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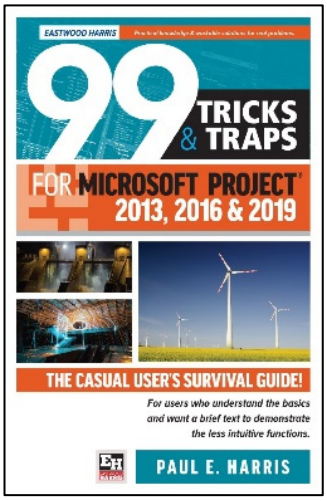
MODELLING EARTHWORKS OPERATIONS WITH ORACLE PRIMAVERA P6

1 Introduction



Many civil construction companies use P6 as their primary scheduling software and they run into a number of issues when trying to model earthmoving operations with P6.

This paper looks at the issues of using P6 resources for mobile equipment and/or earthworks cut and fill quantities and suggests some possible solutions.

2 Issues with P6 and Earthworks Modelling

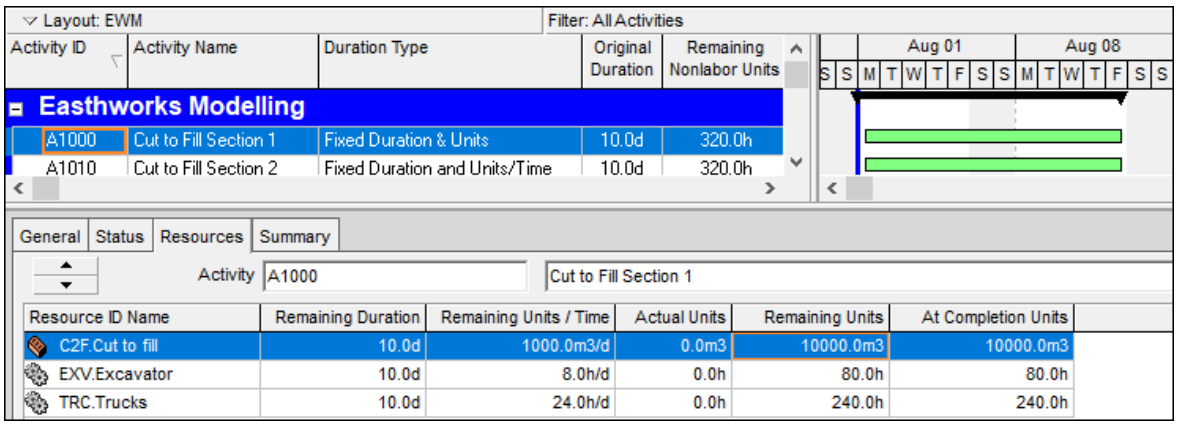
Firstly, I would like to set the scene and create a small P6 schedule that I'll use to demonstrate the issues with modelling earthworks operations with Primavera P6.

The schedule will have activities that I will assign an excavation quantity, an excavator and three trucks against it. I will then model the activities in the way one would expect to model it in P6 with Non Labour Resources for the mobile equipment and Material Resources for the Cut and Fill material and identified the issues.

The picture below shows two activities on an 8 hour per day calendar which:

- Are assigned a10 day duration,
- Have been assigned and excavator and three trucks as Non Labour resources and
- 10,000 cubic metres of cut to fill assigned as a material resource.
- The **User Preferences**, **Resource Assignments** setting has been set **to Preserve the Units, Duration, and Units/Time for existing assignments** so as resources are assigned the existing assignment does not reduce.

I normally do not like using the options of **Fixed Units** or **Fixed Units/Time** because when you add and remove resources the duration changes. Thus, initially we have the option of making the resource is either **Fixed Duration & Units/Time** or **Fixed Duration & Units** and I have created two activities which have one of each option.



What are the current issues:

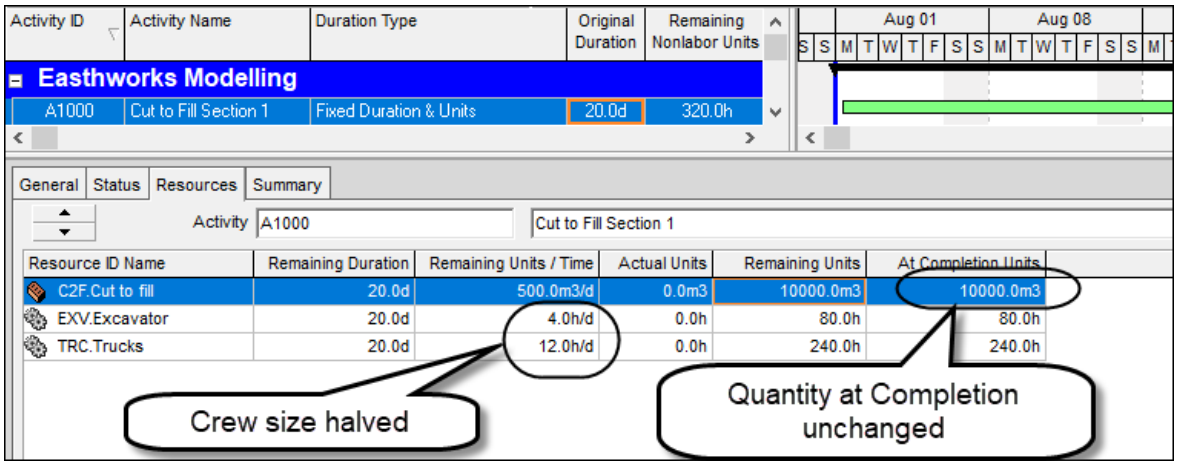
- We can see the mobile equipment quantities as a total in the **Remaining Nonlabour Units** column
- We cannot see the Cut to Fil quantities (which is a Material Resource) in columns in the Activity workspace as this data column does not exist,
- We also cannot see the Material Resource quantities in the Activities Window Status or Summary tabs either.

2.1 Changing Durations

When the increase the duration of both activities by 2 we get the following results:

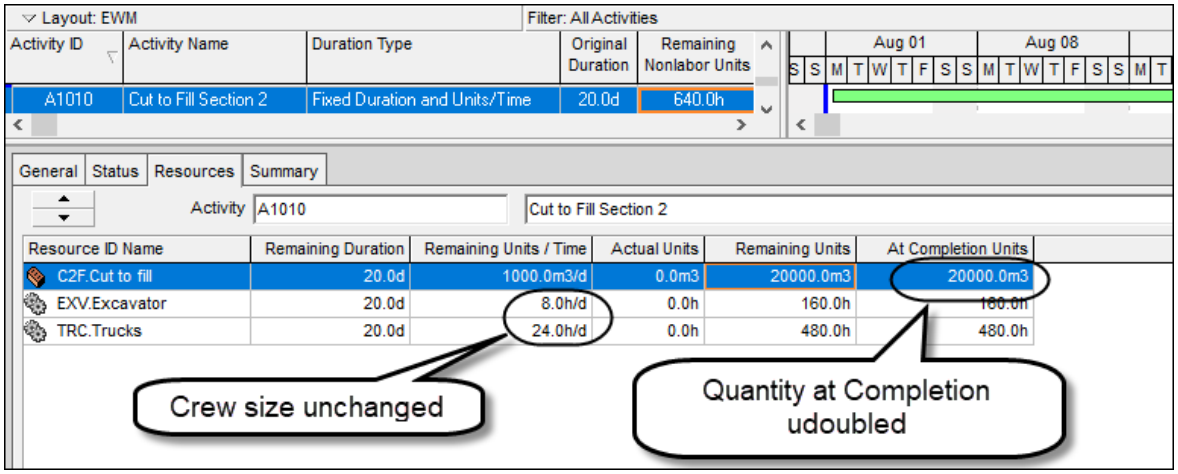
Fixed Duration and Units Activity

- The crew size is halved which is not desirable and
- The Cut to Fill quantity is unchanged and Unit / Time is halved which is desirable.



Fixed Duration and Units/Time Activity

- The crew size is the same which is desirable and
- The Cut to Fill quantity has doubled which is undesirable.



Fixed Units and Fixed Units / Time

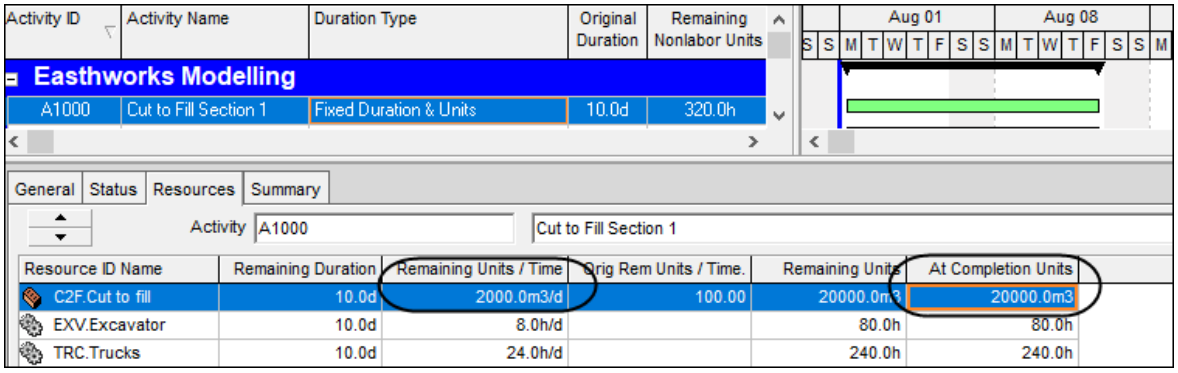
You will find similar issues with both these Duration Types if you decide to use them

2.2 Changing Material Resource Quantities

When you change the Material Resource Quantities we end up with some interesting results:

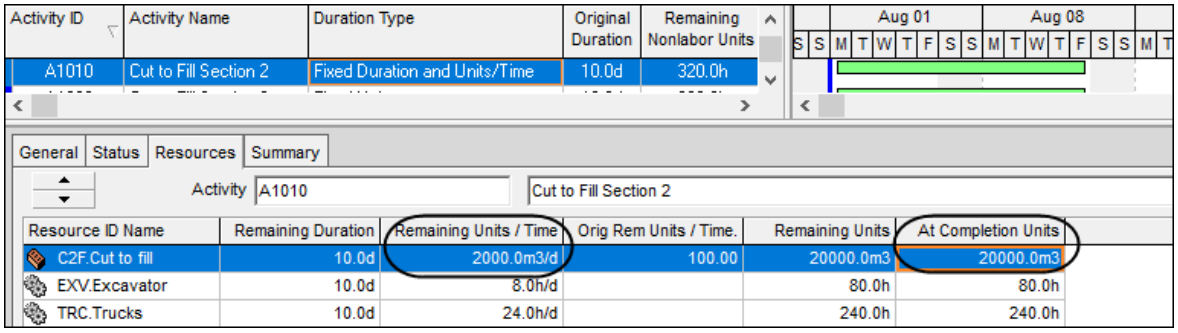
Fixed Duration and Units Activity

Doubling the At Completion Units doubles the Remaining Units / Time and does not increase the activity Duration, which is not desirable:



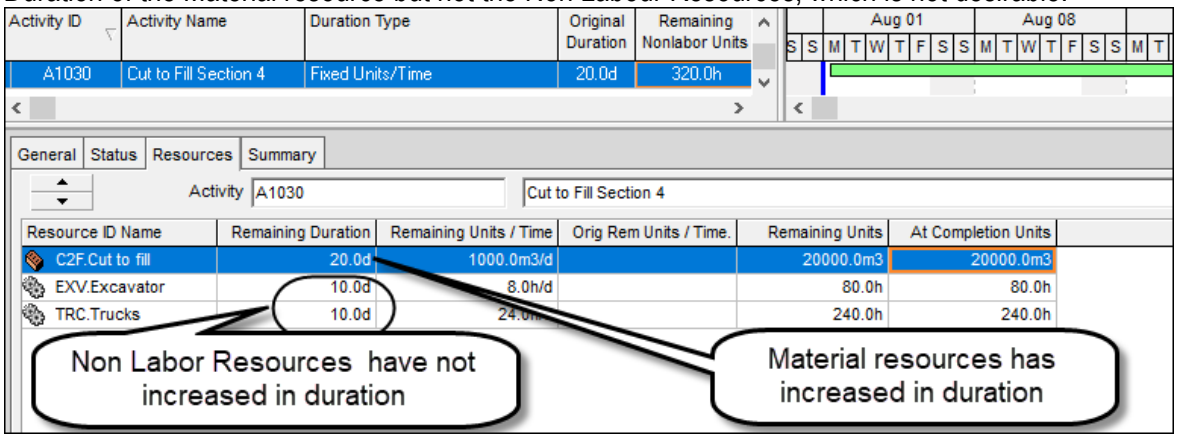
Fixed Duration and Units/Time Activity

Doubling the At Completion Units doubles the Remaining Units / Time and does not increase the activity Duration, which is not desirable:



Fixed Units and Fixed Units / Time

With both of these Duration Types increasing the At Completion Quantity increases the Remaining Duration of the Material resource but not the Non Labour Resources, which is not desirable:



Thus the mobile equipment is no longer working the full duration of the activity.

2.3 Summary of Issues

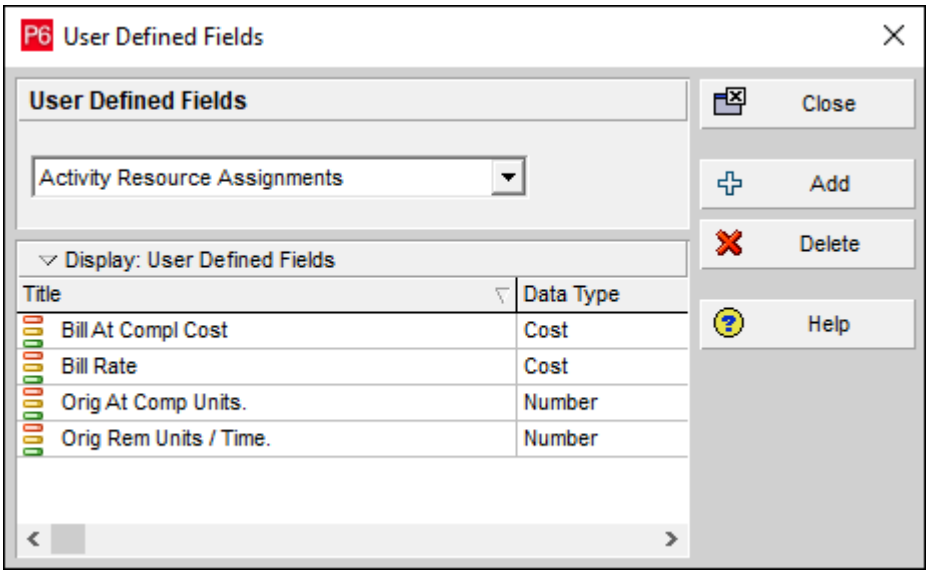
Thus, without being able to assign a duration type to the resource is as opposed to the activity it is difficult to manage activities with both mobile equipment and earthworks quantities assigned to one activity without continually readjusting either the earthworks quantity's or the crew size when the Activity Duration is adjusted or the Resource Remaining Durations when the Material Remaining Quantity is changed.

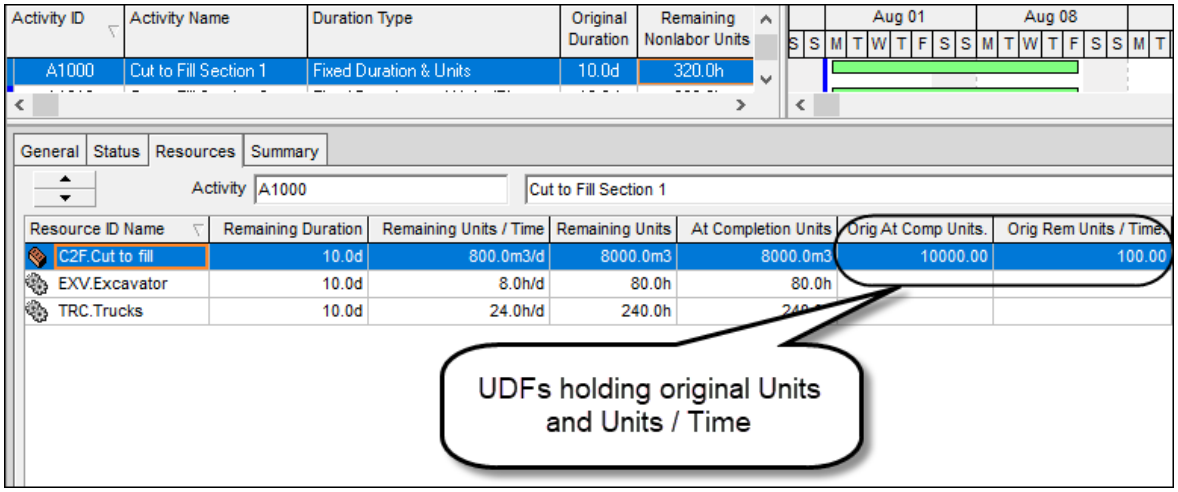
3 Possible Solutions

There are many solutions depending on what you are trying to achieve and will introduce some concepts but ultimately you need to select a solution that will meet your project requirements.

3.1 Activity Resource Assignments User Defined Fields to hold the Original Material Quantities and Unit/Time

You may create a couple of Activity Resource Assignments User Defined Fields to hold the Original Material Quantities and Original Remaining Unit/Time, thus you have a simple check to see the chnnages when you update a duration or other quantity:



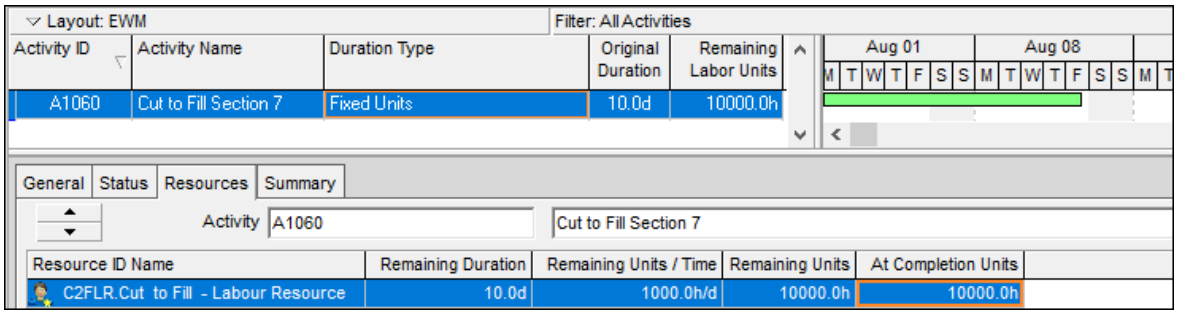


3.2 Using Labour Resources for Materials without Mobile Equipment as Non Labour Resources

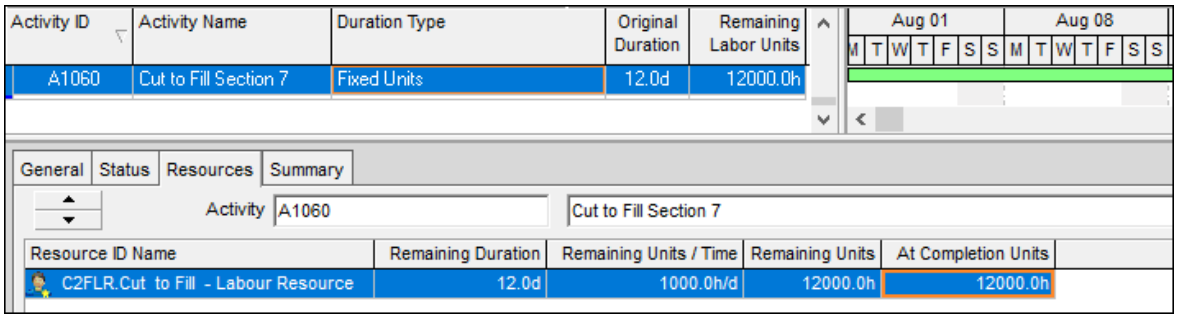
When a single Labour Resource per activity is used for quantities of materials and mobile equipment is not entered as a resource, we now have a couple of advantages:

- Material Quantities may be seen in the Activity Workspace in columns,
- Material Quantities may be updated in the Activity Workspace columns and
- We get better calculation of Remaining Durations when the Duration Type of Fixed Units is used.

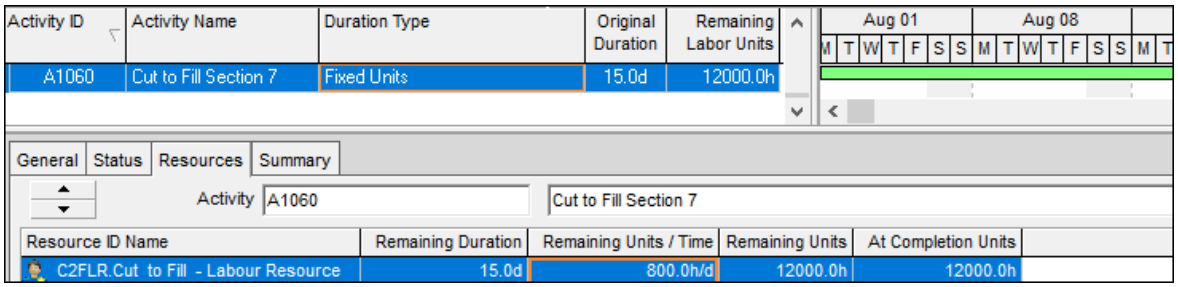
Initial Resources Assignment with a Labour Resource as a Material Quantity:



Increasing the At Completion Quantity increases the Remaining Duration which is desirable:



Changing the production rate by changing the Remaining Units / Time changes the Remaining Duration, which is desirable:

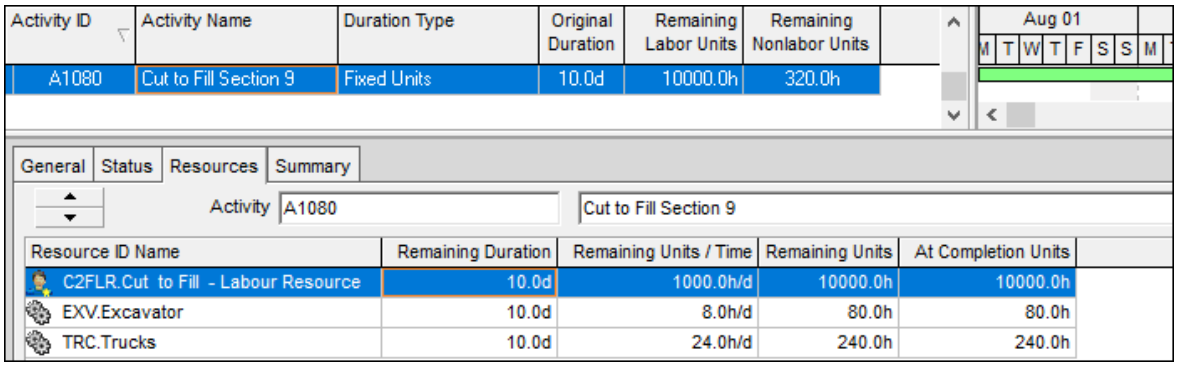


In my experimentation the option of **Fixed Units** gives the best results for earthworks quantities.

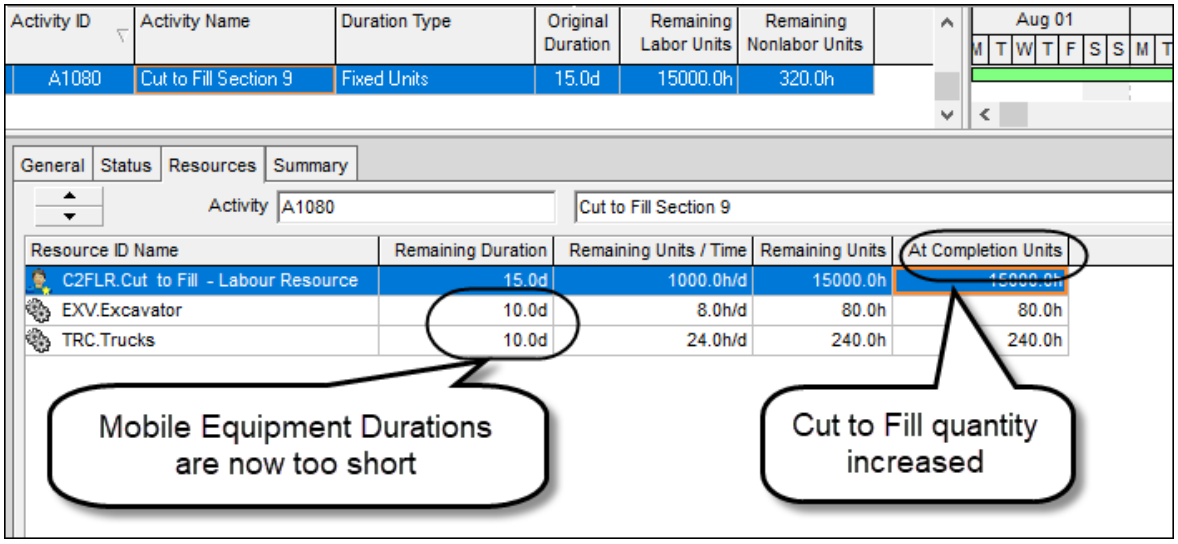
3.3 Using Labour Resources for Materials without Mobile Equipment as Non Labour Resources – this does not work!

When a single Labour Resource per activity is used for quantities of materials and mobile equipment is entered as Non Labour Resources the problems begin again:

Before editing Cut to Fill Quantities:



After editing Cut to Fill Quantities the mobile equipment durations are too short:

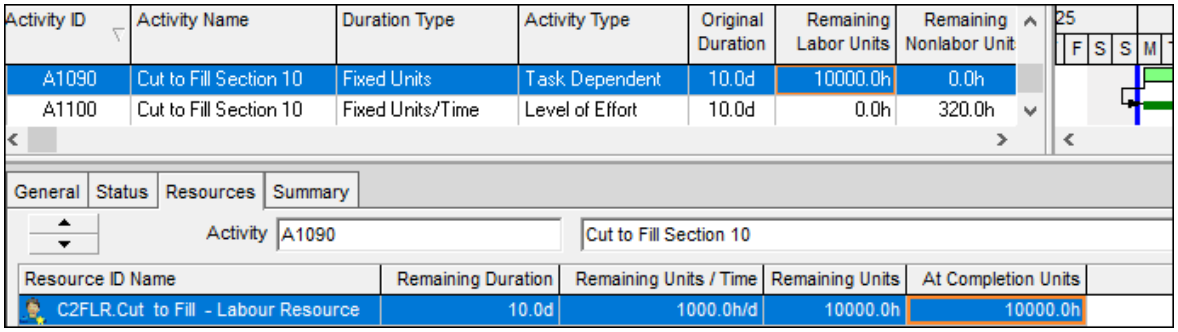


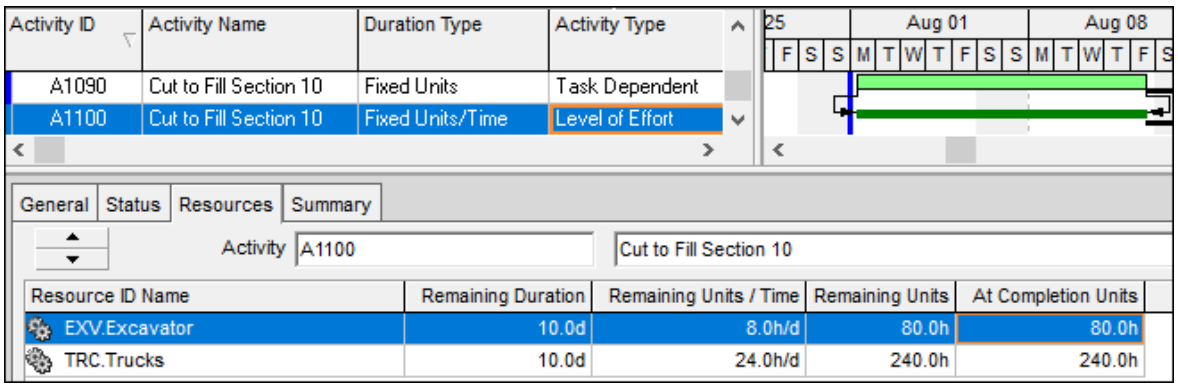
This method does not work.

3.4 Using LOE Activities to Model Mobile Equipment

So, in this situation I've created two activities:

- The first activity is a **Task Dependant** activity that has the Material Resource assigned as a Labour Resource and is **Fixed Units** and
- The second activity is a **Level of Effort** and linked to the first task and has the mobile equipment assigned as a **Fixed Units / Time**:





With this combination:

- The quantities of material and mobile equipment may be seen in the columns and edited in the columns,
- Change the material Remaining Quantity or Unit / Time calculates in a desirable way and
- The duration of the LOE activity with the mobile equipment calculates correctly and the crew size does not change.

Obviously, the issue here is that you have twice the number of desirable activities for the earthworks activities.

4 Summary

These are my thoughts on the issue of managing earthworks operations wit P6 but I would welcome any feedback and I will edit this paper in line with new information.

Paul E Harris
Director Eastwood Harris Pty Ltd
18 June 2021