Workplanes. Beginners guide.

A beginners introduction to the use of work planes. It aims to give an overview of the different types of workplane creation within TC.

IMPORTANT. This document is for TurboCAD v2021 and earlier.

NOTE. In the document some assumptions have been made based on testing. I am not a programmer. Therefore I do not know how TC was programmed to handle all situations. It was written with the best intentions. **Andy H** (on TC forum).

Applicable to Deluxe and Platinum unless stated, or the word ACIS is used. However, deluxe TC surfaces, handles Boolean operations differently than the ACIS solids in Platinum. Therefore some parts of this documents are applicable to Platinum only.

Note2. When describing the objects internal workplane reference. There are a few ways of looking at it. 1) the objects base is used to reference the workplane it was drawn upon. Or 2). The distance, the centre of extents is away from the workplane, is used as a reference. I do not know which is correct, Therefore I use scenario 1) throughout this doc. Both scenario's yield the same end result.

Contents.

Item	Page
Introduction.	2
Workplane indicators.	2
2D Mode.	3
2D/3D depending.	4
3D.	5
Show / hide workplane.	5
Show / hide workplane intersection.	6
Workplane Origin.	7
Edit workplane. scale	8
Edit workplane. rotation	9
Fit workplane to window.	10
Workplane by World.	11
Workplane by Active view.	12
Workplane by Entity	13
Workplane by 3 points.	15
Workplane by Facet.	16
Auto workplane by Face.	17
Workplane by Z axis.	18
Plan by workplane.	20
Named workplane. Inc Design director.	21
Origin.	23
X vector.	23
Z vector.	24
Delete.	24
Select By.	25
Load and Save file.	25
Independent workplane dialog.	26

Item	Page
Previous workplane.	27
Place on workplane.	28
2D.	29
2D thickness.	30
3D Box.	31
Sphere and Taurus.	32
Cylinder, Hemisphere.	33
Polygon prism, Cone.	33
Helix.	34
Mesh	34
Wedge.	35
Extrude, Twisted Extrude.	36
Sweep, Rail sweep.	37
Loft, Prism.	38
Slice by Workplane.	39
Workplane snaps.	40

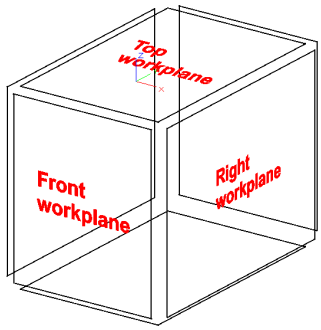
A workplane can be a confusing subject for the some new user. Especially if one does not have a background in CAD work. I know this, because. When I started with TurboCAD back in 2002, I had never seen a cad program in my life. Prior to that I used Corel Draw for design work, And before that I used an Amiga computer.

What is a work plane.

In the text below. We are looking at Model space only. Because paper space is a flat plane.

People will have different ways of describing a workplane. Below is only my interpretation.

Fig 1

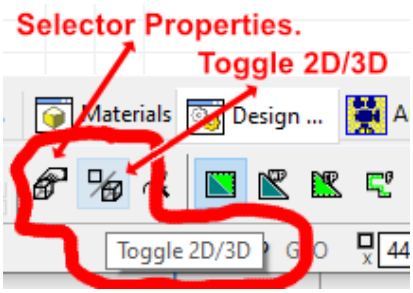


In its simplest sense. A work plane is a piece of clear acetate. If one is drawing in 2D mode only, its one huge piece of acetate. If drawing in 3d mode, it can be one piece (world) or multiple pieces at different heights and angles. Which one would lay down on top of the users chosen background colour. Like laying the acetate on a white drawing board.

If you takes six pieces of the acetate, and arranges them into a box shape. The workplane can be set to any one of the six faces. Depending on which one you choose to draw on. Fig 1.

And that's it really. OK. I'll add a bit more detail.

Fig 2



First a few notes regarding drawing modes. In TC (except designer, which is 2D only). One has 3 modes. 2D, 3D and 2D/3D depending.

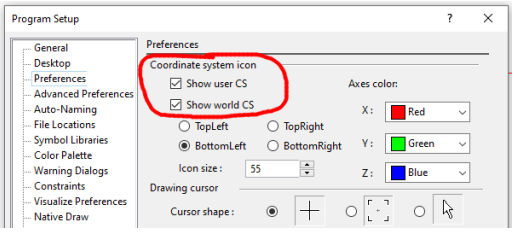
Switching modes can be done in the Selector properties. But for quick switching between 2D and 3D, we have one simple switch, called 'Toggle 2D/3D. This switches between 2D and 3D. The inspection bar will change accordingly, as there is no Z direction in 2D mode.

However one thing to remember, is that. Unlike when one starts a new drawing in 2D. When using the 2D/3D switch to change from 3D to 2D. It uses whatever workplane is active when the switch is pressed.

This document is concerned with work planes. See the TC help files if one is not familiar with the 2D or 3D selector modes.

Indicators for the workplane.

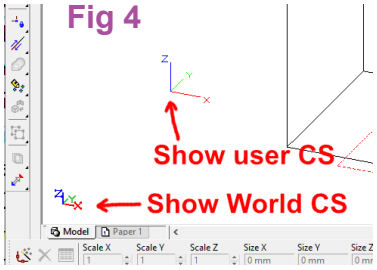
Fig 3



Although labelled CS (Coordinate system), Two icons can help to show how a workplane is orientated. Fig 3.

These can be found in the options menu - preferences dialog - Coordinate system icon. Fig.

Fig 4



These put two icons in the drawing window. Fig 4.

The world CS always shows the orientation of the world, with respect to the current view.

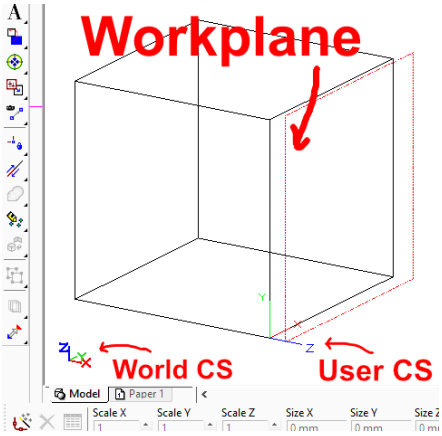
The User CS, shows the orientation of the current workplane.

If the workplane is set to world, the orientation of both icons will be the same. If the workplane has been set to another angle, the difference will be obvious.

In Fig . The workplane was set on the side of the cube. As can be seen the User CS indicator is now orientated differently than the world CS indicator.

Note. Although Fig . Shows the UCS is at a point on the object. This is not always the case, and the indicator may be away from the object. This is of no consequences, as it is simply the orientation that matters, not its location.

Fig 5



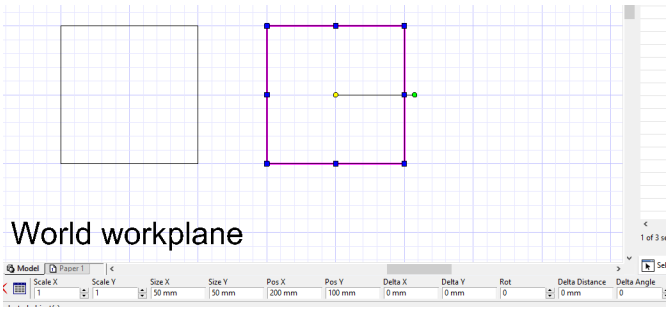
If one uses 2D only mode, then it is unlikely one would run into workplane problems. However if using 3D or 2D/3D depending mode, One needs to know at least the basics of workplane operation.

We will start with 2d only mode.

In 2d only mode, one is generally drawing on what is known as the world workplane. The Navigation bar changed to show X and Y axes only (No Z axes). And the object rotation is a single handle, with a single rotation entry box on the navigation bar.

For flat 2D drawing. This mode gives the simplest and less problematic drawing.

Fig 6

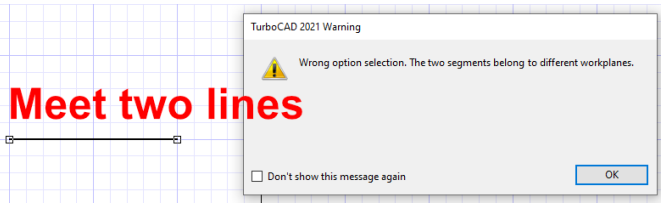


As one is normally drawing on the world workplane, the drawing will be consistent, and should eliminate any problems with some tools. For example. Line tangent to two circles, requires both circles on the same workplane. If drawing in 3D, often one may need to manually put both circles onto a single workplane.

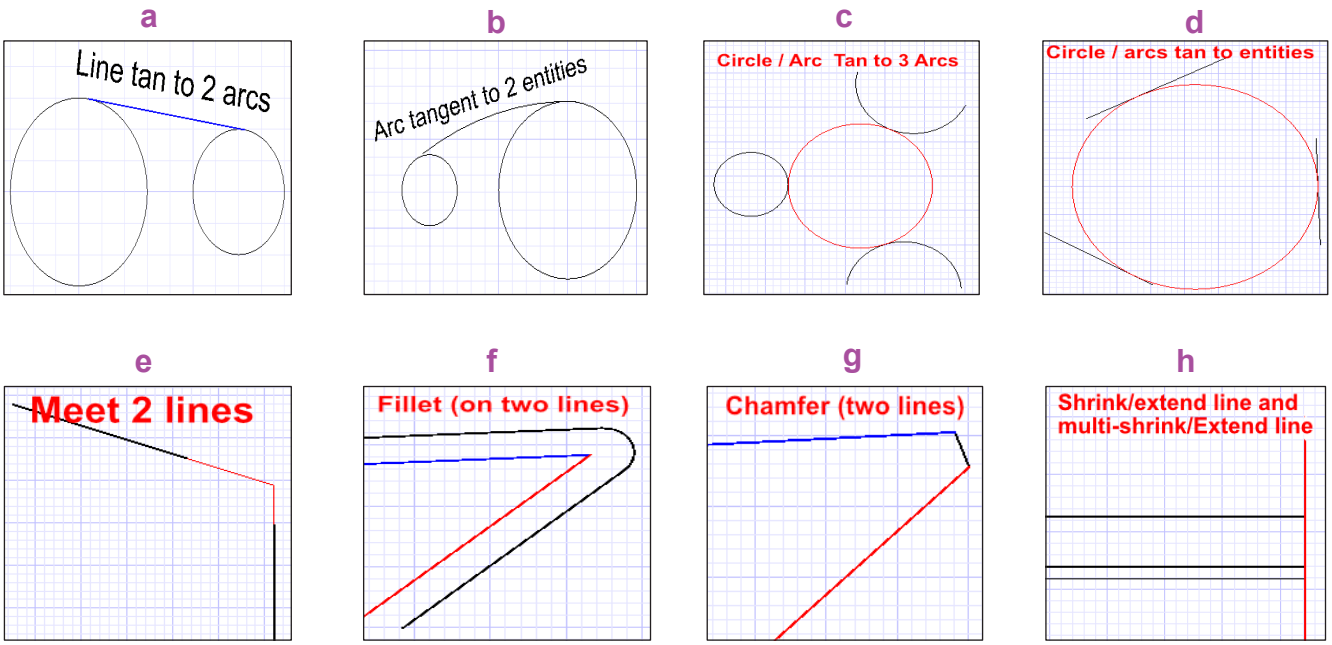
There are a few tools that rely on multiple objects being on the same workplane. Depending on the tool being used, an error message may appear.

This is an indication that some objects were drawn in 3D mode, even if one is currently not working in 2D mode. Switching modes does not cure previously drawn objects.

Fig 7



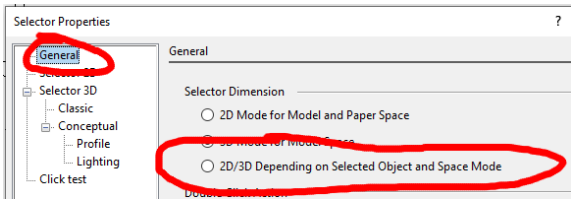
Tools that require objects on the same workplane include .. (among others). **Fig 8**



Working in 2d only mode, should mean the above scenario's work without errors.

2D / 3D depending mode.

Fig 9



This mode attempts to help with drawing 2D, by automatically switching between 2D and 3D modes. Whilst this in theory this should help alleviate problems of objects being on different workplane. It cannot stop all errors.

This is because the switch from 3D to 2D is carried out on the current workplane. Therefore it is still possible for some 2D to be on one workplane, and some on another.

It will certainly help when drawing multiple objects in 2D on the same workplane, it should prevent the problem of moving 2D, and accidentally changing the objects workplane reference. And should alleviate problems associated with the message in Fig .

If one was working in 3d only mode, one may see the message about changing workplanes. Fig . Unless one has chosen to tick , 'Do not show this message again'.

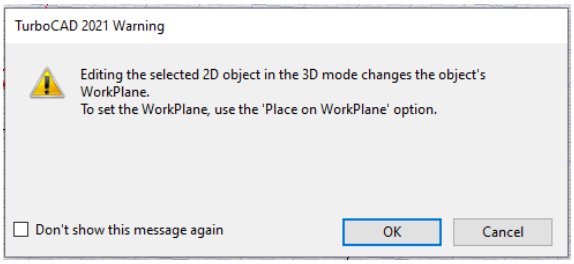


Fig 10

3D mode. (drawing 2D and 3D).

3D mode allows the user to set the workplane to anywhere one wishes. Here we will go through the different workplane icons. These are available on the workplane toolbar, The main menu, and often at the top of the right click menu.

Show / Hide workplane.

Default UI - Tools - New UCS - display workplane
Classic UI. - Workspace - Workplane - Display workplane. (Or Workspace - display workplane).
Ribbon UI - Workspace - work planes

The position in the main menu differs depending on ones user interface (UI). It is also available in the right click menu (assuming the user has not changed things).

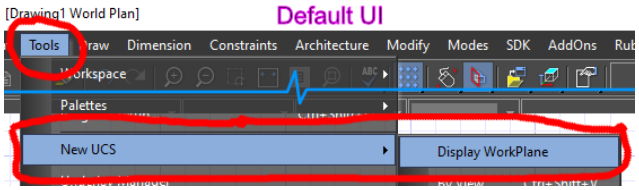


Fig 11

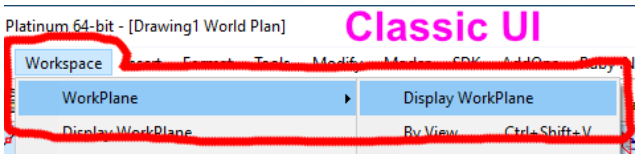


Fig 12

Fig 13

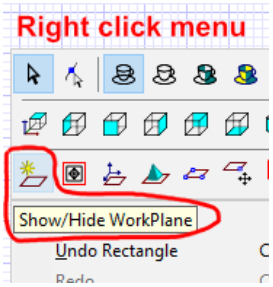


Fig 14

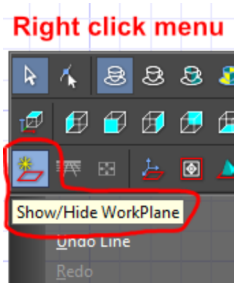
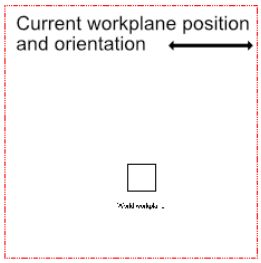


Fig 15



This displays a red dashed square in the TC window, where the current workplane lies. Fig 15.

Its size and orientation, is generally set at the position and angle of the TurboCAD drawing window, at the time the workplane is created.

The workplane dashed lines, will automatically move to wherever the user sets the current workplane.

Fig 16

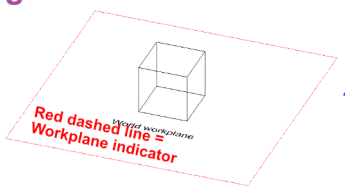
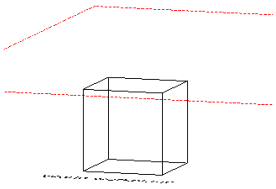


Fig 16. Shows the workplane set to world. This is currently the bottom of the 3D cube.

If we then set a workplane by facet (more on that later), to the top face. The workplane jumps to show it on the top face, ready for drawing. Fig 17.

Fig 17



This workplane indicator is cosmetic. In that, one cannot normally snap to it, nor measure from it. It is mainly a visual indication. However if 'workplane intersection' snap is selected, then, one can snap to where the workplane intersects the object. Even if 'show workplane intersection' is not selected.

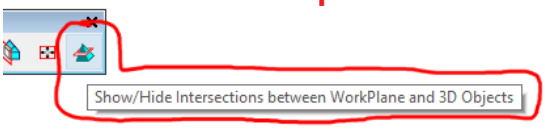
One thing to watch for is. If you zoom out then set the workplane, the workplane will be the size of the view. This means if you then zoom into an object, the workplane will not be visible. If you need to see a workplane around an object (e.g when using slice by workplane). Zoom into the object first, then set the workplane, using one of the workplane tools. Or use the 'Fit workplane to view tool. (see page).

Note. If one subsequently uses a different workplane tool, the workplane size will revert to the extents of the drawing window.

Show/Hide Intersection between workplane and 3D objects.

Fig 18

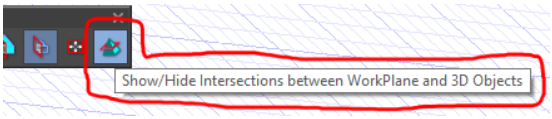
Workplane toolbar



Default UI - Tools - New UCS - display workplane
Classic UI. - Workspace - Workplane - Display workplane
Ribbon UI - Workspace - work planes - workplane

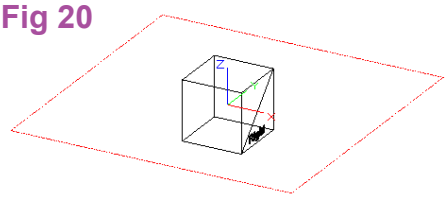
Requires show workplane active.

Fig 19



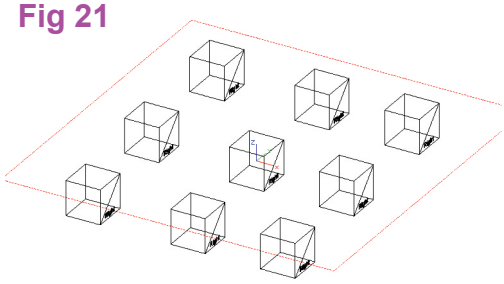
When we set the workplane, it is made to the extents of the current view (TC window).

Fig 20



When we subsequently make multiple objects at different 'Z' heights. It is sometimes difficult to tell where the workplane is, with respect to the objects.

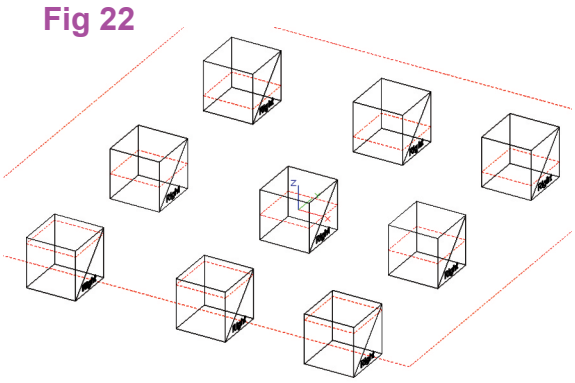
Fig 21



This tool, outlines the object where the workplane intersects it.

As can be seen in Fig 22. Because the 'Z' height of the back three, middle three and front three, differs. The red workplane outline, shows differently for the three sets of objects.

Fig 22



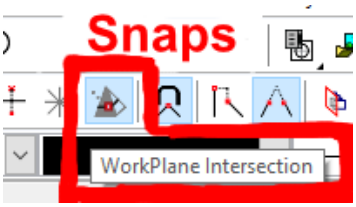
If an object is above or below the workplane, it does not intersect. Therefore there is no red outline on the object. Similarly if the workplane lies on the surface, the outline will not show.

Workplane intersection snap.

Workplane intersect snap, can be used alongside the show workplane, and / or show intersection.

This allows some of the snaps to work directly on the workplane. Ideal for snapping the reference point prior to rotation.
See page 40.

Fig 23



Workplane Origin.

Workplane toolbar

Fig 24

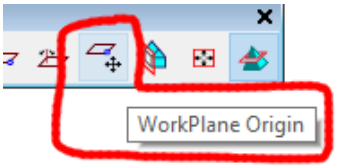
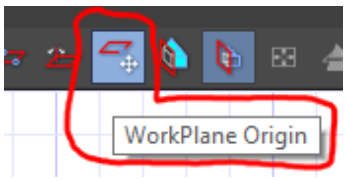


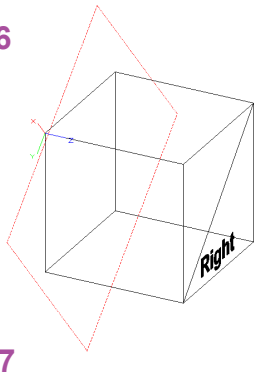
Fig 25



Default UI - Tools - New UCS - Origin
Classic UI. - Workspace - Workplane - Origin
Ribbon UI - Workspace - work planes - Origin

The workplane origin is the 0,0,0 point of the workplane, which the coordinate fields start from.

Fig 26

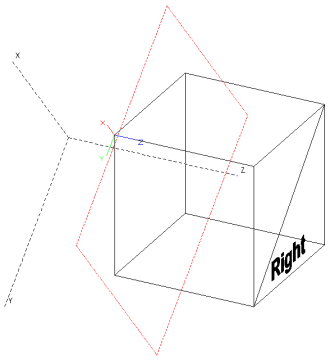


The word origin in this case, refers to the current workplane. The workplane origin tool allows for quick relocation of the workplane, using the same orientation of the existing workplane.

Fig 26. show the original setup

This has a Z axis workplane at about a 45 degree angle on the left side of the object.

Fig 27



Selecting the Workplane Origin tool, changes the cursor to depict the x, y, z of the existing workplane. This allows to it to be re-positioned. Fig 27.

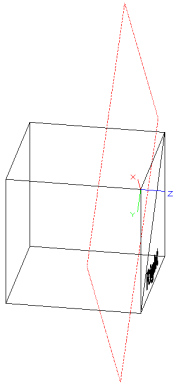


Fig 28

Fig 28. Shows that with a single snap (or seke) of the cursor, the workplane is re-positioned to the right side of the object.

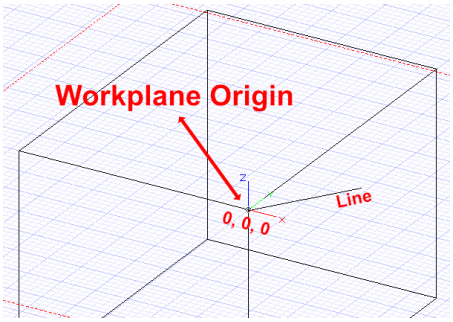
As shown the new workplane position keeps the current orientation.

Fig 29

Example, of using the workplane origin.

1. Draw a 3D box somewhere in the drawing on the world workplane..
2. Select workplane origin tool.
3. Snap the workplane origin to the top front right corner vertex.
4. Select the line tool.
5. Tab to the coordinate fields (bottom right corner of TC).
6. Type '0' into the three boxes and press Enter/Return key on the keyboard.
7. The start of the line is now anchored to the origin point you snapped to. Ready for snapping the end point, or typing in the length and angle.

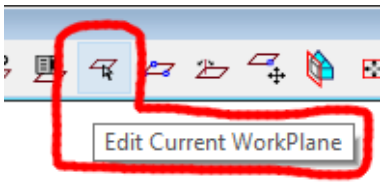
Fig 30



Edit current workplane.

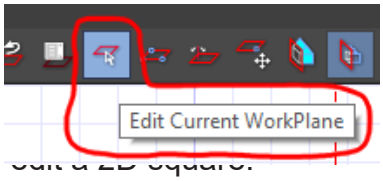
Workplane toolbar

Fig 31



Default UI - Tools - New UCS - Edit.
Classic UI. - Workspace - Workplane - Edit.
Ribbon UI - Workspace - workplane - Edit

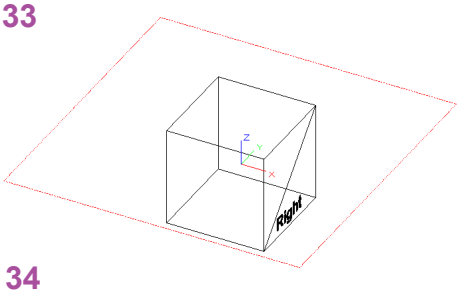
Fig 32



Edit workplane tool allows for moving, rotation, or stretching of the marker and consequently the workplane. In a similar way one can edit a 2D square.

Scaling is not the most useful when editing, as it is mostly not necessary if workplane intersection is used.

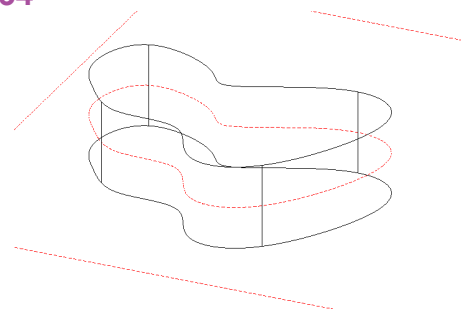
Fig 33



Scale.

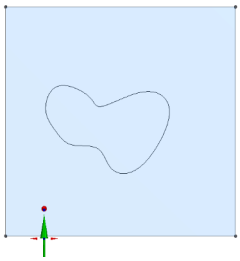
In this example, we will scale the workplane around an 'odd' shaped object. The workplane intersection is not so useful in this case for providing snapping points.

Fig 34



First. Ensure 'show workplane intersection' is turned off. This is because any other objects in the scene, will also show intersection, and the workplane will automatically enlarge, to cover all objects when trying to edit it.

Fig 35



After clicking the workplane edit tool, the existing workplane will be highlighted. If the highlighted are is too big. Exit the tool by clicking away, zoom in closer to the object and click 'fit workplane to window. The re-select edit workplane.

Drag a cornet or a side as appropriate. The same as one would do with a 2d square.

Fig 37. Shows the final result. Note the new sized workplane will show once you have clicked away from the workplane.

Possibly only useful if one has lots of objects in a scene, and wish to visualise the workplane around only one object.

Fig 36

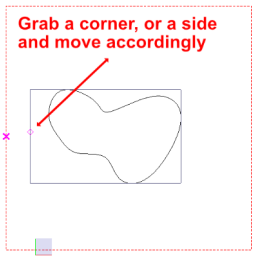
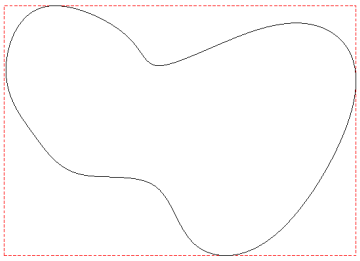


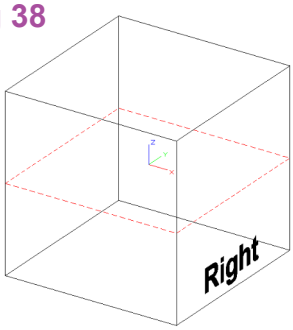
Fig 37



Rotation.

With rotation. You will likely want / need to relocate the workplane reference point first, in order to get the rotation axes correct.

Fig 38



Whilst we could use the workplane intersection. In this example I edited the workplane scale so it is within the cube. Fig 38.

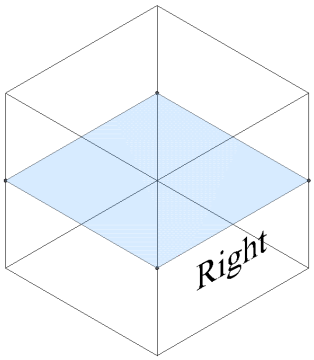
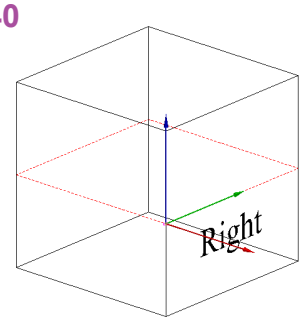


Fig 39

After selecting the edit workplane tool. The workplane will be highlighted. We now need to relocate the workplane reference point.

Fig 40



Pressing 'D' as normal will pick up the reference point. With running snaps / vertex turned on, the reference point is snapped to the vertex of the workplane. Normally one cannot snap to a workplane, but we can when in workplane edit mode.

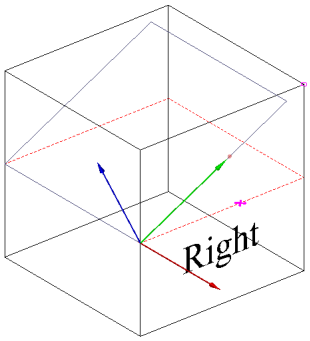


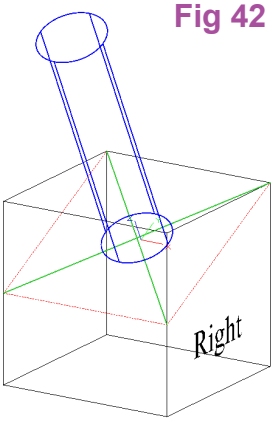
Fig 41

The workplane can be rotated in the same way one would rotate a 2D square whilst in 3D mode. If this case the rotation handle was snapped to the top back corner. As shown in Fig 41.

In the final setup, we have used the edit workplane tool, to extend (scale) the workplane to the top 'back' edge. Click outside the workplane to finish editing.

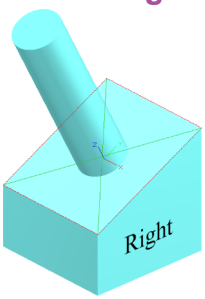
Because we have edited the workplane to the box size, it will allow snapping to occur, in the same way one can snap to workplane intersection.

Fig 42



Two lines were drawn on the workplane snapping to the corners as shown in Green. A cylinder was snapped to the lines intersection and drawn as shown in Fig 42.

Fig 43



Using the 3D Boolean slice tool, with 'by workplane' selected. The cube was sliced, and the top section deleted, the cylinder was then Boolean added to the remainder of the cube. Giving the resultant object in Fig 43.

Fit workplane to window.

Workplane toolbar

A Simple tool, which sets the workplane red dashed square into the current view.

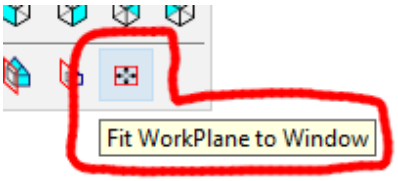


Fig 44

Default UI - Tools - New UCS - Fit to Window.
Classic UI. - Workspace - Workplane - Fit to Window.
Ribbon UI - Workspace - work planes - Fit to Window

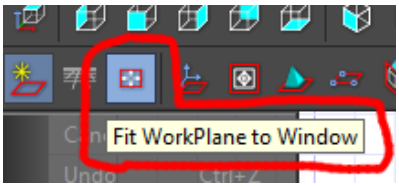


Fig 45

Requires show workplane active.

When one uses the 'show workplane' tool, and sets a workplane using the standard tools. The workplane dashed square is fit to the size of the current view.

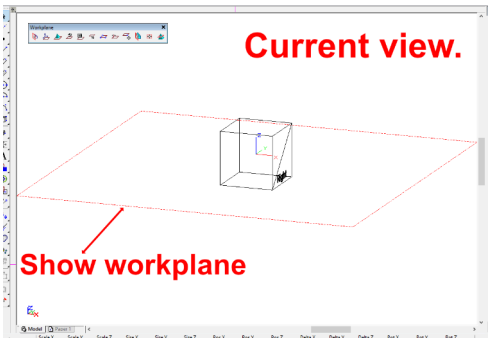


Fig 46

This means that if one zooms in after setting the workplane, the dashes square is barely visible or no longer visible.

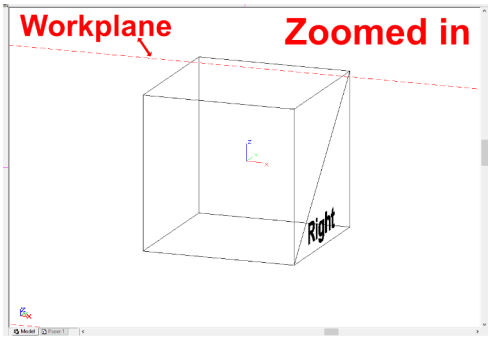


Fig 47

Clicking the Fit to window button, resizes the red dashed square so it fits into the current view.

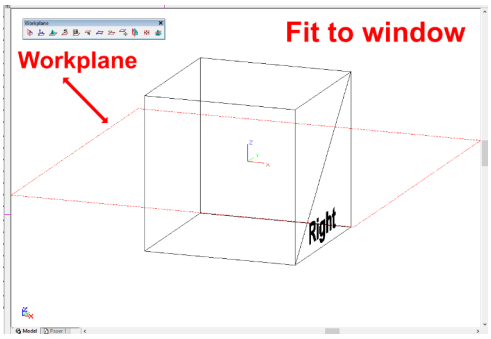


Fig 48

Note. There are times this function will not work. For example, if on has show / hide workplane intersection selected , when fit to windows is used, it can fit the workplane around all objects, even if they are not in view.

Therefore. If fit to workplane fails, ensure show / hide intersection is turned off. (hide). Then try again.

Workplane by world.

Available on the right click menu. In the workplane group on the top toolbar, and in the main menu.

Default UI - Tools - New UCS - By world.
Classic UI. - Workspace - Workplane - By world.
Ribbon UI - Workspace - work planes - workplane
Normal shortcut Ctrl + Alt + W

Workplane toolbar

Fig 49

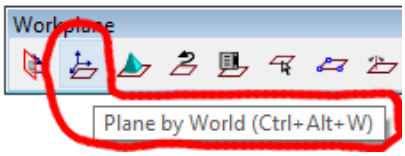
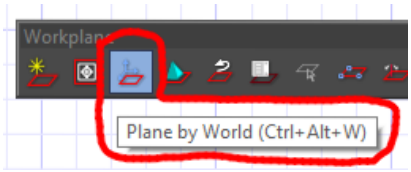


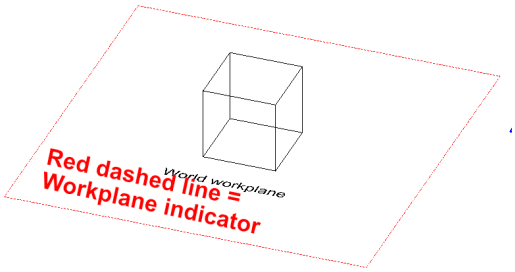
Fig 50



This immediately sets the workplane to coincide with the world coordinate system. This is the same workplane one would normally be drawing on if in 2D mode.

As we still have the workplane on top of the cube, from the previous example. We can select workplane by world, and as seen in Fig 51. The workplane jumps to the bottom of the cube.

Fig 51

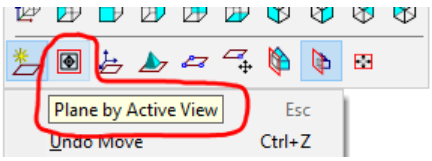


Workplane by world, is probably the most used workplane tool, especially if one drawing contains any 2d objects. But even in 3d, it is often easier to draw 3d objects on the world workplane, and then move them into their position, rather than keep setting up different workplane for each object.

Workplane by active view.

Fig 52

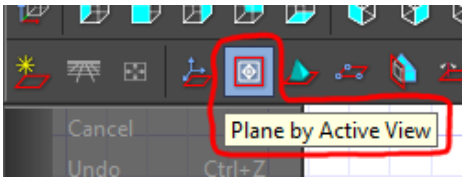
Workplane toolbar



This is one I use quite often. It is a simple way to change the workplane direction to correspond to the current camera view. Its main drawback is the workplane will not be linked to a specific object.
In deluxe it is not on the toolbar, but it is in the menu,

Default UI - Tools - New UCS - By view.
Classic UI. - Workspace - Workplane - By view.
Ribbon UI - Workspace - work planes - By view.
Normal shortcut CTRL + Shift + V

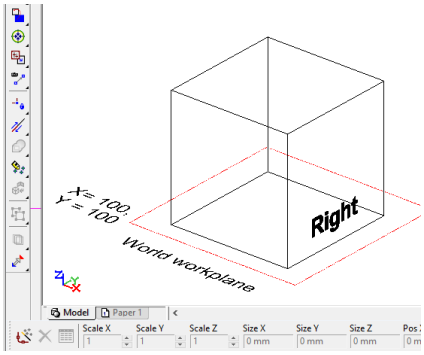
Fig 53



To show this, the cube (3d box) was set so that the bottom left corner, is at world position x = 100, y = 100. And the text 'Right' put on the right face of the cube.

The workplane at present is set to world.

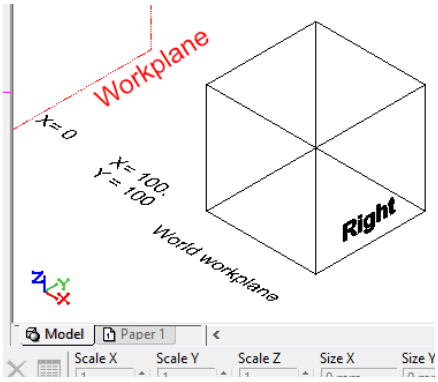
Fig 54



We switch the view to right. And select workplane by active view. As can be seen Fig 55.

The workplane indicator (red dashed line), has moved to the right view. But is not at the object. Instead it automatically set to x = 0 in right and left views. Y = 0 in front and back views. Z = 0 in top and bottom view.

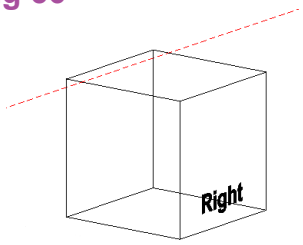
Fig 55



The movement of the workplane using active view, is often acceptable. If after changing to right view, and setting workplane by active view. One draws say a cylinder for a hole. It is simply a matter of moving the cylinder into place.

This is especially useful when drilling a hole in a sphere, where setting up a workplane on the sphere surface, is not a one click action.

Fig 56

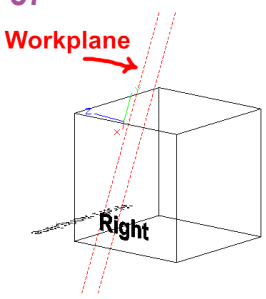


World workplane

The tool is less useful when the view is non-standard. i.e. the view has been rotated.

As can be seen in Fig 57. After rotating the view, and selecting workplane by active view,. The workplane is essentially unusable. Unless one has a specific reason for wishing that angle of the workplane.

Fig 57



One thing to be mindful of, is, If ones drawing becomes physically large the 0,0,0 origin, or a workplane by active view, may become too far away from ones drawing point, that it become too much of a pain to keep moving objects. In this situation it will become better to set up new workplanes to draw on, using the other workplane tools.

Workplane by entity.

Workplane toolbar

Fig 58

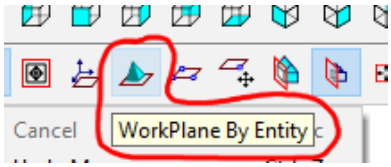
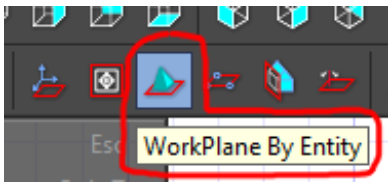


Fig 59

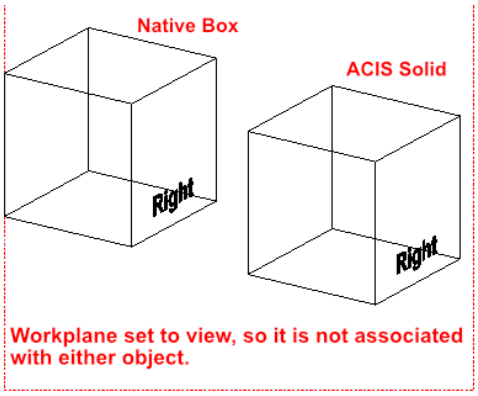


Default UI - Tools - New UCS - By Entity.
Classic UI. - Workspace - Workplane - By Entity.
Ribbon UI - Workspace - work planes - workplane
Normal shortcut CTRL + Alt + G

When an object is created, it adopts the workplane which was set when the object was created. I have no idea how TC is programmed, so I just think of it as an object workplane. This is purely internal to TC, and not something the user has access to.

Workplane by entity, sets the user workplane to match the workplane of the objects, In many cases, this is the objects entity coordinate system. However this is not always the case. With native objects (box, Hemisphere etc.), the objects workplane would be wherever the object was created.
Special note regarding Deluxe (TC Surfaces). TC surfaces work the same as native box, and thus, entity does not set the workplane to centre of extents. Therefore most of the following Entity applies to TC Platinum version.

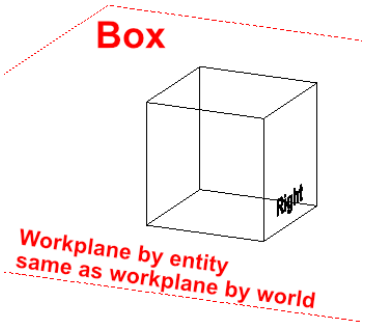
Fig 60



For an example of the above. I made two objects, **both drawn on the world workplane.** One was then exploded once so it becomes an ACIS solid.

The workplane was set to 'by active view'. This was simply done so the workplane was not associated with neither object.

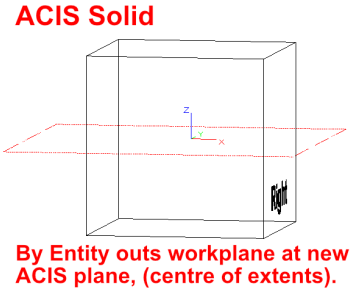
Fig 61



When workplane by Entity is used on the box. The workplane appears on the bottom of the box, essentially setting world CS in this case. Provided the box was drawn on the world workplane.

Setting Workplane by entity on the ACIS sold, Moves the workplane to the centre of the object. This is because, when we exploded the box to ACIS, the objects internal reference was change to the centre of extents. Hence WP by Entity goes to the new location.

Fig 62



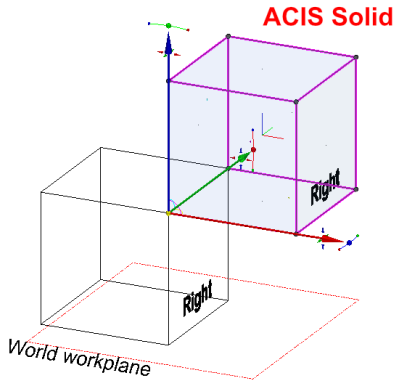
Note. The 'entity' has nothing to do with the user relocatable reference point.

We can see this in the example on the next page.

Fig 63

Fig 63. Shows the ACIS object has been moved to the top of the box.

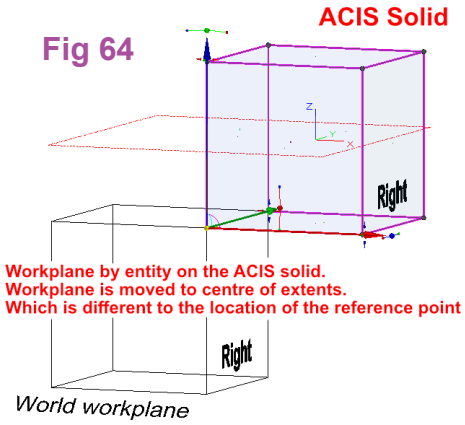
The reference point was moved to the bottom corner to facilitate snapping the solid into place. And left at the new position.



When we carry out a workplane by Entity on the ACIS solid. The workplane is moved to the centre of its extents, not the Reference point position.

This is normal, and just the way the program works.

Fig 64



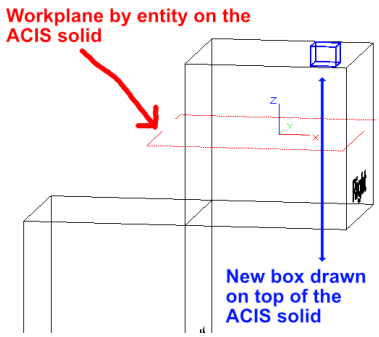
Now for a 'wrinkle'.

Whilst the above example moves the workplane to the centre of extents. Here we show that 'Entity' is not always the centre.

Fig 65

The scenario is the same as previous. But, we will Boolean add a small box on top of the upper cube.

The existing entity workplane is the centre of the upper cube.



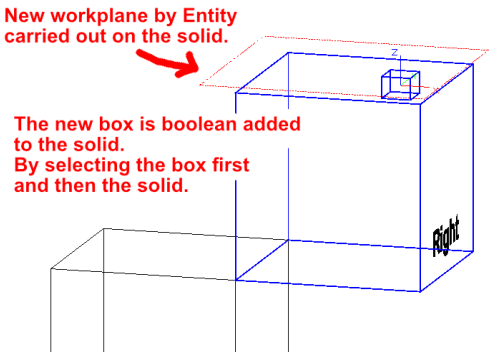
A Boolean is carrier out, by selecting the **new box first** and then the ACIS cube. This transfers the settings from the box, to the newly formed object.

As we can see in Fig 66. When we again carry out a workplane by Entity, the new workplane has taken its location from the new box.

This is because we selected the box first, If we had selected the ACIS solid first, the Entity workplane would have stayed with the ACIS object, as it was originally. Fig 65. above

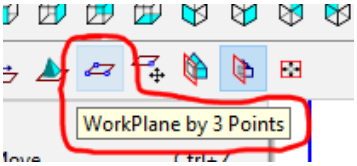
This is a similar affect as when one needs to 'seed' and object, to change the wrapping direction of a material.

Fig 66



Workplane by 3 points.

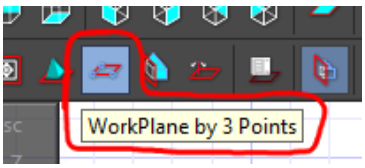
Fig 67 **Workplane toolbar**



This is definitely one of the most useful tools. This is because the user has full control of what location and orientation the workplane will be created.

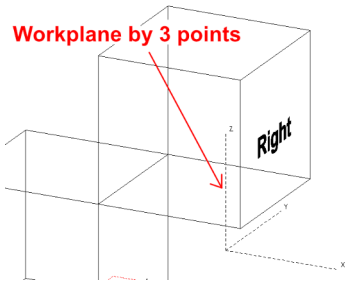
Default UI - Tools - New UCS - By 3 Points.
Classic UI. - Workspace - Workplane - By 3 Points.
Ribbon UI - Workspace - work planes - By 3 Points.
Normal shortcut Shift + Alt + 3 (Qwerty number 3)

Fig 68



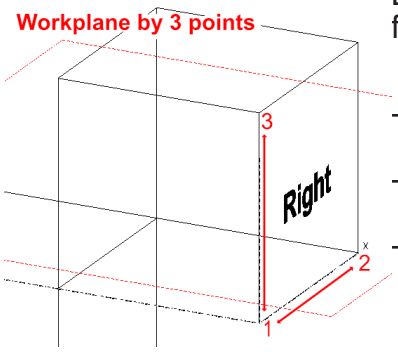
The three points in question are - Start point, then the X direction, lastly the Y direction. The Z direction is automatically set perpendicular to the X, Y plane.

Fig 69



After selecting the workplane by 3 points tool. One is faces with an x, y, z indicator, (with dashed lines). Fig 69.

Fig 70



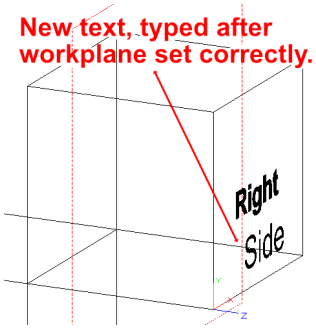
Looking at Fig 70. We complete the following.

The first click point is for the junction of X, Y, Z. (1)

The second snap sets the X direction of the workplane. (2)

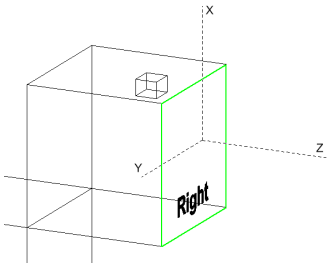
The third snap point sets the Y direction of the workplane. (3

Fig 71



These points are important, especially if text will be typed onto the workplane.

Fig 72



If we look at fig 72. Which shows the default axes of the right face. We can see that the default X is upwards. (Each face of an object has a different x, y, axis. Z is often referred to as the 'Normal' axis.).

That this would mean is that any text, would be at 90 degrees to the word 'Right' so would look odd. Using workplane by 3 points we can set the correct workplane ensuring the text is correctly orientated.

Fig 73

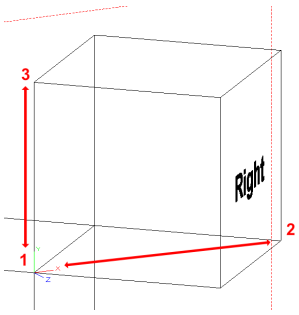
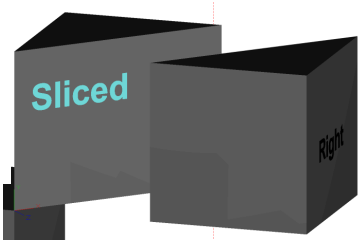


Fig 73. Has the workplane by 3 points used on the diagonal, The first point is set (1), the X direction is the diagonal (2), and Y direction is vertical (3).



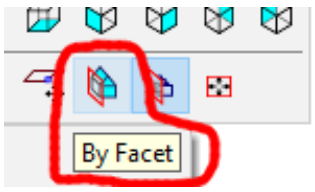
Once set. We can use the Slice by workplane tool. To slice the object. When pulled apart, because the workplane is still set diagonal. We can type text knowing it will be correctly orientated.

Workplane by Facet.

Workplane toolbar

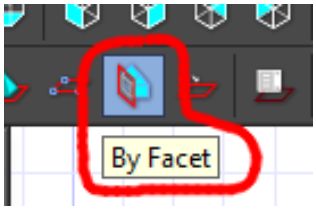
Workplane by Facet is a quick way to set a workplane on a specific object face.

Fig 74



Default UI - Tools - New UCS - By Facet.
Classic UI. - Workspace - Workplane - By Facet.
Ribbon UI - Workspace - work planes - By Facet.
Normal shortcut Shift + Alt + F

Fig 74b



Workplane by facet is good for putting things like cylinders, circles, lines etc. Onto the surface of an object. However because the objects face direction is preset by the program. It is not so useful for objects like text.

Fig 75

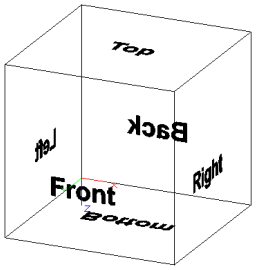
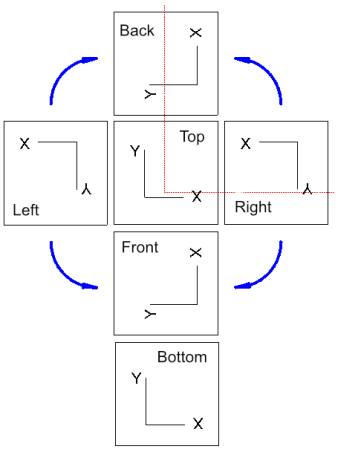


Fig 76



Looking at the cube in Fig 75. We have obviously six faces.

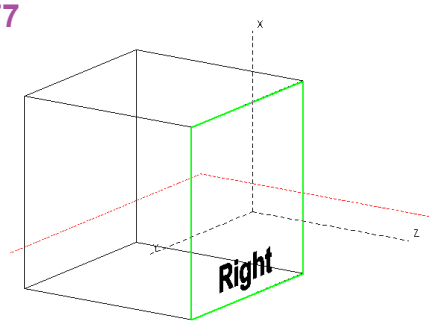
When the faces are hovered over using the workplane by facet tool, we get Fig 76.

As can be seen, the x, y orientation of the faces differ. With some faces the 'x' direction is upwards or downwards.

This means that if one used this tool, and typed text on the face, the text may be at 90 degrees. In some instances like dimension on a vertical surface, this is desirable. But in many cases, the text would need further rotating and positioning. Reducing the usefulness of this tool.

There is a companion tool called Auto workplane by face, But for this example we will assume that is **turned off**. We will cut a 20 diam x 15 mm deep hole in the right side of a 50mm cube.

Fig 77



Activate the workplane by facet tool.

Hover over the desired face (right in this instance) until the outline changes colour (probably green). And the three axes indicators appears. Click to set the face. Fig 77

Draw a diagonal line, and then the cylinder. Which can be snapped to the mid point on the line. As shown on Fig 78.

In this case the cylinder is 20mm diam, and -15mm height.

As can be see, it is a quick and easy to use tool, for setting the workplane. As long as you are aware of the type of objects you wish to use one the face. Not good for text. And some dimensions will be wrong.

See also Auto Workplane by Face.

Fig 78

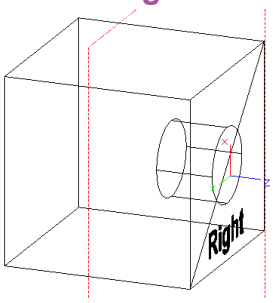
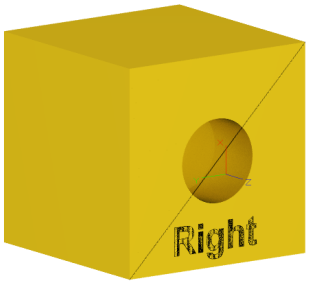


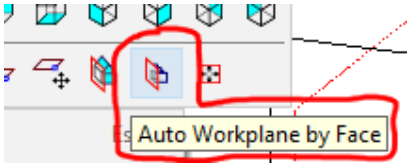
Fig 79



Auto Workplane by Face.

Fig 80

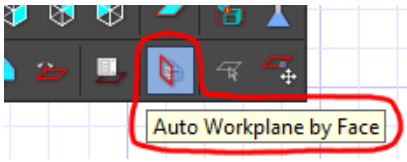
Workplane toolbar



Auto workplane by face, as just an 'always on' workplane by facet. The difference is that this produces a temporary workplane.

Default UI - Tools - New UCS - Auto workplane by face.
Classic UI. - Workspace - Workplane - Auto workplane by face.
Ribbon UI - Workspace - work planes - Auto workplane by face.

Fig 81

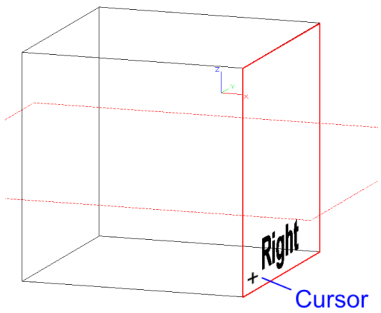


Turn the tool on, and nothing will appear to happen. This is perfectly normal, as the tool doesn't activate until you wish to draw something, and hover over the surface of an object.

For this example, the existing workplane is set to Entity. Fig 82.

Once a tool is selected, for example the line tool. And the cursor is hovered over a face of the object. The object face will change colour. In fig 82. It is shown red.

Fig 82



Snap the first point of the line, and the workplane will change to the selected face. As seen in Fig 83.

Although in Fig 83. It may look like the workplane is 'inside' the object, it is actually just to the side of the right face. One cannot control the location of the red dashed workplane indicator with this tool.

Fig 83

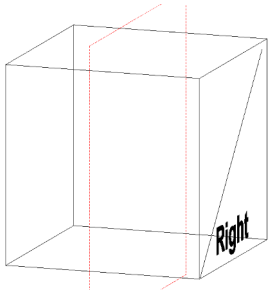
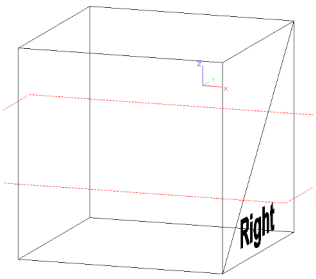
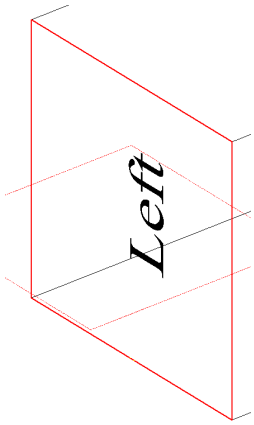


Fig 84



When the second point of the line is snapped into place (to finish the line). The workplane will revert back to the previously set workplane (Entity in this case). As shown in Fig 84.

Fig 85



Before using this tool for text.

Check the orientation of the workplane shown, by using the workplane by facet tool. And noting the x, y, z. Normal dashed indicator. As seen previously in Fig 77.

As can be seen in Fig 85. The auto workplane on the left side is orientated with 'X' axis vertical. Therefore any text may be drawn incorrectly.

One also has no control over the x, y, z orientation of any 3D objects drawn on the face. Without setting up a specific workplane first (like 3 points)

This is a very useful tool for quickly placing objects onto a face. Despite its limitations regarding text, and object orientation.

Workplane by Z axes.

Default UI - Tools - New UCS - By Z Axis.
Classic UI. - Workspace - Workplane - By Z Axis.
Ribbon UI - Workspace - work planes - By Z Axis.

Workplane toolbar

Fig 86

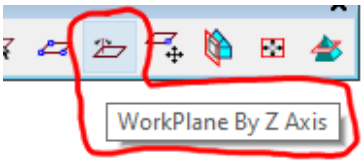
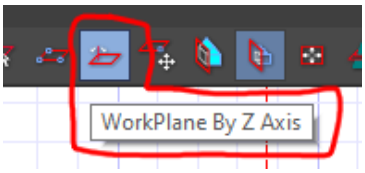


Fig 87



This is one of the less useful workplanes in my opinion. It works by defining a start point, and then the Z axes. But in defining the z axis, it can easily skew the X and Y. Not an issue when drawing line and circles, but many objects including text will look poor.

Example.
Here we have a cube, with the existing workplane set to Entity. In this case, centre of extents of the cube. Fig 88.

Fig 88

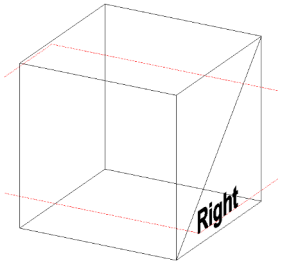
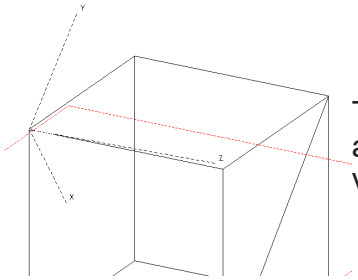
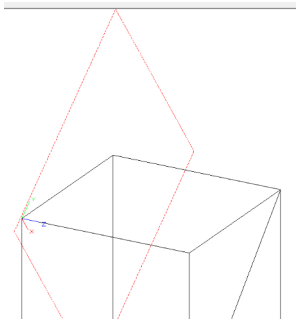


Fig 89



The workplane by z axis tool was selected, and the start point snapped to the left top vertex. Fig 89.

Fig 90

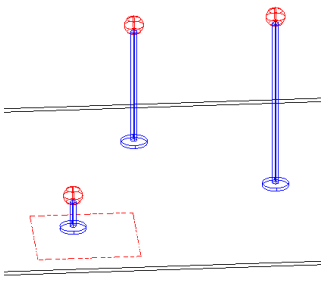


The 'z' axis was snapped to the right hand top front vertex. This clearly shows the x and y axes are at a not-orthogonal angle. Fig 90.

Once snapped, the workplane is created. This is fine for some tools, like circles. Lines, cylinders etc. But because it is at an odd angle (39 degrees in this case,) it is of very little use as a workplane for text, rectangles etc.

Example of useful tool.

Fig 91



Note. The following differs slightly, depending on whether one is using GDI or RedSDK modes, but the principal is the same.

In Fig 97. We have three spheres, on top of three poles. They are set at different heights, and different x, y locations. We want to take a cylinder between the spheres. (as in Fig 95. Next page)

Whilst we could calculate all the angles, but we just need the workplane by Z axis tool.

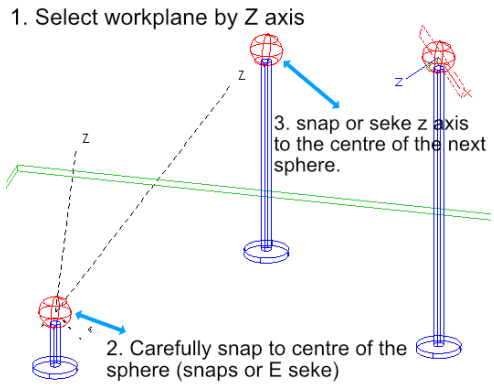
Fig 92. Select the workplane by Z tool. Carefully snap to the centre of extents (or use 'E' seke) of a sphere (marked as step 2), shown in Fig 92.

Care must be taken if degenerative faceting is turned on, to ensure correct snap.

Snap the second ‘Z’ axes to the centre of extents for the second sphere (marked as step 3) in Fig 92.
This sets the workplane correctly.

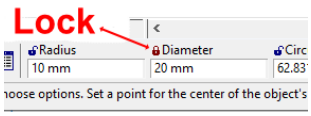
Select cylinder tool. Ensure auto workplane by face is turned OFF.

Fig 92



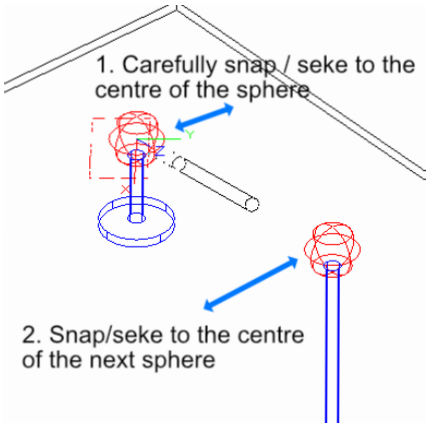
Either.
1) Type in the diam (or radius) on the inspection bar press return key, then lock the field. (click the lock icon).

Fig 93



Snap the cylinder to centre of extents of sphere 1 (Fig 94. (carefully). This will put the cylinder base in position but not the height. Click outside the sphere to activate the height. Drag out the height, and carefully snap to centre of extents of sphere 2.

Fig 94



OR alternatively.

2). Ignore the radius or diameter. Carefully snap the cylinder base to centre of extents for sphere 1 Fig 94. Drag out to set a small diameter and click to set it, size does not matter. Drag out the height and carefully snap to the centre of extents of sphere 2.

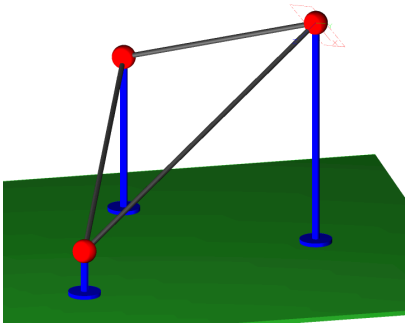
Lastly, in the selection palette, set the radius. OR on the inspection bar, type in the size x and size y (these are the diameter).

If it sounds complicated, that’s just because one hasn’t used the method before. It is actually a very quick method of setting the correct workplane for odd angles.

Repeat the procedure for the remaining rails. To set up a workplane in these situations, by using other tools, would be more work.

The finished item is shown in Fig 95.

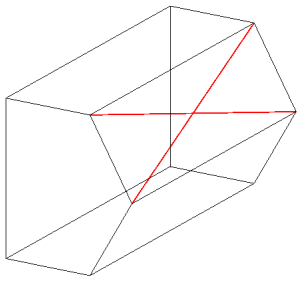
Fig 95



Plan by workplane.

Default UI - View - 3D views - Plan - By Workplane.
Classic UI. - View - Camera - Plan - By Workplane.
Ribbon UI - View - Views - Plan - By workplane.
Normal shortcut CTRL + Shift + W

Fig 96



Plan by workplane has been briefly discussed in the design director section. This section involves the camera menu item,

It sets the current view from the camera, to be the view and rotation equivalent to the current workplane.

Fig 97

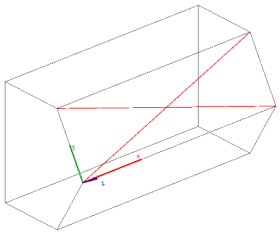
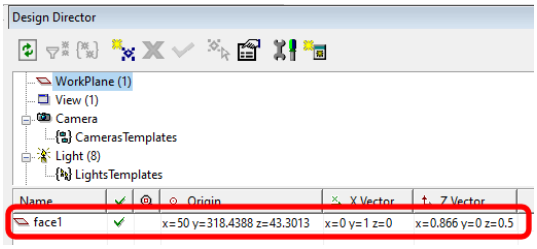


Fig 96. We have a object with an angled face we wish to draw on.

We set up a workplane by 3 points on the desired face, as shown in Fig 97.

Fig 98



Next we create a new workplane, using the design director. This is not actually necessary, but helps in case we need to temporarily change the workplane. We can quickly go back to the desired workplane. (See next page for creating a named workplane).

The next step is to activate plan by workplane. This can be found in the menu. Or. What I do is create a new toolbar, and put my often used icons on there. Including plane on workplane, and plan by workplane.

Fig 99

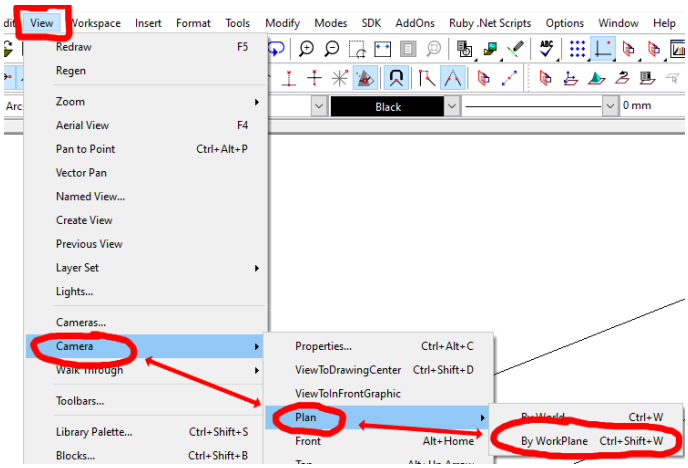
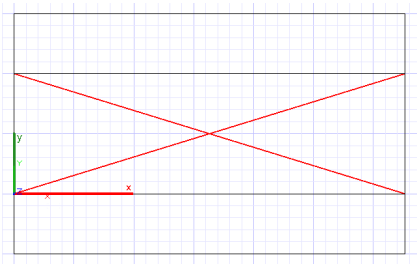


Fig 100

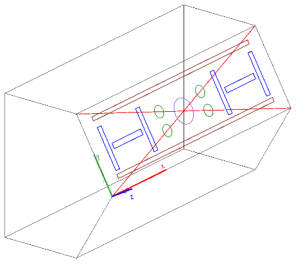
New custom toolbar

Fig 101



Plan by workplane, sets to view looking directly at the desired face. Fig 101. And because the workplane aligns the grid accordingly. This makes it very easy to draw accurately on the face.

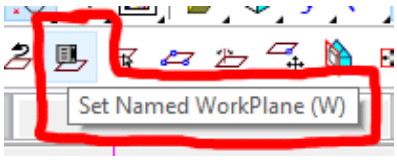
Fig 102



The resultant drawing is shown in Fig .

Named workplane.

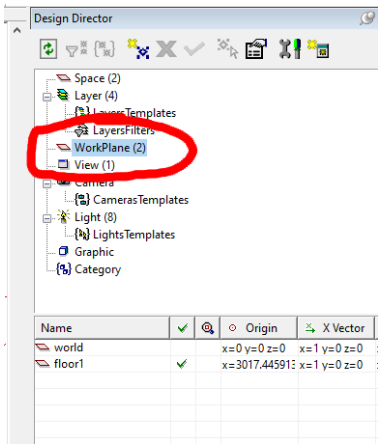
Fig 103 **Workplane toolbar**



Default UI - Tools - New UCS - Named.
Classic UI. - Workspace - Workplane - Named.
Ribbon UI - Workspace - work planes - Named.
Normal shortcut W (opens workplane dialog box).

Named workplane allows one to create multiple workplanes, and quickly switch from one to another. Ideal for things like multi-storey buildings, where one can set up workplanes for each floor.

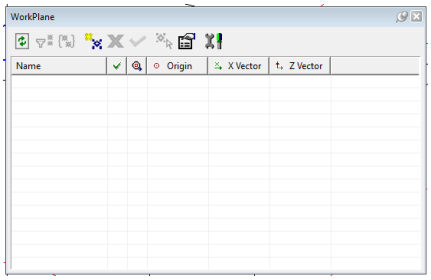
Fig 104



Workplane, is available in the Design director. And a standalone dialog box, available from the workplane menu item, or an icon on the workplane toolbar.

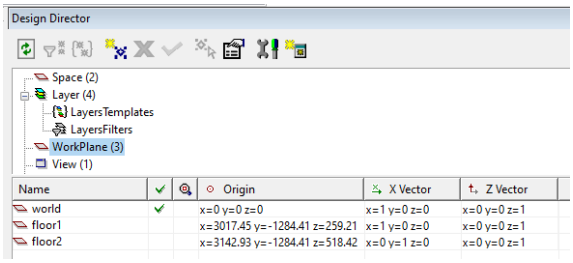
The options allow for adding new workplane, deleting workplane, activating = setting a workplane as the current workplane, Save to / load from file (no idea why you would want to). And select by workplane.

Fig 105



We will start with design director.

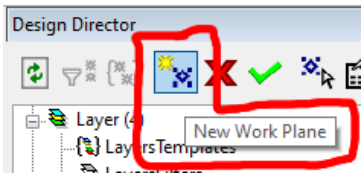
Fig 106



Selecting 'workplane' in design director. Allows any workplanes that have been created using the 'New workplane' option to be displayed. It does not show temporary workplanes created during the normal course of drawing.

To use.
Ensure one has switched to workplane (click on the name workplane in the top section). Set the workplane required in the drawing as normal.

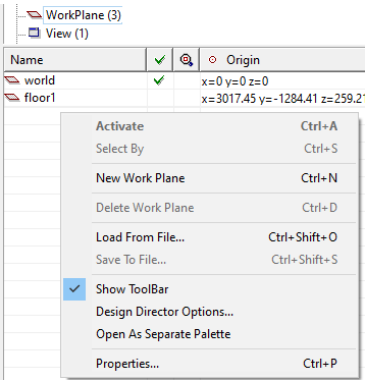
Fig 107



New workplane can be accessed by clicking the icon at the top of the design director, Fig 107.

Or. If one right clicks on the word 'workplane', OR in the area below 'Name, Origin' etc. This brings up the right click menu, where one can select New Work Plane. Fig 108.

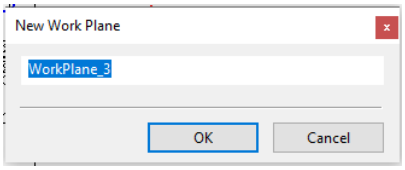
Fig 108



Selecting New Work Plane brings up the name dialog. Fig 109. where one should ideally give it a meaningful (but not too long) name. The name you chose will obviously be determined by the type of drawing one is doing. Click OK to confirm.

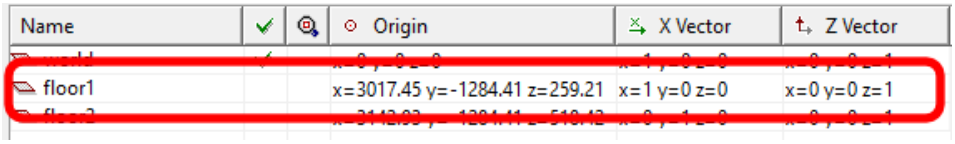
The result is an entry for the new workplane. With the name displayed on the left side. Fig 109.

Fig 109



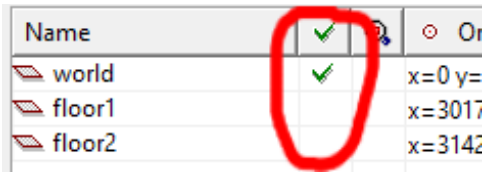
In the Design Director. The first box will contain the name one has just given.

Fig 110



After the name, is the 'Active' tick box. Fig 111.
A tick against ones chosen workplane, denotes the workplane on is currently set for drawing upon. This make it very quick to switch workplane, in the same way one would switch layers,

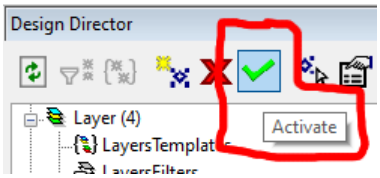
Fig 111



One can simply put a tick in the appropriate box. Or.

One can also select 'Activate' at the top of the design director. Fig 112.

Fig 112



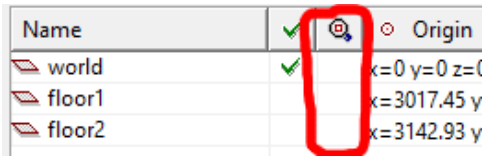
NOTE. If one creates a 'World' workplane. As a named workplane. Then using the normal 'Plane by world' icon or menu item, the workplane in design director may be activated. However this may not always happen though. Also. Newly user created workplane, like 3 points, Entity, or Z axes, will not show as an active workplane in design director. Because they have no named entry associated with them,

If using named workplanes, it is advisable to turn off 'Auto workplane by face', as this can override any activated workplane.

Sometimes with work planes at different 'Z' locations,. When one changes the active workplane, not much may appear to happen. This is normal, as the red dashed workplane indicator will fit the view. And can lead to a visual illusion of where the workplane actually is..

The next box is View by Work Plane. Fig 113.

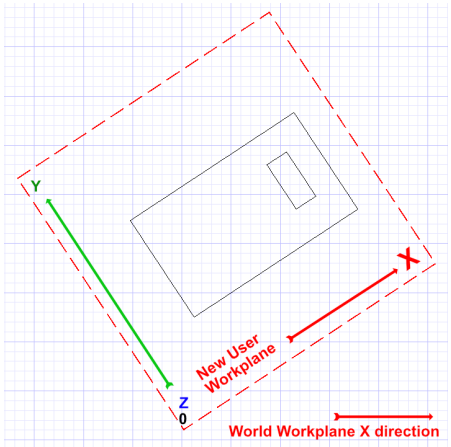
Fig 113



NOTE. In tests, this can be temperamental, and sometimes does not work. Personally I created a toolbar icon for camera - plan - by workplane. Which appears more consistently than this option.

This is the similar to Camera menu item, Plan - By Work plane. It sets the view, normal to the work plane. In other words, looking directly at the work plane. With the view rotated as appropriate.

Fig 114



Plan (View) by workplane can be very handy when drawing on a specific object, using a non standard workplane. For example, working on a circuit board that is at an angle to the world x,y.

Whilst the view is in world plan, and workplane by world. A new workplane was created using workplane by 3 points.

As shown in Fig 114.

Making the new workplane active, whilst still in world plan view, is shown in Fig . As can be seen with the grid lines, the workplane is rotated.

Fig 115

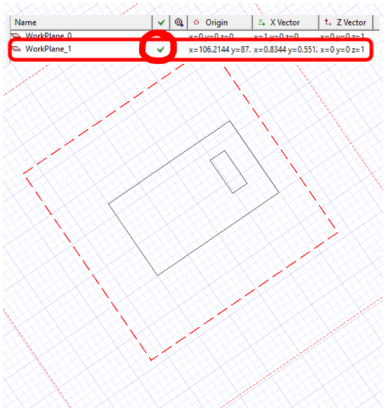


Fig 116

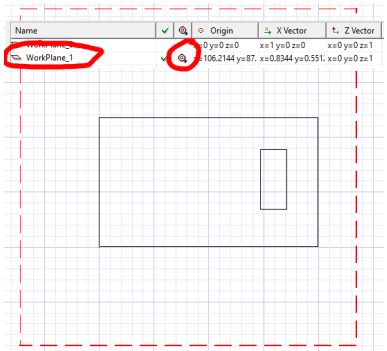
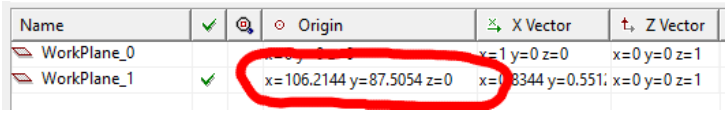


Fig 116. Has the 'view by workplane' selected against the new workplane.

This sets the view orthogonal to the new workplane. So that the 'X' direction of the new workplane, points as normal to the right. Making it easier to draw circuit tracks on the board. Even if the board is rotated. It is simply the view that TC has rotated not any of the objects.

Origin.

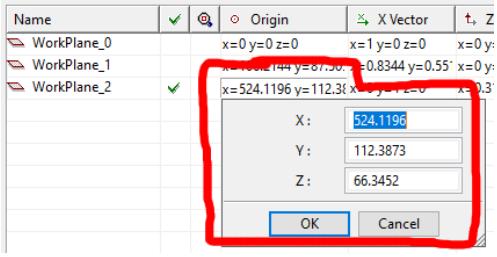
Fig 117



This shows the coordinates of the workplane origin. For world it will be x = 0, y = 0, z = 0. For a user workplane, if will differ depending on how the workplane was created. For example, workplane by 3 points, it is the place the initial click was set, prior to snapping out the x and y directions.

Fig 118

By clicking in the figures field, brings up a an input box. Where one can enter the origin manually. That being said. Personally I leave them alone. As I suspect it is very rare one would need to relocate an origin by using the coordinates. Plus the workplane origin tool is faster and less prone to user error.



X Vector.

This is a vector not a coordinate, for the X, direction of the new workplane.

Fig 119

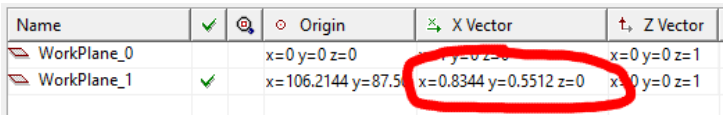


Fig 120

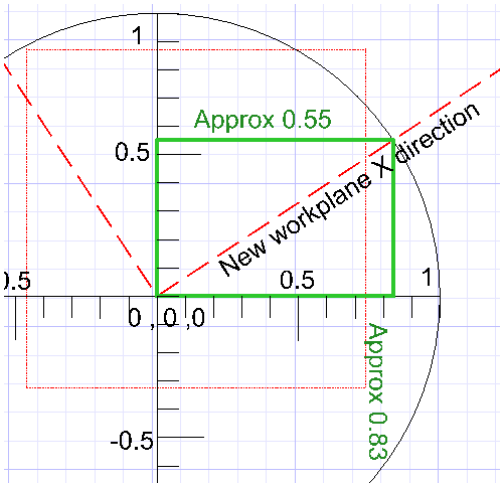


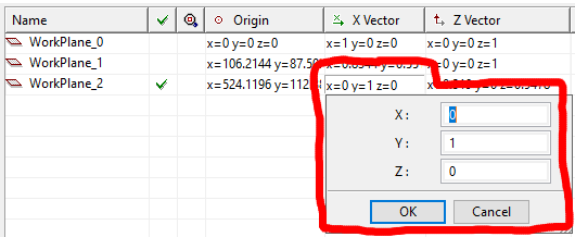
Fig 120. Shows a visual approximation of the vector, with x = 0.83 and y = 0.55. We don't really need to be concerned with the actual maths involved, as all that is handles by TC.

It is just shown here in case anyone was not aware of the difference between vectors and x, y coordinates.

As with the origin, one can input manual figures.
My advice, don't.

The wrong figures will mess up your carefully applied new workplane.

Fig 121



Z Vector.

For any workplane that is parallel to the world workplane, including ones rotated around the Z axes (as in fig .) The Z vector will be 0, 0 ,1.

Fig 122

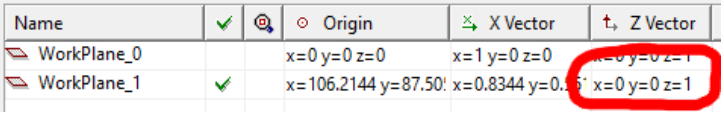
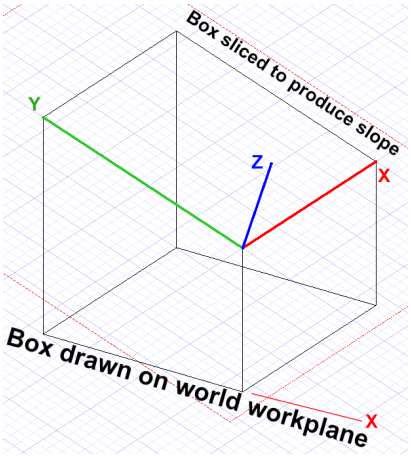


Fig 123



To illustrate the difference. A box was drawn on the world workplane, and then sliced to produce a slope.

A new workplane was set up on the slope, as shown with the x, y, z in Fig 123. We can clearly see the Z direction is angled.

The X, Y, Z axes have been drawn on for clarity.

When we set up a new workplane entry in Design director, it will show a different vectors for the Z Vector.

Fig 124

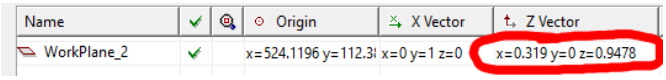
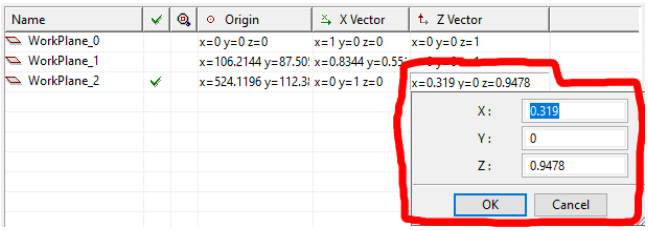


Fig 125



One could calculate the Z Vector, but quite honestly, there is not much point.

The extra effort required in calculating an appropriate Z Vector. Is simply not worth it. And it requires knowledge of how 3D Vectors work. which is beyond the scope of this document.

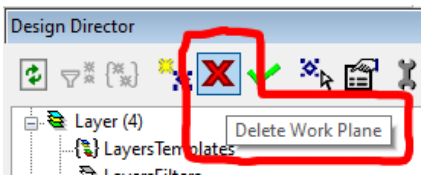
Be in mind, that the X, Y, Z axes have to be 90 degrees to each other. So manually entering the wrong figures simply will not work.

Other options available.

Delete.

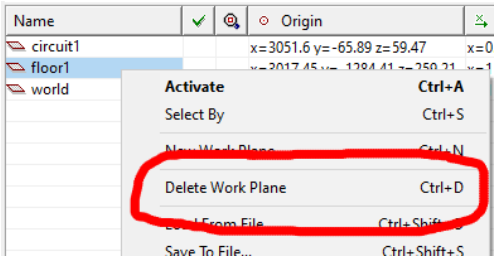
When a workplane is selected in design director, Delete workplane becomes active. It I available as an icon at the top of the design director,

Fig 126



It is also available from the right click menu.

Fig 127

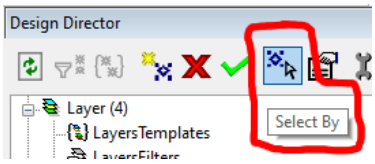


This does one thing, deletes a named workplane.

Caution, In some versions of TC, it does not ask for confirmation. But deletes a workplane instantly. So make sure the correct workplane is selected before deleting.

Select by

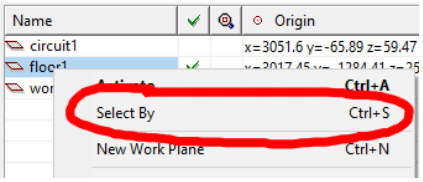
Fig 128



This works best for 2D objects, because 3D objects can have a varied workplane.

Again, it is available from the top of the design director, or the right click menu.

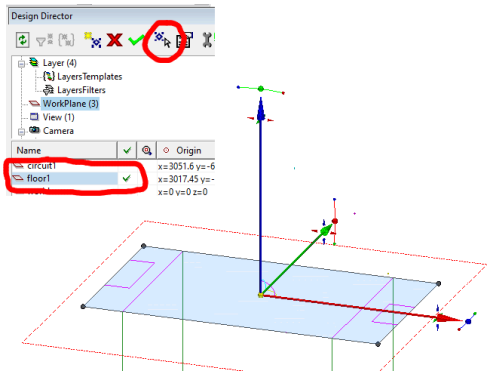
Fig 129



Note, works on object drawn after the workplane is created and made active.

Select the desired workplane in design director. Click Select By. The objects on that workplane will be selected in the drawing. (probably).

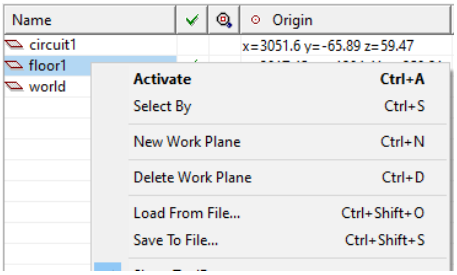
Fig 130



Note. Some objects may visually look to be on the same workplane. But in reality they have difference internal references, This results in the objects not being selected. Also if objects were created before the workplane was made a 'named workplane' they will not be selected.

With 2D objects, selecting the workplane and using 'Place on workplane', will usually cure the problem of not being selected. But with 3D objects, they will often not be selected, unless they were actually drawn on the selected workplane.

Fig 131



Load from and save to file.

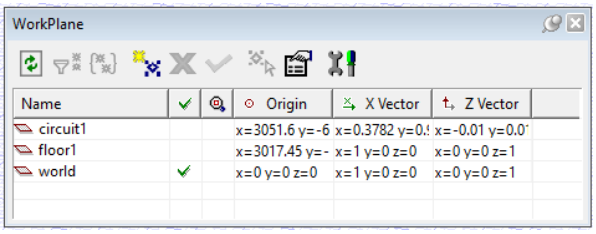
These save a single workplane or multiple workplanes (using the shift key or ctrl key to select all desired workplanes.

And then load the saved workplane into the current (probably blank) drawing.

Its use is probably limited, unless one is copy - pasting objects from one drawing into another. Even then, one may need to use 'place on workplane' to ensure the pasted objects are on the correct workplane.

Independent workplane dialog

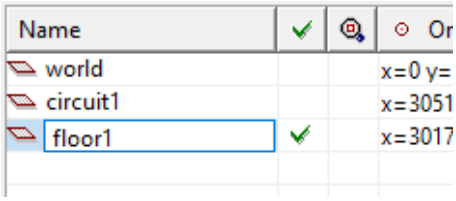
Fig 132



Selecting the menu workplane item 'Named'. Or. Bringing up the normal right click menu, and right clicking a workplane. Or. Clicking 'the open as separate palette icon at the top of the design director. Will bring up the standalone workplane dialog.

This works the same as the design director. For adding new workplane, deleting, select by etc. including right clicking and selecting load / save workplane.

Fig 133

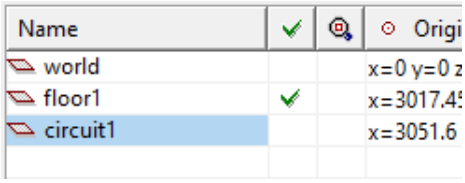


Changing a workplane name.

To change a name. Select the workplane. Click the selected name and click the name a second time. Occasionally one may need to click a third time to get the 'I' bar to appear in the box.

From here we can delete the existing name and type a new one. Or simply edit the existing name.

Fig 134



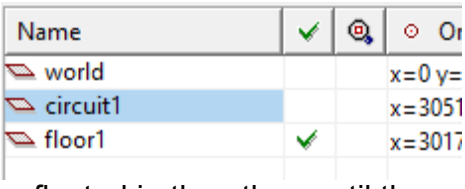
Order.

There is no name order button or entry available. But one can rearrange the names manually.

Click the desired workplane, and drag its name to another location.

The order will be saved with the file. And should be correct after closing and re-opening the file.

Fig 135

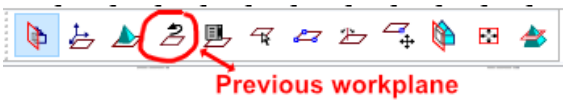


This works the same in the design director and the standalone dialog box. However changes in one may not be reflected in the other, until the file is saved closed and re-opened.

Previous workplane.

Fig 136

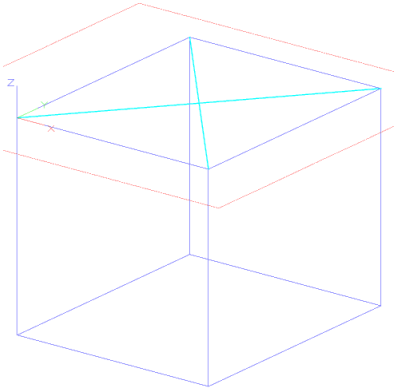
Workplane toolbar



Default UI - Tools - New UCS - Previous
Classic UI. - Workspace - Workplane - Previous
Ribbon UI - Workspace - work planes - Previous.

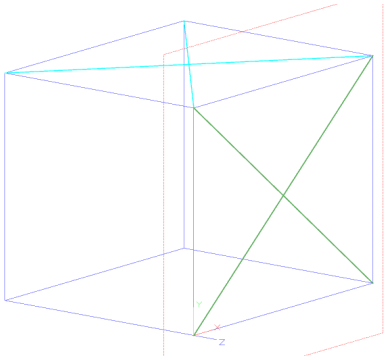
When one sets up a new workplane, TC remembers the last workplane used. This is irrespective of whether a named workplane has been set up.

Fig 137



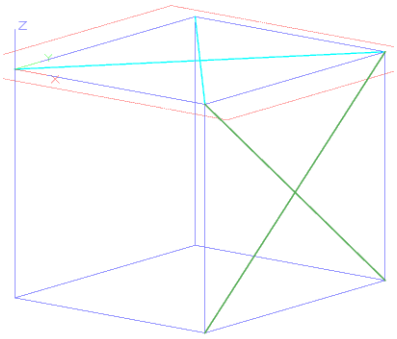
Here we have a cube. A workplane by 3 points was set up, on top of the box, and a cyan cross was drawn.

Fig 138



Next we set up a workplane by 3 points on the right side face. On this we draw green cross.

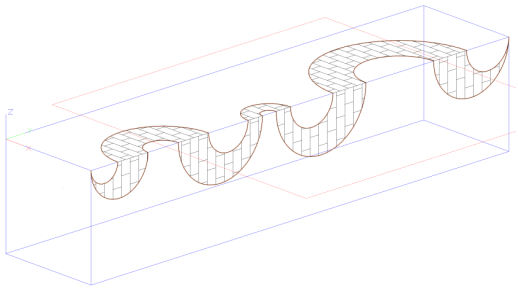
Fig 139



We forgot to add something on the top face. Now we could set up another workplane by 3 points. But as we have just been there, we can press 'Previous'.

TC remembers only one last workplane. So as we have just been on right view, 'Previous' will act like a toggle switch, changing from top to side to top etc.

Fig 140

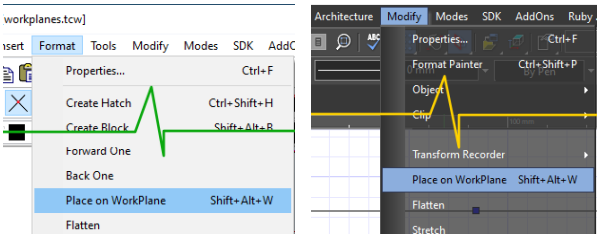


The 'odd' drawing in Fig 140. Was done simply by switching 'Previous' several times . Changing from top to side workplane. (snaps kept missing their place causing hatch to fail).

Place on workplane.

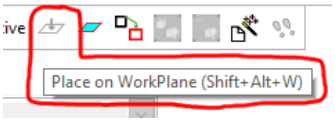
When drawing 2D, with the selector set to 3D, you will likely need to use this tool at some point.

Fig 141



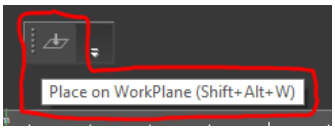
Default UI - Modify - Place on Workplane.
Classic UI. - Workspace - Workplane - Place on Workplane.
Ribbon UI - Workspace - Place on Workplane.

Fig 142



If working in 3D mode, especially drawing 2D objects, then place on workplane will be necessary at some point. Probably often.

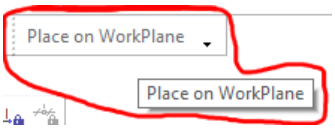
Fig 143



Personally, I created a new toolbar, Fig 142, Fig 143. and put the place on workplane command into it for quick operation.

Older versions of TC did not have an icon, but the command was inserted as text. Fig 144. Newer versions of TC have a icon.

Fig 144



Why would you need it.

As previously stated. Some tools like tangent to 2 arcs, will simply not work if objects are on a different workplane.

NOTE. I am not a programmer, so what is written below is based solely on experimentation.

Objects, whether 2D or 3D, appear to have an associated reference (this is not the same as the user reference point). When an object is created, it takes the reference of the workplane it was drawn on, irrespective of where the user reference point is located..

Some example are..

Fig 145

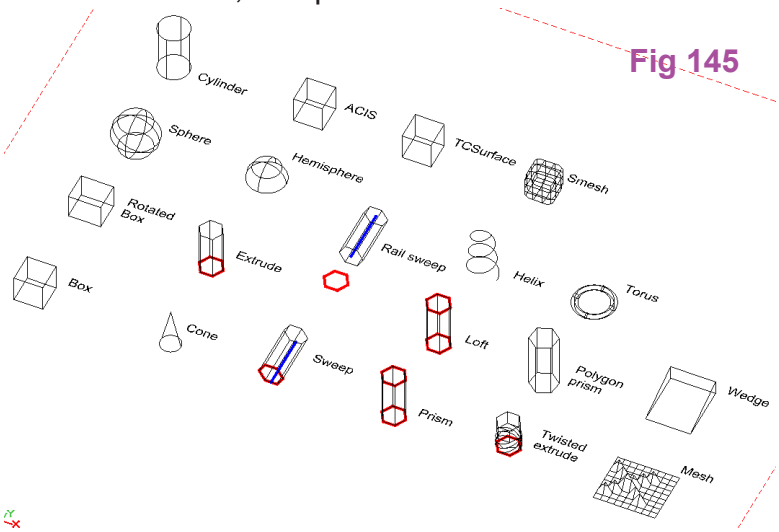
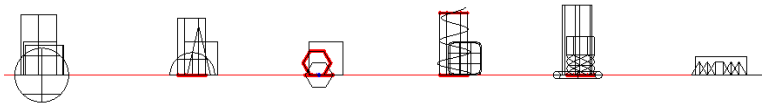


Fig . Shows a variety of objects. They were drawn on the world workplane. The reason for drawing them, is to show the objects workplane reference, in relation to the normal user reference point, on the next page.

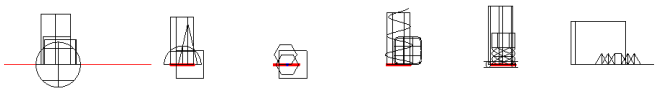
Fig 146



Looking from front view (Fig 146.) we can see most objects have their base on the world workplane. Except Sphere, Torus and rail sweep. They all have the default 'user' reference point, at the objects centre of extents.

In Fig 147. A new workplane was set 50 mm above the original world workplane. All objects were selected, and we used the Place on Workplane tool.

Fig 147



The differences to the original, are, changes to ACIS, TCSurface, and to the wedge.

Lets look at what happens to each objects. (selector properties set to 3D mode).

One important thing to remember, is that Native objects, ACIS and TCSurface react differently to how they are used / placed on a workplane. As will be seen in the following pages, when a Boolean add is carried out. Boolean operations automatically change a native object into an ACIS or TCSurface object.

2D.

With 2D objects (without thickness) like text, rectangle, line, circle etc. Although in 3D mode they have a 'z' axis, they are strictly x, y. This means the results of a 'Place on workplane' are more predictable.

Wherever one places the workplane, the 2D object, will orientate itself to lay flat on the workplane. However the orientation will differ depending on its original position. And the X,Y orientation of the selected 2D objects.

If the text or 2d object is parallel to the positive world workplane, The objects will simply be lowered onto the new workplane. Fig 148/149.

Fig 148

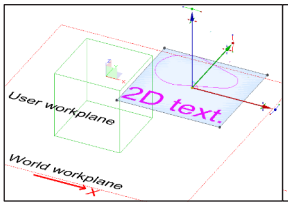
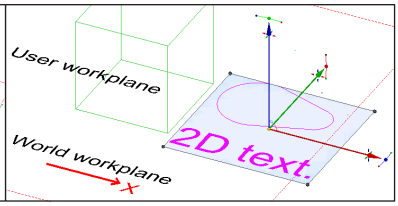


Fig 149



This applies even of the 'Z' rotation, is not the same as the new workplane. Fig 150/151.

Fig 150

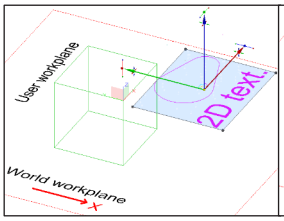
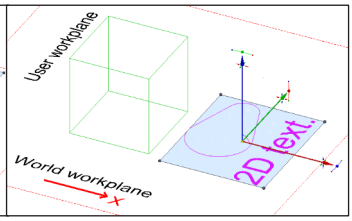


Fig 151



However, if the objects are at an angle to the new workplane. After using the place on workplane tool, the objects are orientated to align with the new workplane x, y axes. Fig 152/153.

This re-orientation can be confusing at first.

Fig 152

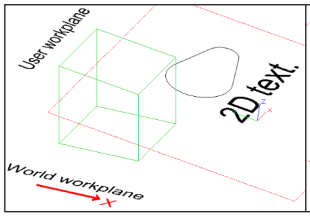


Fig 153

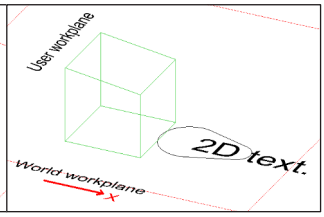


Fig 154

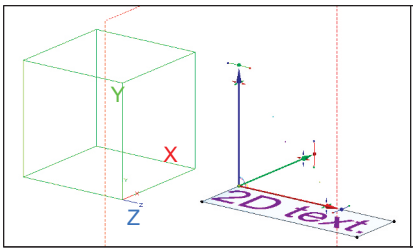
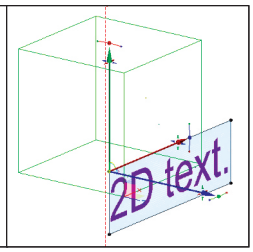


Fig 155



Similarly, if the new workplane is changed from world, to right for example, the objects will be orientated to match the new workplane x, and y direction. Fig 154/155.

2D with thickness.

2D with thickness is reported in selection palette as the original 2D object, for example 'polyline'. Therefore the internal workplane reference, is the same as the 2d object, even though in essence it is a 3D object.

Fig 156

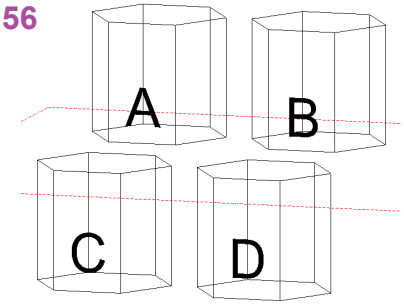
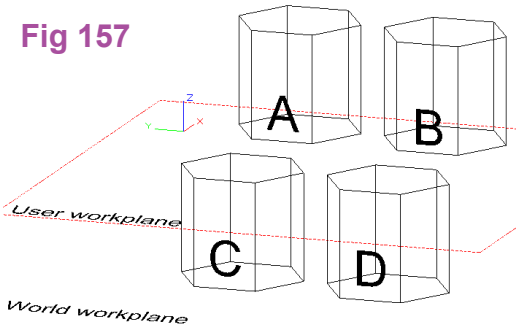


Fig 156. Shows four objects. Originally 2D polylines drawn on the world workplane. A and B are 2D polyline with a positive thickness of 50mm. C and D are 2D polylines with a minus thickness of -50mm.

A and C are ACIS solids. B and D are TC surfaces.

Fig 157

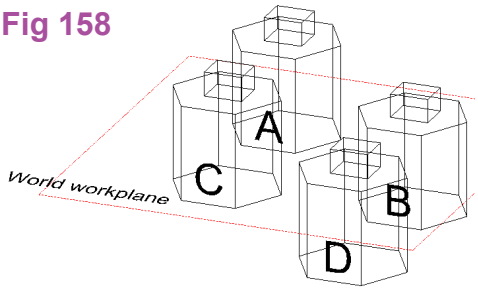


A new workplane was created above the world workplane. The 4 objects were selected and 'place on workplane' used..

The objects moved upwards, just as if they were still 2D polylines.

- -

Fig 158

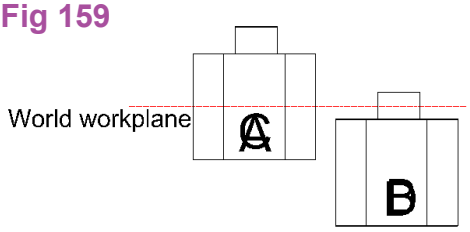


A difference is noticeable when one does a Boolean operation on 2D thickness object.

In Fig 158. A,B,C and D are ACIS solid objects. They were drawn with a and C above the workplane, B and D below the workplane.

Boxes were drawn on the top surfaces ready for Boolean addition.

Fig 159



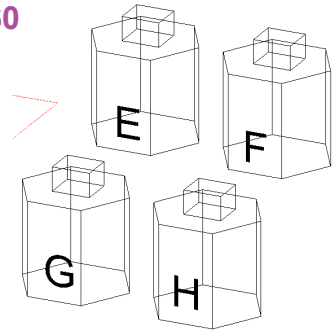
A and C were Boolean added selecting the polygon, and then the box. B and D were added selecting the box, and then the polygon.

As shown in Fig 159. After using the 'Place on workplane tool on all four objects. The new object reference (not the user reference point). Is taken from the centre of extents, of the object that is clicked first.

It is for this reason, that place on workplane becomes less useful, on 3D objects, When an object is further modified, with Boolean addition and subtraction.

- -

Fig 160

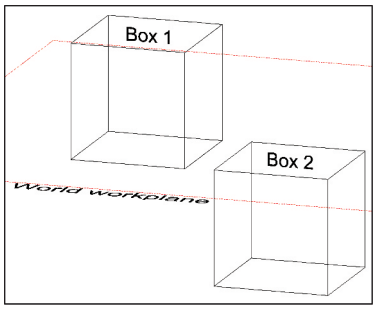


With TCSurface. Things are more predictable. Irrespective of how boo leans are carried out. The reference, remains as to how the first object clicked was drawn.

3D.

Box / Rotated Box (native object).
Deluxe and Platinum

Fig 161

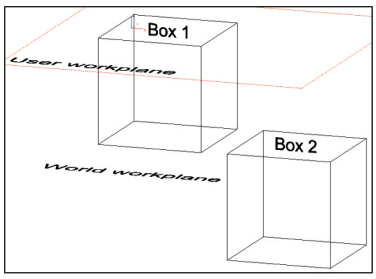


When a box or rotated box is created, its internal reference, is the workplane the box was drawn upon.

Box 1 was drawn on the world workplane, with the positive height. Box 2 was drawn with a negative height.

The object internal reference, is taken from the workplane the object was drawn upon. In this case the bottom of box 1, and the top of box 2.

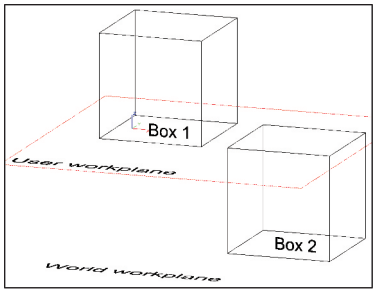
Fig 162



A new user workplane was drawn on the top of box 1. Fig 162

Both objects were selected, and the Place on workplane tool was used.

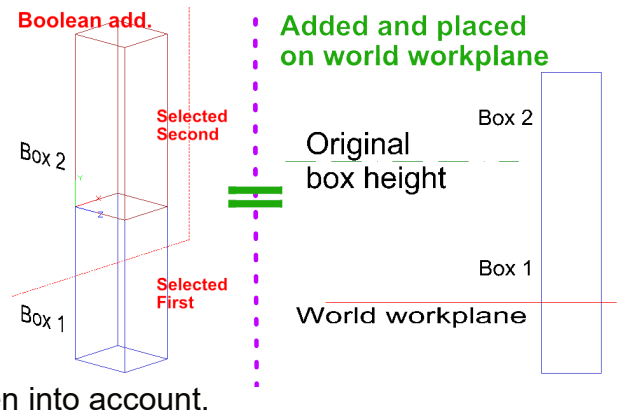
Fig 163



As can be seen in Fig 163. The objects were moved, so that the original reference plane, is placed on the new workplane. So that the bottom of box 1, and the top of box 2 touch the new workplane

The place on workplane after a Boolean add, depends on how the objects were drawn, and what order the objects were added.
Applies to platinum only.

Fig 164

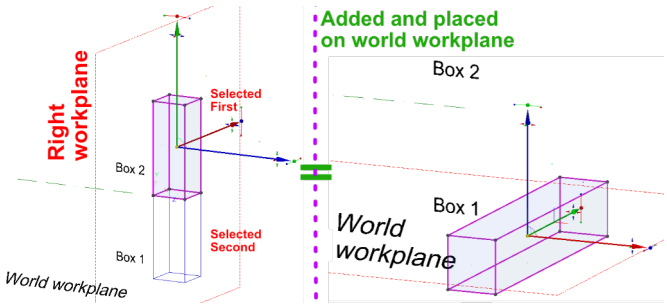


In Fig 164. The top box (2) was drawn on the right side workplane. The bottom box (1) was on the world workplane.

When Boolean added. If the bottom box (on the world WP. Is selected first, the new reference after Boolean, is taken from the centre of extents of the bottom box.

If the top box is selected first, Fig 165. The new ref is taken from its centre of extents. However, The axes of the top box are also taken into account.

Fig 165



The Boolean added object, is flipped so the the X, Y axes are aligned with the current workplane. Which is the world, in this example. Fig 165.

This is simply because the first clicked (2) was drawn on the right workplane, and not the same workplane as the second clicked box (1). And why Place on workplane is not always desirable on 3D objects.

Sphere and Taurus.

Deluxe and Platinum

Upon creation. These two objects react differently than most other objects.

Fig 166

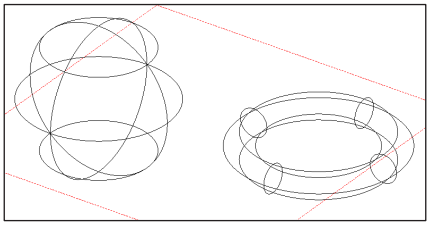
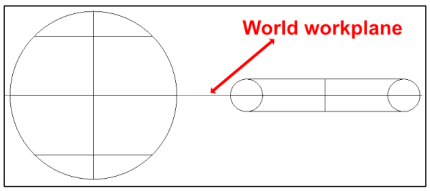
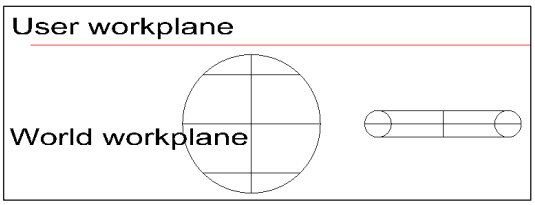


Fig 167



They are drawn part above and part below the current workplane. Essentially at their centre of extents.

Fig 168

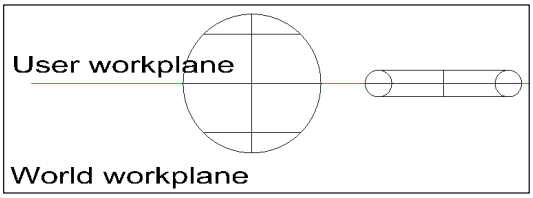


This is also evident when one creates a new workplane. (user workplane in Fig 168.)

After creating the new workplane. The objects were selected, and Place on workplane used.

As can be seen in Fig 169. The objects remain part above and part below the new workplane.

Fig 169



C

In fig 170. A second sphere was created, but this time on the right workplane.

A Boolean operation was carried out adding the two sphere's together.

The bottom sphere (which was drawn on the world workplane), was selected first, then the top object. Followed by a place on workplane command.

The result is that the new reference is taken from the first sphere, as in Fig 171.

Fig 170

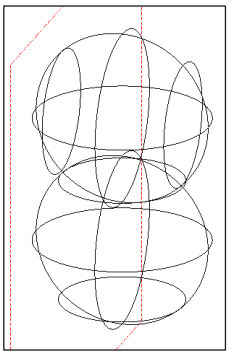


Fig 171

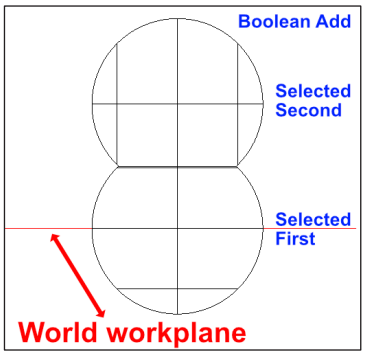
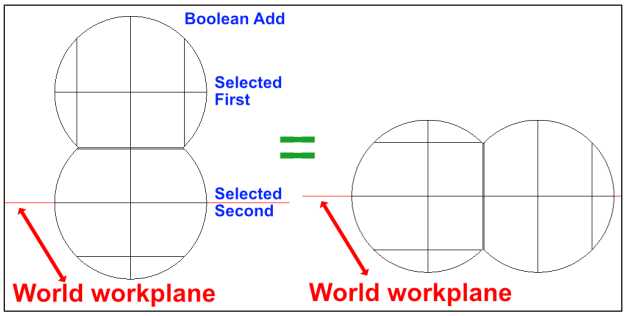


Fig 172



In Fig 172 . The top sphere was chosen first for the Boolean add. Then the bottom one, followed by a place on workplane.

Because the top sphere was drawn on the right workplane, its axes are used when positioning the newly created object.

Resulting in a shift and rotation of the object, to align the axes of the top sphere, with that of the world workplane.

Cylinder, Hemisphere, polygon prism and cone. Deluxe and Platinum

These four object all react the same, and could really have been put under 'Box'. Except when a Boolean is carried out on the hemisphere.

The internal reference is taken from the workplane that the object was drawn upon.

Fig 173. Has the four objects drawn on the world workplane. And because of this, the objects internal reference is taken from the world.

In Fig 174. A new user workplane was set up above the world.

The place on workplane tool was used on all of the objects. This placed the original objects on the new workplane, using the original internal reference. Fig 175.

Fig 173

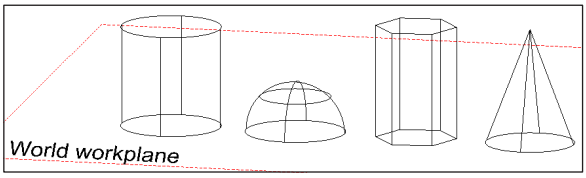


Fig 174

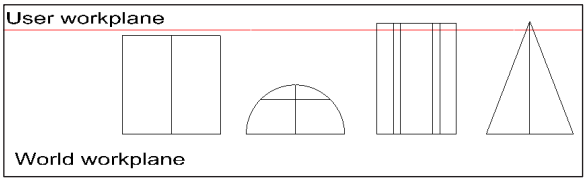
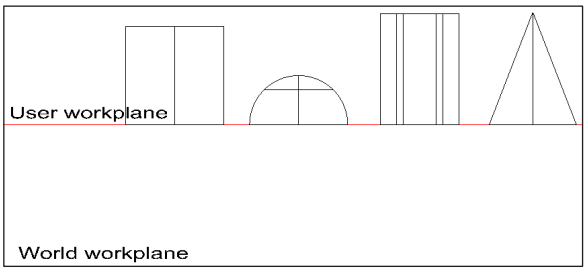


Fig 175



Boolean, applies to platinum only.

When Boolean adding. The only object that does not follow the normal pattern, is the hemisphere.

A box was drawn on the 'Right; workplane, then copied and positioned on each object.

Because it was drawn from the right, the axes are completely different from world. And thus can rotate an object after a Boolean add, depending on the order of addition.

Fig 176

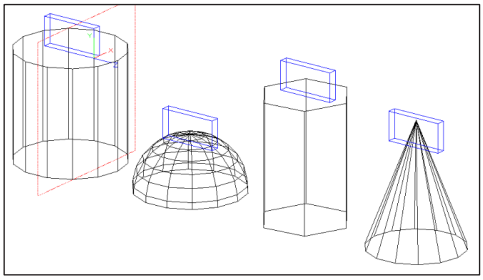


Fig 177

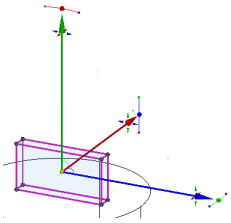
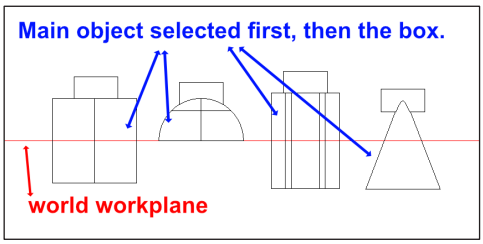


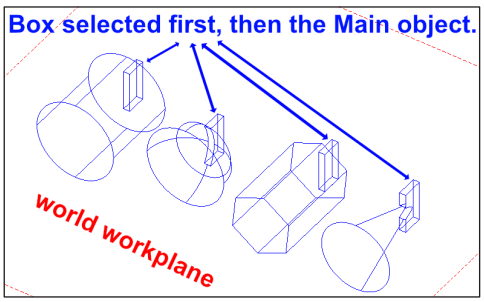
Fig 178



In Fig 178. A Boolean add was carried out, selecting the main objects first, and then selecting the box. Followed by a place on workplane (world in this case).

The resultant object takes centre of extents of the original object and places that on the workplane. Because a Hemisphere is just half a sphere, its centre of extents is its base.

Fig 179



In Fig 179. The box was selected first, and then the main object. This results in the new internal reference, being taken from the centre of extents, of the Box, and the box orientation.

The resultant place on workplane, rotates the new objects, to align the box orientation with the world axes.

Helix.

Deluxe and Platinum

Helix actually looks like it should be the centre of extents, that is used for the internal reference.

But like many other objects it is the workplane that the object is drawn upon, that is used.

As can be seen in Fig 181. Where the object is placed on a user workplane. It is lifted up from the bottom.

Fig 180

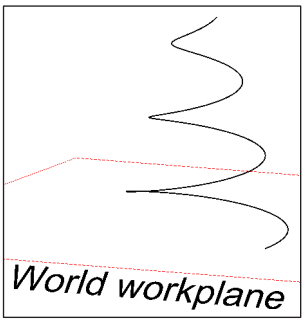
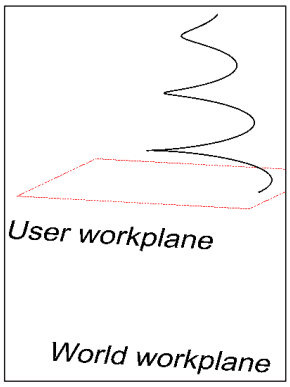


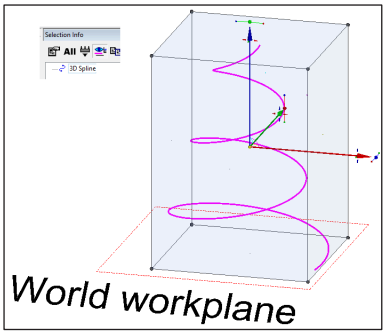
Fig 181



Even after exploding the object down to a 3d spline. The bottom remains as the workplane reference.

One would not normally do a Boolean add on a helix. Helix are generally used as a sweep path.

Fig 182



Mesh.

Deluxe and Platinum

Mesh is another object where one would not normally do a Boolean addition on.

The mesh reference is simply the workplane it was drawn on.

If we set up a new workplane, and subsequently use place on workplane, the mesh is simply re-positioned flat onto the new workplane. Fig 184.

Fig 183

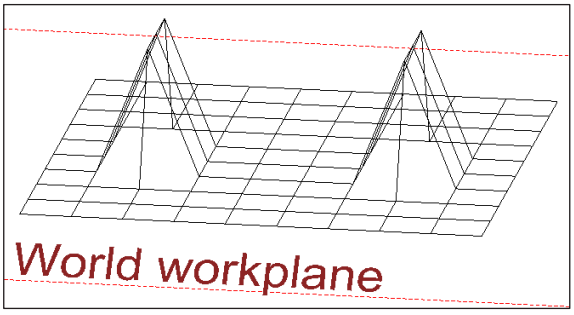


Fig 184

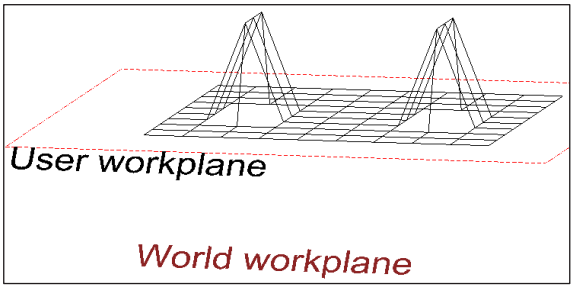


Fig 185. Has a mesh drawn on the right workplane.

If we subsequently create a world workplane. Select the mesh and use place on workplane.

The mesh is flipped to place the base of the mesh onto the new workplane. Fig 186.

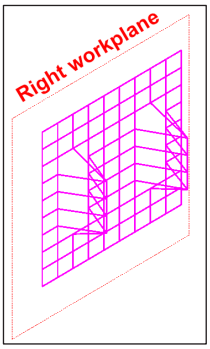
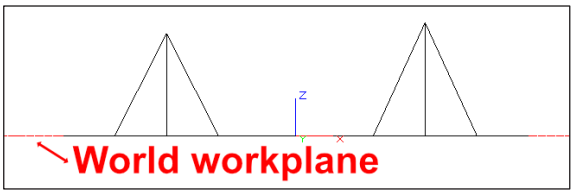


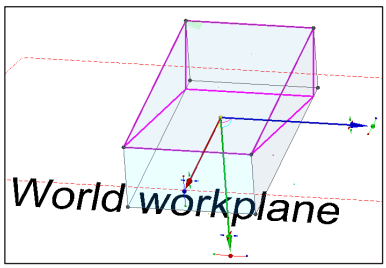
Fig 185

Fig 186



Wedge. Deluxe and Platinum

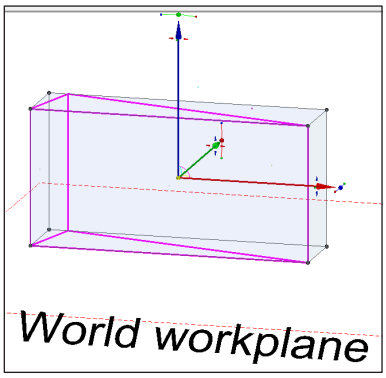
Fig 187



Wedge is pretty unique, When drawn, it does not take on the axes of the workplane it was drawn upon, unlike all other objects.

As shown in Fig 187. The axes uses the hypotenuse and one side, (I've no idea why).

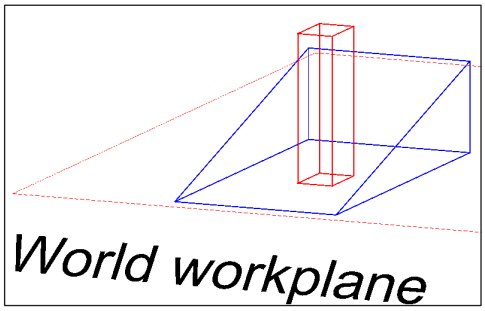
Fig 188



This is evident, if we draw the object on the world workplane, and then without altering anything. We select the object and use place on workplane.

As shown in Fig 188. The object is placed side down on the workplane.

Fig 189



Boolean, applies to platinum only.

Boolean add produces the same difference as other objects. Except the selection order is reversed. For this example a box was drawn also on the world workplane. As shown in Fig 189.

Fig 190

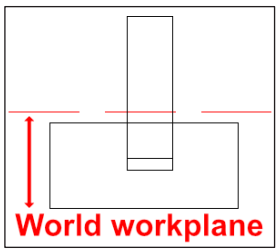
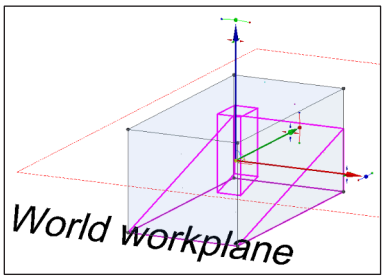
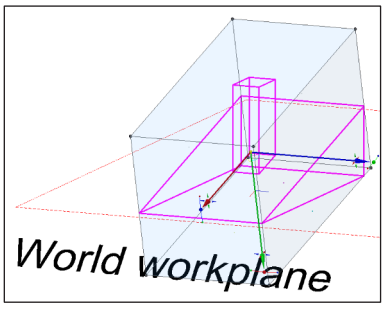


Fig 191



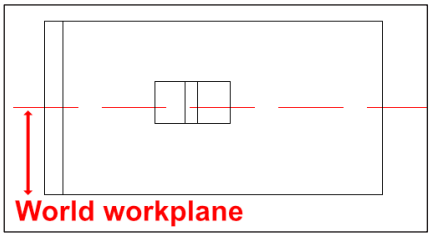
In Fig 190. We select the box first, and then the wedge. This sets the new objects internal reference, to the centre of extents of the original box size. As shown after we use the place on workplane tool.

Fig 193



With Fig 192. We select the wedge first and then the box. This sets the new objects reference as the wedge axes. As can be seen in Fig 193/ the new objects ref is angle instead of orthogonal.

Fig 192

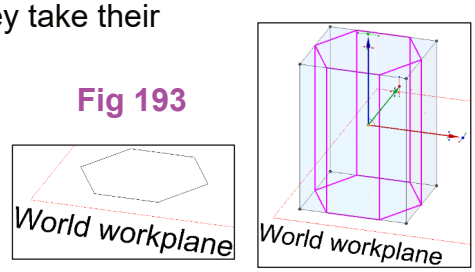


And as we have already seen, after using place on workplane, The wedge gets flipped so its axes align with the world workplane axes. Fig 192.

Extrude and Twisted Extrude. Deluxe and Platinum

Extrudes work with a 2D profile. And similar to thickness, they take their reference and axes from profile.

Fig 193



As can be seen in Fig 193. With the profile drawn on the world workplane, the base of the extrude, and the axes, matches the world system.

If a profile is drawn on the world workplane (Fig 193), and then rotated 90 degrees Fig 194. The subsequent extrude will keep the same orientation as the profile. As one would expect.

Fig 194

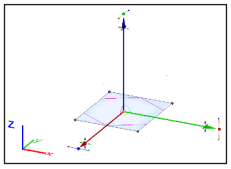


Fig 195

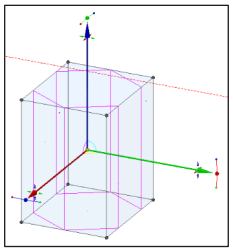
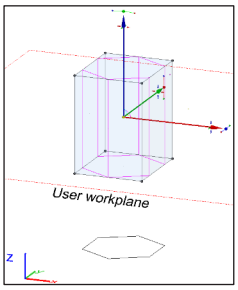


Fig 196



It will take its internal ref from the world workplane. If one creates a user workplane. The internal reference will keep its orientated as per world, even though the user ref point is changed.

Boolean, applies to platinum only.

Boolean add is essentially the same as with other objects. The new object uses the reference of the first object clicked.

In Fig 197. The bottom object was selected first during a Boolean add. When using the place on workplane. This position for the new object, as the centre of extents of the first object, and orientated as per the first ref.

Fig 197

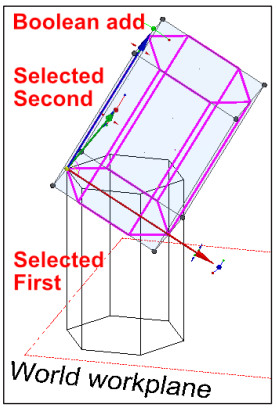
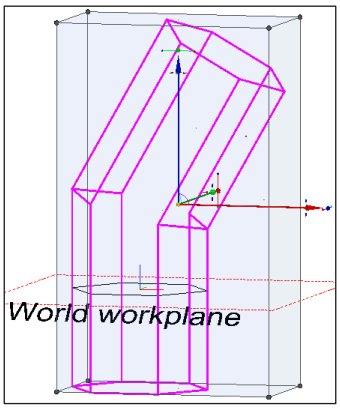


Fig 198



In this second example, Fig 199. The top object was selected first, during the Boolean add.

The new added object uses the centre of extents of the top object, and the internal reference of that object. Therefore, when being placed on workplane, the new object is flipped to align the top extrude extents, with the workplane. Fig 200.

Fig 199

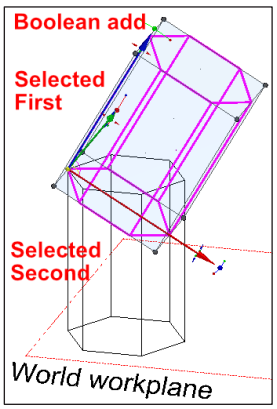
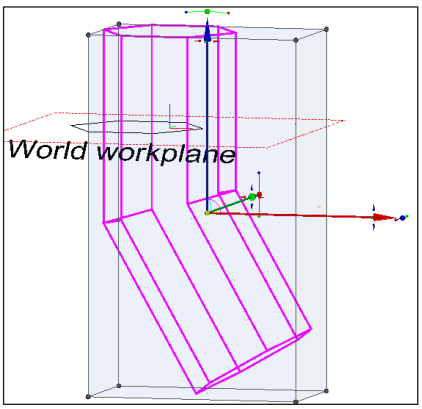


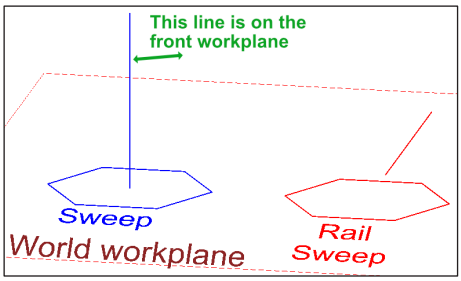
Fig 200



Sweep and Rail Sweep. (Sweep in platinum, rail sweep in platinum and deluxe).

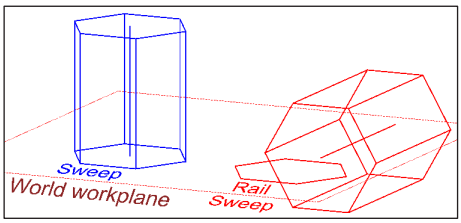
Deluxe and Platinum

Fig 201



Sweep and rail sweep are very similar, differing mainly because rail sweep can automatically orientate the profile. Sweep cannot.

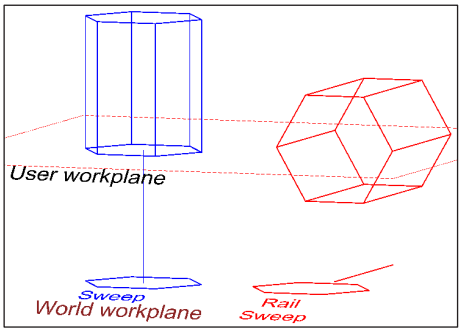
Fig 202



The sweep / rail sweep are carried out as normal. The way the paths have been drawn sweep object is vertical, and rail sweep horizontal.

The sweep reference is taken from the base of the sweep, the rail sweep is drawn half above and half below the workplane. Because the path is on the world workplane.

Fig 203



If one creates a user workplane above world. Place on workplane moves the moves the objects using the base of the object with the sweep, and the centre with rail sweep,

Boolean, applies to platinum only.

Fig 204

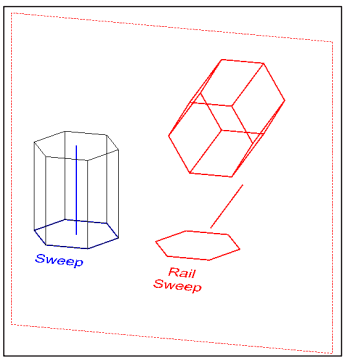
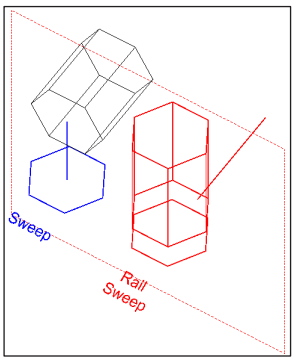


Fig 205



Setting up a vertical workplane, in front view and using place on workplane. The objects are rotated as expected, placing the base of the sweep onto the new workplane. And the centre of the rail sweep, onto the new workplane.

Using Boolean add, changed the internal reference.

If we select the main object first and then the box to add. The ref is change to the centre of extents for the first object clicked. Fig 206 (after place on workplane.

By selecting the box first and then the main object, the ref is changed to the centre of extents of the box. Note the resultant object changes from sweep to an ACIS solid. Place on workplane, aligns the extents of the box onto the new workplane, Fig 207.

Fig 206

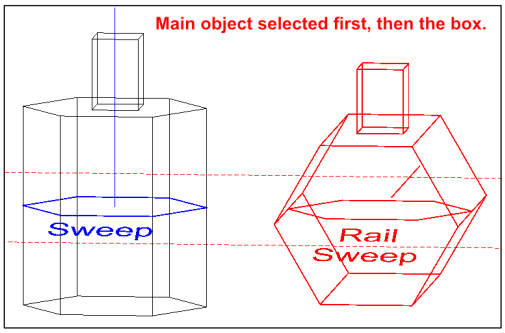
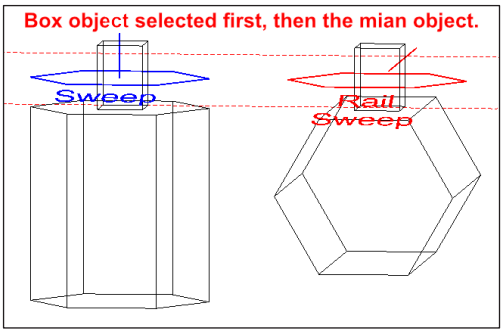


Fig 207

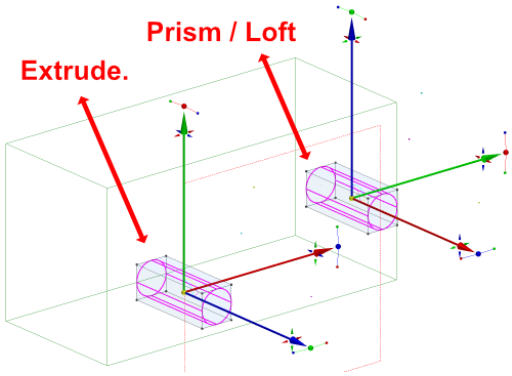


Loft and Prism.

Lofting and Boolean, applies to platinum only.

Loft and prism, appear to take the reference from the first profile clicked. However, because they are based on multiple 2d profiles, they do not follow the normal place on workplane procedure.

Fig 208



This may be because they don't follow the standard X, Y, Z axis directions. For example, If one draws a circle on the right workplane, copies and moves the copy so it can be lofted. The Z direction is the same as the world workplane. Contrast this with extruding the circle, on the right workplane, The objects has the Z axis pointing in the +X world direction. Fig 208.

In the example below. The first loft and prism profiles were drawn on the world workplane, then the other profiles copies and orientated. Fig 209.

The profiles were lifted off the world workplane prior to the 3D being created. Fig 210.

When loft / prism is used, and we then we use the place on workplane tool. The objects remain as they are, floating in air. Fig 211. It is assumed that when created, they take their internal reference for the position and orientation, from world coordinates. This make it unpredictable o what is going to happen, if one does not know how the object was created.

Fig 209

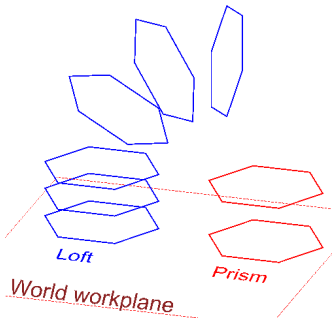


Fig 210

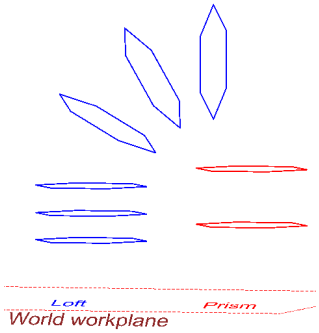
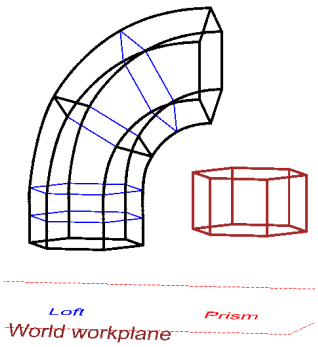


Fig 211



Boolean works the same as other objects, in that the resultant objects reference is taken from the first object clicked.

Fig 212. Has the lost / prism selected first when Boolean adding.

Fig 213. Shown the resultant ref is the centre of extents of the loft / prism, and that is used to place the object onto the workplane.

Fig 212

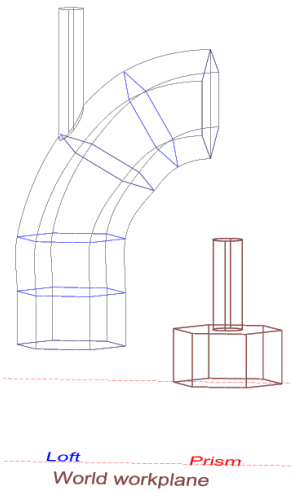
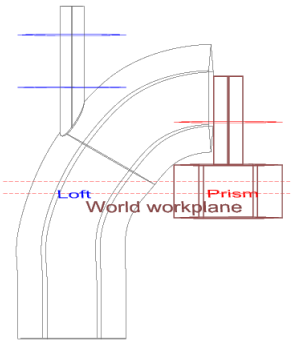
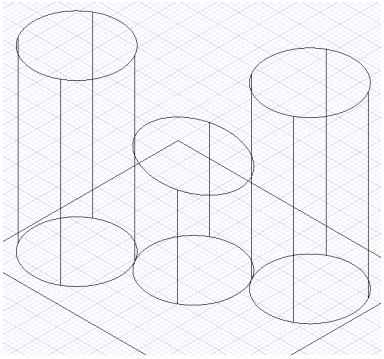


Fig 213



Slice by workplane.

Fig 214

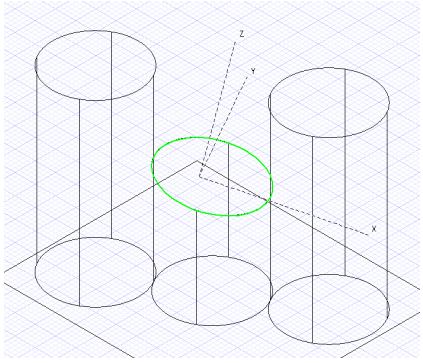


Probably not high on the most useful tools list, it is included here as it involves the workplane.

Fig 214. Shows the setup. We wish the two outer cylinders cutting so the slope goes from left the right. Continuing on each cylinder. As the cylinders are angled, we cannot simply go to the front or right view.

We could set up a workplane by 3 points, then use plan by workplane, then normal slice. But that won't explain this tool option.

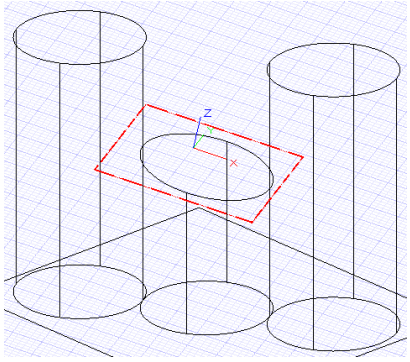
Fig 215



We can set a workplane in a number of ways. Here we will use the workplane by facet tool.

Clicking on the face of the sloped cylinder as shown in Fig 215.

Fig 216



As can be see in Fig 216. A workplane is created in line with the face. (shown exaggerated for the image here.

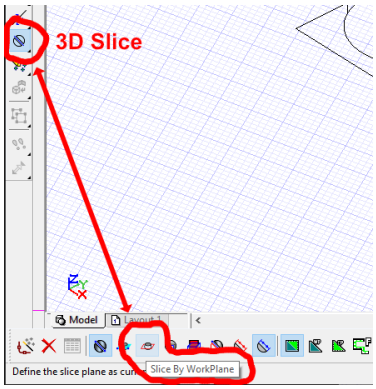
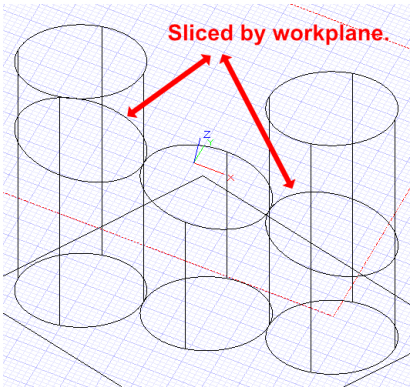


Fig 217

Select the slice tool. And on the inspection bar, select slice by workplane icon. Fig 217.

Fig 218



Select the two cylinders to be sliced. TC slices the cylinders based on the the current workplane. Fig 218.

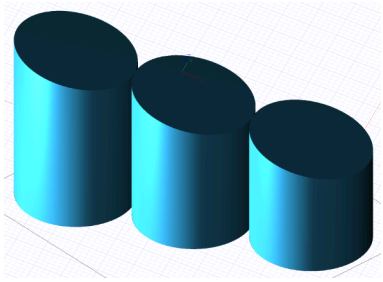


Fig 219

The resultant drawing is shown in Fig 219. Quick and simple with minimum setup required.

Workplane snaps.

Snaps will not work on the workplane itself, but will work at the intersection between the workplane and an object. Although there may be no actual indication, even with magnetic snap turned on, it will work, but for best effect, turn on show workplane intersection.

If we look at Fig . We have show workplane intersection turned on, this helps visualise where it is snapping. For the snaps we have a minimum selected, I.e vertex snap for this instance, we also have snap to workplane intersection turned on, and magnetic point,. No-snaps is turned off, i.e. snaps are working.

Fig 220

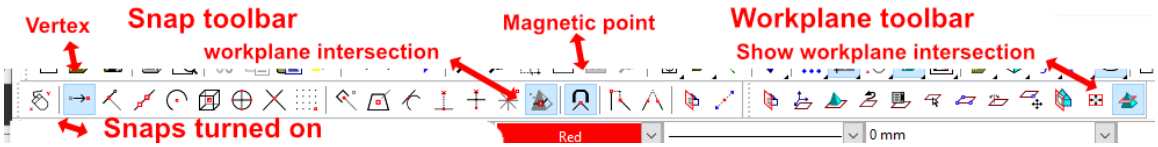
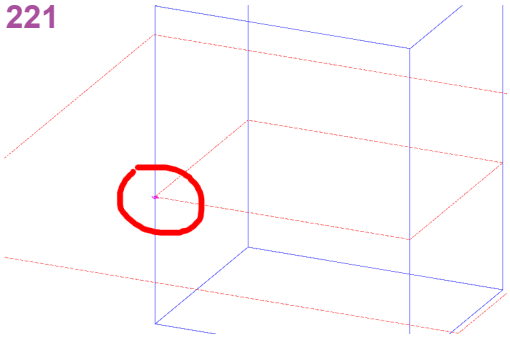
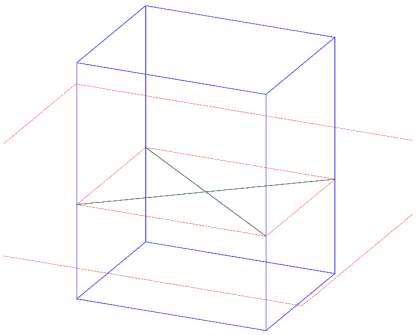


Fig 221



After selecting the line tool, we can hover over where the workplane intersection is located, and can see from the magnetic point, that the snap will be successful.

Fig 222

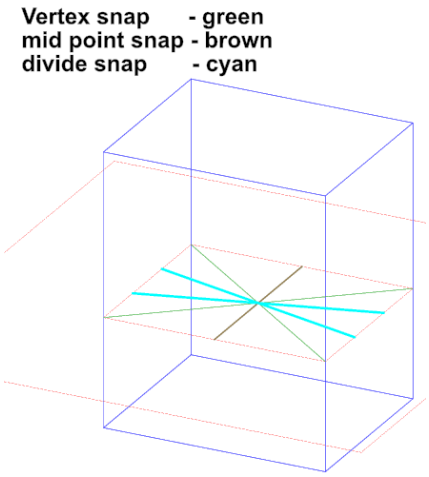


From here we can snap to the four vertex of the intersection.

Other snaps can be used, as shown in Fig 223.

These include Mid point, and divide snap.

Fig 223



The End.