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ELECOSOFT POWERPROJECT DELAY ANALYSIS TECHNIQUES

1 Abstract

Many construction contracts specify that a delay must be calculated on the critical path of the contract program.

Often project programs are completed in Elecosoft Powerproject and therefore to demonstrate a delay the scheduler needs to add delays to the program to demonstrate and calculate the delay.

This paper outlines the various techniques for demonstrating delays using Elecosoft Powerproject.

2 Introduction

2.1 What is a Delay

Delay may be defined in contracts in many different ways:

- An event that impacts the timing of projects activities and may impact on:
  - The contract end date,
  - Stage end date, or
  - The Date for Practical Completion,

It may also be defined as:

- An impact to the Critical Path, or
- An event that consumes Float,
- An event that causes work to start or finish later than planned,

It is important that you check that what you intend to claim as a delay is claimable under the contract,

Also make sure you know any time bars for submitting claims.

2.2 How to perform a Delay Analysis

The process of performing a Delay Analysis should be based on evidence derived from project records:

- Identify the delays and the time periods that they impacted on the project,
- Select the appropriate “Delay Analysis” process based on the available evidence,
- Impact the schedule(s) with the evidence objectively,
- Calculate the impact to the schedule for each delay,
- Assign the responsibility for each delay,
- Calculate the delay impact by each party,
- Apply contract terms and conditions to the impacts,
- Evaluate damages.

2.3 Delay Categories

Delays are often assigned categories such as:

- Inexcusable, an extension of time is NOT granted.
- Excusable, an extension of time would be granted.
- Compensable is an Excusable delay and costs would be paid.
- Non Compensable is an Excusable delay and costs would NOT be paid.

2.4 Understanding Delays

Before a delay may be assigned a category it must have a value calculated and delays may occur in different ways for example:

- They may occur at the start of the task,
- They may occur during the task and therefore splitting the work and the task is no longer contiguous, and the crew are not gainfully engaged in work,
- There may be a reason for low productivity and resulting in the work taking longer,
- The delay may affect one task or it may affect multiple activities, for example:
    - A delay affecting one task could be a delay in delivering some equipment,
    - A delay affecting multiple activities might be a delay where there is adverse weather affecting the whole site.
- It may be on the critical path or it may be off the critical path,
- Some delays may initially not be on the critical path and have float but then may result in the task being moving on to the critical path. In this case the full delay of the task is not equal to the critical path delay.
- Finally, how you demonstrate acceleration in a program? I'll cover this issue as well.

2.5 Assigning Delays and Software Functionality

This process of adding delays to a program is often not obvious and there are several techniques that I will document in this paper that show you methods that you can use to demonstrate delays and calculate delay values.

Elecosoft Powerproject has far more functionality than Microsoft Project and Oracle Primavera P6 and some of the advantages of Powerproject for delay analysis are:

- It allows the splitting of activities into multiple splits, P6 does not.
- It allows the colouring, categorizing and turning off links between tasks thus this makes it simple to turn off all delay tasks in one command without having to either reducing the durations of delay tasks or deleting them as one normally does when using Microsoft Project or P6.
- The ability to colour non work period on or behind each task thus it is simple to highlight for example a weather delay that have been entered into a calendar as a non-work period.
- It has user definable Unique Numbering of tasks making the identification of delay tasks simpler than Microsoft Project.

3 Aim

The aim of this paper is to demonstrate various techniques of assigning delays to activities in an Powerproject program, which will in turn allow you to select the method that is appropriate to your project and activities. I also outlined the advantages and disadvantages of each technique.

4 Prerequisites

4.1 Prereading

It is suggested that before you read this paper you should have a good understanding of delay analysis by reading some of the following types of papers:

- AACE International Recommended Practice 29R-03 Forensic Analysis
- Society of Construction Delay and Disruption Protocol.

4.2 Planning your project

Many contracts are silent on how delay claim values should be calculated and this is the first step in the process is working out how delays are evaluated.

I recommend that the client and contractor agree the method that they are going to use to evaluate delays when the contract is signed and ensure the process is written into the contract, some of the issues you need to agree upon:

- What program will be used to evaluate delays, a couple of options are:
    - The contract program, or
    - The last updated program.
- It is delays only to the critical path, or all delays, or delays to activities that have high costs that are considered as delays?
- If you are a contractor will you record and calculate both the Client and Contractor delays or just Client delays?
- Contractors should ensure that they have planned the process of collecting delay information is such a way that it is simple to update the program.
    - Ensure site progress reports have Task Unique IDs against all items in the report.
    - Ensure they delay claim numbers are used in the daily reports and the updated schedule.
    - Ensure there is a written procedure for the project team to follow.

5 Methodology

I will use a very simple program with a few activities, a finish milestone and a baseline to represent the Contract Program demonstrate the various methods of assigning delays against a single task.

In all the pictures the Baselined Contract Program is the lower bar in the pictures.

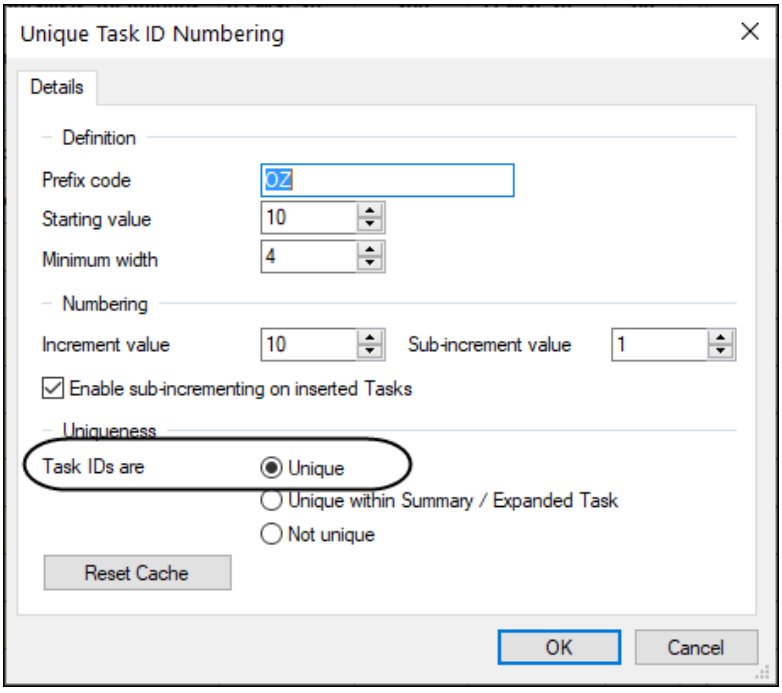
6 Unique Task Numbers and Baselines

6.1 Unique Numbers for Tasks

It is important in claims analysis that each task has a unique ID which may be referred to in all documentation.

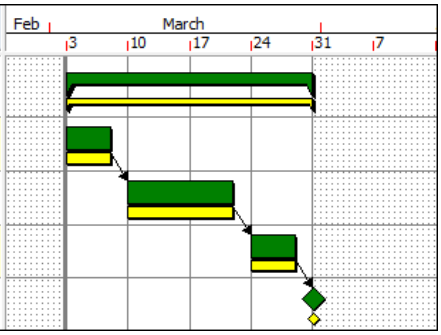
Each task may be assigned a Unique ID when it is created and this number is not used again in the schedule, even if the task is deleted.

To ensure all task IDs are unique you must select form the **Unique Task ID Numbering** form, **Task IDs are Unique**.



The **Unique ID** is assigned to all new tasks and when tasks are created by copy and pasting existing tasks they are assigned a new **Unique ID** with this setting:

Line	Unique task ID	Name	Start	Duration	Finish	Finish variance
1	**OZ0010**	**Delay Analysis Techniques**	**03 Mar**	**20d**	**31 Mar**	
2	OZ0020	Perpare Site	03 Mar	5d	07 Mar	
3	OZ0030	Equipment Delivery	10 Mar	10d	21 Mar	
4	OZ0040	Erection	24 Mar	5d	28 Mar	
5	OZ0050	Handover	31 Mar		31 Mar	



There is also the option of using the **Task ID (WBN)** numbering for creating unique numbering in Powerproject, I will not cover this subject in this paper.

6.2 Setting a Baseline with Powerproject

Powerproject has better functions than either P6 or Microsoft Project and:

- A Powerproject baseline is a complete copy of a project including all resources, relationships etc.
- An unlimited number of baselines may be recorded and up to 10 Baselines may be displayed in the Gantt Chart.
- Baseline schedules may have a name and description assigned.
- Baseline data may be made part of the schedule file or saved as a standalone file.
- Partial Baseline are allowed.
- Users may view all Baseline data, including each resource properties and relationships, from the current project.
- It will display the Baseline Critical Path.

7 Modelling Task Delays

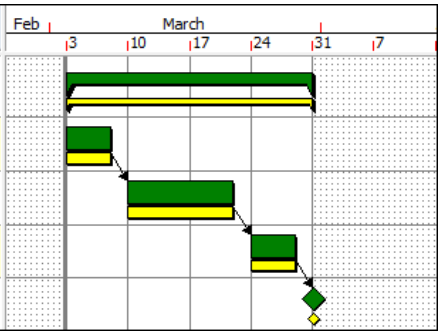
7.1 Adding a delay to represent a delay before the task starts

7.1.1 Extending the Duration of the Delayed Task

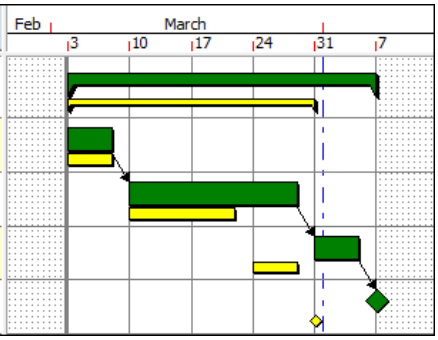
The simplest method of adding a delay to a task is just extending the duration.

The pictures below show the before and after increasing the duration of the **Equipment Delivery** task to demonstrate a delay to the delivery of the equipment:

Line	Unique task ID	Name	Start	Duration	Finish	Finish variance
1	**OZ0010**	**Delay Analysis Techniques**	**03 Mar**	**20d**	**31 Mar**	
2	OZ0020	Perpare Site	03 Mar	5d	07 Mar	
3	OZ0030	Equipment Delivery	10 Mar	10d	21 Mar	
4	OZ0040	Erection	24 Mar	5d	28 Mar	
5	OZ0050	Handover	31 Mar		31 Mar	



Line	Unique task ID	Name	Start	Duration	Finish	Finish variance
1	**OZ0010**	**Delay Analysis Techniques**	**03 Mar**	**25d**	**07 Apr**	**-5d**
2	OZ0020	Perpare Site	03 Mar	5d	07 Mar	
3	OZ0030	Equipment Delivery	10 Mar	15d	28 Mar	-5d
4	OZ0040	Erection	31 Mar	5d	04 Apr	-5d
5	OZ0050	Handover	07 Apr		07 Apr	-5d



Advantages

- It is very simple and easy to increase the duration of task and demonstrate the delay to the project end date.

Disadvantages

- It does not show if the delay is at the beginning of the task or in the middle of the task,

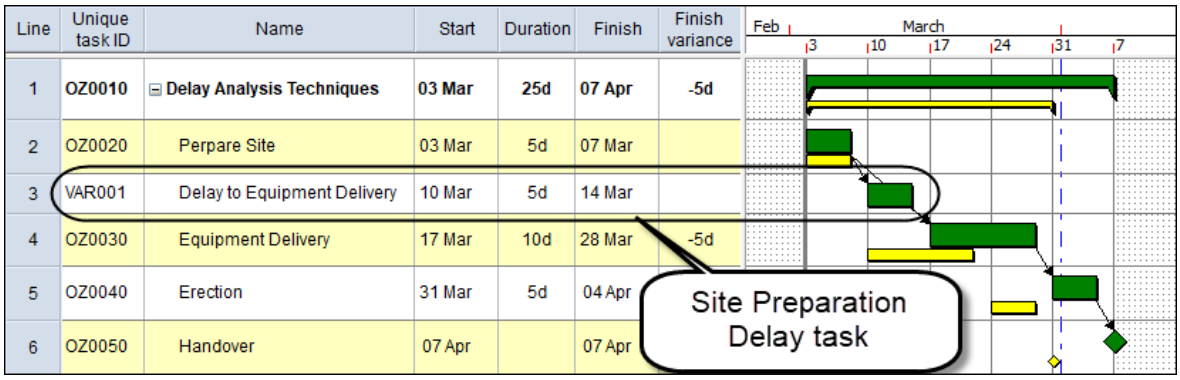
- It does not show you the value of the delay.
- If the task is a resourced task, then the cost will be increased which is undesirable if the resource is were not working during the delay period.
- It is not possible to simply zero out the duration of the task in order to bring the project schedule back to its original status.
- Not simple to identify client or contractor delays.

Recommendations

- I suggest you do not use this method.

7.1.2 Adding a delay task before the start of the delayed task

This method inserts a task to represent the delay before the task starts.



Advantages

- This is a good method to demonstrate a delay to the start of a task.
- It could be used to demonstrate a delay in the middle of a task, as long as there is sufficient evidence in the task description.
- The cost of the delay could be modeled by assigning resources to the delay task.
- It is also simple to change the duration to zero to remove the delay and create a collapsed schedule.
- Multiple delay activities may be used to identify customer and contractor delays.
- It is also possible to code up activities and then be able to filter them out by client or contractor delays and zero out either the contractor or the client delays to calculate the impact of either the customer or the contractors delays.

Disadvantages

- I cannot identify any real disadvantages with this method.

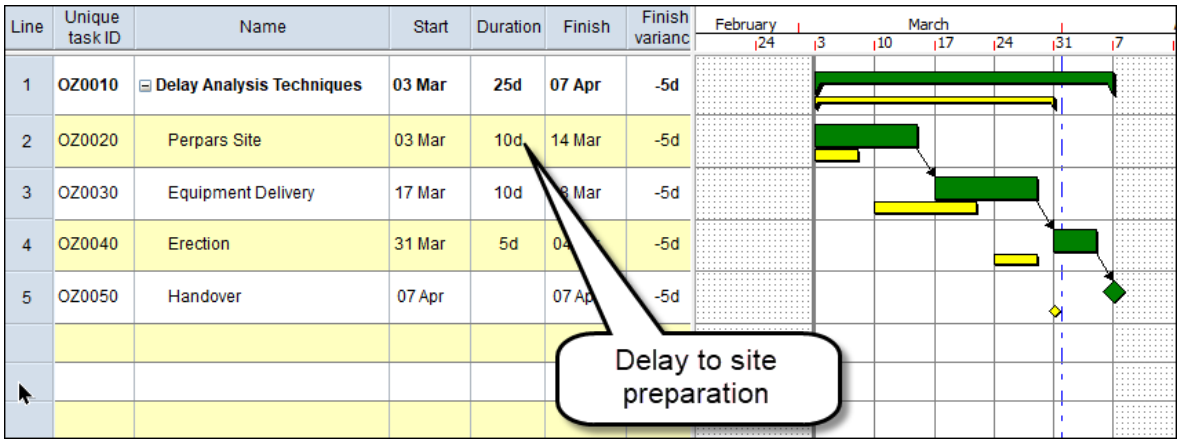
Recommendations

This is the method I recommend for all activities when there are delays before the work starts.

7.2 Modelling a delay after a task starts

7.2.1 Extending the Duration of the Delayed Task

The **Prepare Site** task has been extended and this is exactly the same method as demonstrated in para 7.1.1 and I do not recommend you use this method for the same reasons.

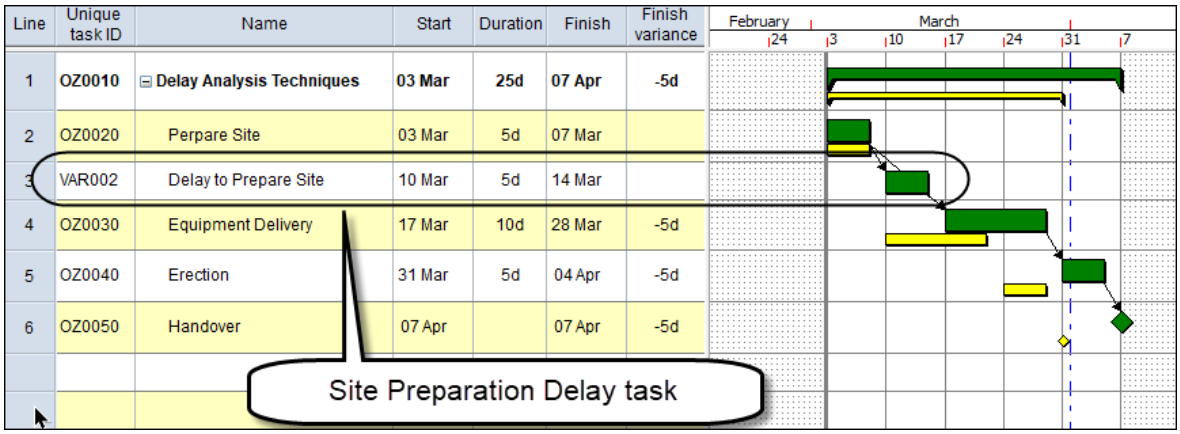


7.2.2 Adding a delay task before the start of the delayed task

If the delay occurs after the task starts, then it is best not to put the delay at the start as one would want to set the actual start of the original task when the task started.

7.2.3 Adding a delay task after the delayed task

The picture below shows a delay task **VAR002 Delay to Prepare Site** has been added after the original task duration.



Disadvantages

- The delay task does not clearly demonstrate when the delay happened.
- The delay does not impact the end date of the delayed task.

Advantages

- This is quick and simple.
- This allows the assignment of the delay activities to the contractor or client and filtering against client or contractor delays.
- May provide a collapsed program by zeroing of task durations.

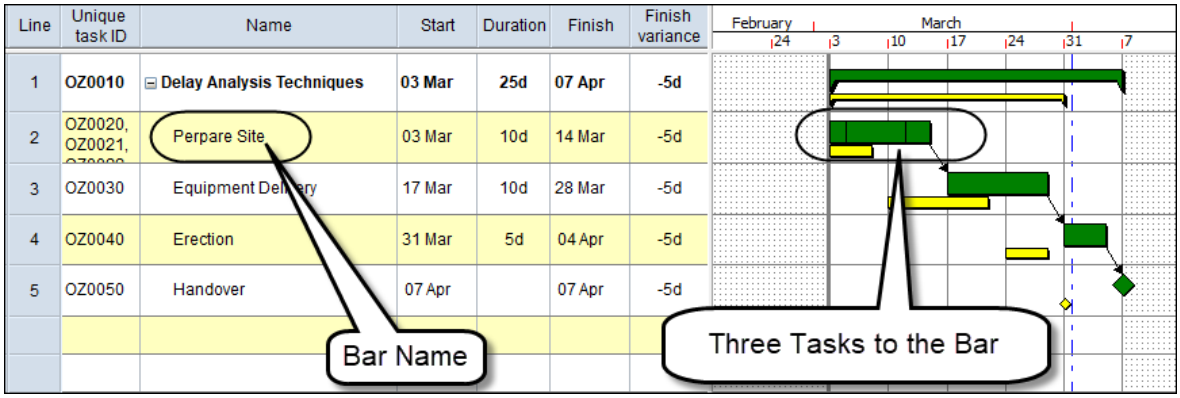
Recommendations

- This method is suitable when the customer is in agreement to allowing delays during a task execution to be added at the end of a delayed task.

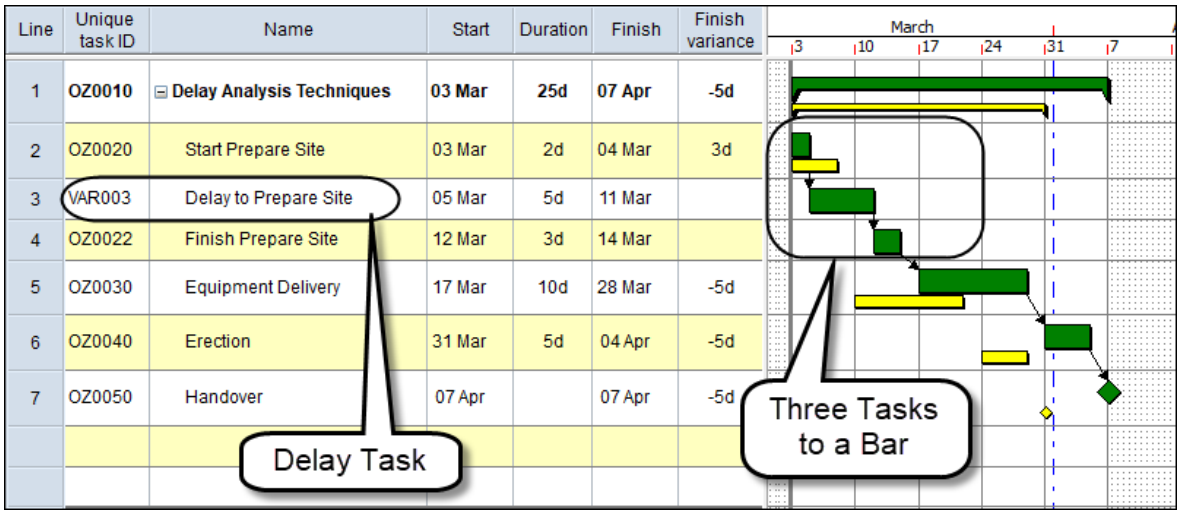
7.2.4 Using Powerproject Task Splitting

Powerproject allows task splitting into multiple spits and then you have a situation where you will have **Multiple Tasks to a Bar**. This process allows the user to split the task into three and name the three **Tasks** under the **Bar**. **Multiple Tasks to a Bar** is a Powerproject function not available in P6 or Microsoft Project.

The **Bar** may be rolled up:



Or unrolled:



Advantages

- It is simple to demonstrate the delay value by splitting the task into three tasks.
- The cost of the delay could be modeled by assigning resources to the delay task.
- It may be used for a collapse as built by changing the delay task durations to zero.
- It is possible to assign codes and filter out delays and zero out either the client or the contractor delay to evaluate the total delay by the contractor all the client on a project schedule that has not been updated with actuals.
- This method allows multiple delays.

- The cost of the delay could be modeled by assigning resources to the delay task.
- It clearly identifies when the work started and finished and when the delay happened.

Disadvantages

- The Baseline is only assigned to the first Task but when the Tasks and rolled up to the Bar the Finish Variance calculates correctly but when unrolled the variance are zero as there is no baseline associated with them.
- It is a very time-consuming method.

Recommendations

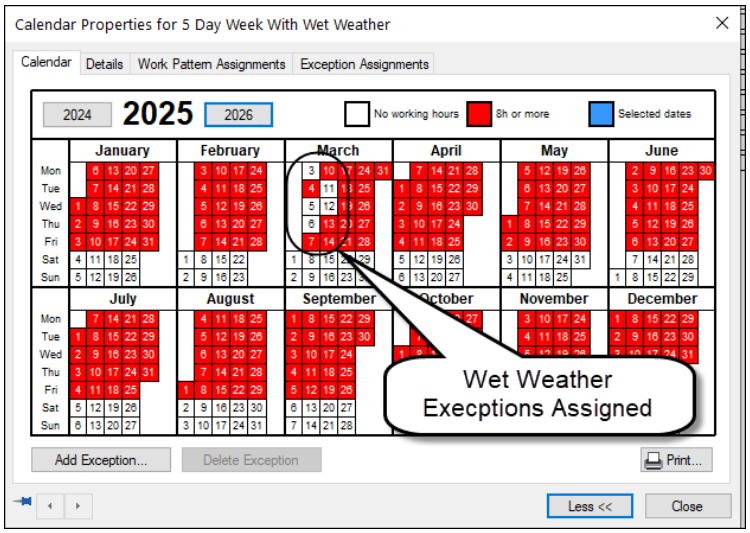
- This is the recommended method in Powerproject if you have the time to do it.

7.3 Modeling delays using a calendar

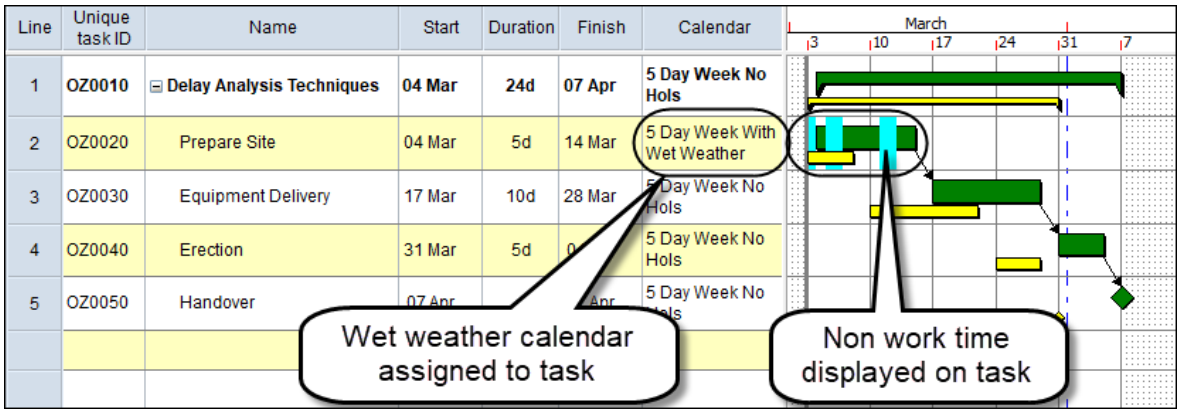
7.3.1 Modeling a delay against a single task

If you wish to model a delay against a single task using a calendar, then you will need to create a new calendar just for that task and assign that calendar to the single task. You may wish to use this technique when one task is affected by wet ground conditions.

In this example I have created a new calendar called **Prepare Site Wet Weather**, assigned five non-work days to it and assigned the calendar to the task.



You can see the impact of the delay on the **Prepare Site** task in the picture below with the Non Work days highlighted on the task that has been assigned the Wet Weather calendar:



Advantages

- The duration of the task that has been delayed remains the correct planned duration.
- The delay may be removed to create a collapsed as built by changing the calendar.

Disadvantages

- The delay value may not be calculated as a task and only available by inspection over calendar, only by looking at a variance column.
- This does not show the value of the delay as a task.

7.3.2 Modeling a delay against multiple activities using a calendar

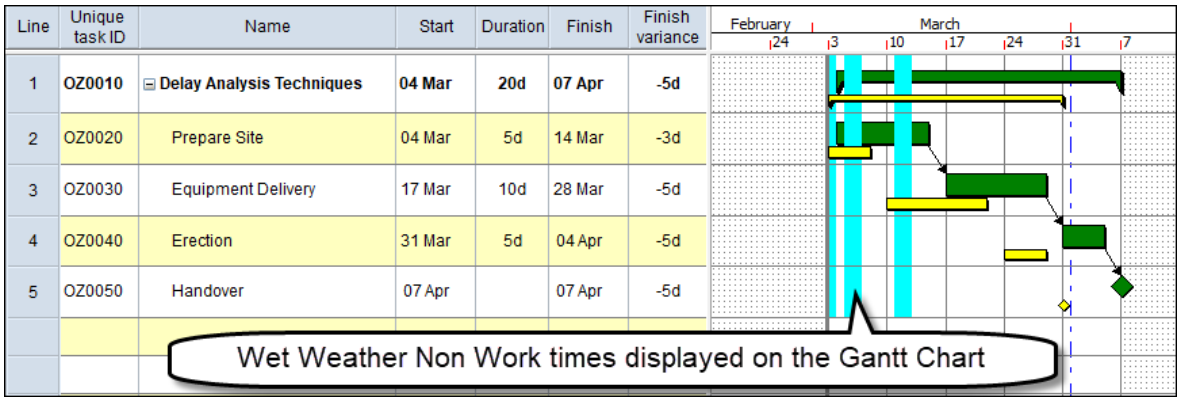
This method is exactly the same as modeling a delay on a single task with the calendar but you assign a calendar to multiple activities.

This method is ideal when a whole site is being shut down due to bad weather or large number of activities can be assigned a calendar to represent inclement weather.

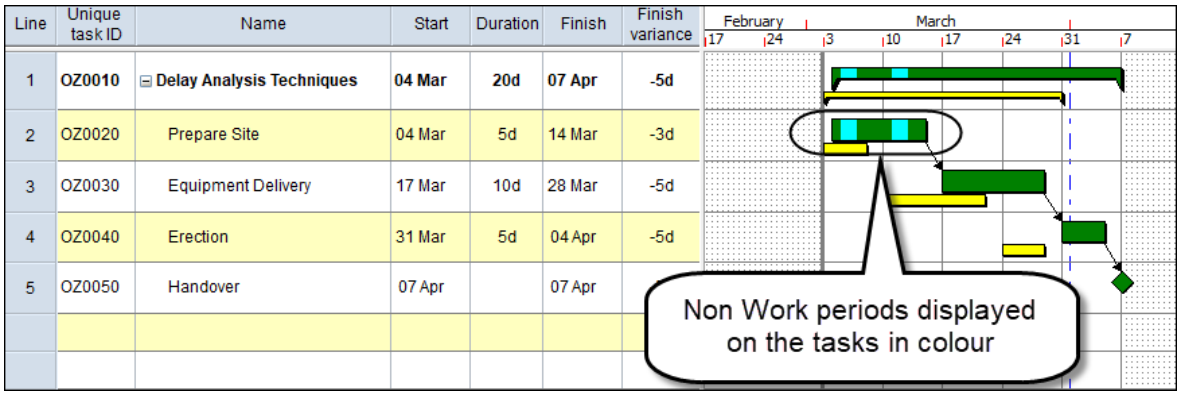
For example, all crane activities could be assigned a windy weather calendar and when the crane may not be used non work periods are assigned to the windy weather calendar.

7.3.3 Methods of displaying Non-Working time

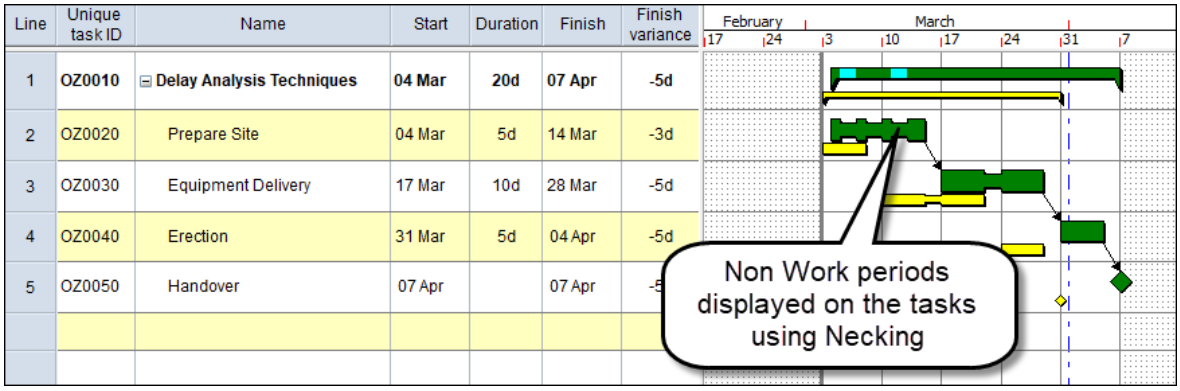
Wet Weather displayed on the Gant Chart:



Non-work time displayed on the Gantt chart bars:



Bars necked to display non work times:

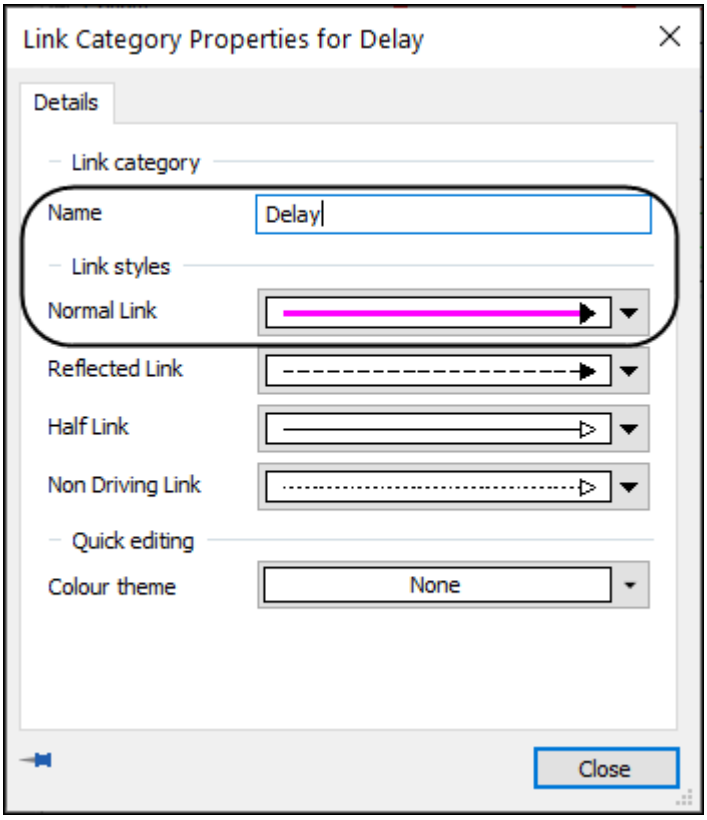


8 Using Link Categories to Remove Delay Task Impact

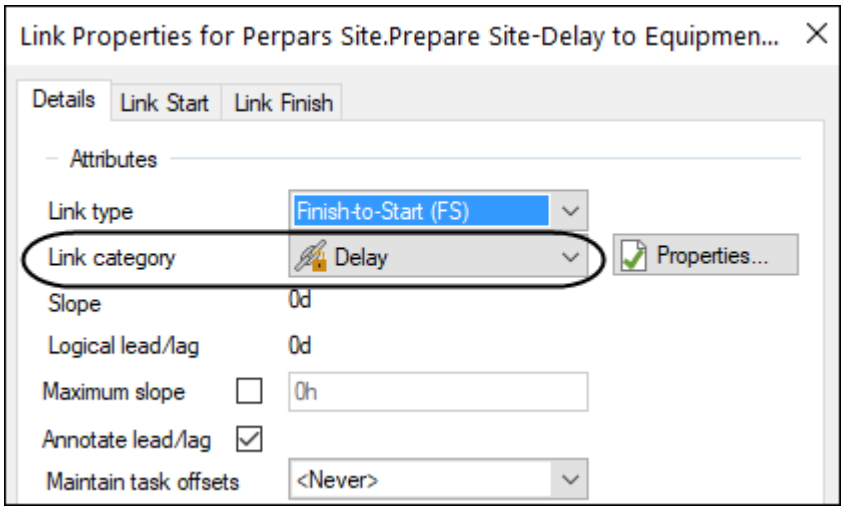
Powerproject has the ability to create and assign Categories to Links. **Link Categories** may be assigned to Links and in turn they may formatted or made inactive, thus allowing multiple logic options in one program.

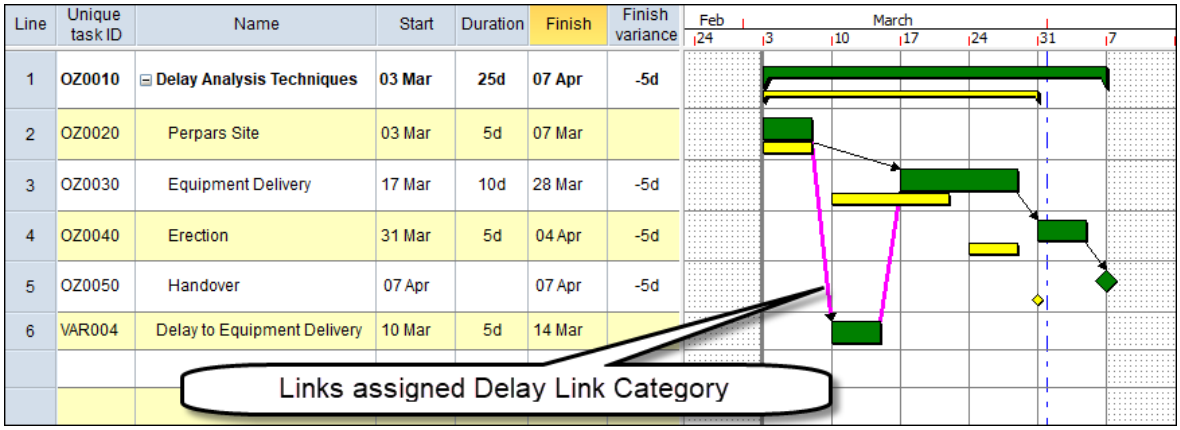
Thus, this function enables links for delay tasks to be turned on and off and a schedule collapsed back to the unimpacted state. This is quicker and simpler than changing all the durations of delay task to zero.

- A new **Link Category** is created in the **Library Explorer** and the colour and size may be formatted:

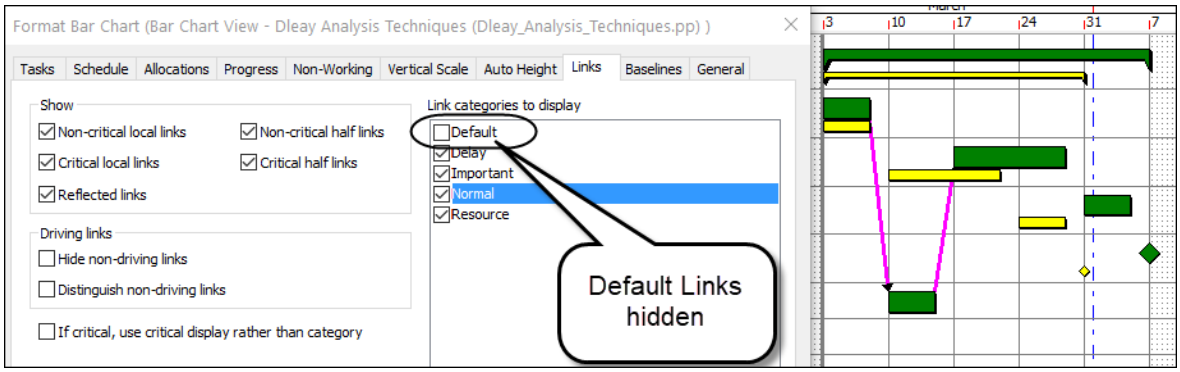


- The Link is assigned a Category in the Link Properties form:

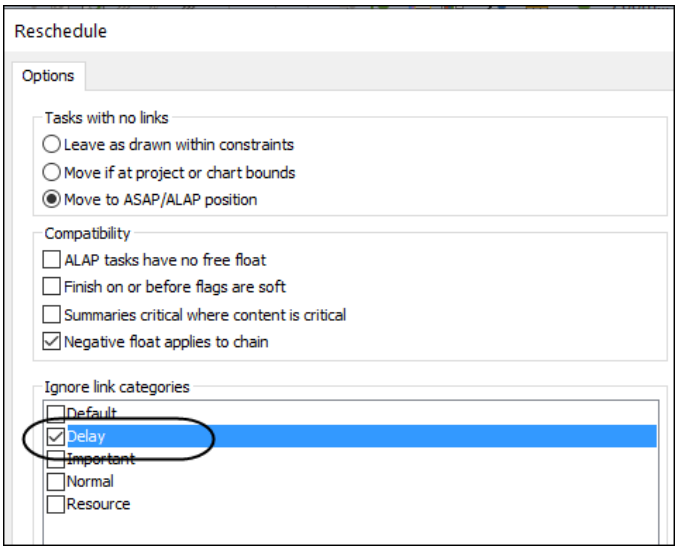




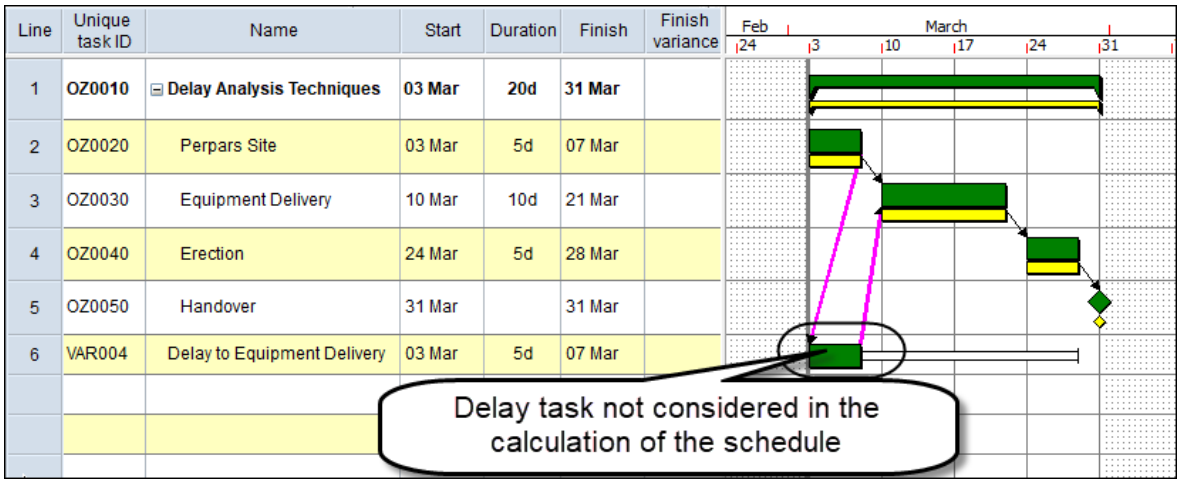
- For clarity Link Categories may be hidden or displayed in the **Format Bar Chart** form, thus only the **Delay Links** are displayed:



- Link Categories may be ignored in the Reschedule form:



- Then the Delay tasks are ignored in the schedule calculation resulting in a Collapsed schedule:

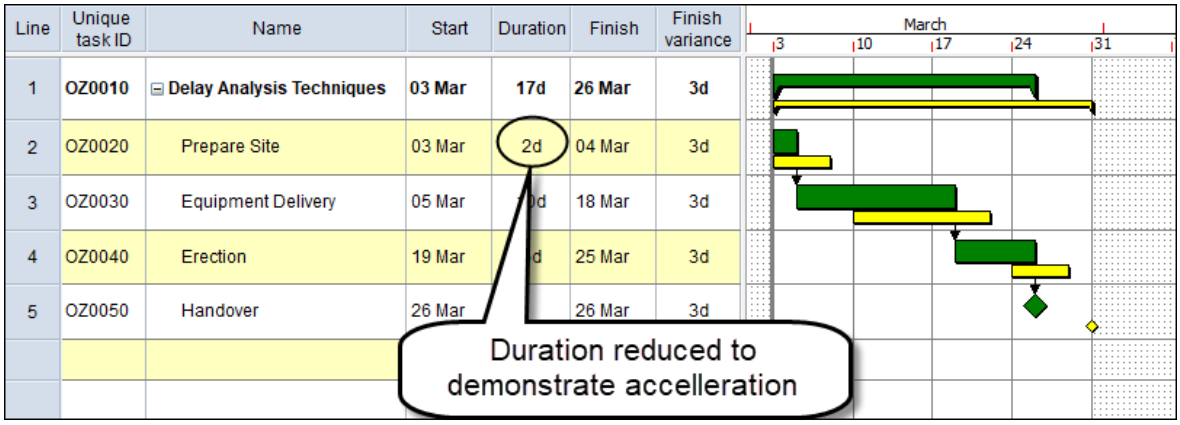


9 Acceleration

There are several methods of demonstrating acceleration:

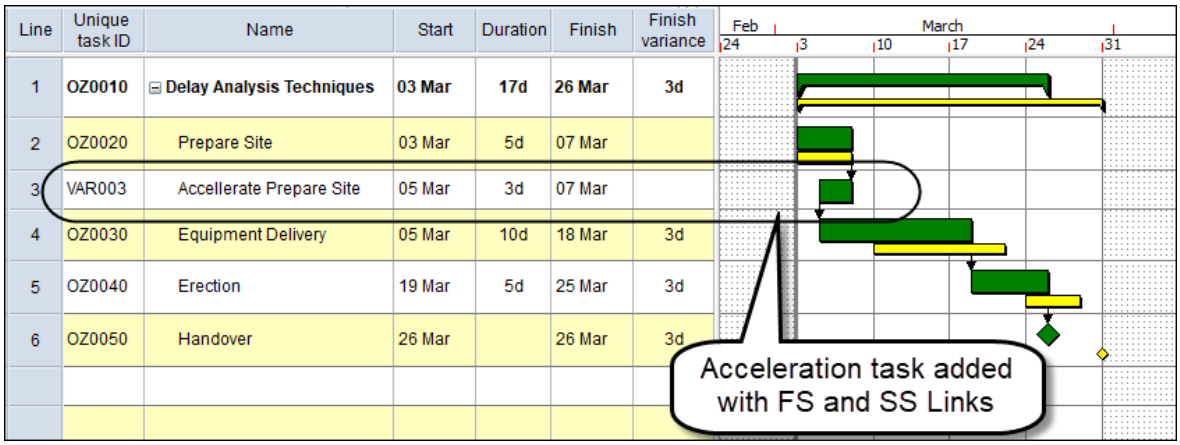
9.1 Reducing the task duration

The first one is to reduce the duration of the task which I do not recommend as the delay value is not visible in the program.



9.2 Adding an acceleration task

The second one is to put an acceleration task with SS and FF relationships and as you increase the acceleration it reduces the end date of the project as per the picture below.



Advantages

- The delay task may be zeroed out to remove the acceleration.
- The delay task may have codes and be filtered to isolate acceleration activities.

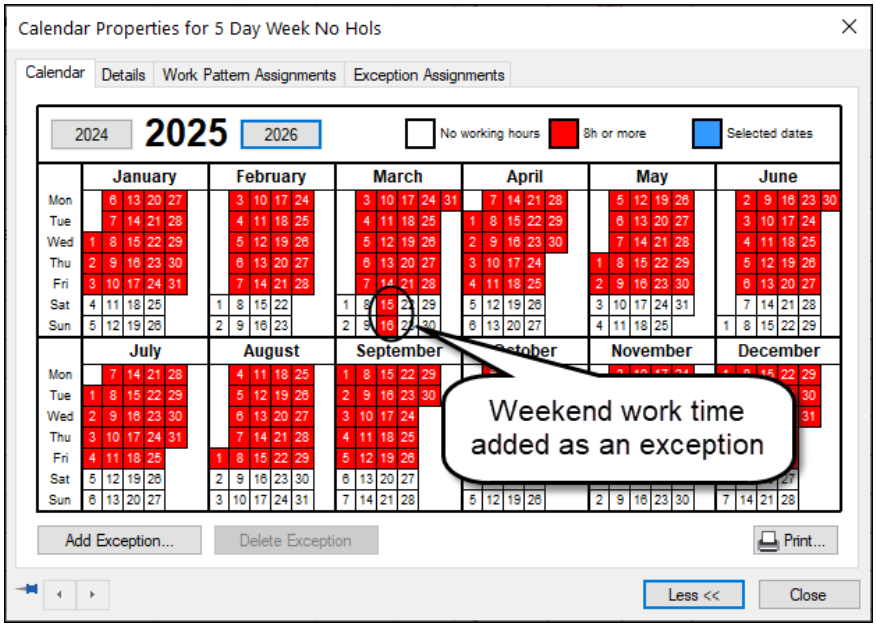
Disadvantages

- The disadvantage of this method is that if you accelerate the last task in a project then the last task will be scheduled beyond the end of the project.
- Some people would object to the use of and task in this unusual manner.
- This method also does not reduce the costs against the task when the delayed task is a resourced task.
- You may put a negative cost against the acceleration task to reduce costs.

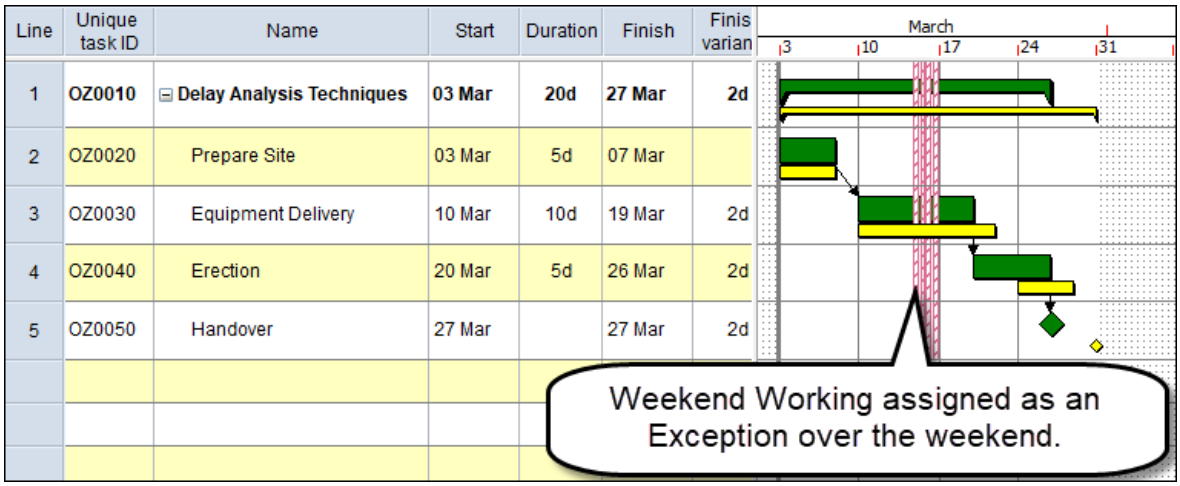
9.3 Making changes to the calendar to allow more working time

If the acceleration has been achieved by working on non-work days such as Saturdays or Sundays or by increasing them the number of hours per day worked against activities then it may be appropriate to make changes to the calendar:

- Two weekend days have been set as working days in the calendar below:



- The picture below shows the calendar against all the activities has now allowed for Saturday and Sunday workdays.



10 Updating the program after delays have been assigned

Delays are normally added to activities at each update and it is normal to actualize the program by applying actual starts and actual finishes two activities that are all complete and actual start and remaining durations to those that are in progress, and then the program rescheduled to calculate a new project end date.

Normally at this point in time client and contractor delays are transfer to a spreadsheet to calculate the total delay value for each party at the end of the project.

Another option that some companies adopt is not to actualize their schedule and keep what I term a **Live As Built** program but this is quite difficult and very rare. Then all the delays may be zeroed and a collapsed As Built program is available. I have written a paper on the three methods of updating a program and you may wish to read this next. You will find the paper here: http://eastwoodharris.com/DL/TP/PS-2768_Rev2018-04-16.pdf

11 Conclusion

11.1 Elecosoft Powerproject

Elecosoft Powerproject is excellent for evaluating and demonstrating delays in construction projects.

It has many strengths over its major competitors like Oracle Primavera P6 and Microsoft Project including:

- User Defined Unique Task Numbering, not available in Microsoft Project,
- Colouring and displaying non work time on or behind tasks,
- The ability to create multiple task spits in the past and future,
- The ability to create and turn on or off and colour Links with Link Categories.

11.2 Microsoft Project issues

Microsoft issues include:

- Does not save a complete project as a baseline,
- Limit of 11 baselines,
- Not being able to name or add notes to baselines,
- Lack of inbuilt Baseline variance data fields,
- The inability to add more than one relationship between two tasks making it difficult to create a Closed Network,
- Inability to see the start and finish date and times of task splits,
- The difficulty in updating a project properly with all the incomplete work in the past and complete work in the future.

11.3 Oracle Primavera issues

Oracle Primavera is a far better tool than Microsoft Project for this type of work and the issues include:

- Inability to colour non work time in the Gantt Chart,
- Inability to assign calendar exceptions a name,
- Inability to add multiple splits to activities
- Inability to read all baseline data.

12 Bibliography

The following are documents that you may consider reading in association with this paper:

- AACE International Recommended Practice 29R-03 Forensic Analysis
- Society of Construction Delay and Disruption Protocol
- Create and Update an Unresourced Project Using Elecosoft (Asta) Powerproject Version 16 - ISBN 978-1-925185-81-2 (1-925185-81-8)

Paul E Harris
Director Eastwood Harris Pty Ltd
Updated 23 August 2021
www.eh.com.au