Cadfil – Pipe Winder Data Entry Sheet

cadfil70

Main Options   Fibre Create Menu   Payout View Menu   RTM View Menu   QuickCAD   NC Post-Process   Utilities   Help

Quick-CAD

Multi-Layer Pipe Winding

Cylinder Radius	100.000
Clearance Radius	150.000
Fibre Band Width	25.000
Band Thickness	0.400
Start Position (from Chuck/Ref. Pt.)	300.000
Total Length Of Winding	3000.000
Friction Coefficient e.g. 0.2	0.150
Mandrel Rotation +1/-1	1

Open   Save   Exit   Help   Calculate (Update)

Add Layer   Delete Layer   Insert Layer

Band Pattern Mode Select
0: Automatic, Use Minimum Dwell

Feed Rate Mode Select
0: Constant F value

Generate NC Data

Layer Number	Hoop	Helical	Number of Repeats	Wind Angle	% Cover Factor	Machine Feed-Rate	Circuits per Layer	Band Pattern Number	Dwell Rotation at each End	Wind Time (Minutes)	Waste Length
1	●	○	3	82.721	100	22000	1	1	12.431	0.432	0.758
2	○	●	1	45	100	15000	18	7	2.79	8.98	289.25
	●	○									
	●	○									
	●	○									
	●	○									
	●	○									
	●	○									
	●	○									
	●	○									

Final Thickness   2.00

Total Wind Time   9.412

Running
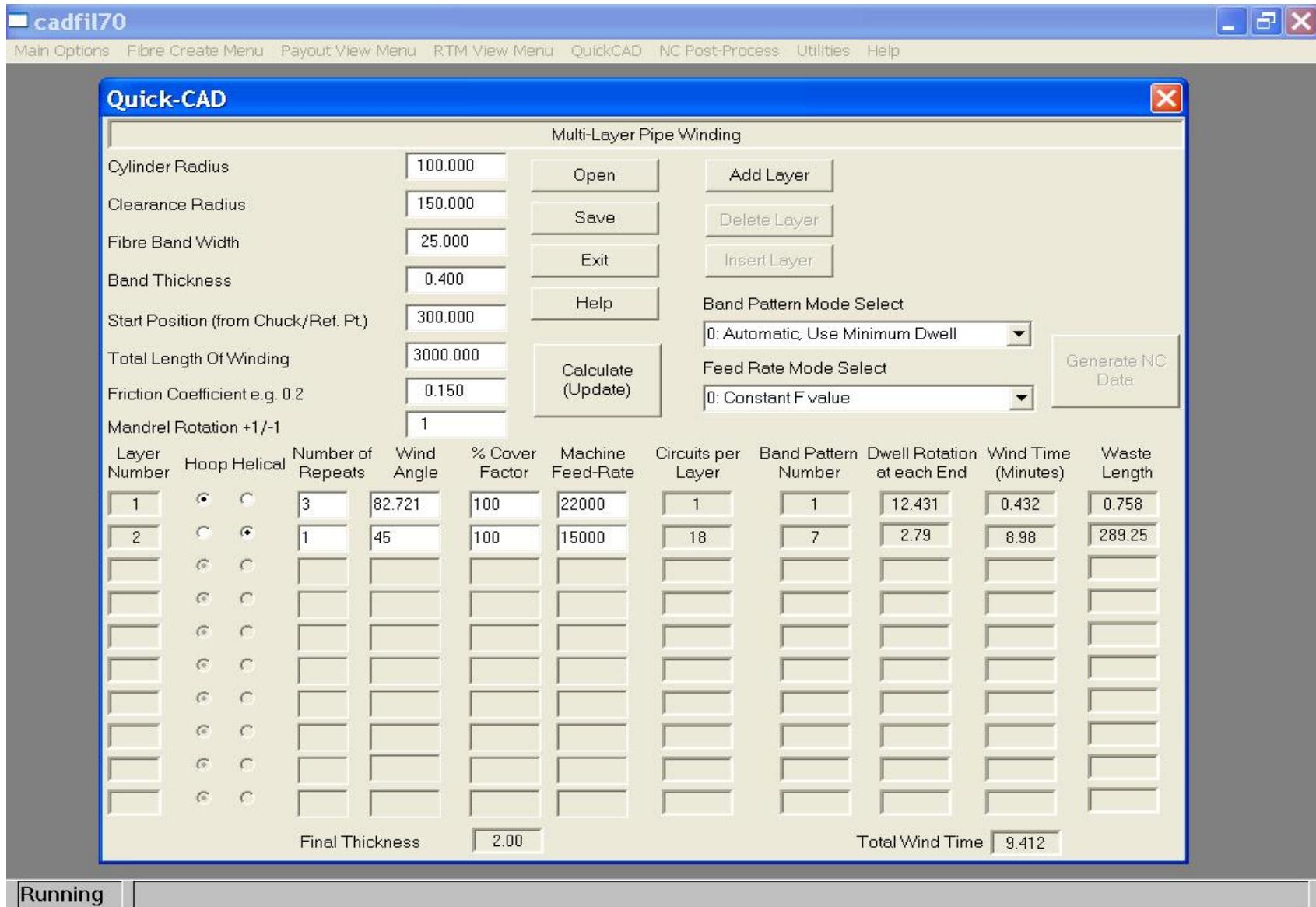
Pipe Winder Data Overview

The Cadfil Pipe winding software is designed for higher angle winding (40-90 degrees) on pipes and is ideal for use on 2 axis winders. When Pipe-Winder is included as part of a higher specification package (e.g. Cadfil-Lite) then more machine axes may be available.

Multi-layer and angle winding patterns can be quickly generated with both hoop (90 degree) and helical winding. Pipe winding is not suitable for low angles (less than 30 degrees) as this involves winding over an end-cap. For such applications Cadfil-Lite is more suitable.

The thickness of the winding and winding times are automatically calculated. Each layer is calculated making allowance for the thickness of the previous winding to ensure band pattern and fibre angles are always optimum. For each later the 'turning length' at the end where with winding angle is changing for the turning around is automatically calculated. For some applications this length is considered as waste as it is cut away after winding.

Creating a program with pipe-winder is simple. There is a single window dialog box (data entry screen) show on the first page of this document. The steps for program generation are:

1) Enter the '**Header**' Information – Basic information such as mandrel diameter and the fibre band width that is constant for each layer.

2) Click The '**Add layer**' button to activate a new layer. Enter the data specific to that layer such as winding angle etc.

3) Click 'Add layer' to add the next layer. Layers can be deleted using the '**Delete layer**' button or a new layer can in inserted part way though the sequence using the '**Insert Layer**' button. In both these cases the '**layer number**' in the left most column is used to select where to insert or delete a layer. The date entry form allows for 10 separate layers. If more are required a second pipe winding can me made using the initial 'mandrel radius' as the final mandrel radius after the first 10 layers.

4) Click the **'Calculate (update)'** button to fill out calculated values in the data table. You will be asked to save the data and must give a file name. Error messages will be given if data is incorrect or missing. You must correct the data.

5) After a successful '**Calculate (update)'** the '**Generate NC-Data'** button becomes active, click this to generate the complete winding program, after NC generate the wind times are added to the table. You get and option to view the program in the default text editor (normally notepad).

Cadfil – Pipe Winder Data Entry 'Header' Information

Mandrel and machine clearance data.

Get saved data from a file.

Cylinder Radius	100.000
Clearance Radius	150.000
Fibre Band Width	25.000
Band Thickness	0.400
Start Position (from Chuck/Ref. Pt.)	300.000
Total Length Of Winding	3000.000
Friction Coefficient e.g. 0.2	0.150
Mandrel Rotation +1/-1	1

Open
Save
Exit
Help
Calculate (Update)

Save new or modified data to a file.

Fibre band data. The thickness updates for each layer to keep the winding angle accurate.

Data that is constant for each layer.

'Header' Parameters explained

Cylinder radius. Is the radius of the mandrel at the start of winding. If the mandrel diameter is 200mm the radius is 100mm.

Clearance Radius is the distance of the payout head (fibre comb or similar) from the mandrel rotation centre, so if the mandrel radius was 100mm and the clearance radius was 150mm the machine payout head will be 50mm (150-100) from the surface of the mandrel. For machines with more than 2 axis this position can be set automatically in the NC code. For 2 axis machine this must be set manually or a value that is possible (or fixed) on the machine must be entered. If the machine is a large distance from the mandrel accuracy will reduce (variation in wind length and band structure). For large mandrels (more than 1m diameters) a surface clearance of 250mm (10 inches) is OK. For small mandrels (<300mm diameter) a surface clearance of 50-75 mm (2-3 inches) is OK.

Fibre band-width is the true width of the fibres band as it lays onto the mandrel, if you considered it as a tape.

The **Band thickness** is the thickness of the fibre band as it lays down on the mandrel if you consider it as a tape. One way to measure is make a single layer of hoop and the band thickness is half the increase in mandrel diameter.

Start position. This is the position along the machine carriage where the winding will start. It is measured from a fixed position often the machine chuck face or headstock. This reference is set up in the post-processor configuration file. Your machine supplier or software supplier should be able to advice/or set up this file.

The **total length of winding** is exactly what it says. This included any turning length so if you need a length of tube with an exact wind angle all the way along it you will need to use a longer wind length to allow for the turning length. The waste is automatically calculated. So if you want say 2000mm at 45 degrees enter this data and 'calculate'. If the waste length is given as 200mm then increase the total length of winding to 2200mm. If a negative length is used the winding will start in the negative direction of the carriage, so the start position must be specified to suit this, there is a diagram latter in this document.

The **friction coefficient** is used to calculate the turning area. Cadfil supplies a default value but this can be changed by the user. If friction is increased the tuning lengths get shorter but if too high a value is used the fibres will slip. Typically a value of 0.1-0.2 is used.

Mandrel rotation +1/-1 is the direction the mandrel rotates, a value of +1 (default) give positive(+) mandrel rotation, -1 gives negative (–) mandrel rotation.

Each layer can be repeated a number of times. For 'hoop' 1 layer is a single machine traverse, uses 2 for a double layer that comes back.

Wind angle calculated from band width automatically for hoop winding.

The machine speed can be changed for each layer. A default value is applied but can be over-ridden

Layer Number	Hoop	Helical	Number of Repeats	Wind Angle	% Cover Factor	Machine Feed-Rate	Circuits per Layer	Band Pattern Number	Dwell Rotation at each End	Wind Time (Minutes)	Waste Length
1	●	○	2	88.481	100.0	10000.0	1	0	0.0	14.4	2.1
2	○	●	1	55.000	100.0	10000.0	22	5	13.8	22.8	515.8
3	●	○	1	88.491	100.0	10000.0	1	0	0.0	7.2	2.1
	○	○									
	○	○									

Layer Sequence Numbers: Up to 10 layers per form can be entered.

Cover factor is 100% by default but the user can over-ride it here. This can be used to 'adjust' the band width. If a cover factor 200% is used the programmed bandwidth will halve so the bands will overlap. For a cover factor of 50% the winding will have gaps. During winding the bandwidth may be slightly different for different wind angles so the user can adjust here.

Automatically generated data when the 'Calculate' button is clicked.

'Layer' Parameters explained

The previous page shows the data layout for each layers. New layers can be made using the add or insert buttons or deleted with the delete layer button. The data items are described below.

Hoop/Helical Buttons. Each layer is either hoop or helical. If hoop is selected the wind angle will be calculated to give a helical lead of one band with. If you wish the Bands to overlap or gap for a hoop winding use the 'cover factor' parameter. Helical winding creates a +/- layer at the wind angle specified by the user.

Number of repeats allow the layer to be repeated a number of times. For example with a helical winding setting 3 gives 3 +/- layers. It is not good to set the number of repeats to high numbers as the mandrel radius increases with each layer and the wind angle will thus change slightly with each repeat layer. Eventually gaps will start to appear between the bands. This effect is more pronounced if the mandrel has a small diameter as the change in thickness with each layer will be proportionately more. For hoop winding each layer is a single traverse., if an odd number is specified i.e. 1,3,5 the next layer will start at the other end of the winding length.

Wind angle is the helical angle in degrees, 0 is axial 90 is circumferential (hoop). For simple pipe winding (no end caps) angles below 40 degrees are not advisable as the turning length (waste) increased dramatically.

Cover factor is 100% by default but the user can over-ride it. This can be used to 'adjust' the band width. If a cover factor of 200% is used the programmed bandwidth will halve so the bands will overlap. For a cover factor of 50% the winding will have gaps. During winding the bandwidth may be slightly different for different wind angles so the user can adjust for this here if required.
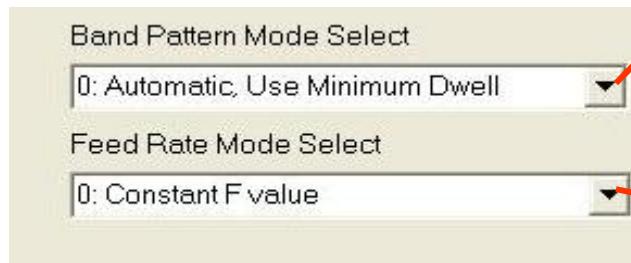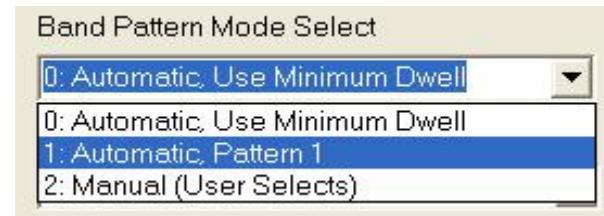
Machine feed rate is the winding speed for each layer. The default value is from the machine configuration file. The winding machine supplier should assist in the setup of this file.

Circuits per layer, is a calculated value of how many circuit the winding program makes to complete one full layer. For hoop winding this is always 1.

Band pattern Number is the number of 'starts' and is explained on following pages of this document. There is nio pattren as such for hoop winding.

Dwell rotation is additional mandrel rotation at the ends to make a particular band pattern work correctly. The amount of dwell can be minimised by keeping the default band pattern selection mode (mode 0). **Wind time** is the layer wind time, a total is shown at the bottom. Times are calculated at NC generate stage. **Waste length** is the length out of the total wind length used for turning, where the wind angle is not true. Half of this amount will be at each end.

Pull down menu for band pattern selection. There are three options. The user can choose that a pattern 1 of is automatically selected or the pattern with the smallest dwell is selected. In manual mode the user selects from a pattern table of all possible pattern options for each layer.

Band Pattern Mode Select

0: Automatic, Use Minimum Dwell

0: Automatic, Use Minimum Dwell
1: Automatic, Pattern 1
2: Manual (User Selects)

Band Pattern Mode Select

0: Automatic, Use Minimum Dwell

Feed Rate Mode Select

0: Constant F value

Feed Rate Mode Select

0: Constant F value

0: Constant F value
1: F value On Mandrel
2: F value On Mandrel+Carriage
3: F value On Mandrel+Carriage+Xfeed

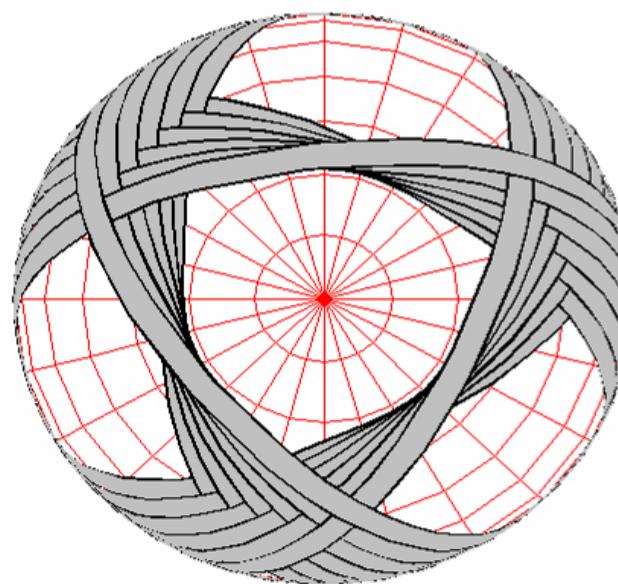**Pull down menu to select the machine speed options.**

Different Band Patterns shown part way through winding. Images generated using CADFIL – Pipe Winder Graphics Module (optional)
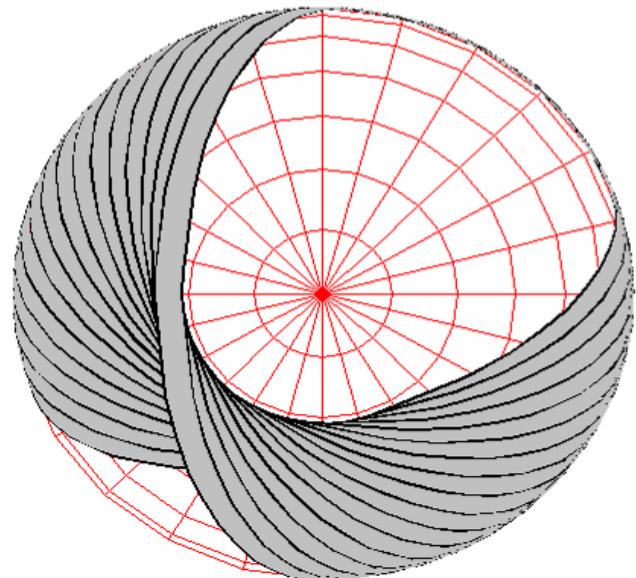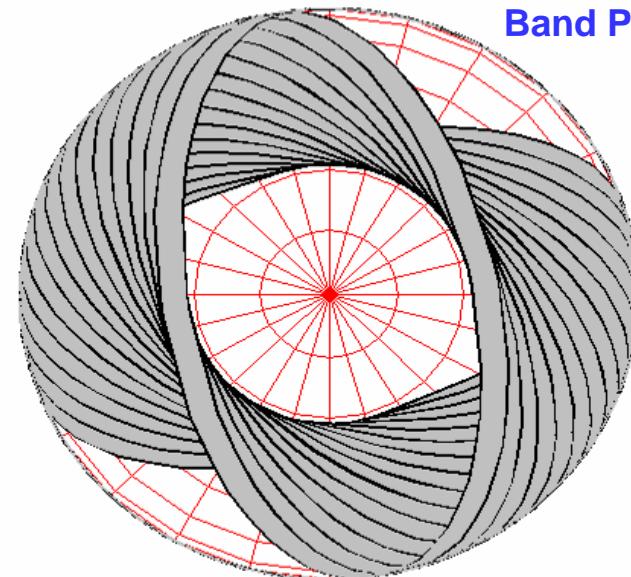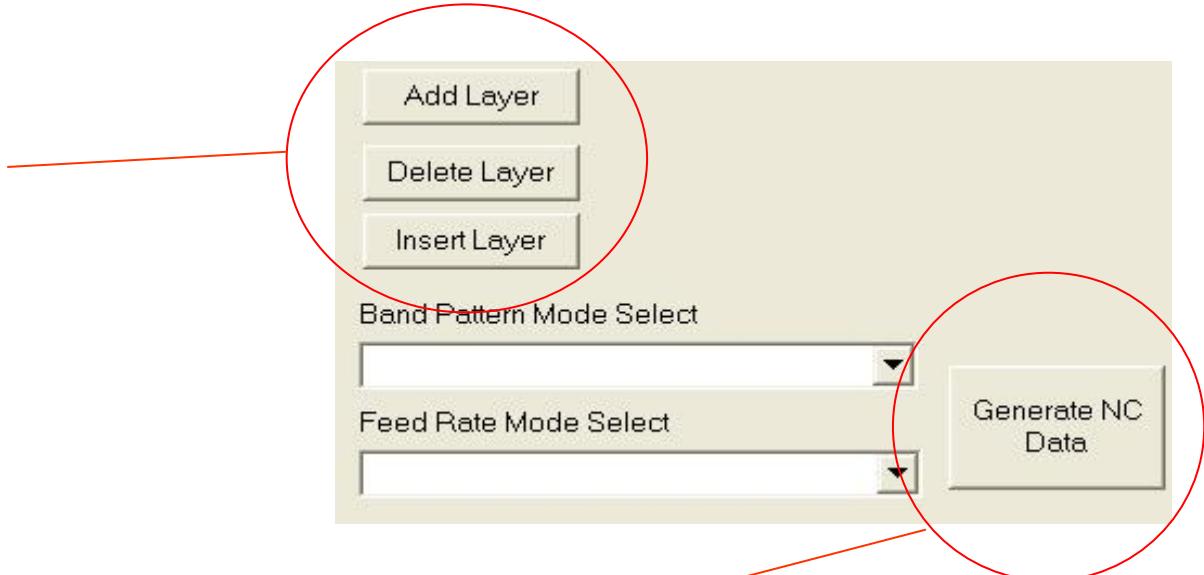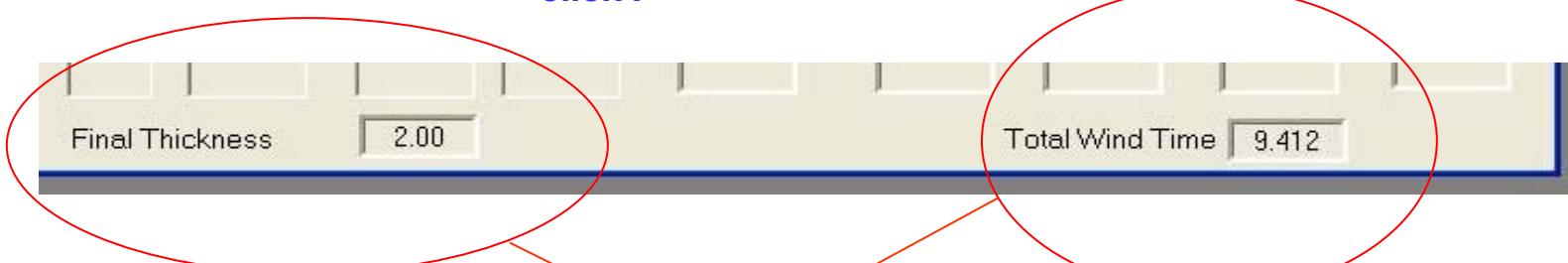
Band Pattern of 2
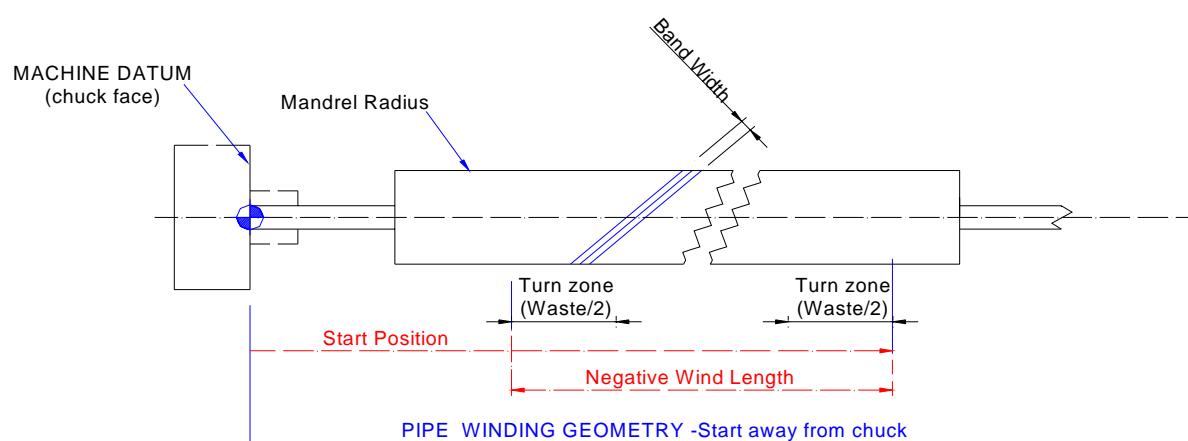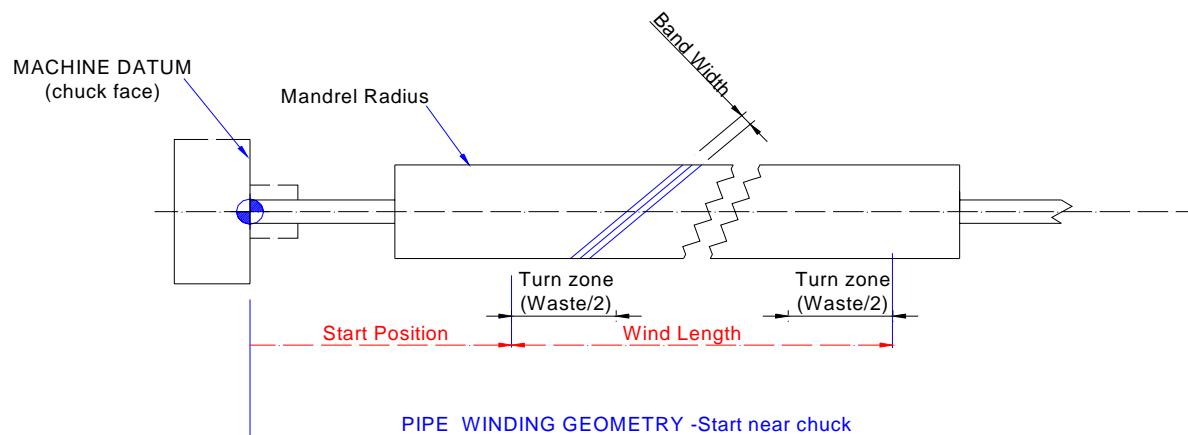
Band Pattern of 1

Band Pattern of 3

Control buttons to Add, Delete or Insert layer data into the table.

Add Layer

Delete Layer

Insert Layer

Band Pattern Mode Select

Feed Rate Mode Select

Generate NC Data

When the data has been entered the NC file can be generated by a single 'click'.

Final Thickness 2.00

Total Wind Time 9.412

Other Useful information

MACHINE DATUM
(chuck face)

Mandrel Radius

Band Width

Turn zone
(Waste/2)

Turn zone
(Waste/2)

Start Position

Wind Length

PIPE WINDING GEOMETRY -Start near chuck

MACHINE DATUM
(chuck face)

Mandrel Radius

Band Width

Turn zone
(Waste/2)

Turn zone
(Waste/2)

Start Position

Negative Wind Length

PIPE WINDING GEOMETRY -Start away from chuck

The Start position can be at either end of the mandrel.

To start away from the chuck and then initially wind towards it use a negative Total Length of Winding (wind length in the lower diagram)

For Hoop winding each repeat (layer) is one traverse of the carriage. If the repeats are an odd number then the next helical layer will automatically swap ends of the mandrel to start. This ensures that the winding is always continuous.