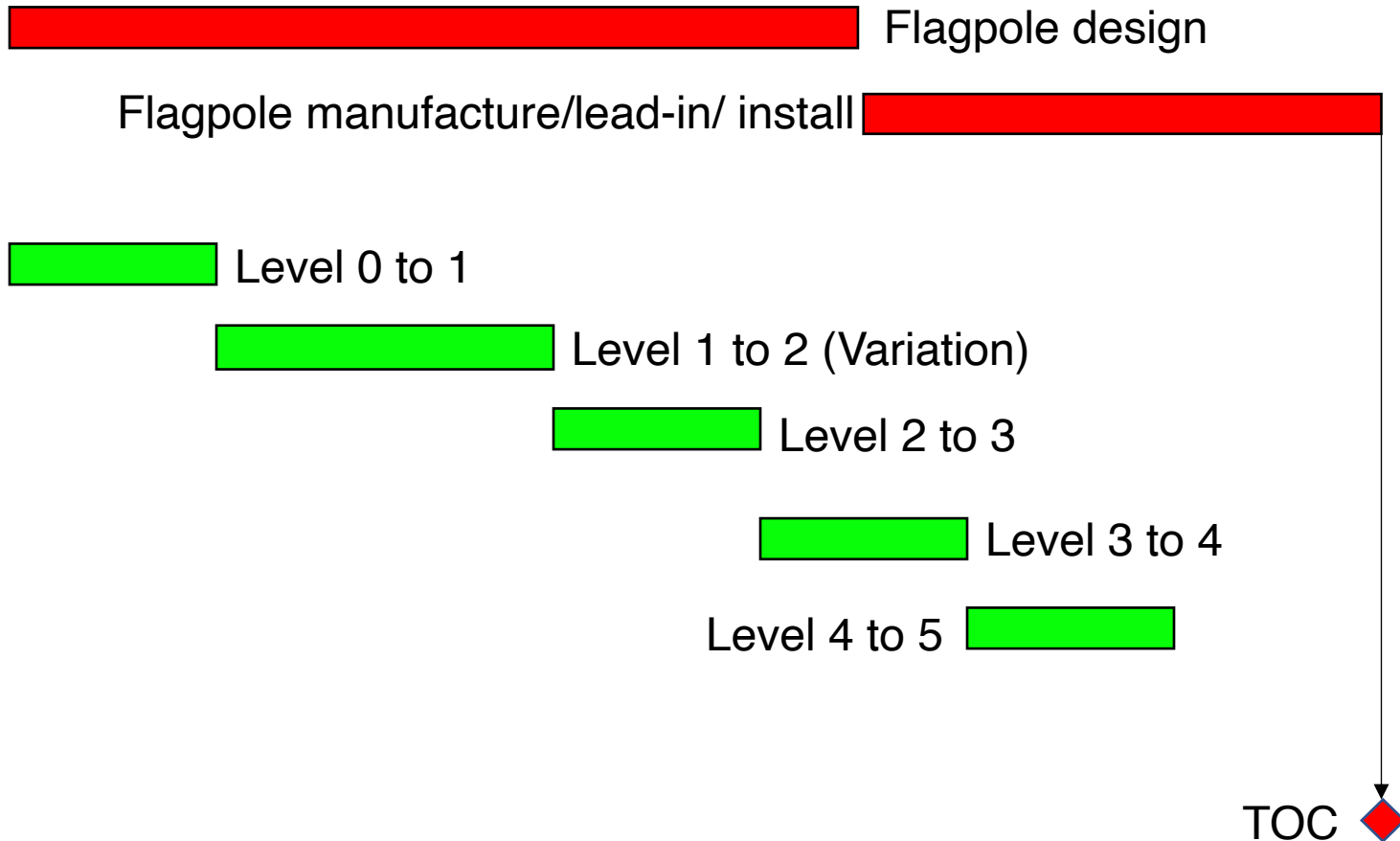
Flagpole imported
from in Italy (1% of
work)



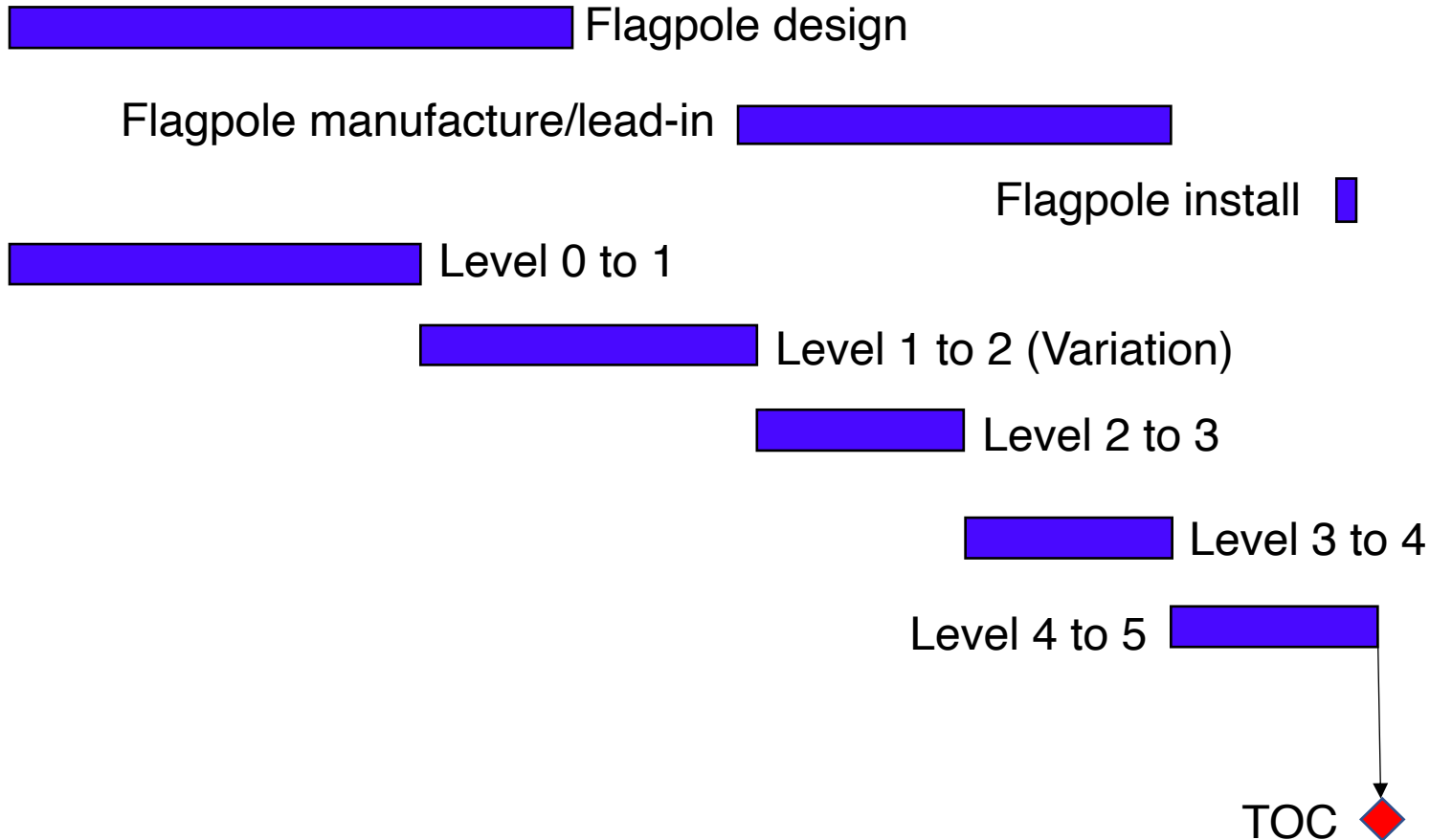
Residential tower
onto which flagpole is
fixed (99% of work)



Planned Programme



As-Built Programme



Finally, common sense?

Did the flag poll *really* delay completion?

Probably not.

Focus usually on the critical path through physical construction work, not the offsite activities.

Summary

- In construction project management, the critical path is a management tool **based on calculations and theory**
- In forensic analysis, the critical path is a **factual issue** to be determined on the **range** of evidence
- Remember: we are interested in the critical path of the project, **not** the critical path of the P6 schedule.

Interested to learn more?

BTEC Level 7

Advanced Professional Award

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Next programme starts **16 April 2022**

- Module 1: Delay Analysis Methodologies for Dispute Resolution
- Module 2: Forensic Delay Analysis Practice
- Module 3: Delay Expert Report Writing

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Questions?

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