CHAPTER 1

RESOURCE LEVELLING

INFOCUS

Ideally you will always have enough resources to complete the tasks in your project. However, this is not always the case and sometimes you will not have enough resources for the work you've scheduled. This is known as ***over-allocation***.

Resources become ***over-allocated*** in a project when they are scheduled to do more work than can be accomplished in the specified time. Resource levelling resolves any over-allocations which exist in your project.

Project gives you two options when levelling – letting Project level the schedule for you, or resolving the resource over-allocations yourself.

In this session you will:

- ✓ gain an understanding of resource over allocations
- ✓ learn how to create resource chaos in a project
- ✓ learn how to track down resource over allocations using the ***Resource Graph***
- ✓ learn how to check ***Resource Usage*** for over-allocations
- ✓ learn how to create an over-allocated resources report
- ✓ learn how to change work effort to fix over allocations
- ✓ gain an understanding of assigning overtime to resources
- ✓ learn how to assign overtime to fix over-allocations
- ✓ learn how to assign contract labour to fix over-allocations
- ✓ learn how to switch work assignments to fix over allocations
- ✓ learn how to reschedule tasks to fix over allocations.

UNDERSTANDING RESOURCE LEVELLING

Levelling refers to the even allocation of resources. When you assign more resources to a task than you have available the resource is said to be ***over-allocated*** and requires levelling.

Sometimes over-allocation is also referred to as a resource conflict – you simply have too much work for a resource to do.

Resolving Resource Conflict Using Levelling

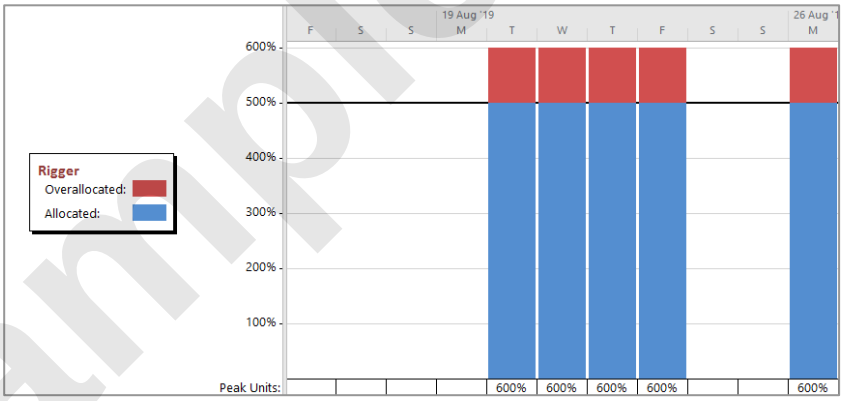
Resource conflicts occur normally when you are entering the resources against the tasks. You may not have noticed that the same resource is required in more than one place. However, because Project is constantly recalculating the start and finish dates it is able to provide you with accurate details about these overlaps, or ***over-allocations***, in work commitments.

The process of resolving these over-allocations is called ***levelling*** (or ***leveling***). This term stems from the fact that in an ideal project, all of your resources will be spread evenly, or flatly, across the scope of tasks. An over-allocation suggests that you have a bump or peak usage that needs to be evened out.

Project has a special ***Resource Graph*** view as shown below which demonstrates this concept of over-allocation and levelling.

In the graph, the thicker line at 500% indicates that this is the maximum units that we have in the resource pool. Any bar above this line indicates an over-allocation of resources. This peaking needs to be eliminated.

Project provides you with the ability to automatically or manually level over-allocations.



If you choose ***automatic levelling***, Project will attempt to resolve the conflict for you. Usually this is done by ***slipping*** the task dates out. It does this by adding delay to the tasks so that resources are not required at the same time. However, with automatic levelling you do forfeit control over your project. Most people prefer to resolve over-allocations manually.

This can be done by:

- ***moving a task*** that has an over-allocated resource within the project so that the task dates are changed to a date when the resource is free
- ***increasing the maximum units*** of the resource (usually by hiring or seconding additional staff)
- ***assigning a different resource*** that is currently free to the task
- ***assigning overtime***
- ***extending working days*** on the calendar used by the resource so that more time is available to work on the tasks.

Obviously not all of these options are practical. For example, if you have a deadline to meet, slipping the task dates by moving the task further down the timeframe is not a good idea. In this circumstance you may be better off hiring more staff or allocating another resource to the task.

Similarly, if your project is constrained by costs then you may need to slip the dates out rather than hire or buy additional resources or allocate overtime to the task.

CREATING RESOURCE PROBLEMS

Our case study project is functional – we have ample resources to complete the required tasks. However, the project manager has just been advised that a second project is to begin elsewhere and some of the resources he has in the resource pool will be taken away to work on the new project. Having carefully assigned resources to the various tasks this will now cause problems.

Try This Yourself:

Open File

Before starting this exercise you MUST open the file Levelling_1.mpp...

1. Click on the ***Project*** tab, then click on ***Project Information*** in the ***Properties*** group

   The case study project is currently scheduled to finish on Wednesday April 22…

2. Click on **[OK]** to close the dialog box
3. Click on the ***View*** tab, then click on ***Resource Sheet*** in the ***Resource Views*** group
4. Click on ***200%*** in ***Max*** for ***Draftsperson***, type **100%** and press Enter
5. Point to the warning icon and read the message that appears
6. Repeat step ***4*** and change the number of resource units for the following resources: **Rigger 500%**, **Carpenter 600%**, **Driver 200%**

	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate
1	Architect	Work		Arc	Consultar	100%	$0.00/hr
2	Draftsperson	Work		Dft	Staff	100%	$0.00/hr
3	Building Clerk	Work		BC	Staff	100%	$0.00/hr
4	Supervisor	Work		Sup	Staff	100%	$0.00/hr
5	Rigger	Work		Rig	Wages	600%	$0.00/hr
6	Boilermaker	Work		BM	Wages	600%	$0.00/hr
7	Welder	Work		Weld	Wages	500%	$0.00/hr
8	Carpenter	Work		Car	Wages	800%	$0.00/hr
9	Painter	Work		Ptr	Wages	500%	$0.00/hr

4 *This action has effectively halved the drafting resources in your project. Since there were more resources available when you did the initial assignments there are now times when the resource is over committed. Our committed (allocated) resources appear in red. A warning icon appears in the left column.*

	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate
1	Architect	Work		Arc	Consultar	100%	$0.00/hr
2	Draftsperson	Work		Dft	Staff	100%	$0.00/hr
3	Building Clerk	Work		BC	Staff	100%	$0.00/hr
4	Supervisor	Work		Sup	Staff	100%	$0.00/hr
5	Rigger	Work		Rig	Wages	500%	$0.00/hr
6	Boilermaker	Work		BM	Wages	600%	$0.00/hr
7	Welder	Work		Weld	Wages	500%	$0.00/hr
8	Carpenter	Work		Car	Wages	600%	$0.00/hr
9	Painter	Work		Ptr	Wages	500%	$0.00/hr
10	Labourer	Work		Lab	Wages	1,000%	$0.00/hr
11	Driver	Work		Drv	Wages	200%	$0.00/hr
12	No Barrier Fencing	Work		NBF	Contractc	100%	$0.00/hr
13	Rock Solid Concrete	Work		RSC	Contractc	100%	$0.00/hr

6

For Your Reference…

To ***create resource problems***:

- Reduce the number of units of a resource

Handy to Know…

- Over-allocations occur when more resources are assigned to a task than there are units in the resource pool. For example, Project will allow you to assign ten carpenters to a task even though only five exist in the resource pool.

TRACKING DOWN OVER ALLOCATIONS

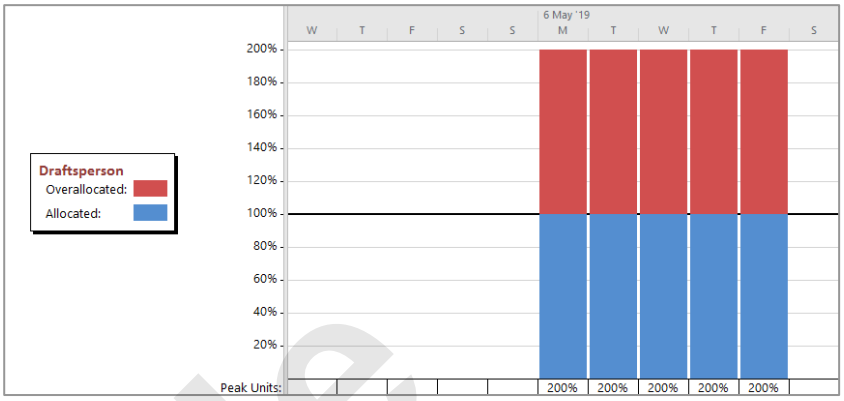
Over allocations aren't immediately apparent, unless they arise when you are changing data in the resource sheet as we have done. Over-allocations can be problematic and it is a good idea to check the resource pool on a regular basis to see whether there are over-allocations in your project. Remember, over-allocated resources appear bolded red in the resource pool.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file Levelling_2.mpp...*

1. Click on the ***View*** tab, then click on ***Other Views*** in the ***Resource Views*** group and select **Resource Graph**
2. Press Ctrl + Home , then Alt + Home to move to the start of the project
3. Press Pg Dn until the ***Draftsperson*** comes into view

   This resource is over-allocated as indicated by the colouring of the name and in the chart…
4. Press Pg Dn until you can see the ***Rigger***, then press Alt + Home to return to the start of the project
5. Click on the ***Resource*** tab, then click on ***Next Overallocation*** in the ***Level*** group to see the over-allocation for the ***Riggers***
6. Click on ***Next Overallocation*** again – you will be advised that there are no more over-allocations for this resource
7. Click on **[OK]**
8. Repeat steps ***4*** to ***7*** with the ***Carpenter*** resource



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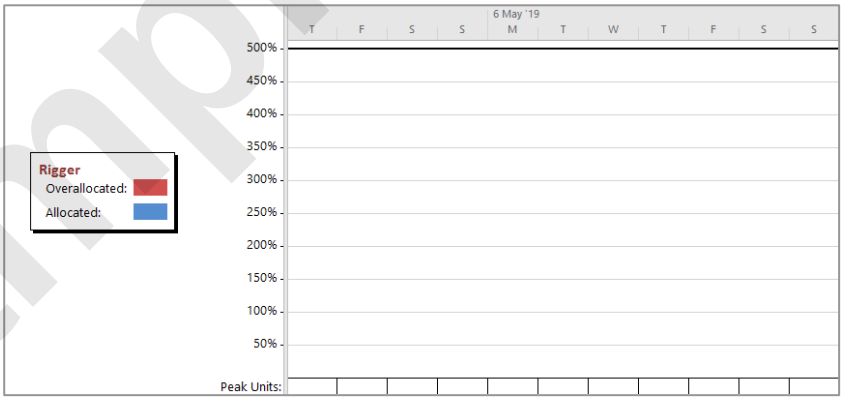

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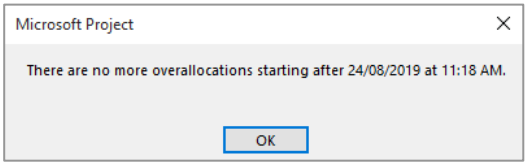

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For Your Reference…

To ***display over-allocations*** as a ***chart***:

1. Click on the ***View*** tab, then click on ***Other Views*** in the ***Resource Views*** group and select **Resource Graph**
2. Click on the over-allocated resource
3. Click on the ***Resource*** tab, then click on the ***Next Overallocation*** command

Handy to Know…

- There are a few ways to resolve over-allocation issues, including changing how long a task will take to complete and assigning more resources to a task.

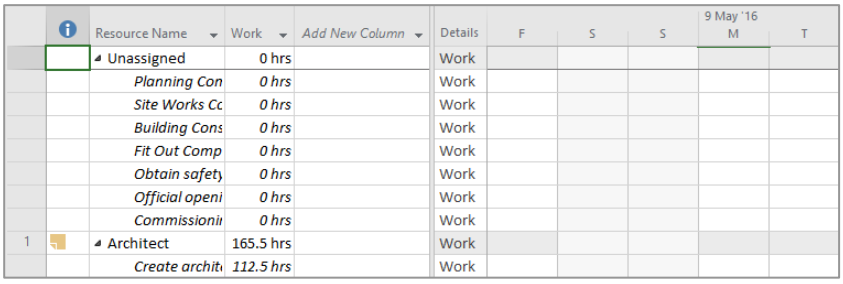
CHECKING RESOURCE USAGE

Another great way of tracking over-allocations, and more importantly the extent of over-allocation, is through the ***Resource Usage*** view. This view presents a sheet to the left which is organised in order of resources and the tasks that they are working on. To the right is a timeline view which shows the hours the resource works. Over allocated resources appear in red colouring.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file Levelling_3.mpp...*

1. Click on the ***View*** tab, then click on ***Resource Usage*** in ***Resource Views***
2. Press Ctrl + Home to move to the top of the resource list
3. Scroll to and click on ***Draftsperson***, click on the ***Task*** tab, then click on ***Scroll to Task*** in the ***Editing*** group to display the usage information for this resource
4. Scroll to and click on ***Rigger*** and click on ***Scroll to Task*** in the ***Editing*** group to display the usage information for this resource



	Resource Name	Work	Add New Column	Details	9 May '16 F	S	S	M	T
	Unassigned	0 hrs		Work					
	Planning Con	0 hrs		Work					
	Site Works Cc	0 hrs		Work					
	Building Cons	0 hrs		Work					
	Fit Out Comp	0 hrs		Work					
	Obtain safety	0 hrs		Work					
	Official openi	0 hrs		Work					
	Commissioni	0 hrs		Work					
1	Architect	165.5 hrs		Work					
	Create archit	112.5 hrs		Work					

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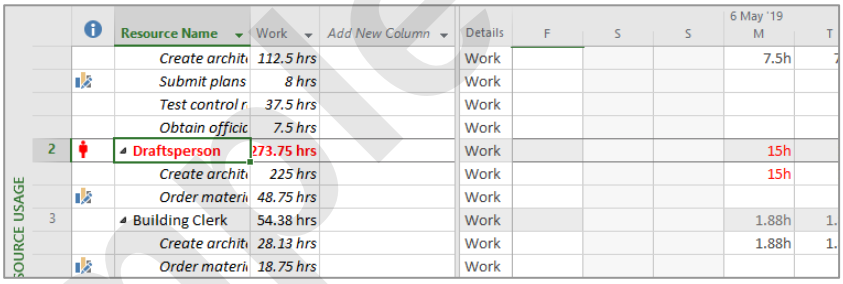
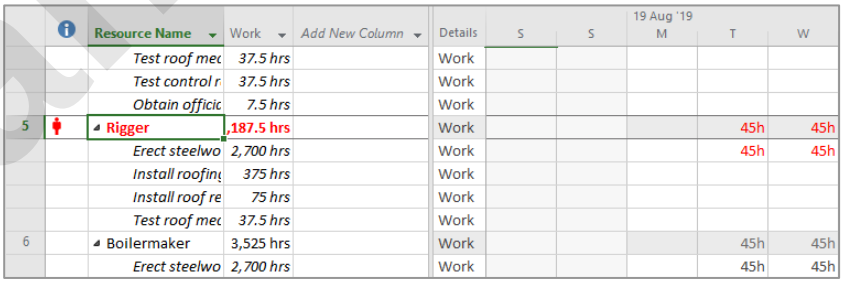


	Resource Name	Work	Add New Column	Details	6 May '19 F	S	S	M	T
	Create archit	112.5 hrs		Work				7.5h	
	Submit plans	8 hrs		Work					
	Test control r	37.5 hrs		Work					
	Obtain officic	7.5 hrs		Work					
2	Draftsperson	273.75 hrs		Work				15h	
	Create archit	225 hrs		Work				15h	
	Order materi	48.75 hrs		Work					
3	Building Clerk	54.38 hrs		Work				1.88h	1.
	Create archit	28.13 hrs		Work				1.88h	1.
	Order materi	18.75 hrs		Work					

3



	Resource Name	Work	Add New Column	Details	19 Aug '19 S	S	M	T	W
	Test roof mec	37.5 hrs		Work					
	Test control r	37.5 hrs		Work					
	Obtain officic	7.5 hrs		Work					
5	Rigger	1,187.5 hrs		Work				45h	45h
	Erect steelwo	2,700 hrs		Work				45h	45h
	Install roofing	375 hrs		Work					
	Install roof re	75 hrs		Work					
	Test roof mec	37.5 hrs		Work					
6	Boilermaker	3,525 hrs		Work				45h	45h
	Erect steelwo	2,700 hrs		Work				45h	45h

4

For Your Reference…

To ***check*** for ***over-allocations*** in ***resource usage***:

1. Click on the ***View*** tab, then click on ***Resource Usage*** in the ***Resource Views*** group
2. Scroll to over-allocated resources

Handy to Know…

- At the time of writing, we found that the ***Next Overallocation*** command (to move to the task in the timeline) in the ***Resource Usage*** view was erratic and inconsistent due to a bug when used in ***Resource Usage*** view.

CREATING AN OVER ALLOCATION REPORT

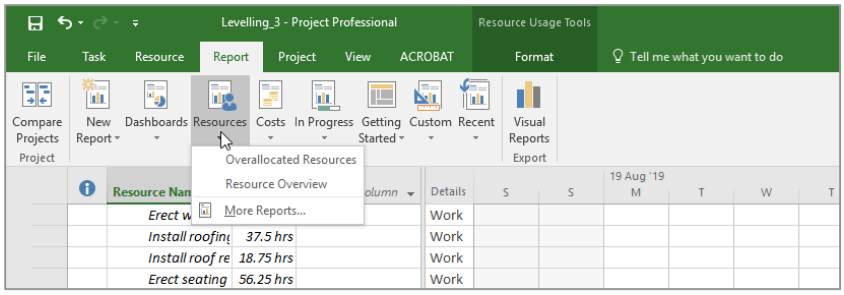
Project contains a number of in-built and pre-defined reports which help you locate all sorts of information about, and problems in, your project. One such report, the ***Overallocated Resources*** report, lists all of the resources that are over allocated in your project and which tasks contain those over allocations. This is a handy report to use when levelling your project.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file Levelling_3.mpp...*

1. Click on the ***Report*** tab, then click on ***Resources*** in the ***View Reports*** group to display a list of reports
2. Select **Overallocated Resources** to display the report

   The report shows which resources are over allocated and when the over allocations occur…
3. Click on the ***File*** tab, then click on ***Print***
4. Click on **[Print]** to print the report, or click on the ***Back*** arrow if you prefer not to print
5. Click on the ***View*** tab, then click on ***Resource Usage*** in the ***Resource Views*** group



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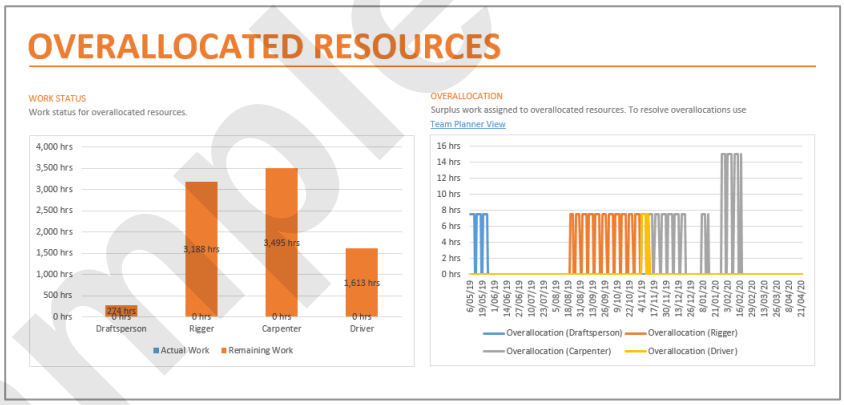

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For Your Reference…

To ***create*** an ***over-allocated resources report***:

1. Click on the ***Report*** tab, then click on ***Resources*** in the ***View Reports*** group
2. Select **Overallocated Resources**

Handy to Know…

- It is recommended that you print the over-allocated resources report before commencing levelling operations so that you have an idea of what is required as well as a record to refer back to.

CHANGING WORK EFFORT

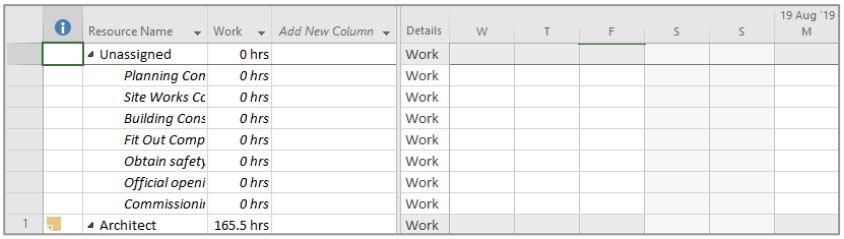
There is no right or wrong way to level over-allocations – the methods that you choose are determined by the nature of your project. The best way to tackle over-allocations is one at a time. We'll start with the ***Draftsperson***. We identified a work requirement for two draftspersons to create the architectural plans. It has been decided that there is only enough work for one.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file Levelling_3.mpp...*

1. Click on the ***View*** tab, then click on ***Resource Usage*** in the ***Resource Views*** group to display the ***Resource Usage*** sheet
2. Scroll to and click on ***Draftsperson***, click on the ***Task*** tab, then click on ***Scroll to Task*** in the ***Editing*** group to display usage information for this resource
3. Click on ***Gantt Chart*** in the ***View*** group to see a ***Gantt Chart*** view
4. Point to the information icon next to ***Create architectural plans*** under ***Planning***, then right-click on it and select **Fix in Task Inspector**
5. Click on **[Reduce Work]** to remove the over-allocation
6. Click on ***Create architectural plans***, then click on ***Details*** in the ***Properties*** group to see a task form in the lower pane of the screen

   Notice that the hours for the draftsperson show 112.5h (3w x 37.5h)…
7. Click on the close button of the ***Task Inspector***



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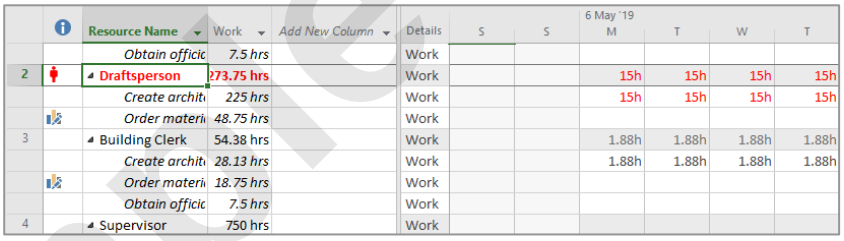
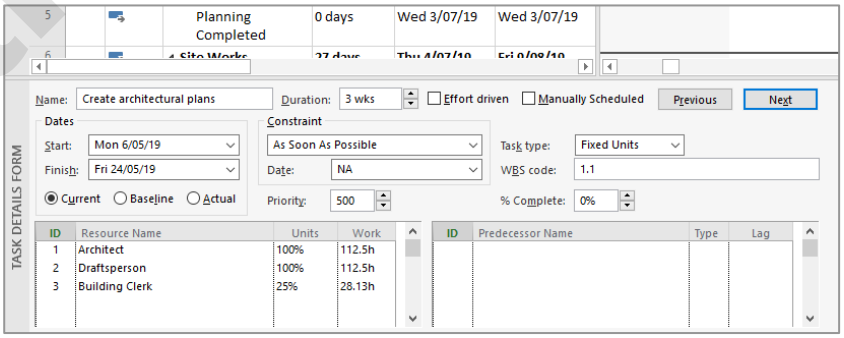


2 *The problem here is that the task Create architectural plans requires/shows 15 hours of draftsperson work on most days – since a day is 7.5 hours this means that there is a requirement for 2 draftspeople.*



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For Your Reference…

To ***resolve over-allocation*** by ***changing work effort***:

1. Right-click on the icon next to the task with the over-allocation and click on ***Fix in Task Inspector***
2. Click on **[Reduce Work]** to remove the over allocation

Handy to Know…

- If you know that reducing the Work will fix an over-allocation, you could manually type the desired hours in the Work field for the resource rather than using the ***Task Inspector***.

UNDERSTANDING OVERTIME

You can reduce the overall duration of a resource assignment in a task by assigning ***overtime*** to the resource. The total work for the assigned resources remains the same, but the task duration is reduced. In Project, overtime is defined as the work scheduled to take place beyond the regular working hours of the resource.

The Effect of Overtime On Task Duration

We have an over-allocation with the riggers. As you'll soon see, this is only in one task – ***erecting the steelwork***. In our case study there is a specific amount of work to be done on this. The riggers prepare and assemble some of the steelwork units that are then lifted into place.

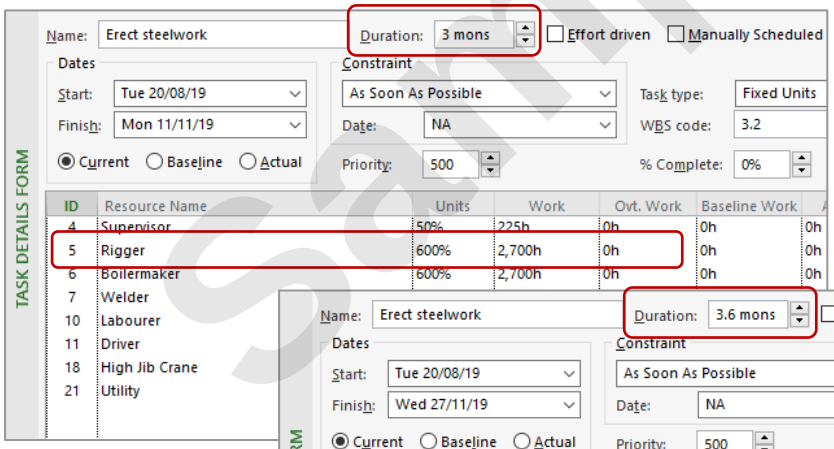
We are short one rigger. This shortfall can be overcome by assigning overtime to the other riggers – they'll work enough overtime to cover the shortfall of one rigger.

In Project, assigning overtime can shorten the duration of a task. A task requires a specific amount of work effort by the resources to complete the task within the required duration. The duration of the task is calculated on the basis that the work effort will be done in regular work time.

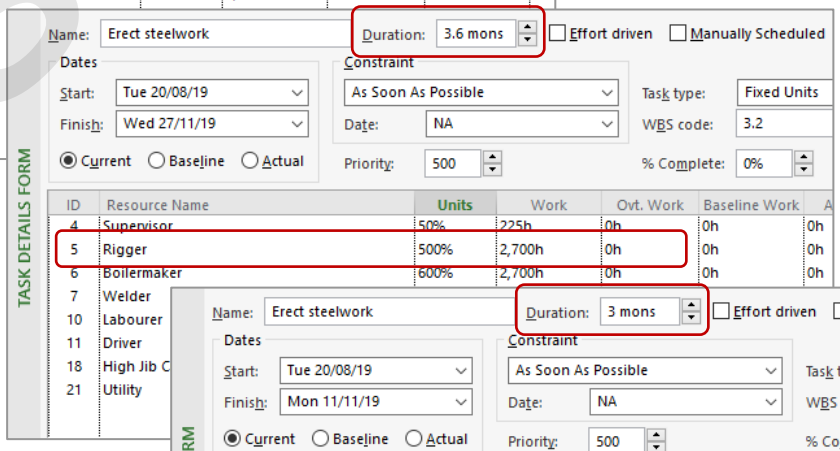
However, if some of that work effort is done in overtime (that is, outside of ***regular work time***) then the duration of the task will shorten – providing effort from other resources doesn't come into play. Consider the table below:

Total Work	Ovt Hours	Reg Work Time	Duration
15h	0h	15h	2 days
15h	3.75h	11.25h	1.5 days

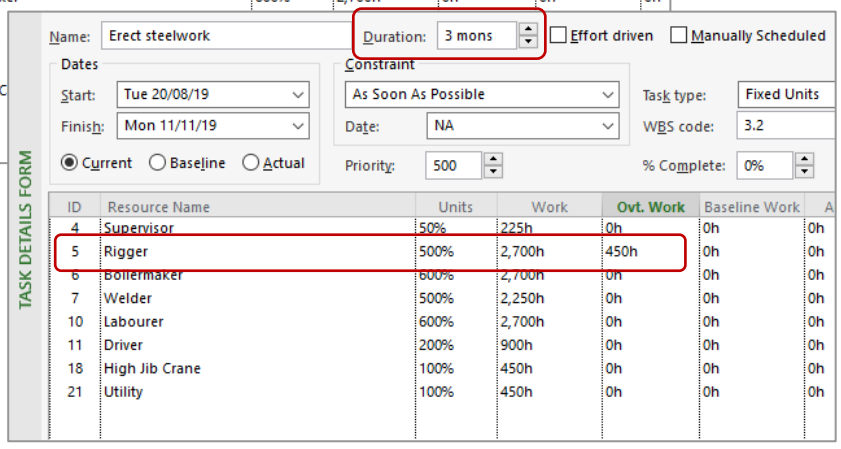
Our task is effort driven and currently requires six riggers per day to complete.



If we take one rigger away, the duration will be longer – assuming that the same amount of work needs to be done by the five remaining riggers.



However, by assigning overtime we should be able to return the duration to its original amount. This is presented numerically in the form below.



ASSIGNING OVERTIME

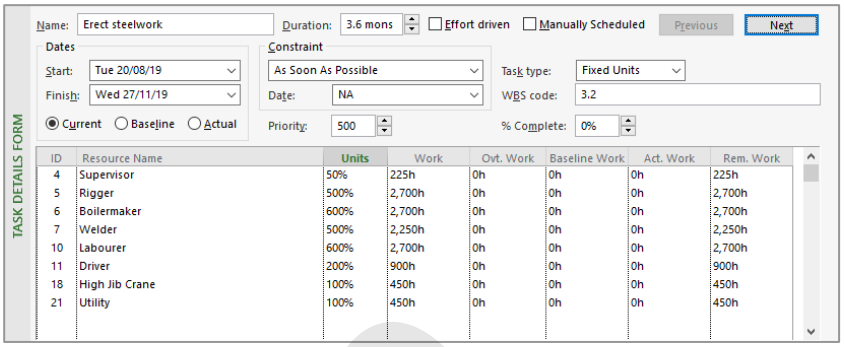
To resolve a resource over-allocation, you may need to assign ***overtime***. By definition, overtime is something that happens outside of the normal working hours. The value in ***Work*** represents total hours for a resource. Any value in overtime is subtracted from the total ***Work*** and this in turn may impact on the task ***duration***. Generally, more overtime results in a shorter task duration.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file Levelling_4.mpp...*

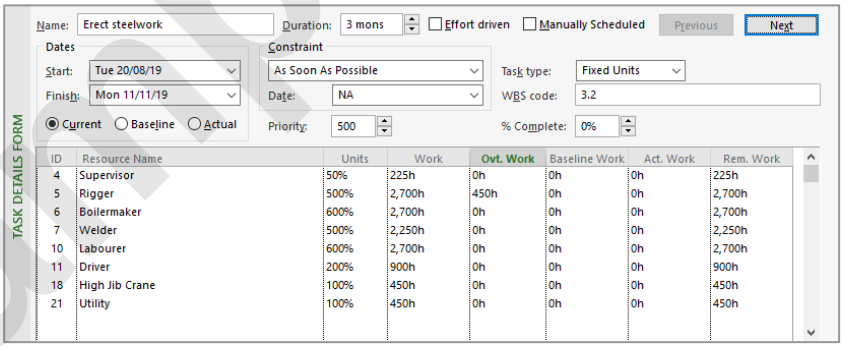
1. Ensure you have a split screen view with the ***Gantt Chart*** and the ***Task Details Form***, click in the top pane, click on the ***View*** tab, then click on ***Resource Usage*** in the ***Resource Views*** group
2. In the ***Gantt Chart***, scroll down, click on ***Rigger***, click on the ***Task*** tab, then click on ***Scroll to Task*** in the ***Editing*** group to display this task in the timeline
3. Click in the ***Task Details Form***, click on the ***Task Form Tools: Format*** tab, then ensure ***Work*** is selected in the ***Details*** group
4. Click on ***600%*** in ***Units*** for ***Rigger***, type **500** and click on **[OK]**
5. Click on ***0h*** in ***Ovt. Work*** for ***Rigger***, type **450h** and click on **[OK]**

   The task is back to 3 months and the Rigger resource is no longer over-allocated



ID	Resource Name	Units	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
4	Supervisor	50%	225h	0h	0h	0h	225h
5	Rigger	500%	2,700h	0h	0h	0h	2,700h
6	Boilermaker	600%	2,700h	0h	0h	0h	2,700h
7	Welder	500%	2,250h	0h	0h	0h	2,250h
10	Labourer	600%	2,700h	0h	0h	0h	2,700h
11	Driver	200%	900h	0h	0h	0h	900h
18	High Jib Crane	100%	450h	0h	0h	0h	450h
21	Utility	100%	450h	0h	0h	0h	450h

4 *The duration has extended to 3.6 months because the Work for the Riggers (2,700h) is now divided by 5 riggers to derive total work of 540 hours for each rigger. Since there are 150 hours of work per week (37.5 x 5) when you divide the total hours (540h) for a rigger by 150 you get 3.6 months.*



ID	Resource Name	Units	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
4	Supervisor	50%	225h	0h	0h	0h	225h
5	Rigger	500%	2,700h	450h	0h	0h	2,700h
6	Boilermaker	600%	2,700h	0h	0h	0h	2,700h
7	Welder	500%	2,250h	0h	0h	0h	2,250h
10	Labourer	600%	2,700h	0h	0h	0h	2,700h
11	Driver	200%	900h	0h	0h	0h	900h
18	High Jib Crane	100%	450h	0h	0h	0h	450h
21	Utility	100%	450h	0h	0h	0h	450h

5

For Your Reference…

To ***assign overtime*** to a ***resource***:

1. Ensure a ***Task Form*** appears with the ***Work*** format selected
2. Type the appropriate overtime in the ***Ovt. Work*** field, then click on **[OK]**

Handy to Know…

- Project subtracts overtime from total ***Work*** (*2,700 – 450 = 2,250*), then divides this by the number of specific resources (*2,250 / 5 = 450*). This in turn is then divided by the number of hours per week (*450 / 150 = 3*) to determine how many weeks of work are required by this resource.

HIRING CONTRACT LABOUR

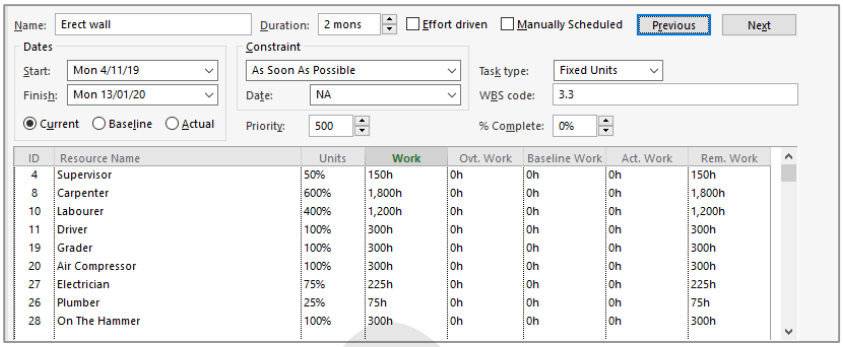
Our case study project doesn't have enough carpenters to complete the work that needs to be done. If it is absolutely necessary, we have permission to bring in additional contract tradespeople. We will have to add a new resource to the pool, then assign the resource to the task, being careful that we don't accidentally change the duration due to the effort-driven nature of the task.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file Levelling_5.mpp...*

1. Scroll down the Gantt chart until the ***Carpenter*** resource can be seen, click on ***Erect wall***, click on the ***Task*** tab, then click on ***Scroll to Task*** in the ***Editing*** group
2. In the ***Task Details Form*** click in ***Resource Name*** below ***Plumber***, type **On The Hammer**, then click on **[OK]**

   We can hire contract labour from this agency to perform some of the carpentry work…
3. Click on ***700%*** in ***Units*** for ***Carpenter*** and type **600%**, click on ***2,100h*** in ***Work and*** type **1800**, then click on **[OK]**
4. Double-click on ***On The Hammer*** to display the ***Resource Information*** dialog box
5. Change the ***Units*** to ***1000%***, type **OTH** in ***Initials*** and type **Contract Labour** in ***Group***
6. Click on **[OK]**



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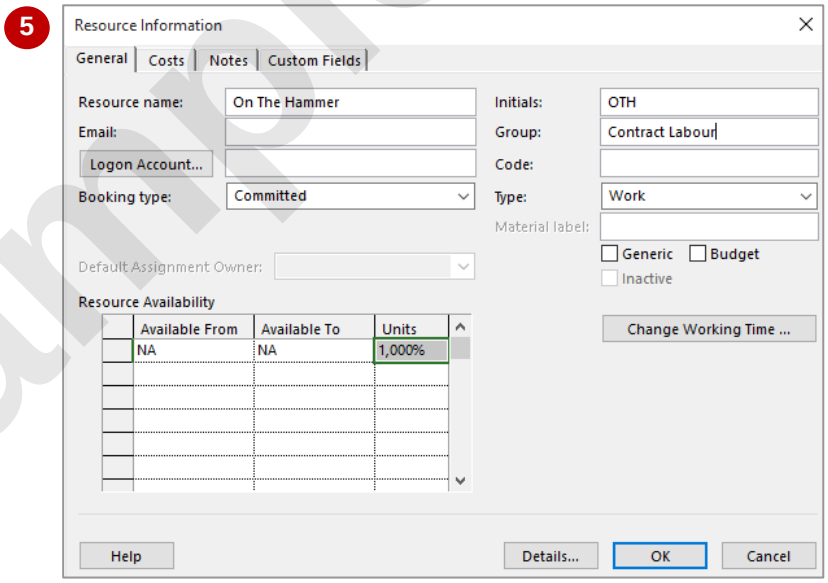


5

For Your Reference…

To ***add*** a ***new resource*** to ***cover over-allocations***:

1. Click in ***Resource Name***, type the name of the resource, then click on **[OK]**
2. Enter the appropriate Work for this new resource, then deduct the same amount from the over-allocated resource

Handy to Know…

- If you have access to an endless supply of contract labour, you will be able to enter a large sum of units (such as 1000%).

SWITCHING WORK ASSIGNMENTS

The task of erecting the seating tiers requires eight carpenters, but there are only six in the pool. We could use the contract labour, but we only have permission to do so if it is absolutely necessary. Instead, we can give some of the more menial carpentry tasks to the labourers we already have.

Try This Yourself:

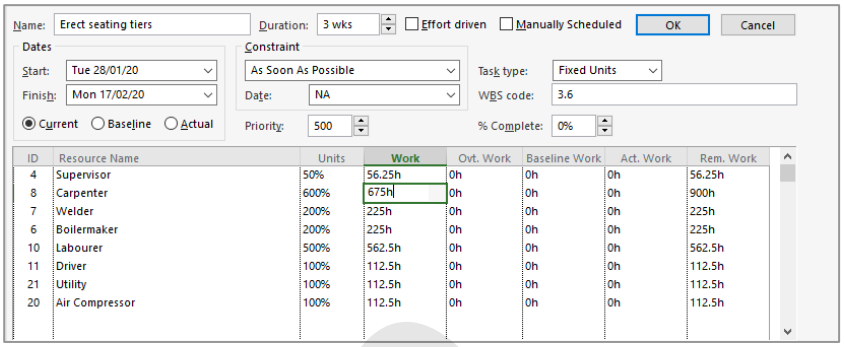
Same File *Continue using the previous file with this exercise, or open the file Levelling_6.mpp...*

1. Click on ***Erect seating tiers*** in the Gantt chart, click on the ***Task*** tab, then click on ***Scroll to Task*** in the ***Editing*** group
2. In the ***Task Details Form***, type **600%** in ***Units*** for ***Carpenter***, then type **675h** in ***Work***

   This represents 3 weeks work for 6 carpenters (6 x 3 x 37.5 = 675)...
3. Type **700%** in ***Units*** for ***Labourer*** and type **787.5h** in ***Work***

   This represents 3 weeks work for 7 labourers (7 x 3 x 37.5 = 787.5)...
4. Click on **[OK]** to record the revised assignments

   The carpenter resource no longer appears over-allocated



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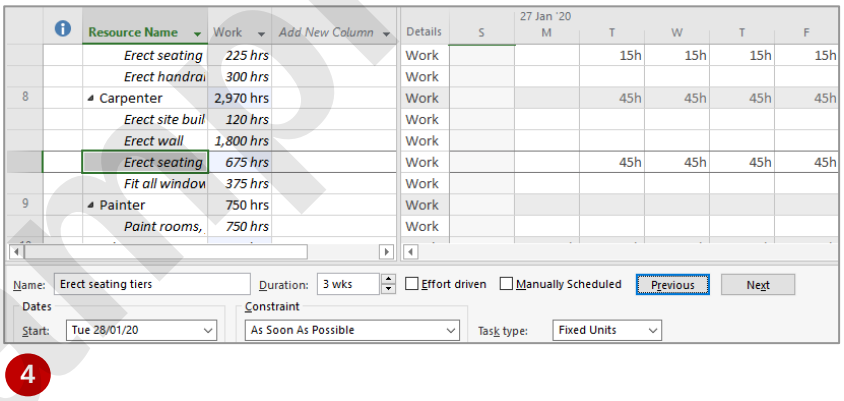

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For Your Reference…

To ***switch work assignments***:

1. Select the task
2. Adjust the units and/or work effort for the over allocated resource
3. Click on **[OK]**

Handy to Know…

- Switching assignments in Project is relatively easy to do, providing you take into consideration the effort-driven nature of your tasks.

RESCHEDULING TASKS

We have an over-allocation of drivers. This over-allocation has arisen because the resource is required on two different tasks at the same time. We don't want to use additional resources, and overtime isn't practical as the work of the driver is required in normal working time. We need to reschedule the tasks in such a way that allows us to still meet the project deadlines and timeframes.

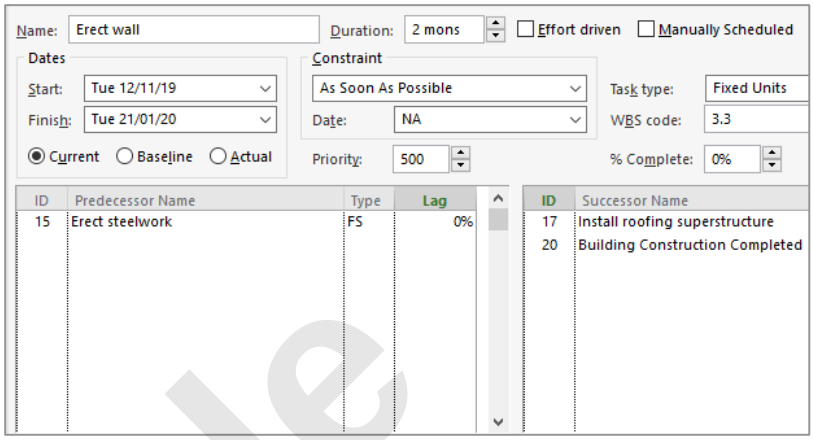
Try This Yourself:

Same File

Continue using the previous file with this exercise, or open the file Levelling_7.mpp...

1. Scroll down in the top pane and click on the ***Driver*** resource, click on the ***Task*** tab, then click on ***Scroll to Task*** in the ***Editing*** group
2. Use the scroll bar below the timeline to scroll right until red values appear in the ***Driver*** row
3. Click on ***Erect wall*** in the upper pane, then click on the ***Task Details Form*** (lower pane)
4. Click on the ***Task Form Tools: Format*** tab, then click on ***Predecessors & Successors*** in the ***Details*** group
5. Click on ***-10%*** in ***Lag***, type **0** and click on **[OK]** to remove the over allocation
6. Click on the ***Project*** tab, then click on ***Project Information*** in the ***Properties*** group

   The finish date is now Thursday, May 7…
7. Click on **[OK]**
8. Double-click on the divider line between the panes to remove the lower pane, click on the ***Task*** tab, then click on ***Gantt Chart*** in the ***View*** group



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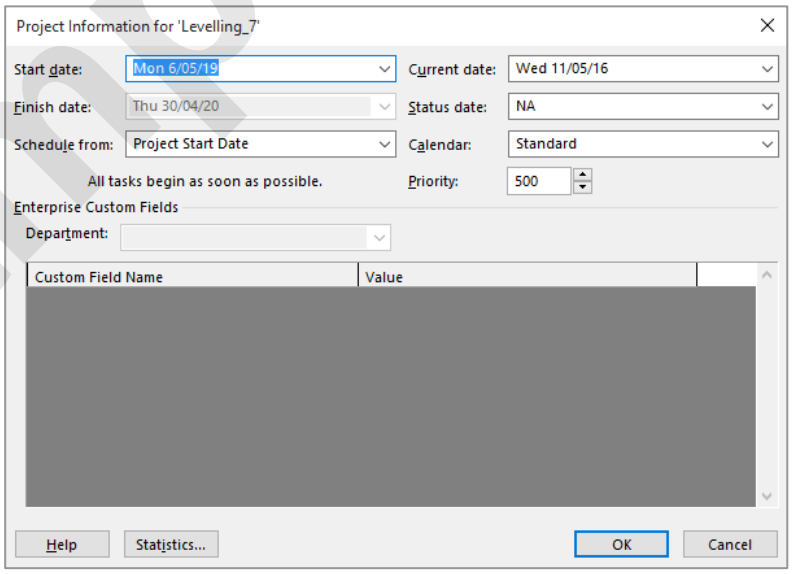

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For Your Reference…

To ***reschedule*** an ***over-allocated task***:

1. Display the predecessors in a task form
2. Adjust for lag or predecessor relationships

Handy to Know…

- When you want to switch to another view from a combination view, remember to remove the split in the window. For example, double-click on the line between the two panes, then select ***Resource Sheet*** view to check that all over-allocations have gone.