Beginners guide to lofting.

This is a simple overview guide to the different types of lofting that can be accomplished in TC platinum. Version (prior to TC 2022). Including the different types of 2d profiles that can be used.

It does not go into every variation, nor every profile. But gives a brief description of the most common way to loft.

V1.2

Important note. This guide does not apply to TC versions from 2022 onward. Anyone using TC 2022 or later, should consult the relevant TC help file.

Andy H.

Contents

Doe's and Dont's	3
Do you need to loft.	3
What can be lofted	3
Drawing cosmetic guidelines	3
Not lofting guidelines.	
Offset tool.	3
Join polyline tool	4
Full profile	4
Symmetrical profile Spine	5
Symmetrical profile Bezier	6
Simple open profile	7
Simple open profile2	8
Lofting with minimal profile.	9
Lofting with minimal profile 2.	10
3D spline	11
Compound profile	12
Problems	13
- Profile direction	13
- Equal node count	13
- Sudden changes in direction	13
- Changes in profile shape	14
- Changes in profile type	14
- Loft direction	14
- Too many profiles	14
Self intersection	15
Mirror and Add.	16
Other problems	16
Lofting with guidelines	17
Face to Face lofting	21
Branch lofting	29

Lofting with TurboCad

Do's and Don't's Courtesy of **Henry O Hubich**

1. Don't try to loft a Group.

2. Don't bother drawing symmetrical profiles to make a symmetrical object. Model half the object, then mirror copy it.

3. Do draw a single profile, then place a copy where you want the next profile to be and then edit it as necessary.
Repeat for each successive profile.

4. Do make the profiles as simple and clean as possible.

5. Do be aware of the Format|Create solid|From surface option, new in v10. In many cases, you can use open profiles and then invoke that option to fill in the resulting hollow shell. (Doesn't always work well.) Also be aware that a hollow shell is acceptable in some cases.

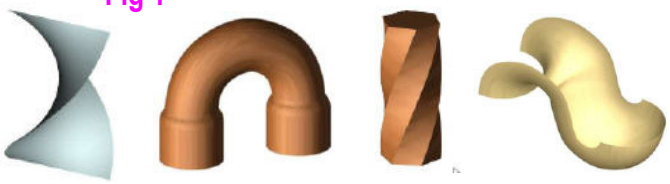
6. Do consider alternative approaches to profile arrangement -- e.g., terrain can be lofted from contour lines or from cross sections.

7. Do anticipate adjusting your profiles to repair imperfections in the finished loft. Lots a luck.

Do you need to loft. - Can a form be better achieved using extrude with a twist, extrude along path, or boolean, these are lofts that may be better extruded or swept.

I lofted them just for fun

Fig 1

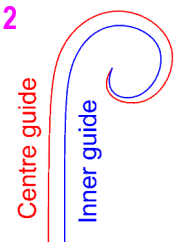


Profile -Think of yourself as a navigator, and Genie (the heart of TC) as the driver. Your job is to guide her using the best and smoothest route. If Genie thinks your navigation (profiles) are crap she will cut corners, come to a stop and complain, (throw up self intersecting error). Or put in a few dents and scratches and blame it on you,,,,, *hmm - does that scenario sound familiar.*

What can be lofted - 'All Open' or 'all Closed' 2D profiles, be they polylines, arcs, circles, spline, bezier, and 3D spline / polylines v10.2 pro on. *(not sure about v10.1).* BUT **not if they are a Group, Region, Block or Symbol.** These must either be exploded down, or groups and block can be lofted in their own edit mode.

You cannot loft between an open and closed profile.

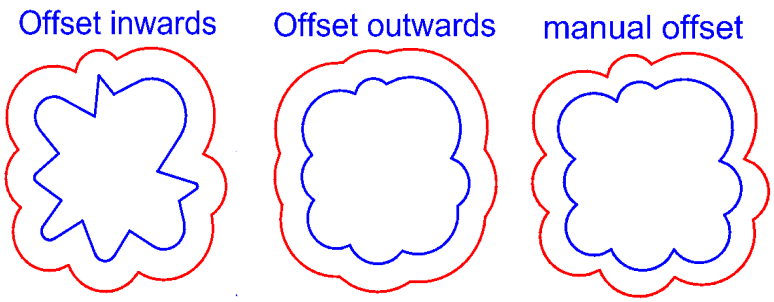
Fig 2



Drawing cosmetic guidelines (Not lofting guidelines). - My personal approach is to draw spline guidelines for the profiles to follow, These are simply visual aids to simplify alignment of the profiles. As in Fig 2, most often it is just one or twp spline guides, be they hand drawn or **offset.** *And I usually eyeball everything*

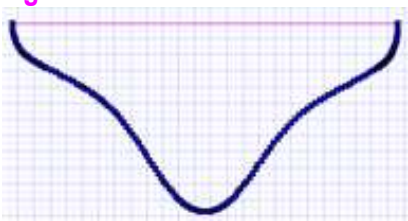
Offset tool. If you use the offset to get different sized profiles, especially on polylines with arcs. And your shape has tight corners. The offset tool may round these over, or distort then, as in the cloud in Fig 3. This is not a bug, but the way TC calculates the offset centre of arcs. Its better to draw the inner first and offset and node edit the outer, or manually scale the image and node edit.
Genie makes nice 'clouds' - shame to let offset mess them up.

Fig 3



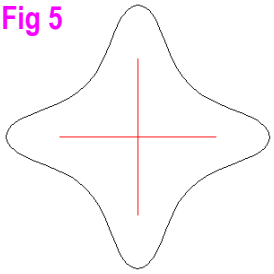
Join Polyline tool. - Its OK on Arcs and lines, but use sparingly IMO on splines. *I dislike all the lines it produces*. using join Polyline on a spline or bexier, converts it into lots of little Polylines. fig 4. i.e. toooo many nodes, which can give Genie a headache as she tries to work out what goes where. If you have to use join Polyline, then try the convert to curves tool, on a copy of the objects to see if its ok. Often it will work OK, but sometimes *yuk*.

Fig 4



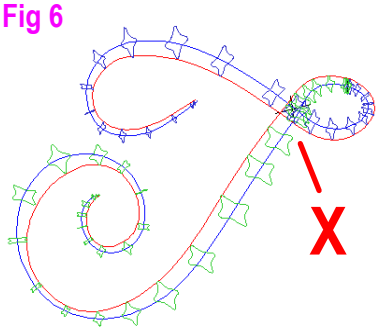
Full profile. Closed Spline Fig 5.
Quantity and positions of profiles is trial, error, and experience. Use guidelines to roughly tell the positioning. Quantity is guesswork. Whilst I try not to overdo' it, I do put in possibly a few more than needed. One can always 'miss' a profile out when selecting for lofting.

Fig 5



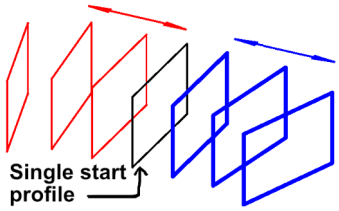
Looking at Fig 6. Each profile is N' SEKE to the centre line (blue), and scaled down equally in both X and Y scale boxes. The red spline is just there as a guide to give an indication of how much to scale up / down

Fig 6



One problem. with this shape is, if the profiles in Fig 6 were lofted as a whole, there would be *the dreaded* **self intersection** error. Due to the overlapping at the point X. There are a few options to get round this.

Fig 7



One is simply choose a single profile as the start point or end point for both sides. Fig 7. If one looks at Fig 6, one would loft all the blue then all the green.

A second method is to use extra profiles to overlap the join. This requires keeping the loft as straight as possible where the two halves meets, Fig 8. The 'overlap'. Profiles are drawn very close together. Wide apart would increase the chance of a mismatch when lofted.

Fig 8

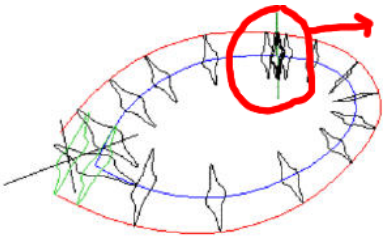
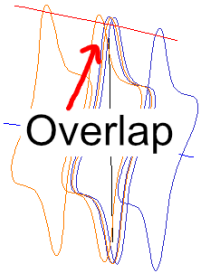


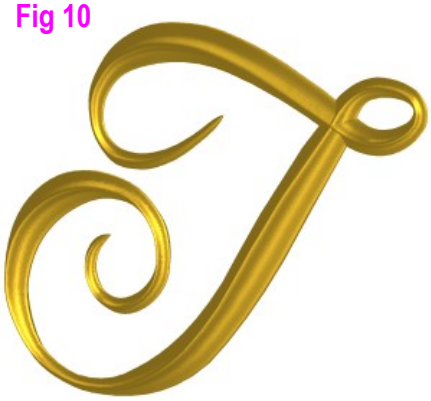
Fig 9



Or another way would be to create an angled profile specially shaped across the intersect, Marked 'X' in fig 6. This provides a single point to loft the letter using 3 lofts. Though this may require careful set up to avoid incorrect shape changes, no pic - *I didn't think of it earlier.*

If there was a natural straight portion to the loft, then the single method would be more successful at avoiding a seam. The second choice would be overlap method, if a suitable place could be found. The letter in Fig 10, was done using overlap.

Fig 10



A drawback to using a full profile is. It often takes longer to loft the profiles, if it has any complexity. So the delays between loft / tweak / loft / tweak can become tedious and lead to errors

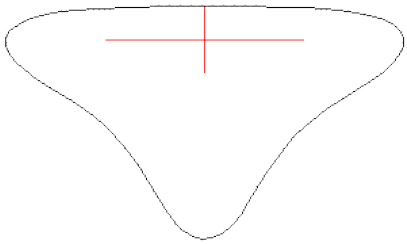
The more complex a profile is, I.e. the more nodes it contains, the more chance of errors creeping in, If one needs to alter some nodes its more difficult to alter both sides exactly the same

Problem - The main problem using a full profile is complexity, by that I mean more corners & nodes,

Cause - simply how it was drawn, *yep no one else to blame for this one*

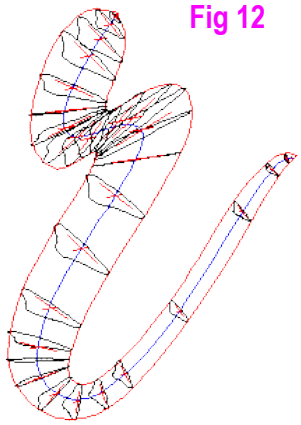
Solution - These can often give very good results but if using a full profile causes some problems like going round tight corners, then simplify the profile or choose a different method of lofting is the best solution. Sometimes one can get round some problem by **lofting in stages,** and boolean adding. This may produce seams, but choose a hidden positions, or choice of material, will dictate if seams are obvious. It depends if the drawing is for production (model file) / 3D printing (stl), or visual / 2D print. If 2D printing. *Its all in the mind, if people can't see it - its not there.*

Fig 11



Symmetrical profiles - Spline, Its often not necessary to draw a full profile if both sides are symmetrical, genie finds it much easier to use nice shallow bends than a lot of tight corners. With this **Spline** profile Fig 11, some nodes were deleted and the profile altered, the Ref point of the profile has also been moved to the intersection of the red centre lines and the profile and cross are grouped

Fig 12



The profiles are placed into position, snapping to the blue centre line. *(hope your not using a monochrome monitor).* Fig 12, - This is the reason for relocating the ref point, and allows for the Blue line to be used a slicing point or for mirror copying, When lofting don't forget the *teeny weeny* profile, Fig 13. Here the smallest is 1/128"

Fig 13

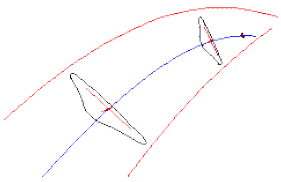


Fig 14

As can be seen from the grey render Fig 14, *I messed it up*. **Tweaking is normally always needed**. this has a big bulge at the end. *Mine's around my waist but I'll not go into that.* - Re-scaling the profiles sorted it out.

There are two options now, either simply mirror copy along the blue line (when viewed from the side), and boolean add together. Or slice the lofting along the blue line,(when viewed from the side), and then mirror copy along the slicing line. If the two sides are to have a different material, this option would be needed without the Boolean add. *Obviously.*

Fig 15

Problems - Ref point moving to default location. This will mean that if you select the profile and snap it to a line, it will be positioned incorrectly.

Cause - Activating default ref point (local menu or button) - *clumsy*. Occasionally happens on opening file, or moving file to different version (can occur when Boolean is used but unlikely in this case).

Solution - group the profile and red cross when snapping to the guide. Then before un-grouping keep a single copy of the profile on separate layer. Then, if the worse happens *sooner or later it will,* and it proves difficult to realign, its a simply a matter to making a new profile from the copy. This problem doesn't happen often, but its better to be safe.

Symmetrical profiles - Bezier

The next lofting uses a similar approach to half spline, but uses a bezier curve, where tight corners in the profile can be utilised. Fig 16. But there are drawbacks. The main one being, editing the nodes and handles. *The blue and green bits when selecting in edit mode.*

First thing to do is draw the profile, and in properties Fig 17, Decide if you need to alter the number of segments between controls points. On slow computers, if it was left at default 20, for a complex lofts the computer may start to slow down, Fig. 20, below, it simple shows, the difference, the more lines the slower things can get, think of it as quality at a price. Note, on modern fast computers, 20 should be fine.

Fig 16

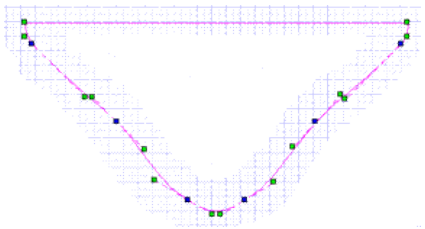


Fig 17

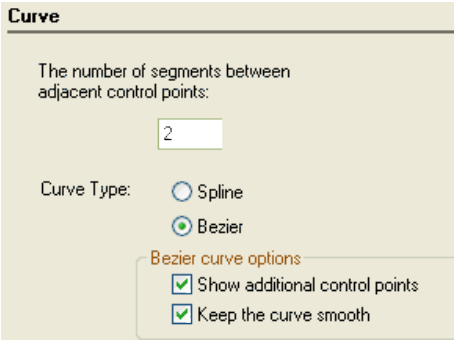
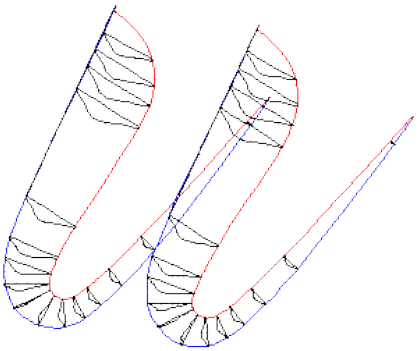


Fig 18

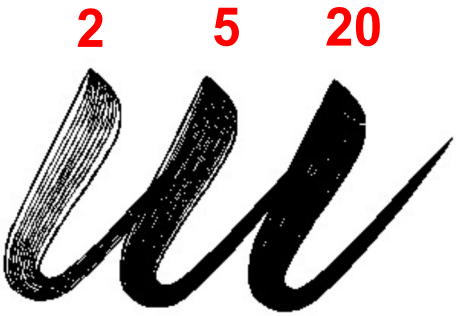


The loft is done in the same manner as the spline, except, that it's possible to put the ref point on the 'virtual' vertex and snap to an outer guideline. Fig 18. This can make ref point relocation a little bit Easier. When positioning the ref point, it seems easier with running snaps on, zoom in, nearest on graphic, with magnetic on, and using snap aperture to find corner. Sometimes vertex running snap will also find the corner. *If your having a good day and haven't upset Genie too much*

Fig 19

Number of segments between control points

Fig 20



Problem - Tweaking the 'control points' of a bezier node, once all the profiles are in position, especially if done on a few profiles,

Cause - None ***Blame*** - *its your fault for not getting them right in the first place*

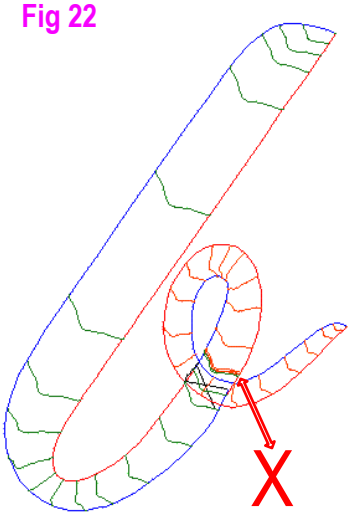
Solution, - Care, pure and simple. There is no magical solution that I know of, with bezier control point editing. Just experiment on a few copied profiles, to see if the desired shape is possible. Using grid snap with a fine grid, will give indication and possibly something to snap to.

Simple Open Profiles.

Fig 21

This next one is done as an sheet object. In some cases it is not necessary to have a closed 'solid' object, A single side, or a mirrored open 'sheet' will do. *TC calls it a solid - I look on it as an ACIS Surface - even though after using convert solid to surface its still called a solid, though not to be confused with a TC surface, but then again, a TC Surface looks like a solid - confused - sorry. I am.*

Fig 22



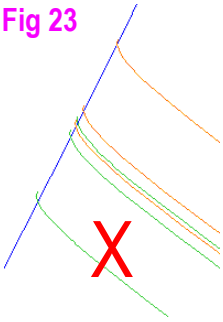
These can look just as good and sometimes better than a solid. One can still do boolean add if its necessary (within limitations) to join two bits together. And if a solid is found to be needed later it *might* - *(and that's a big might*) be able to convert it to solid, - often but not always.

If one lofted a garden and wanted to dig a pond, this on its own is no good as you would fall through as soon as you cut the surface away. (see convert to solid - page 14). But if no digging was required this would be perfect for producing a quick and pretty accurate top surface.

The Profile was drawn as a 2D open spline, Fig 21

The ref point is then relocated to the vertex and then 'N' snapped to the guideline (red). Once they are all in position, they are re-orientated, and re-scaled, so the loft will follow the curve when lofted.

Fig 23



The loft is done in two pieces (Orange and Green in Fig 22.

Self intersection is avoided by the 'join' point shown by the 'X'. Fig 23

The beauty of this method is speed and ease of editing, having a vertex makes relocating ref point a snip. And lofting can sometimes be more accurate than using a solid, by that I mean less kinks or twists.

Fig 24

Problem, - Back of loft not flat, and boolean add shows a gap

Cause - snapping to guideline accuracy (*a bummer in 10.2)*

Solution, - there are times in TC where the snaps 'miss' their target.
The 'N' SEKE is notorious for this on my system. It is often necessary to zoom in to ensure the SEKE goes when one wants it. Zooming in side view will show if this has happened. If not corrected, the loft may become slightly twisted, and there may be a gap if the object is mirrored.

Simply find the offending profile, re snap it the guide, and re-loft. *or if the loft looks ok, - cheat and slice off the extra bit.*

Simple Profiles 2.

Fig 25

This one simply shows the ease of altering simple profiles, once they have been out into position, i.e. for a design change.*(or you messed up when designing the first attempt).*

The object was done using an open spline Fig 25. Using the method described on previous page, it actually lofted fine. But I decided to a change the shape. One method would be to redraw the profile and replace the existing ones, but as it lofted pretty well, I decided not to disturb their position. *OK I'm being lazy.*

Fig 26

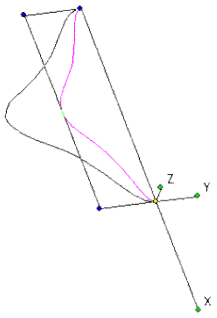
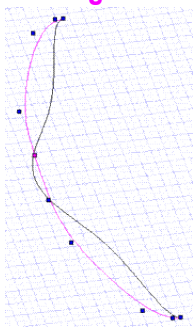


Fig 27



The first thing was to select all the profiles which needed altering, then make a copy, group the copy, and put the its own layer. Select the copy and move its ref point to a back vertex. The whole copy was then scaled in height by 0.5% Fig 26. It is scaled in one direction only, (Y = 0.5 in this case).

Next, each profile needed altering, in node edit mode, (with grid and ortho snap on). Move the two centre nodes of the original profile to touch the copy, as Fig 27. Its not necessary to use a snap or SEKE just place by eye. I use the grid purely as a visual indication,

Fig 28

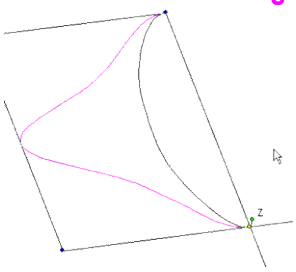
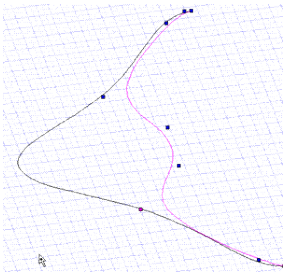


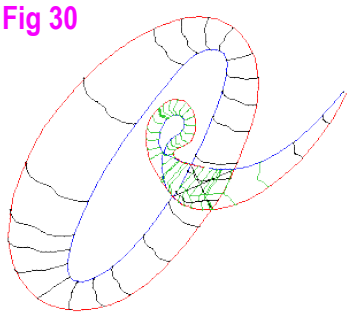
Fig 29



Now select the group of copies, check ref point is ok, an rescale height (same box as previous) , type in 3, Fig 28.

Lastly move two intermediate nodes up to meet the copy, again using eyeball is sufficient Fig 29) The result is shown in Fig 30.

Fig 30



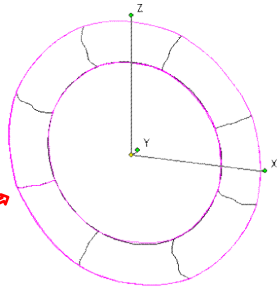
Whilst this method may seen cumbersome, there are no problems of outer shape change, or alignment, and actually only takes a few minutes, to alter the whole lot.

The **problem** of self intersecting with the 'green' profiles is overcome as previously, by lofting in two pieces, either overlap or single profile methods.

Fig 31

A note about start and finish, the large 'O' Fig032 is one loft. Normally one can click the same single profile to start and finish a closed loft. But occasionally TC will throw this up as an error. Reason - no idea, *at least I'm honest*. But if this happens, simply find a suitable hidden point, and create a separation with two profile very close together. Do the loft, and then do a second loft between the two profiles and add together.

Fig 32



Start and finish here

Working across the grain, - lofting with minimal profiles

Lofting between two or three simple profiles, I'm sure everyone has done. Its generally accurate, and well, easy. *OK, if you haven't tried it, draw a line, offset it one inch, select loft tool, click one, click tuther select finish, - you done a loft. There ya go, we can carry on now*. This is only a slight variation in that the straight part of the 'a' is rotated to give a narrowing effect at the ends. As can be seen from the Figures, things are set up just slightly differently.

The red lines are the bases of each loft - the base profiles. There are two closed spline for the 'o' part, (one red, two blue, and two open spline each for the rest, *(don't actually know what its called, but 'the rest' sounds about right)*. Fig 34 shows the red's separated for clarity. The blue lines are the second loft profiles, the black in Fig 35 are polylines used as construction lines.
NOTE if one is only doing half of the object and mirror copying, then there is no need for the polylines, simply a 'best guess' will suffice,

Fig 33

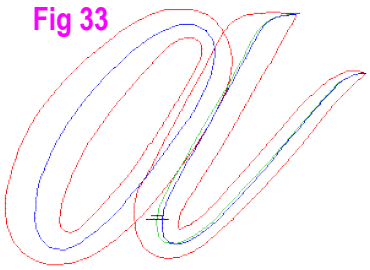


Fig 34

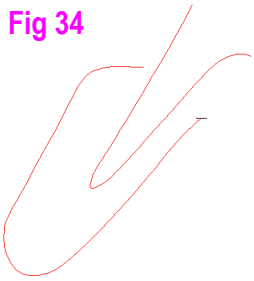


Fig 35

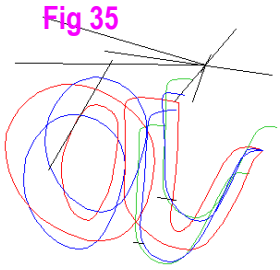
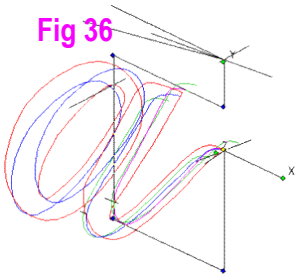


Fig 36



I used polylines to do both sides at the same time. I'll skip the setup for the polylines,as its standard construction line drawing. In Fig 36 each blue straight profile is selected and the ref point is set at the vertex, which is going to be a fixed point. Then using side / top view the profiles are rotated to a desired angle. Fig 37 shows the rotation from top view.

In Fig 38 the profiles are again rotated, but this time in side view, to angle the top back in a touch, so it wouldn't appear too flat. Once satisfied with the angles, everything is lofted. For the '0' loft both red's with each blue, *unless your only doing half,* Again both red's with each blue, then subtract the both side of the middle for the '0'. Note - this is easier done in draft render mode., all done, *unless you want to boolean add everything*

Fig 37

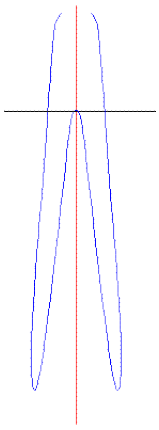


Fig 38

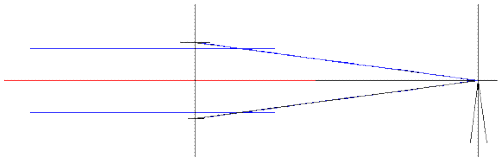


Fig 39

Working across the grain, - lofting with minimal profiles (2)

This has been completed this way, just to show another variation. It uses conventional loft for the 'o', and cookie cutter for the 'straight' part of the 'd'

Fig 40

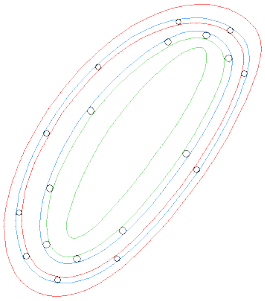


Fig 41

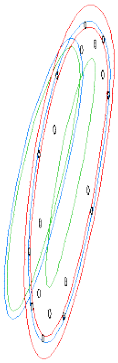
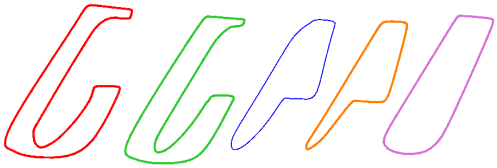


Fig 42

Starting with the '0' there are two red, two blue and two green, Fig 40. The small circles are just for reference, as I used eyeball to draw the profiles. The outer green and inner blue are grouped, moved forward about 1 ½ ", the ref point is relocated to bottom left and the group is angled using top and side view, as shown in Fig 41 un-group, *don't forget that bit, or it ain't gona loft,*

Loft the two blue, loft the two green, and extruding the two red, - ensure the inner red protrudes further than outer red, subtract inner red from the outer red object, select the object created from green, and increase its size by 1.001, (in X,Y and Z), this is to ensure it protrudes slightly, use it to subtract (cut a hole from from Blue, move red a touch back so it engulfs the 'o' and subtract, this is just to give a flat on the outer edge of the 'o' Fig 42

Fig 43



Now for the cutter, *and some fun.* There are 5 profiles needed Fig 43. Lofted red and green, create one side of the cutter. Lofted blue and orange, create the second side of the cutter. Purple profile is extruded for the base object, which will be cut by the cutter profiles.

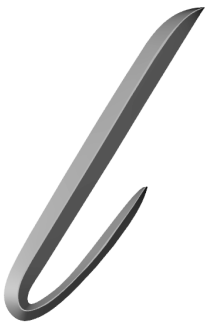
Fig 44

Fig 44. Shows the profiles as placed ready to be lofted, The Blue and green profiles are raised up and wil be to top face of the loft. Fig 45.

Fig 45

The last thing is to extrude the purple profile, so it is just short of the top (red and blue) profiles.

Fig 46



Loft the profiles Red / Green, Blue / orange.

Select 3D subtract tool, and subtract the two lofts from the extrusion Fig 46.

The 'O' can then be boolean added, or simple placed alongside, to complete the letter. Fig 47

Fig 47

3D spline

3d splines may sound complicated, but when it works right, it is a very versatile and powerful addition to the lofting toolbox,It is easily possible to create closed 3D spline. In this example we will use sheet objects, lofting to a 3D polyline. Simply to supply another alternative approach.

Fig 48

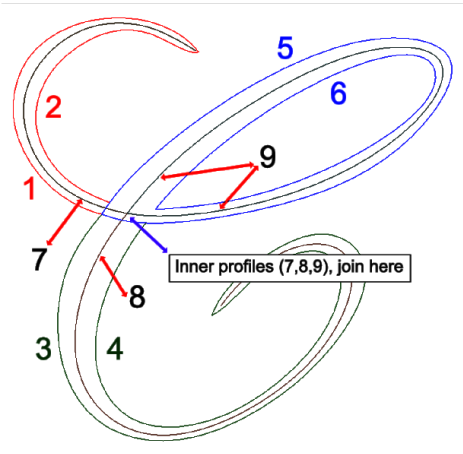
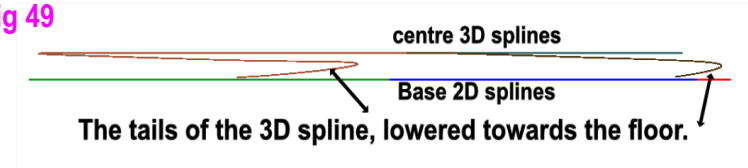


Fig 48. Shows the setup from plan view. There are six base 2D splines, two red, two blue, and two green. The centre lines, consist of three 3D splines. These 3D splines are raised above the base 2D splines and the tails are lowered in height. Creating a tapered object when lofted. Fig 49.

Fig 49



This type of lofting is mainly cosmetic (for rendering purposes only). This is because there will be minor inaccuracies where the two separate lofts of each leg, meet the 3D splines. This inaccuracy is shown in Fig 50.

Fig 50

To loft, we.
Loft from 1 to 7. Loft 2 to 7.
Loft 3 to 8. Loft 4 to 8.
Loft 5 to 9. Loft 6 to 9.

There is no need to do any boolean add the parts together.

To complete, we need to subtract the 'hole'.

This leaves the finished letter as in Fig 52.

Fig 51

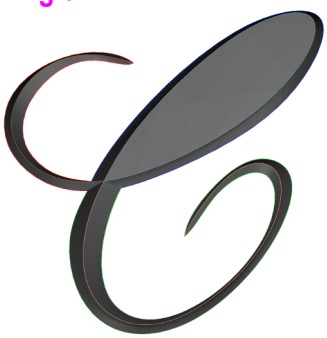


Fig 52

With some manipulation of the profiles, and re-positioning the start / end points. It is possible to loft without a centre seam. i.e. loft 1, 7 and 2 as a single loft. Then loft 3, 8, 4. And lastly 5, 9, 6.

This can produce a rounded section at the centre.

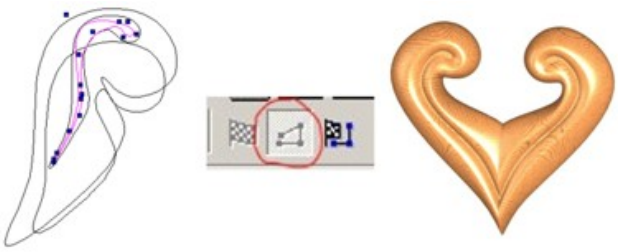
We may still need to clean out the middle of the 'o', as this may (or may not) be solid. Fig 53

Fig 53

Fig 54

Sometimes **things just won't work**.

Fig 54



In this example, I was trying to get one of the profiles 'tight in' so it would look like a sort of carving when lofted. But as soon as I try to move the nodes inwards, it won't loft in v10.2. Indeed no matter how it was altered, copied, redrawn, It wouldn't loft. I ended up using v10.5, where it will loft by using the ' use compound profile ' option, the result is a single loft mirror copied. **This just shows that some problems are version specific.**

Compound Profile. If you use the compound profile option, to loft 'open' profiles, you **must** select the 'finish selecting button ' after each profile is clicked. If you can't click on a profile, check the compound profile button on the inspection bar. For quick lofts where one can be reasonably sure the profiles are correct, I would try lofts with this button off.

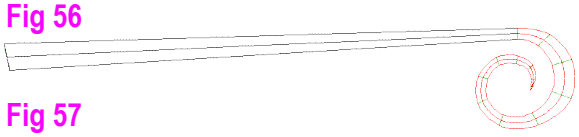
This item was new in v10.?, and can be another good addition to the lofter's toolbox. It allows for changing the shape of the loft after the initial loft has been created. This can be via node editing, changing position of a profile, or through rotation.

Fig 55

With this example, I made an error. When I moved something else out of the way I accidentally moved a profile. The left most profile in Fig 55.

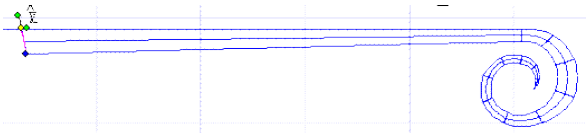
Fig 56. Shows the resultant loft, where if dips down on the left.

Fig 56



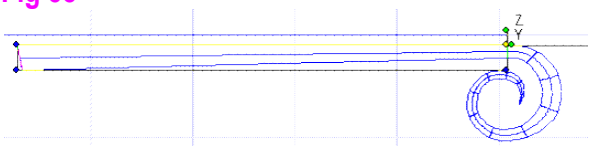
Because Compound profile was used, it was simply a matter of grabbing the left profile, and moving it upwards. Fig 57. The loft automatically updates to the new shape.

Fig 57



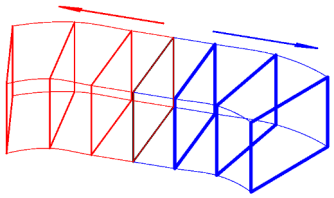
Compound profile is a powerful feature, but its not without needing a little care sometimes.

Fig 58



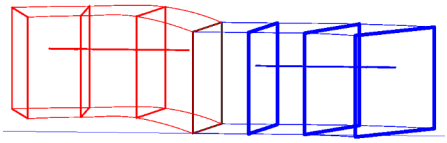
In Fig 56. We see there is a red and black section. The profile where the two join, was used twice, once for the red, and once for the black. If we adjust this single profile. It will change the shape of both lofts. Fig 58.

Fig 59



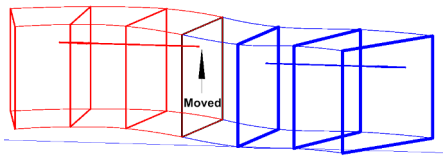
In some circumstances, using a single profile for multiple lofts, can cause problems. This simple example, we have a central profile, which was lofted along red and blue profiles.

Fig 60



If we needed to raise up the red profiles. If will result in a sharp edge when the blue meets red. Fig 60.

Fig 61



Therefore we need to check other profiles, and alter them accordingly,. In this case raising the central (connected) profile, half the distance, results in a smooth progression from blue to red. Fig 61

Fig 62

Lets look at a few problems one can encounter when lofting,

Problem - Twisting and tears in the rendering.

Cause - **A**) Incorrect profile direction. **B**) Incorrect node count. **C**) Sudden changes of direction. **D**) Sudden changes in profile shape. **E**) Changing from one type of profile to another, (example spline to an arc to a besier. **F**) Loft direction. **G**) Too many profiles.

Solutions - A) - **profile direction.** When going round a bend, think of the car scenario. You are looking forward towards the bonnet, your are sitting at '0' and the bonnet is at +Z. Now you do a 'U' turn, you still want to be looking at +Z i.e where you are going. If you turn round 180 degrees whilst driving forward - you will crash.

in Fig 63. two profile are facing the **wrong direction**, at position 'X'.

Fig 63

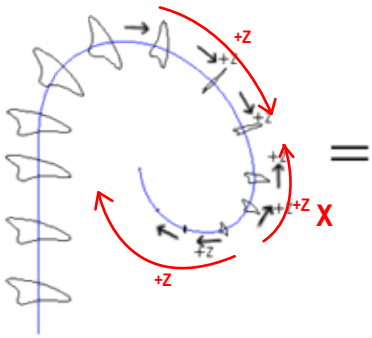


Fig 64

Whilst all the profiles look perfect, it results of a bad loft. This is not always the case. Genie will try her best to accommodate the profiles, but sometimes things get into a spin.

If your careful when aligning the profiles errors can be limited. keep in mind the +Z direction of the profiles. Having all profiles facing either all +Z, or all -Z, should eliminate this kind of problem. If the loft is to do a 'U' turn the profile also does a 'U' turn, not simply copied into position. It doesn't usually matter (see F). which direction you select the profiles when lofting.

B), - **Equal Node Count.** Genie finds it much easier if the node count is the same for all profiles, this can helps limit tears in the loft. I find the easiest way is to create the most complex profile first, thus the maximum node count needed. Then copy this profile to other positions, and simply edit (Move, do NOT delete), the nodes as necessary.

If more nodes are needed, add same to all profiles, at the same place. In Fig. 65, two extra nodes where added to the opposite sides of 2 profiles. None added to the rest of the profiles, with disastrous results *note - I did his deliberately - honest.*

Fig 65

Fig 66

C). - **Sudden changes in direction**, - Fig 67 / 68 Trying to take a bend too tight, without adequate profile setup can cause big problems, and may result in 'self intersecting error' or tears in the loft. If you have to take a bend tight, use plenty of profiles (but don't overdo it), and make sure they don't touch. *OK I know this could be extruded but its just an example*

Fig 67

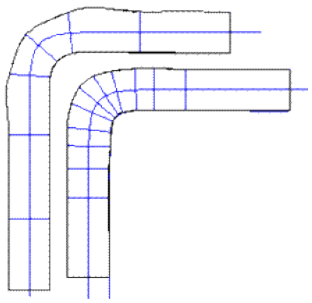
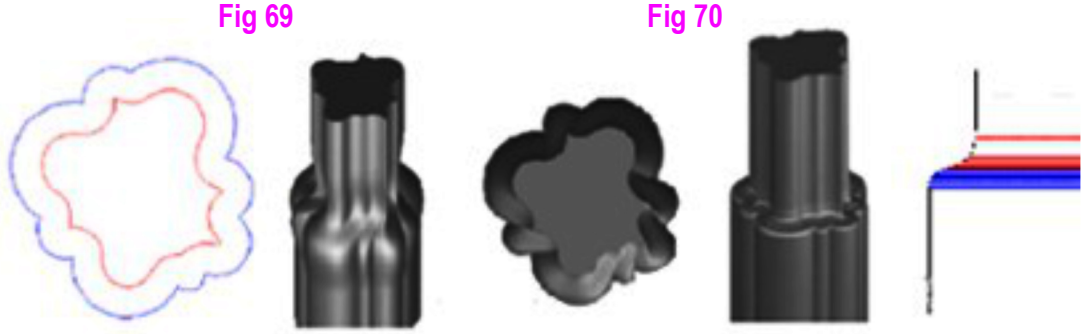


Fig 68

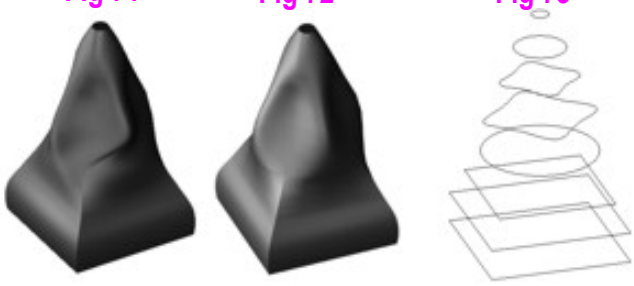
D). - **Change of profile shape**. - A sudden change in profile shape (I.e. Profiles close together), without adequate intermediate profiles, may distort the loft Fig 69 . Either - add and edit profiles to smooth out the change Fig 70, or loft as two separate pieces and boolean add. Occasionally if the change is too dramatic, lofting a separate objects and adding is the only way. *(got this one right in the end though :-)*

Fig 69 Fig 70



E). - **change in profile type**. - Changing profile type will disrupt the node count. Do a test loft on that section, and add profile to compensate. The biggest problem is changing from rectangle, to a spline / bezier. Unless you desperately have to do this - my suggestion is - don't. Fig 71 is lofted in one go, and clearly shows the twisting. If your lucky the nodes may actually line up, but unlikely. So best to do this as two separate lofts if possible. Try to go from a square to a circle first then circle to spline / bezier where the transition is much smoother.
Fig 72 is done as two lofts.(*Oh and the shape is actually suppose to look like that, I call it my contribution to modern rubbish art).*

Fig 71 Fig 72 Fig 73



F). - **Loft direction**. - Occasionally even when things have been set up perfectly, all profiles aligned correctly, etc. The loft will go bad. Its just one of those internal program things. Simply try to loft in the opposite direction, i.e. From finish to start, before moving or tweaking profiles.

Sometimes this simple remedy will work wonders. In this example it lofts OK, from the bottom profile to the end of the curve. Fig 75, But there Is a blemish on the curve, which is not present in the wireframe. Simply lofting the opposite direction (from curve to bottom profile), cured this and no blemish occurred Fig 77

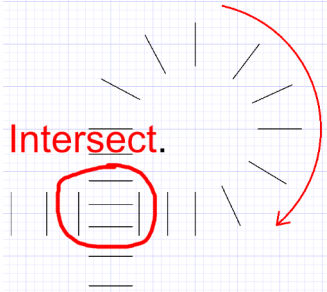
Fig 74 Fig 75 Fig 76 Fig 77

G). - **Too many profiles,** - yep, actually having a lot of profiles can be bad. This increase the chance of just one being misshapen, add profiles to what you perceive to be key points. This is where the spline guides (on page 1), can really help in determining what you can get away with. Obviously on a straight loft this is not a problem, as you only need 2 for the straight and another couple where it changes shape. When adding more profiles, select an existing one and copy it then tweak, rather than draw a new one from scratch. This helps keep all the nodes aligned properly.

Self Intersection -
This is a common one, to my way of thinking its when the profiles are positioned in such a way as to cause the loft to overlap or crash. But the reasons don't always appear obvious on screen. The best method to finding problems is to do test lofts at various stages, this should soon find any culprits. Some causes are

- Crashing. This is the simplest.

Fig 78



Looking at Fig 78. We can see the, as the loft is produced, it runs into itself, causing self intersection. Like the old snake video game, A loft cannot bash into itself or its game over.

- incorrect profile positioning on a curve. Looking at fig 79. It was lofted using only the black and blue profiles, the red was not selected. This lofts just fine. However, Selecting all the profiles including red, causes self intersection. When zoomed in, we can see in Fig 80. the red and blue profiles overlap, as the try to go round the bend. This is a classic self intersection.

Fig 79

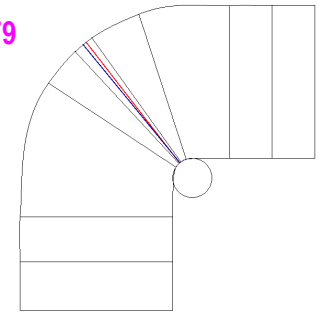
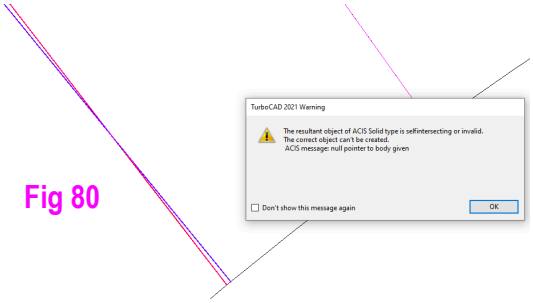


Fig 80

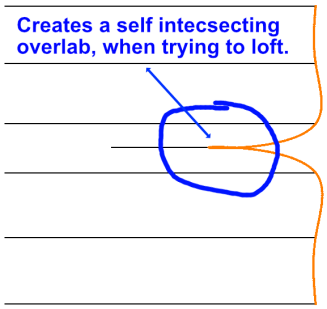


- accidentally selecting profiles in the wrong order. Easy to do if one has quite a few profiles. Example, one has 5 profiles, selecting 1,2,3,4,5 works. Selecting 1,2,4,3,5 Fails with self intersection.

- incorrect scaling causing the loft to go from big to little to big in too short a space.

Not the easiest to explain. Lofting is generally based on curvature, so for this example we can simulate the effect using spline by 'Fit point'.

Fig 81



Lofting doesn't naturally change direction sharply. Looking at Fig 81. We can see the, trying to get from a larger profile, to a smaller one, produces an 'over bend'. Then back out to a larger profile, produces another 'over bend'. These two curves overlap slightly. And it is this overlap that causes the self intersection error. Sometimes using spline fit point, is a good indication of where an error has occurred.

If one wishes to change direction this tightly, one needs intermediate profiles, to guide the loft into position.

- changing shape. I.e. loft leading into the shape 'bashes into' loft leading away. Very similar to the previous one. But it can also occur across the loft instead of along the loft if there are sudden changes in the shape of the profiles. Without allowing enough space for this to be accomodated.

- **and profiles out of alignment.** This is another simple one. Looking at profiles in just one view, doesn't guarantee accuracy. Looking at Fig 82.
It looks perfect, seven profiles in a row.
However switching to top view in Fig 83,
we can see one of the profiles accidentally
shifted backwards , and will cause
problems when trying to loft.

Fig 82

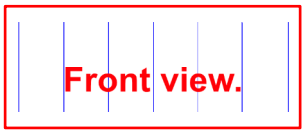
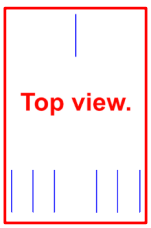


Fig 83



Mirror and Add,

Fig 84

PROBLEM - as can be seen in Fig 84. After mirror copy, there is red in the blue section and blue in the red section. + a cross pattern in the middle.

CAUSE - Incorrect profile. This can occurs then lofting half a profile, but the edges of the profile sticks out slightly beyond the mirror line. The cross pattern is often due to 2 faces occupying the same space, and is generally cosmetic.

SOLUTION - the simplest method to get rid of it is Slice the lofting along a mirror line, before mirror copy. But there are the odd time, when a slice down the centre line will, actually cause damage to the object, in these instances slice slightly over centre. Another way is to redo the profiles, which, as all the legwork has been done already with profile alignment, etc. It only take a few minutes to adjust and replace the profiles.

The **cross pattern** will also disappear with slicing, this 'patches' pattern can occurs on any object when lofted, where two faces coincide, If you find this pattern when you don't expect it, it is likely that there is a duplicate object with a different or no material. To check simply drag a selection window around the whole object (or part of it if open window mode is used), and check in selection properties how many objects there are.

Other lofting problems,

Occasionally a loft will take a very **long time**, and give the appearance that the program has 'hung' or crashed. Whilst I don't rule it out, it is often caused by a bad profile, and is simply taking genie a very long time to decide if the loft is possible.

On one such occasion, I was re-scaling, and hadn't realised I had typed in a big figure, fortunately it was late at night, so left TC working on the loft overnight. The result I found in the morning is shown in Fig 85. No wonder it took a while, *good job I wasn't designing a toilet seat*

Fig 85

All the previous lofting's DO NOT specify the correct way to do the lofts, but have been drawn in various guises to show different methods which can be adopted, or what can affect how a loft is produced. *Disclaimer, - if you try anything and it crashes it ain't my fault, everything is at your own risk, :-) Andy JH.....UK*

The End

Fig 86

Lofting with guidelines

Guidelines in this respect, are not simply for manual alignment, as previously discussed. But to aid TC, by telling it which way you want the lift to proceed. And can also reduce the amount of profiles needed.

In its simplest form, it can be a simple line arc or curve between two points. But there is little point in just drawing a straight line between two points, as the normal loft will suffice for that.

This first example Fig 87, would be difficult to draw with conventional loft, or any other conventional tool. It consists of two circles drawn at 90 degrees to each other. The first circle 50mm diam, the second 20mm diam.

To essentially 'force' the loft into the shape we require, we can use guidelines. These are drawn black in Fig 88. But, where to put them. With circles, I find it perfectly acceptable to use the quadrant points. However, **one must ensure that the loft is actually possible**. By that, I mean it is no good positioning the guidelines, which would make it impossible for the loft to be completed. The guideline must no overlap.

Fig 87

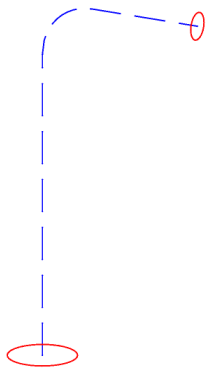


Fig 88

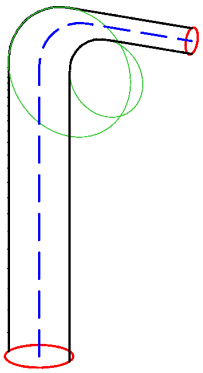
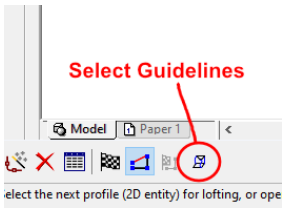


Fig 89



We select the loft tool. Compound profile is optional. Select the two circles (red), then select the guidelines icon on the inspection bar Fig 89. (or in the right click menu). Select the two black guidelines. Then click finish.

Fig 90

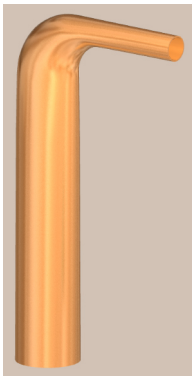


Fig 91

The resultant loft is shown in Fig 90.
Having been shelled by -1mm (inside shell), before rendering. Often the fact an object will shell OK. Means the loft is without flaws.

The guidelines should be the **full** distance from one profile to the next, To illustrate that point. The above setup was adjusted, so that that one of the guidelines missed snapping to the quadrant point of the smaller circle. Fig092. When lofted, it still works, but it is distorted.

Re-snapping to the quadrant point allows the loft to be successful.

Fig 92

Fig 93

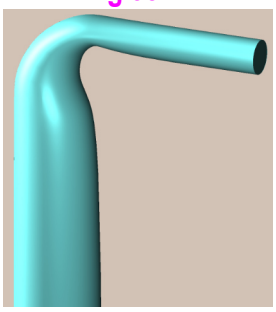
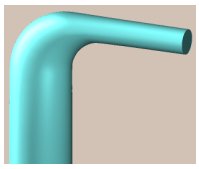


Fig 94



Whilst lines can be used for guidelines, the question is why would one wish to do so,. When normal loft without guidelines does exactly that. The next example shows using lines (a two point polyline).

The TC help files say Quote '' Guide lines can be arcs, 2D or 3D Splines or lines. Beziers, and polyline cannot be used as guide lines. ''. However this is not strictly true. One can use a 3D polyline providing it is only two points. This is helpful because setting up a workplane in 3d, so that one can use a 2d line, is difficult in some circumstances.

This example uses a two point 3d polyline to twist from an ellipse to rectangle, Fig 95.
Fig 96. Shows what happens if we just loft direct between the two profiles.

Fig 95

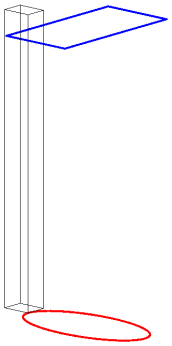
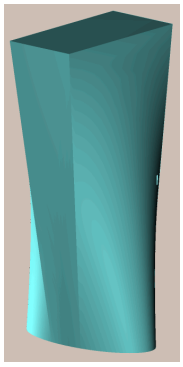


Fig 96



Four 3d lines were drawn from the quadrant points of the ellipse, to the mid points of the rectangles. Care must be taken to ensure the twist is correct, and does not try to self-intersect Fif 97.

Fig 97

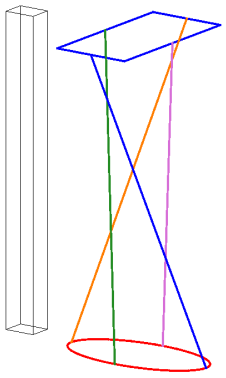
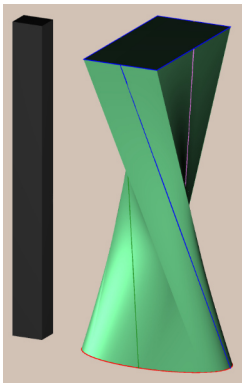
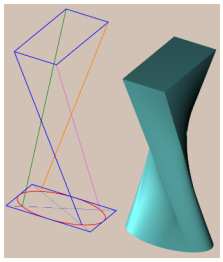


Fig 98



For the finished loft, we select the two main profiles. Then click the guidelines button. Click the guides in turn, going round the ellipse. Blue, green, orange then magenta. The finished loft is shown in Fig98.

Fig 99



In this particular instance, positioning of the guidelines, is not critical. The loft easily can be successful, with guides to the corners of the rectangle. Connecting to the ellipse, was done using intersection, with diagonal lines drawn from the corners of a box drawn surrounding the ellipse, Fig 99.

Whilst in the above scenario, actual placement of the guides does not matter too much. There are occasions where the placement is crucial. The following example is one such occasion.

Fig 100

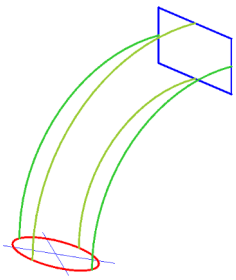
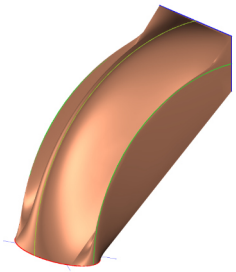


Fig 101

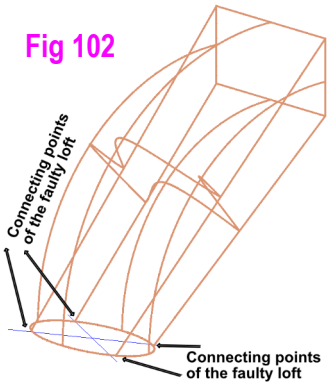


First, we try the same positions for the guidelines as previous. Going from quadrant points, to mid points. As shown in Fig 100.

Unfortunately, this proved a complete failure. As can be seen in Fig 101. Therefore we need a different approach.

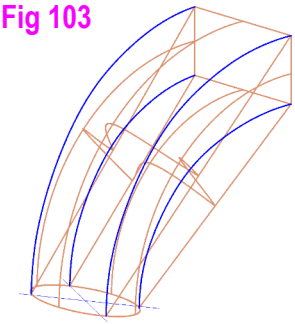
If we look at Fig 102. We can find the points at which the faulty loft connects to the ellipse. The ones we want, are the four points shown by the black arrows. And are actually very close the the Blue cross, which was drawn from corner points of a box, the same size as the ellipse.

Fig 102



The next step is to draw four 3d splines, these are drawn from the points found in Fig 103. On previous page, to the corners of the rectangle.

Fig 103



Unfortunately, because we are placing the guides on the ellipse edges, rather than the quadrant points. We are going to have to estimate the curvature.

Fig 104

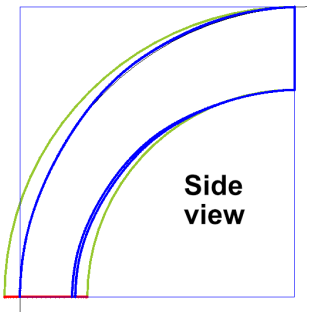


Fig 105

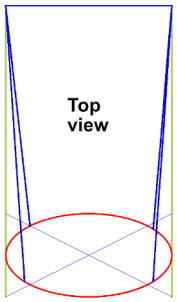


Fig 104. Show side view of our estimation, using 3D splines (shown blue). The green lines are true arcs. The side curves are simply estimated. For the top view, we can align the splines with the ones on the faulty loft (Fig 105.)

Fig 106. Shown the setup, and wireframe loft. Whereas Fig 107. Shows the completed loft. Which as we can see, is far better than the failed attempt on the previous page.

Fig 106

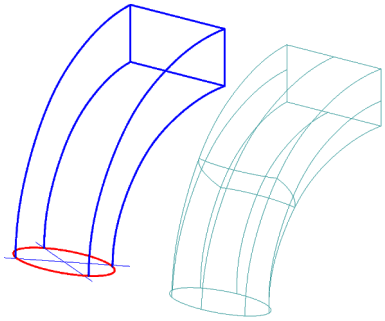
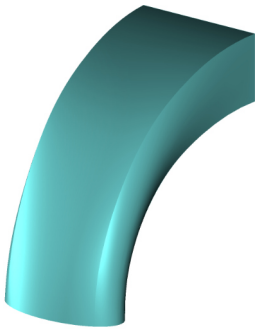


Fig 107



Note, because we had to estimate the curvature, rather that use true arcs. It is obviously personal preference as the the correct curvature one produces.

In Fig 108. We can see I didn't estimate it correctly. The inner curve is correct, but the outer curve is a little off. But as I used compound profile, it was simply a matter of using node edit mode, to adjust the spline nodes. This can get us much closer to an arc. Fig 109.

Fig 108

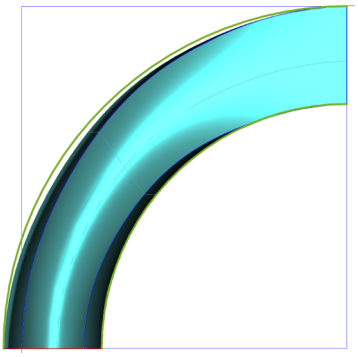
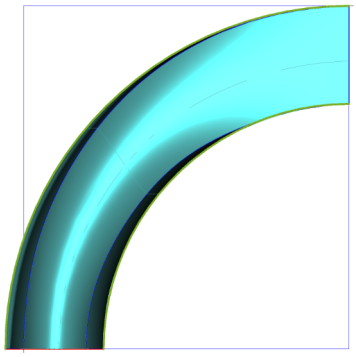


Fig 109



Up to now, we have just gone a simple path from two different profiles. This example adds another variation. It uses the path to alter the shape of the loft,0between two identical circles Fig110. Because we have only used two paths (2d splines), where the shape changes, becomes oval as in Fig 111. If four splines were being used, then using the revolve tool would be a better option. But revolve doesn't do ovals.

Fig 110

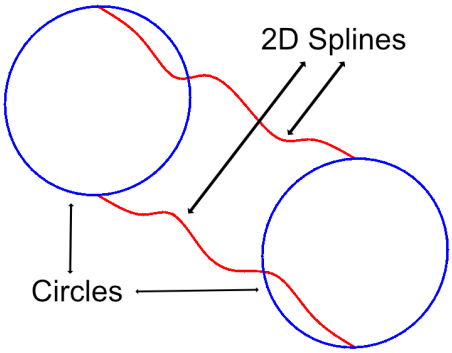
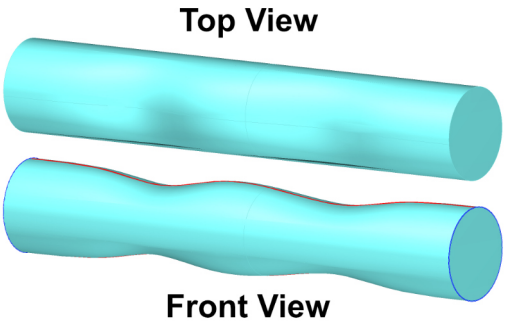


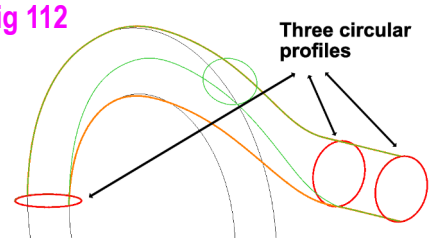
Fig 111



Although a useful tool, the guides are not without problems, that must be taken into account.

Ignoring the fact the shape is better done using the sweep tool. Fig 112, shape was drawn for illustration purposes only. And demonstrates a problem using more than two profiles (circles shown in Red).

Fig 112



As can be seen, Fig 113. Although the control point is touching the second circle, the guide is just below it, As anyone who uses splines will know, the control points are on the spline frame, not the spline itself.

When lofted, selecting all three circles, then the two guides. The resultant loft is flawed. Fig 114.

Fig 113

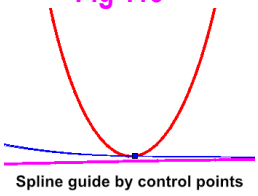
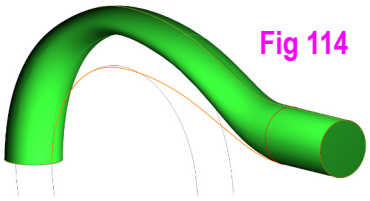


Fig 114



To resolve the problem, we need to get the spline touching the circle. For this, using edit mode, we need to switch to 'fit points' (icon on inspection bar). With that we can snap the actual spline to the circle. Fig 115.

As compound profile had been originally used for the loft. Once the spline was moved, the loft auto-updated. And as can be seen Fig 117, it repairs the flaw in the loft. To the correct shape.

Fig 115

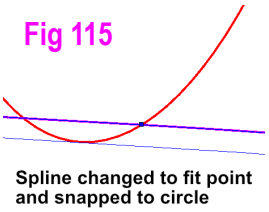


Fig 116

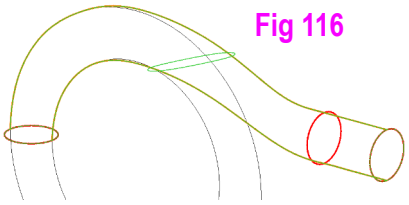
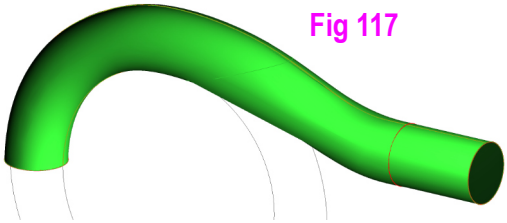


Fig 117



All the above is simply to emphasise the need for accurate positioning of the guidelines. Not just on the two outer profiles, but equally important if more than two profiles are used.

Practical example. Shaped handle.

Two profiles are used which are slightly different. The red is for the horizontal end, and the blue for the vertical end. Fig 118.

Fig 119. Shows the setup. The black loft is direct from the blue to red. This was done to get some snap points for the orange 3D spline guides.

Fig 118

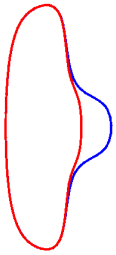
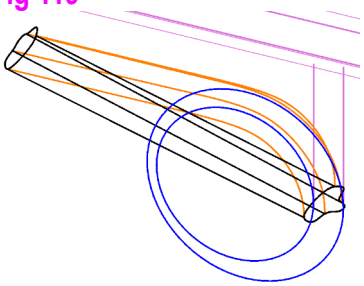


Fig 119



The first loft in Fig 120, shows that the guides are not totally correct, as can be seen with the two blue circles.

As compound profile was used, some minor tweaking of the spline nodes, brings the loft more in line with the desired curvature. Fig 121.

Fig 120

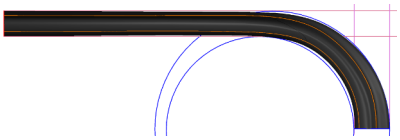


Fig 121

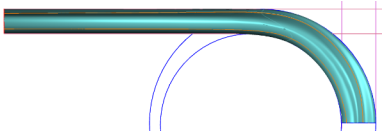


Fig 122

Face to face lofting

Face to face lofting is carried out on Acis objects but although it will work on Acis surface objects the results may not be what was expected (explained later), Acis starts to loft tangent through the edges of adjacent faces (Thanks to Murray Dickinson for that information) and produces a smooth transition, which means if you wish the loft to go directly at 45 degrees to the face you would need to use standard lofting techniques.

Fig 123

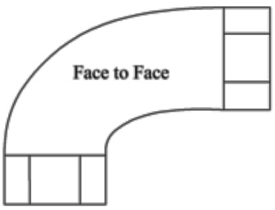
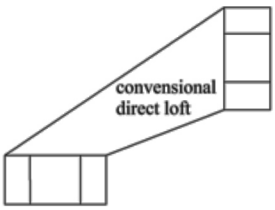
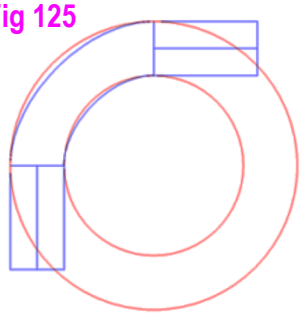


Fig 124



One thing to note when using face to face loft to create the bend for a pipe, is that it may not create the desired curvature on the bend, this is best explained in a picture. The two red circles in the image Fig 125, are what one could expect the curvature of the pipe to be at an elbow, however as can be seen Acis takes a slightly different path, whilst in most cases this is totally acceptable. However if one is producing accurate 2D drawings, or 3D printing. then other methods may be better. Example standard lofting, or sweeping.

Fig 125



Another example of how ACIS creates the loft can be seen in Fig 126 - 128. This shows one of the objects has been chamfered, this prevent ACIS from carrying out the loft. One cure is to 'pull' out the face slightly giving the desired edge for the loft to be completed.

Fig 126

Fig 127

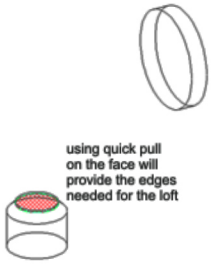
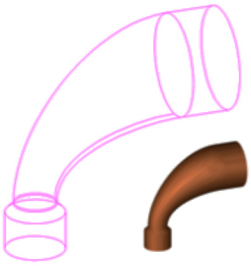


Fig 128



In this example we will draw a drawer handle, however there is one point that needs to be taken into account. Acis can't loft 'face to face' if the said faces are on the same plane, or opposed to each other. To get round this they are angled towards each other, however simply angling the top face can also produce an error,Fig 130. Angling one or both of the objects allows the loft to complete.

Fig 129

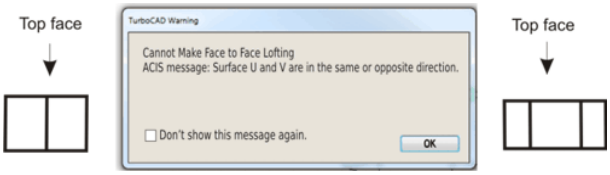
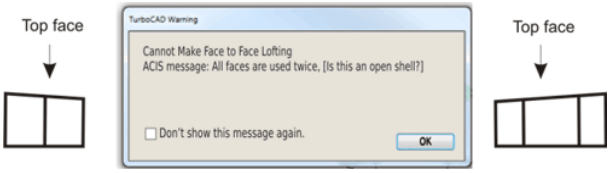
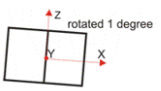


Fig 130



In this next example, Fig 131. A circle and polygon style object was extruded to the desired height. As the faces are in the same plane they need to be rotated slightly to prevent an error occurring, therefore rotate 'Y' axis in this case. For the circle 1 degree, and the hexagon -1 degree (or whatever figures you prefer). The corners are blended to produce a smooth appearance with the inside edge given a larger blend, Fig 132.

Fig 131



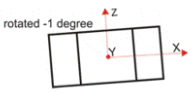
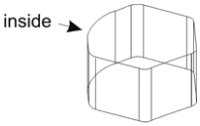
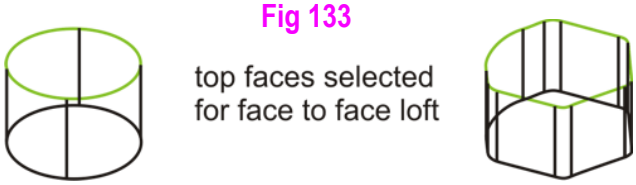


Fig 132



Activate ‘face to face’ loft tool and click the two top faces to create the loft Fig 133.

Fig 133



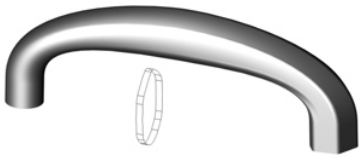
TC will automatically create the loft after the second face is clicked, and the result will be a a complete single ACIS object consisting of the two original objects and the loft. Fig 134.

Fig 134

Face to Face Loft Examples

Fig 135

Fig 136

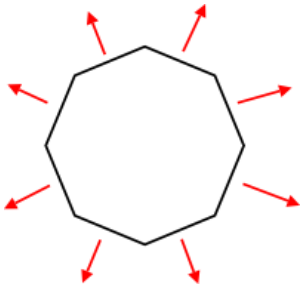


For variation, A copy of the profiles were lofted face to face, then a centre section was sliced out. This centre section was then enlarged and used to create an intermediate object, and two face to face lofts carried out. Fig 136.

Fig 137

To get a flat face to the bottom it can be simply sliced flat, an alternative would be to do multiple lofts with only the top two angled, and of course one isn’t restricted to the original shape for the intermittent piece, more on that later.

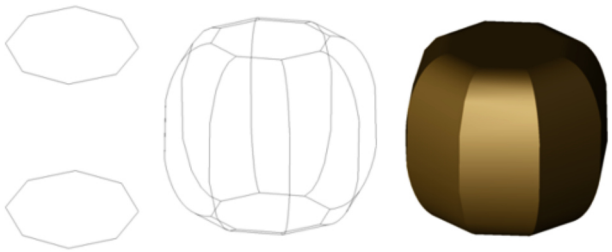
Fig 138



ACIS surface objects from profile

Lofting face to face on ACIS surface objects, which are a result of using the 2D profiles, and selecting the ‘surface from profile’ tool does actually work. But the results are probably not what is expected. This is because ACIS produces a loft from the edges. A surface object created from profile has no thickness and thus no edges. Fig 138. Shows the direction that the loft would be created from the object.

Fig 139



The resultant loft created when lofted face to face is shown fig 139. This shows the 2d profiles which are converted to ACIS surface objects.

The centre image shows the resultant loft, and rendered far right. As can be seen that because the loft lines radiate out from the sides of the surface object, the result is unusual.

If the surface objects are angled the loft takes on a more unusual shape (Fig 140). Note, lofting with the angles greater then +/- 45 degrees probably won't work and create an error.

Lofting can also be carried out between an ACIS solid and an ACIS surface created by 'surface from profile'. As can be seen in Fig 141. TC will loft from the solid object as expected and from the sides of the surface object.

Fig 140

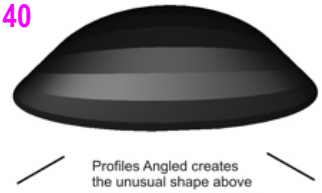


Fig 141

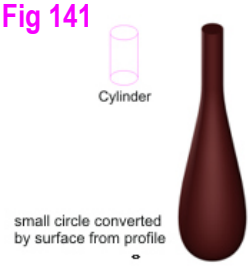
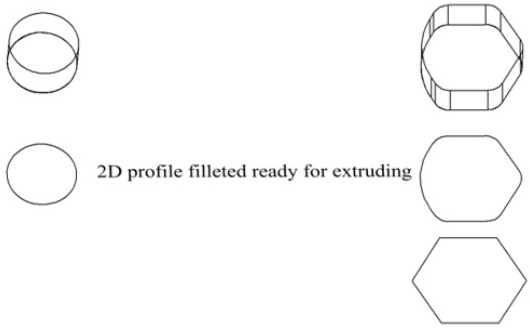


Fig 142



Face to Face Loft Examples

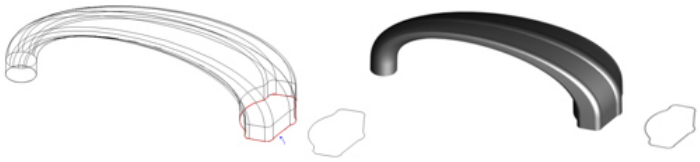
Post editing a face to face loft.

Face to face lofting does not have a compound profile option, and lofting face to face will normally break an extrusion link, when the extrusion is created using and compound profile.

EXCEPT. If Part tree - ACIS (allow editable history) are turned on. One can complete some post loft editing.

In the example Fig 143, a circle and filleted polygon are used for the profile. These are extruded with the compound profile option turned on, they are then angled using 1 degree and –1 degree 'Y' direction as previously, and face to face lofted.

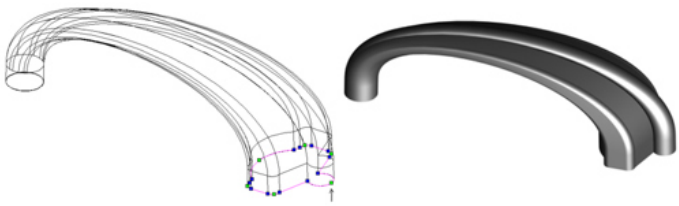
Fig 143



Once lofted, the polygon profile was selected and scaled times 2 in the Y direction, the loft will update to the new shape, the 2d profile is included to shown the resultant loft mimics the change in profile shape, the 'ribs' in the 2D profile are simply due to the way the profile was originally filleted.

One can also use node edit to change the profile shape, in the example Fig 144 the centre 'rib' is node edited to increase its size. As with any alteration one must exercise a little care when node editing.

Fig 144

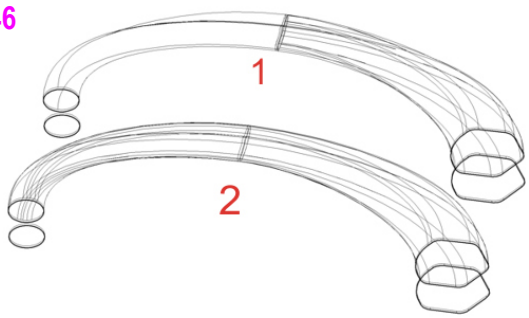


Post editing can also be carried out if an intermediate object is used. The best way in my opinion, is to slice out a central section, as discussed earlier, then Trace around the piece using a polyline incorporating lines and arc's to form a closed profile. Fig 145

Note - turning on degenerative faceting may be needed to snap the polyline in place, this profile is then extruded with compound profile to produce a thin section for the intermittent faces. The resultant loft can then be edited in node edit mode, be careful not to over-do the changes. (Part tree should be turned on).

Fig 145

Fig 146



The final pictures show why I would prefer to use a polyline to trace the centre section, No 1. is a spline traced and adjusted in height, No 2. is traced with arcs and lines and adjusted.

NOTE turning degenerative faceting may allow the difference to be seen more easily, as can seen in Fig 147. A polyline more accurately reproduces the lofting lines to give a loft less prone to errors or kinks.

Fig 147

Estimating a face to face curve

This page is regarding the estimation of the face to face loft curve. This page was written as an example, It is highly unlikely you would need to estimate the curve unless one was drawing 2D which will be turned into 3D at a later date.

Fig 148

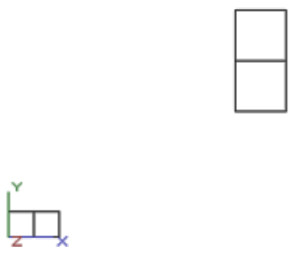
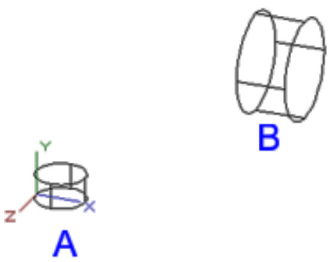
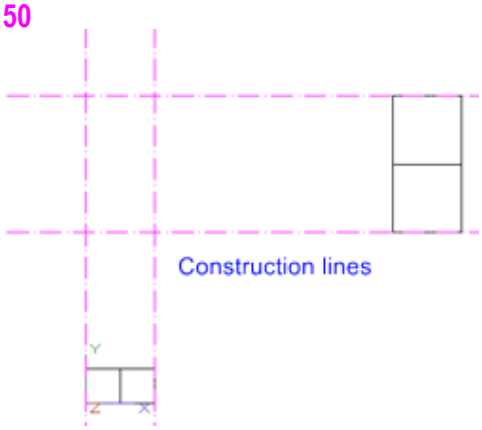


Fig 149



In this first example we will draw from profiles at right angles, figure 148 shows the profile and Fig 149 shows how cylinders were set up for the loft.

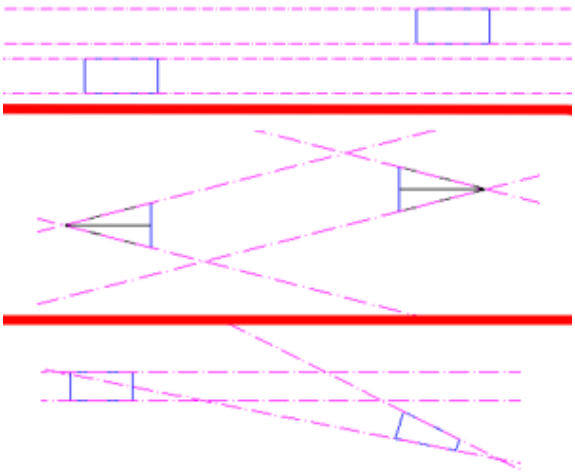
Fig 150



To start, we draw construction lines tangent to the profiles, and because this loft will have 2 curves (top and bottom) we need four construction lines as shown in Fig 150.

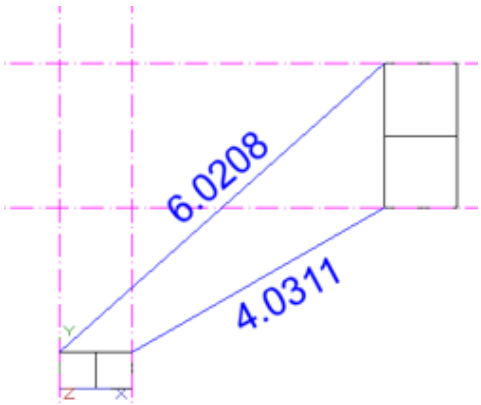
In this case they are orthogonal. But the could just as easily be diagonal as shown below. It depends on the objects being used.

Fig 151



Whilst talking of the construction lines, in straight objects this tangent is effectively perpendicular to the face. However going from a cone to a cone the construction lines would not be perpendicular to the face, which needs to be remembered for an accurate estimate of the loft (see Fig 151).

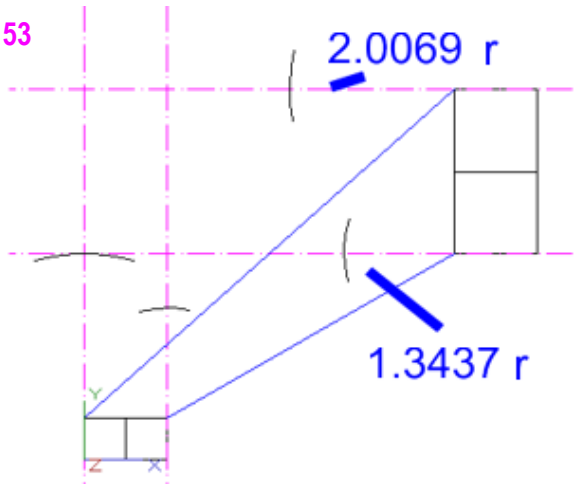
Fig 152



The next step in our example. Is to draw diagonal lines linking the profiles where the loft will start and finish as in Fig 152, we can read the length of the lines in the selection palette.

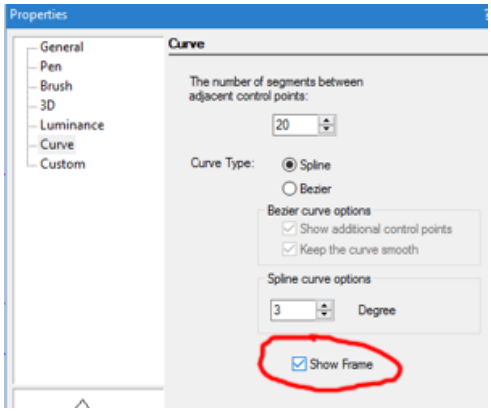
Then we need points which are one third of the line length, one could use the edit tool to divide the lines into three and use the vertices as snap points, in this example we will use arcs and the type the figures into the inspection bar fields. (there are many others ways to obtain the desired results)

Fig 153



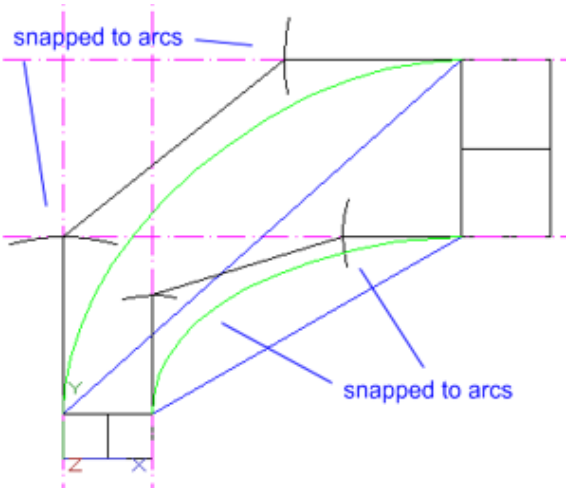
Using the arc tool snap the a line vertex. In the inspection bar, type in the radius and lock field to prevent accidental alteration, draw the are so that it intersects its relevant construction line, repeat at the opposite end of the line, and then repeat with the second line, the result is shown in Fig 153

Fig 154



Activate the spline by control points tool, right click and select properties, under the curve section tick 'show frame', this is simply so one can instantly see if the spline is snapped correctly.

Fig 155



Snap the spline into place, using vertex, first arc/construction intersection, second arc spline / construction intersection, end vertex, repeat with second line, DO NOT be tempted to add more nodes, the spline should end up with three frame segments only.

Fig 155 shows the finished drawing, the spline (shown green) is how a face to face loft will connect the two profiles.

And just to prove it Fig 156

Fig 156

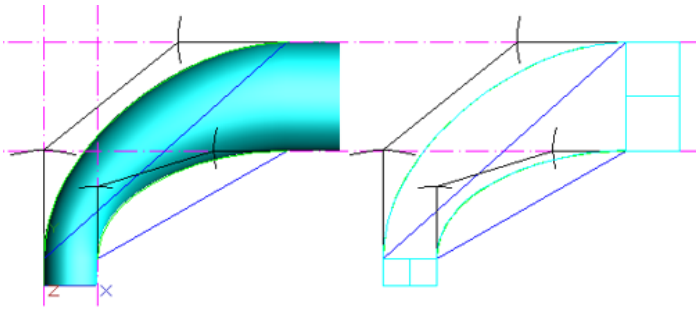
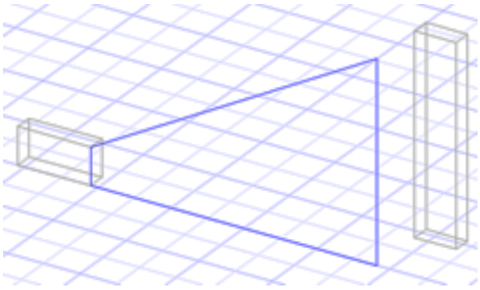
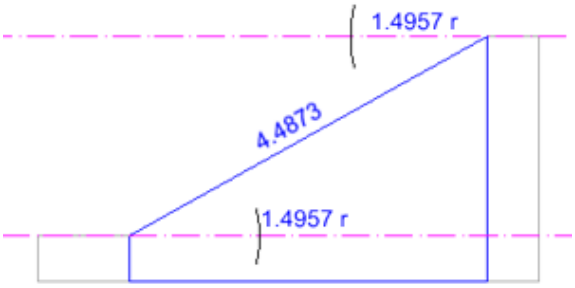


Fig 157



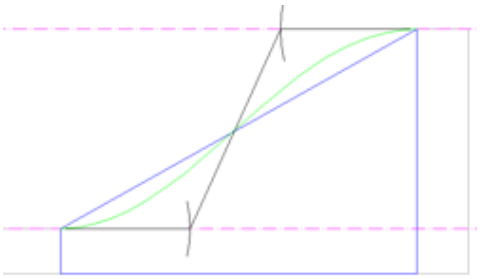
This second example uses two profiles which are on different workplanes, as can be seen in Fig 157. We will project the position onto a single workplane. This is less accurate, but generally pretty close.

Fig 158



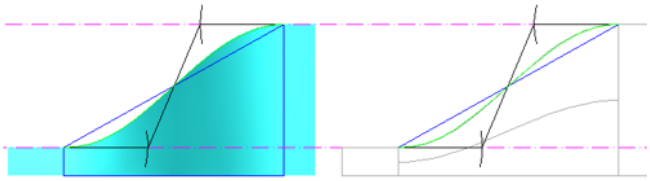
Because we are now on a single workplane the setup is the same as previously described, except in the case we only need one curve. Thus only two construction lines, again the line length is divided by three and two arcs drawn Fig 158

Fig 159



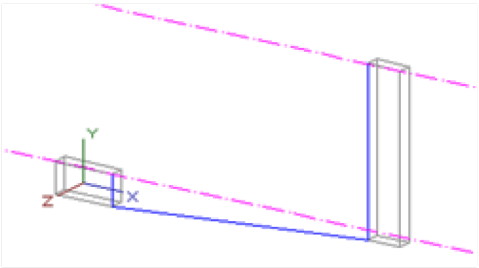
The spline by control points is again snapped to the vertices and arc/construction intersections as in Fig 159

Fig 160



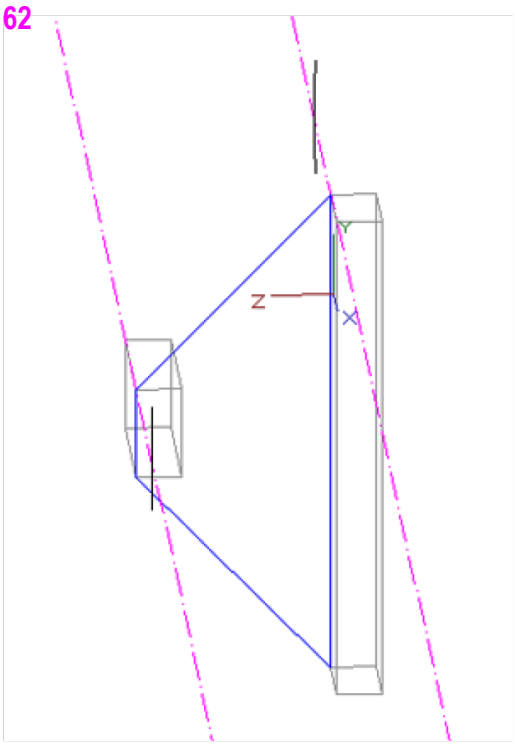
When checked against an actual face to face loft, Fig 160, it is very close. The discrepancy is due to our drawing being 2D whereas the loft is curved in 3D in multiple directions.

Fig 161



In this next example we will attempt to a more accurate curve by using a 3D spline. This involves setting up two different workplanes. One for each of the object faces, as shown in Fig 161, a construction line is drawn on each workplane

Fig 162



As can be seen in Fig 162. This shows a rotated view of the construction lines, which are tangent to each object, and thus on different workplanes.

For ease, a 3D polyline is drawn as the diagonal (this simply saves having to create a third workplane). Its length is read from the selection palette and divided by three. When drawing the arcs ensure they are on the correct workplane for their intersection with the respective construction line. Fig 163

Fig 163

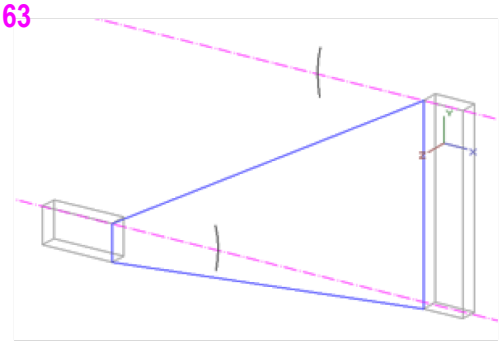
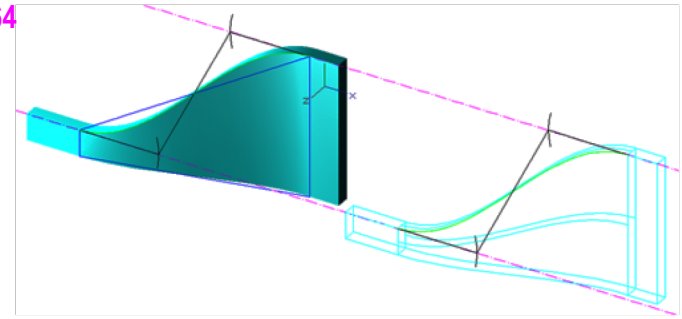
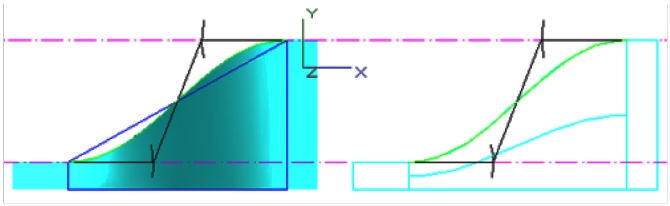


Fig 164



Using the 3D spline by control points snap (with show frame selected) to the vertices and arc / construction intersection, as previously. As can be seen from Fig 164 and 165 this gives a reasonably accurate representation of any resultant face to face loft.

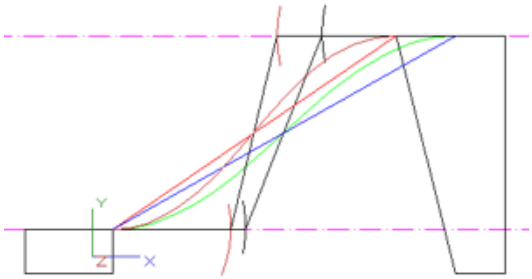
Fig 165



Being honest, normally there is no reason to carry out the drawings shown above. It is quicker to just loft and see what results. All the above was typed simply to give an understanding on how the loft shape can be simulated in 2D.

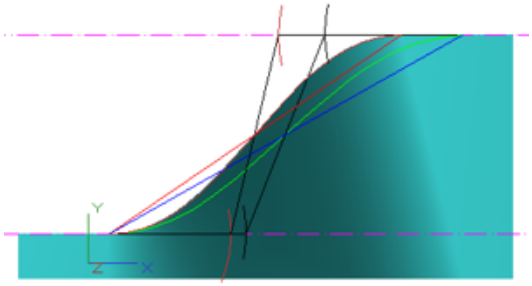
There is one last example. Generally one cannot influence the shape of the face to face loft. One cannot move 2D profiles or add guidelines. However, one way a drawing in 2D could be used, is the check a loft using different shaped profiles.

Fig 166



I'll not go through the procedure again. But using same example as previously, the right hand profile shape has been altered. Looking at Fig 166, this change in shape alters the line length (new line shown red). And thus when divided by three alters the arc / construction line intersection, (shown orange). The resultant spline (orange) takes on a different shape when snapped into position,

Fig 167



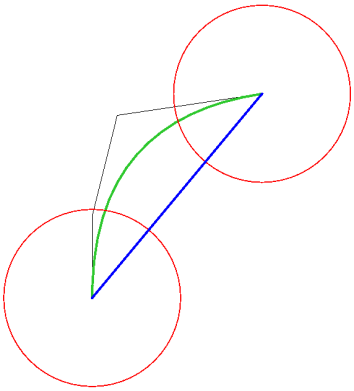
As can be seen from this last image Fig 167, the resultant loft takes this new shape. This is simply due to changing the shape of one profile.

There may be occasions when the above is not applicable and the loft is not as expected, but the above was written in the hope of providing a better understanding of how TC attempts to creates a face to face loft. This should be viewed with the other lofting tools. For example normal lofting, loft with guidelines etc in deciding the best method for any given situation.

Reverse engineering. Whilst it is theoretically possible, to start with two spline, and create the objects, in order to use face to face loft, to match the splines. It would be very time consuming, likely requiring much setup and testing. And even then, the face to face may not match the splines. Therefore, it is simply not worth the effort.

Looking at Fig 168. The red circles represents a third along the diagonal. As can be seen, there is no way to get the green spline frame points to touch both circles, while maintaining the curvature.

Fig 168



Branch lofting

Branch lofting, is very easy to use, But its actual usefulness is debatable.

OK. The main difference between, creating separate objects and boolean adding, and creating Branch lofting, is in the way the blending is done at the branch. The blending in Fig 169. Would be difficult the achieve using conventional methods.

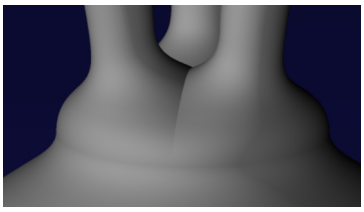
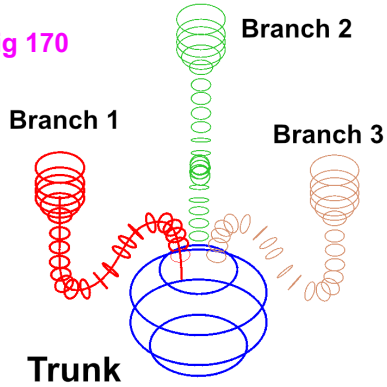


Fig 169

However it can be unrealistic in real life.

To use, first draw the profiles for the Trunk and Branch. Fig 170.

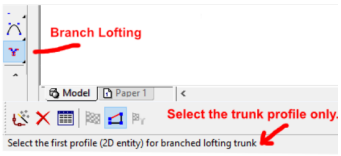
Fig 170



Select the branch lofting tool.

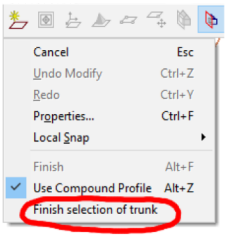
Select all the profiles relating to the trunk Fig 171. Shown blue in Fig 170.

Fig 171



When all the trunk profiles have been selected. Select 'Finish selection of trunk'. Either right click menu, or on inspection bar. Fig 172.

Fig 172



Select all the profiles in the first branch Fig 173.

Shown red in fig 170. The select 'Finish selection of branch. Fig 174.

Fig 173

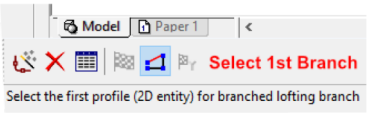
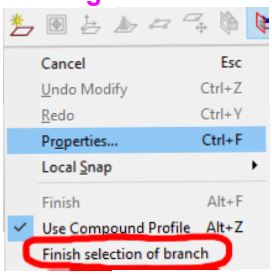


Fig 174



Select all the green profiles Fig 170, (then finish selection of branch).

Select all the tan profiles Fig 170, (then finish selection of branch).

Lastly click Finish Fig 175.

Fig 175

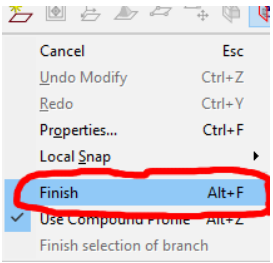


Fig 176

The finished loft, (+ some added bits). Is shown in Fig 176.

The end