



WINFOIL 2.0.5

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AUTHOR MEMBER

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TRADEMARKS

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OVERVIEW

USER INTERFACE

TECHNICAL SUPPORT

MENU COMMANDS

FILE MENU

EDIT MENU

AIRFOIL LIST COMMAND
WING LIST COMMAND
IMPORT
EXPORT
PRINT COMMAND
PRINTER SETUP COMMAND
EXIT COMMAND

UNDO COMMAND
CUT COMMAND
COPY COMMAND
PASTE COMMAND

HELP MENU
INDEX COMMAND
REGISTRATION COMMAND
ABOUT COMMAND



OVERVIEW

Winfoil was originally released in September 1993 as version 1.0. A new version 1.5 was released in December 1993. This version replaces all other versions. Winfoil has been totally rewritten using Microsofts' Visual Basic.

Listed below are the features provided by the previous versions which are also included in version 2.0.5;

Print airfoils sections in metric or imperial dimensions.

Print one per page or automatically adjust to print more than one per page.

Print airfoils for a range of chord lengths.

Print airfoil name, grid, chord length and coordinates.

Print to the windows clipboard.

Store airfoil lift, drag and pitching moment coefficients for airfoil comparison and selection.

Export airfoil data for input into other programs.

Online help.

Context sensitive Help. Press the Function Key **F1** to select help on the currently selected feature within WINFOIL or press the **HELP** button.

Fast screen redraws

Improved user interface - toolbars

Print Airfoils larger than page size.

CAD like user interface screens to design wings and airfoils

Design wings or tails of any shape. Winfoil will automatically determine rib lengths.

Airfoil thickness shown

Airfoil thickness variation allowed for printing.

Different airfoil sections can be selected for a wing design. Winfoil will automatically print the airfoil sections along the span.

Automatic calculation of area, aspect ratio and mean aerodynamic chord.

Comments can now be entered for each airfoil.

Airfoil data import capability.

Horizontal and vertical tail sizing calculations for conventional aircraft configurations.

Reynolds number calculation in air and water.
Print wing planform . Left , right or both panels.
Print wing specifications and rib lengths.
Use windows calculator from within Winfoil to perform scaling calculations
Enter wing coordinates from the keyboard
DXF file export capability.

The following new features are provided with version 2.0.4;

Enhanced airfoil editing. Can now select and manipulate coordinates with a mouse.
Soartech airfoil import capability.



USER INTERFACE

The Winfoil user interface has been enhanced to include a Tool Bar which provides quick access to some of the menu commands.



This button selects the Airfoil List screen.



This button selects the Airfoil Coordinate screen.



This button selects the Wing List screen.



This button selects;

1. Print Airfoil screen if the currently selected screen is the Airfoil List screen
2. Print Wing screen if the currently selected screen is the Wing List screen.
3. Print airfoil coordinates if the currently selected screen is the Airfoil Coordinates

screen.



This button selects Winfoil Help.



Selecting this button will cause Winfoil to terminate.

At the bottom of the screen is a region called the Status Bar.

The left indented panel of the Status Bar indicates the function of a button on the Tool Bar when the mouse pointer passes over a button. The right indented panels indicate the current date and time.

Winfoil is an **MDI** application . You may view the Airfoil List , Airfoil Coordinates and Wing List screens all at once or you may view one screen with all other screens minimised. You may also **tile** the screens by selecting the **Tile** menu option from the **Windows menu**. By selecting the **Cascade** menu option from the **Windows menu** you can view the three screens as overlapping screens.

MDI stands for **Multiple Document Interface**. An **MDI** application contains multiple screens within one container screen. This allows the user to display multiple screens at the same time with each screen displayed in its own window.



PRINT AIRFOIL SCREEN

This screen controls the printing of the airfoil(s).

Airfoil Name

Airfoil name of currently selected airfoil.

Measurement Units

select millimetres or inches by clicking on the appropriate radio button.

Airfoil Chords to Print

Enter different airfoil chord lengths to print .These chord lengths are stored in a database table within WINFOIL.

T/C% Airfoil Thickness as a percentage

Enter a different thickness percentage to vary the thickness of the printed airfoil.

To reset the thickness to the original value, click on the **RESET** button.

Print Resolution

Varying this will alter the degree of accuracy of the airfoil plot.10 - rough plot , 100 - fine plot. Increasing this number will also increase the time required to plot the airfoil.

Skin Thickness

Depending on the value given an outline will be plotted on the airfoil indicating a wing skin.

Print Options

Print Airfoil Name

Select this option to print the Airfoil Name.

Print Grid

Select this option to print a grid on the airfoil indicating the chordwise stations in 10 percent intervals.

Print X Station

Select this option to label the chord wise station intervals.

Print Chord Length

Select this option to print the chord length in the selected unit of measurement.

New Page after each

Select this option to print a new page after each airfoil is plotted. If this option is not checked then Winfoil will automatically print each airfoil one after the other and start printing on a new page when necessary.

Print to Clipboard Button

This feature enables airfoils to be sent to the clipboard. Airfoil size is limited to screen size so if multiple airfoils are printed only those which fit on one screen size will be captured.

Print to DXF File Button

This feature added for V 2.0.4

DXF FILE

Cancelling the Print Job

A dialogue box will appear after the **PRINT BUTTON** is clicked on indicating the progress of printing.

You may cancel the print job at any time by clicking on the **CANCEL** button or if this dialogue box has disappeared by deleting the print job in **PRINT MANAGER**.

Winfoil can now cater for airfoils longer than the paper size. It will automatically 'tile' the printed airfoil over multiple pages.

Use the PRINT SETUP COMMAND in the File menu to change the print orientation to Landscape or Portrait .



PRINT WING SCREEN

This screen controls the printing of ;

1. Wing Ribs

2. Wing Specifications

3. Wing Planform

You may select to print all or any combination of the above.

Name

This is the name of the currently selected wing.

Type

This is the type of wing. Eg; Vertical Tail, Horizontal Tail or Wing.

Units

Measurement units. Eg; Inches or Millimetres.

Root Airfoil

The airfoil section selected for the wing root.

Tip Airfoil

The airfoil selected for the wing tip.

T/C%

This is the airfoil maximum thickness. You may vary this by entering a new value for the thickness. Winfoil will automatically calculate the new coordinates for the airfoil based on the ratio of the new thickness and the original thickness. To reset the thickness to its original value , click on the **Reset** button.

A list of the Ribs for the wing is listed on the screen. If there are more ribs than will fit in the grid then you can scroll the grid by moving the vertical scroll bar on the right of the grid.

The **Print** column of the grid indicates if the rib is to be printed. This is toggled on and off by clicking in the appropriate cell. A **tick** means print, a **cross** means do not print.

There are two buttons immediately below the grid. One sets all ribs to be printed, the other sets all ribs not to be printed.

There are a number of print options available. These are as follows;

Rib Number

Print the number of the Rib. Ribs are numbered sequentially starting from the root of the wing and ending at the tip of the wing.

Rib Length

The length of the Rib is printed with the selected units of measurement.

Wing Specifications

The wing specifications are printed. These include;

1. Wing area
2. Wing aspect ratio.
3. Mean aerodynamic chord length and position.
4. Measurement units.
5. Type.
6. Wing root airfoil section.
7. Wing tip airfoil section.
8. Number of ribs per wing half.
9. Rib spacing.
10. Each rib number, length and distance from the leading edge reference line

X Station

This is the distance horizontal distance spanwise from the wing root.

Grid

Selecting this option prints a grid over each rib with stations marked at ten percent intervals.

New Page after Each

Selecting this option will result in each rib being printed on separate pages.

Start Distance

Select this option to print the distance from the leading edge reference line

Wing Planform

Select this option to print the wing planform with the mean aerodynamic chord position and the rib positions. Selecting this option will cause the WING PANEL PRINT SELECTION SCREEN to appear.

Print Resolution

Varying this will alter the degree of accuracy of the airfoil plot. 10 - rough plot , 100 - fine plot. Increasing this number will also increase the time required to plot the airfoil.

Skin Thickness

Depending on the value given an outline will be plotted on the airfoil indicating a wing skin.

Print to DXF File Button

This feature added for V 2.0.4

DXF FILE

Cancelling the Print Job

A dialogue box will appear after the **PRINT BUTTON** is clicked on indicating the progress of printing.

You may cancel the print job at any time by clicking on the **CANCEL** button or if this dialog box has disappeared by deleting the print job in **PRINT MANAGER**.

Use the PRINT SETUP COMMAND in the File menu to change the print orientation to Landscape or Portrait .



ADD AIRFOIL COORDINATES

This screen is used to add new airfoil coordinates. You must enter data in pairs ie; upper and lower coordinate pair. The x coordinate pairs do not have to match. All coordinates are expressed as a percentage of the chord.

The X axis is the axis running lengthways along the chord of the airfoil. The Y axis is the axis running perpendicular to the X axis.

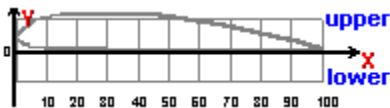
Xupper : Upper surface x coordinate (distance from the leading edge)

Yupper : Upper surface y coordinate (height above datum line)

Xlower : Lower surface x coordinate (distance from the leading edge)

Ylower : Lower surface y coordinate (height above the datum line)

Note : negative values lie below the datum line.



To exit this screen click on the **CLOSE** button.

Update Options

These options are used to speed up data entry.

Auto Update

This option when checked will automatically update the database when you tab off the last field in this screen (YLOWER). If this option is not checked then you must click on the **ADD** button to add the coordinates.

Normal

This option when set will require data to be entered in each field.

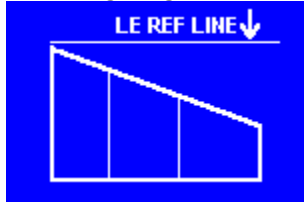
Xupper=XLower

When this option is set the Xlower field will be set to the value in the Xupper field.

Symmetrical Section

When this option is set the Ylower field will be set to the negative value of the Yupper field.

The **Leading Edge Reference Line** is the line running spanwise from the wing root leading edge.





PRINT COMMAND

This command prints;

1. Airfoil if the currently selected screen is the Airfoil List screen.

The **PRINT AIRFOIL SCREEN** will be shown if this menu item is selected.

2. Airfoil coordinates if the currently selected screen is the Airfoil Coordinates screen.

3. Wing or Tail if the currently selected screen is the Wing List screen.

The **PRINT WING SCREEN** will be shown if this menu item is selected.

AIRFOIL LIST COMMAND

This command displays the Airfoil List Screen. This screen lists all available Airfoils stored in the Winfoil Database. Selection of an airfoil from the list will make Winfoil Plot the airfoil section in the box provided. Any comments about the airfoil will be listed in the box directly under the airfoil plot.

T/C % is the thickness to chord ratio of the airfoil. ie; a T/C % = 10.00 means that the airfoil is ten percent thick.

CL MAX is the maximum lift coefficient of the airfoil. The higher this value the greater the amount of lift that the airfoil generates. A short take off and landing aircraft requires a high lift airfoil therefore one would select an airfoil with a very high CL (Coefficient of lift).

CD MIN is the minimum drag coefficient. An airfoil with a low drag coefficient and good lift coefficient will provide excellent gliding performance. A high drag airfoil will provide poor glide performance ,acceleration and climb performance.

CM MAX is the maximum pitching moment coefficient. A positive value means that the airfoil will pitch up , a negative value means that the airfoil will pitch down. Tailless aircraft require a positive pitching moment for pitch stability. Therefore one would choose an airfoil with a positive pitching moment . This can also be achieved with an airfoil with zero pitching moment (eg; symmetrical) and a control deflection upwards eg; up elevator. The larger the pitching coefficient the greater the force required to balance the aircraft. To minimise tail areas for minimal drag on conventional wing and tail designs one would select an airfoil with a low pitching moment.

Currently the above data is only available for a small range of airfoils. Winfoil version 2.1 will include wind tunnel test data (lift and drag curves for a range of Reynolds numbers) from Princeton University. This data has been obtained with permission from [SoarTech](#) .Data in the airfoil list screen is for the lowest Reynolds number. Typically airfoil performance improves with higher Reynolds numbers therefore it is more important to have details on performance at low Reynolds numbers.

This screen can also be accessed quickly from the toolbar by clicking on the  button.

To add a new airfoil;


Click on the **ADD** button this action will display the **ADD AIRFOIL SCREEN** .

To edit an airfoil;

Select the airfoil as above and click on the **CHANGE** button this action will display the [AIRFOIL COORDINATES SCREEN](#) .

Double clicking on a row within the list of airfoils will perform the same action as clicking on the **CHANGE** button.

To print an airfoil;

Select an airfoil by clicking on a row in the table or by tabbing to a row then select [PRINT](#) from the **FILE MENU** .or click on the **PRINT**  button in the toolbar.

To search for a particular airfoil;

Click on the **SEARCH** button. This action will display the **AIRFOIL SEARCH SCREEN**. Enter the name of the airfoil to search for and click on the **SEARCH** button to perform the search. WINFOIL will search for the airfoil with a name which nearest matches the search name. Click on the **CLOSE** button to close this screen.

To delete an airfoil;

Click on the **DELETE** button.

To delete all airfoils stored in Winfoil;

Click on the **DELETE ALL** button.

To select another screen;

Select from the **FILE** menu or click on a button in the toolbar. The function of the button will be shown on the status bar at the left side of the bottom of the screen.



IMPORT DATA

This feature allows Winfoil to load airfoil data in the form of ascii text files into the Winfoil airfoil database. Currently two import formats are supported;

1. Winfoil Airfoil Coordinates.
2. Soartech airfoil Coordinates.

The format of the Winfoil data must be as follows;

Two data files are required :

1. Airfoil Data File

This file contains the airfoil name, c_{lmax}, c_{dmin} and c_{dmax}. Example shown below. Note the comma after each value and as the last character on each line.

```
CLARK Y,0.00,0.0000,0.0000,  
CLARK YH,0.00,0.0000,0.0000,
```

Winfoil will automatically verify the formatting of the file before attempting to load the data. An error message will be displayed if the formatting is invalid. This data format is identical to the export format of the earlier versions of Winfoil so that you can export the data you have entered in previous versions and import it into the new version.

2. Airfoil Coordinate Data File

This file contains the airfoil name, upper x coordinate, upper y coordinate, lower x coordinate and lower y coordinate. All coordinates are expressed as percentages and all values are separated by commas with a comma signifying the end of each line.

Example shown below.

```
CLARK Y,000.0000,003.5000,000.0000,003.5000,  
CLARK Y,000.5000,004.5500,000.5000,002.8000,  
CLARK Y,001.0000,005.2000,001.0000,002.3000,
```

Winfoil will check if the airfoil that is imported already exists. If the airfoil already exists then

you will be prompted to whether you want the data in Winfoil overwritten by the imported data. You can select to overwrite , skip or cancel the import operation.



EXPORT DATA

This feature allows Winfoil to export airfoil data in the form of ascii text files. This data can then be used in spreadsheets or other applications. The format of the data is as follows;

Two data files are produced:

1. Airfoil Data File

This file contains the airfoil name, maximum lift coefficient, minimum drag coefficient and maximum pitching moment coefficient. An example of the file layout is shown below. Please note the comma after each value and the comma at the end of each line.

```
CLARK Y,0.00,0.0000,0.0000,  
CLARK YH,0.00,0.0000,0.0000,
```

This data format is identical to the export format of the earlier versions of Winfoil.

2. Airfoil Coordinate Data File

This file contains the airfoil name, upper x coordinate, upper y coordinate, lower x coordinate and lower y coordinate. All coordinates are expressed as percentages and all values are separated by commas with a comma signifying the end of each line.

Example shown below.

```
CLARK Y,000.0000,003.5000,000.0000,003.5000,  
CLARK Y,000.5000,004.5500,000.5000,002.8000,  
CLARK Y,001.0000,005.2000,001.0000,002.3000,
```

Data can be saved as a back-up for future use. This data can be used to recover in the case of hard disk failure or other hardware problems which cause data loss.



PRINTER SETUP COMMAND

Selecting this command will display a setup Dialog box containing currently installed printers. To change printers, select a printer and click on the OK button. To change printing options click on the SETUP button. You can then change any options as required. To obtain help on the available options click on the HELP button.



EXIT COMMAND

This command ends WINFOIL and returns to Program Manager.



UNDO COMMAND

This command undoes any edit CUT,PASTE or Copy previously performed.



CUT COMMAND

This command allows data to be cut from a selected data field on a screen to the Windows Clipboard for pasting into another field within WINFOIL or to any other windows application.



COPY COMMAND

This command allows selected data fields to be copied to the Windows clipboard. This data can then be pasted back into a field within WINFOIL or to another Windows Application.



WINFOIL Version 2.1

This version of WINFOIL is currently under development and will be completed around December 1995. This version of WINFOIL will be sent to all registered users of version 2.02, 2.0.4, 2.0.5 and will be available to all registered users of previous versions of WINFOIL for a reduced price.

The following additional features are planned for this release;

1. Ability to design and print spars and control surfaces.
2. Airfoil editing tools will be enhanced.
3. Airfoil camber line will be plotted.
4. Enhancements will be made to wing and tail printing.
5. More airfoils
6. Airfoil lift and drag curves for a range on Reynolds numbers and airfoils.



PASTE COMMAND

This command allows text that has been placed in the Windows Clipboard to be pasted in any selected data field within WINFOIL. Text may be placed into the clipboard from WINFOIL or from any other Windows application. Only text may be pasted into WINFOIL.



HELP INDEX

This command selects invokes WINFOIL Help.



REGISTRATION COMMAND

This command displays the **WINFOIL REGISTRATION SCREEN (Mail Orders Only)**. To register WINFOIL please complete the screen, obtain a print out and send to the address on the screen.

Click on the **PRINT** button to print the screen.

Click on the **CLOSE** button to exit this screen.

PRICING

This program is shareware. You are permitted to use this program for a period of 30 days after which continued use will require payment of the registration fee.

Pricing is as follows;

1. Registration through Compuserve (GO SWREG) Registration ID : 6441

Fee \$18 US (Australia / New Zealand)

Fee \$28 US (All other countries)

2. Mail order Australia only

Fee \$25 Australian Cheque or Money Order only.

3. Mail order elsewhere

Fee \$18 US (New Zealand) International Money Order only

Fee \$28 US (All other countries) International Money Order only

Registered users will receive a registered version of Winfoil with 120 airfoils and a free upgrade when available. The registration fee will license one copy for use on any one computer at any one time. You must treat this software just like a book. An example is that this software may be used by any number of people and may be freely moved from one computer location to another, so long as there is no possibility of it being used at one location while it's being used at another. Just as a book cannot be read by two different persons at the same time.

Anyone distributing WINFOIL for any kind of remuneration must first contact MALCOLM HARDY at the address below for authorization. This authorization will be automatically granted to distributors recognized by the (ASP) as adhering to its guidelines for shareware distributors, and such distributors may begin offering WINFOIL immediately (However MALCOLM HARDY must still be advised so that the distributor can be kept up-to-date with the latest version of WINFOIL.).

You are encouraged to pass an unregistered copy of WINFOIL along to your friends for evaluation. Please encourage them to register their copy if they find that they can use it.

Please see Registration details and order form in the HELP menu in Winfoil or write to

MALCOLM HARDY
6 TIBOOBURRA ST
ENGADINE NSW 2233
AUSTRALIA

Phone (AH) (02) 548 2982

or;

Compuserve 100244,2132
Internet malhardy@ozemail.com.
 au

DEFINITION OF SHAREWARE

Shareware distribution gives users a chance to try software before buying it. If you try a Shareware program and continue using it, you are expected to register. Individual programs differ on details - some request registration while others require it, some specify a maximum trial period. With registration, you get anything from the simple right to continue using the software to an updated program with printed manual.

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Shareware is a distribution method, not a type of software. You should find software that suits your needs and pocketbook, whether it's commercial or Shareware. The Shareware system makes fitting your needs easier, because you can try before you buy. And because the overhead is low, prices are low also. Shareware has the ultimate money-back guarantee -- if you don't use the product, you don't pay for it.



ABOUT COMMAND

This command displays Copyright information and details on the Software products used to create this program. This screen has been enhanced to also show the mode of operation, memory available and free system resources.



AIRFOIL COORDINATES SCREEN

This screen is used to add, change or delete Airfoil Coordinates , comments and edit airfoils with a mouse. The Lift, Drag and Pitching moment coefficients for the Airfoils in the WINFOIL database are for the lowest Reynolds number and standard roughness conditions. They are to be used only as a guide to selection of a suitable airfoil. Performance in regard to model aircraft will of course vary due to the low Reynolds number at which model aircraft fly.

This screen can also be accessed quickly from the toolbar by clicking on the  button.

To add a new airfoil;

1. Enter **CL MAX, CD MIN, CM MAX** if known.

To add new coordinates click on the **ADD** button. This action will cause the ADD COORDINATES screen to appear.

To change a coordinate ;

1. Select the coordinate.
2. Click on the **CHANGE** button.

OR

1. Double click on the selected coordinate row.

This action will cause the CHANGE COORDINATES screen to appear.

To delete a coordinate;

Select a coordinate and click on the **DELETE** button.

You will be prompted by a dialogue box reminding you that you are about to delete an airfoil when you select this button.

Be **careful** when you select this button, any deleted airfoils cannot be recovered!.

To enter comments about an airfoil;

Click on the **COMMENTS** button.

To preview the airfoil or correct the airfoil leading edge;

The curve fitting routine used by **WINFOIL** requires that a reasonable number of coordinates are entered to approximate the curvature of an airfoil. What can happen is that the leading edge curvature will not match correctly if there are not enough coordinates entered for this region.

Click on the **AIRFOIL CAD** button. This action will cause the AIRFOIL CAD screen to appear. This screen is used to input the coordinates of the airfoil using the mouse and a leading edge template. The leading edge template can be positioned on the screen with the mouse so as to provide a guide to coordinate positioning to ensure an accurate leading edge radius.

To print the airfoil coordinates;

Select PRINT from the **FILE MENU** .or click on the **PRINT**  button in the toolbar.

Printing Airfoil Coordinates

Select PRINT from the FILE MENU to print the airfoil coordinates and details.

To exit this screen;

Click on the **CLOSE** button.

To select another screen;

Select from the **FILE** menu or click on a button in the toolbar. The function of the button will be shown on the status bar at the left side of the bottom of the screen.



CHANGE AIRFOIL COORDINATES

This screen is used to change the airfoil coordinates. You must enter data in pairs ie; upper and lower coordinate pair. The x coordinate pairs do not have to match. All coordinates are expressed as a percentage of the chord.

The X axis is the axis running lengthways along the chord of the airfoil. The Y axis is the axis running perpendicular to the X axis.

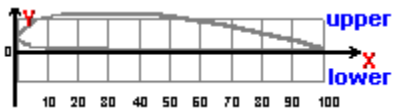
Xupper : Upper surface x coordinate (distance from the leading edge)

Yupper : Upper surface y coordinate (height above datum line)

Xlower : Lower surface x coordinate (distance from the leading edge)

Ylower : Lower surface y coordinate (height above the datum line)

Note : negative values lie below the datum line.



To change the coordinates click on the **CHANGE** button. To exit this screen click on the **CLOSE** button.



AIRFOIL CAD TOOLBAR FUNCTIONS

Listed below are the functions performed by each of the toolbar buttons for this screen;



Redraw airfoil section



Show airfoil coordinate points. The red points indicate existing data. The blue points indicate new airfoil coordinates added whilst in this screen. Clicking on this button will toggle this feature on and off.



This button increases the size of the airfoil.



This button reduces the size of the airfoil.



This button is used to select the Leading Edge Radius Template feature.

When this button is clicked, any movement of the mouse within the airfoil window will cause

a circle to move about over the plot of the airfoil. The position of this template can be set with

a click on the left mouse button. Coordinates can then be set by using the mouse. The size of

the circle is dependant on the radius set in the **LE RADIUS** box. This is expressed as a percentage of the thickness of the airfoil. The default value is 2%.



This button is used to toggle the Leading Edge Radius Template on and off.



This button is used to identify a coordinate pair. Click on this button then move the mouse pointer over the airfoil window. Click in the airfoil window near or on a coordinate pair with the left mouse button. Winfoil will search for the nearest coordinate pair and will when found, highlight the pair with a grey rectangle.



This button is used to add new coordinates. If the left mouse button is pushed whilst the mouse pointer in the airfoil window then a coordinate will be placed at that position. Clicking

on the right mouse button will cancel this operation. All coordinates are entered as a pair, ie; a top coordinate and a bottom coordinate. Once the position of the top coordinate is set, then the lower coordinate x position will be restrained by the upper coordinate x position. However you are free to vary the y position of the lower coordinate.



This button is used to end the process of coordinate addition.



This button is used to discard all changes made. All new coordinates will be deleted. **If a coordinate pair is selected (Framed with a grey rectangle) then this button will delete the selected coordinate pair.**



This button is used to accept the new coordinates and redraw the airfoil.



This button is used to select Help on this screen.



AIRFOIL CAD SCREEN

This screen is used to correct and/or modify an airfoil using a mouse. This screen consists of a scrollable region (airfoil window) on which the airfoil is plotted, status bar and tool bar.

The status bar is used to inform the user of the functions of each button on the toolbar and to show the date and time.

The buttons on the toolbar are used to enter new coordinates, delete coordinates, increase and decrease the size of the airfoil plot and to toggle on and off the visibility of the data coordinates.

The position of the mouse pointer within the airfoil window is shown as a percentage of the chord length (X% & Y%). The x axis is the axis running along the chord of the airfoil. The y axis is the axis perpendicular to the x axis with its origin at the leading edge of the airfoil.

A template facility is provided so as to accurately set the position of the coordinates for the leading edge.

Tool Bar Functions

How to add Coordinates

How to modify Coordinates

How to delete Coordinates



To exit this screen click on the **CLOSE** button. If new coordinates have been entered you will be prompted as to whether you want to accept the changes. You can discard these changes if you wish to.

The **Leading Edge Radius Template** is used as a guide to the positioning of coordinates to ensure that an accurate leading edge radius is obtained. Most airfoil data includes information on the size of the leading edge radius as a percentage of the thickness and a position.





HOW TO ADD AIRFOIL COORDINATES - AIRFOIL CAD


This is a step by step guide to adding/modifying airfoil coordinates in Airfoil CAD.


1. Increase the size of the airfoil by clicking on the  button. Scroll the airfoil so that the leading edge is in the centre of the airfoil window. The size of the airfoil should be such that accurate placing of coordinates can be made. If the size of the airfoil is too large click on the  button to reduce the size.

If you wish to modify the leading edge radius proceed to step 2 otherwise to step 3.


2. Select a leading edge radius. If this is unknown try the default setting of 2%. Click on the  button. Move the mousepointer within the airfoil window and position the Leading Edge Radius Template in an appropriate position.


3. Click on the  button. Start adding coordinates, one pair at a time by moving the mouse pointer in the airfoil window to the position required eg; top of Leading Edge Radius Template. Click on the left mouse button. Move the mouse pointer down, eg; bottom of Leading Edge Template and click on the left mouse button. The new coordinate pair will be shown as 2 blue spheres. Continue to add coordinate pairs starting with the top coordinate then the bottom repeating the process as many times as required.


4. Click on the  button to end the coordinate addition.


5. Click on the  button to save the new coordinates and to redraw the airfoil. If the changes are to your satisfaction then click on the **CLOSE** button to accept the changes.

Important - At any time you wish to end coordinate addition because you have made a mistake ,


simply click on the right mouse button whilst in the airfoil window or click on the  button to discard the changes

Modification of a coordinate pair can be achieved by clicking on the  button. Click on this button then move the mouse pointer over the airfoil window. Click in the airfoil window near or on a coordinate pair with the left mouse button. Winfoil will search for the nearest coordinate pair and will when found , highlight the pair with a grey rectangle.

To move one of the coordinates belonging to the pair (you may only shift the coordinate up or down) click on the grey HANDLE and drag it up or down to the desired position. This action will automatically save the change. To undo the change, click on the  button.

Deletion of a coordinate pair can be achieved by clicking on the  button. coordinate pair.

Click on this button then move the mouse pointer over the airfoil window. Click in the airfoil window near or on a coordinate pair with the left mouse button. Winfoil will search for the nearest

coordinate pair and will when found , highlight the pair with a grey rectangle. Click on the  button to delete the coordinate pair.



WING LIST

This screen lists specifications for wings and tailplanes designed in Winfoil.

This screen can also be accessed quickly from the toolbar by clicking on the  button.

The following details are listed;

Airfoil name

Span

Area

Aspect Ratio

Measurement Units - INCHES or MILLIMETRES

Type - WING for wing, HORZ TAIL for horizontal tail, VER TAIL for vertical tail

Design Steps

1. Determine airfoil sections to be used based on Lift , Drag & Pitching moment data if available or base on other successful aircraft designs. If airfoil not in Winfoil then obtain and enter Airfoil coordinates.
2. Determine required wing area. Base on other designs. Also determine the required Aspect Ratio. This can be calculated as follows;

$$\text{Aspect Ratio} = (\text{Wing Span})^2 / \text{Wing Area}$$

High Aspect Ratio (long narrow wings) reduces Induced drag but lowers Reynolds Number (low airfoil performance) and increases structural loading (good for gliding). Reduces roll rate (high inertia).

Low Aspect Ratio (short wide wings) increases Induced drag but increases Reynolds Number (good airfoil performance) and reduces structural loading (good for aerobatics). Improves roll rate.

Typical values;

Glider	12
Trainer	6
Pylon racer	5
Funfly	3

Tail Aspect ratios are typically 3-4

Notes on Wing / tail shapes

Elliptical shape is the optimum for minimum induced drag but is hard to build.

Tapered wing approximates elliptical shape without the structural complexity. Gliders typically use a multi tapered/section wing

Swept back wings increase dihedral effect (increase roll stability) but also increase roll rate. Also prone to tip stall and require washout. Tips tend to twist downwards.

Swept forward wings reduce dihedral effect and can be known to eliminate tip stalling. Require additional torsional stiffness as tips will twist upwards increasing the angle of attack resulting in wing failure.

Straight non tapered wing will in most cases stall at the root first. This shape is used on most trainer aircraft.

3. Add wing [ADD WING SCREEN](#)4. Once desired wing area & aspect ratio are obtained.

5. Check Reynolds number using REYNOLDS NUMBER GRAPH

6. Determine Horizontal and Vertical Tail areas using HORIZONTAL TAIL SIZING GRAPH and VERTICAL TAIL SIZING GRAPH7. Design Horizontal and Vertical tails (repeat step 3, 4)

To add a wing;

Click on the **ADD** button. This will cause the ADD WING SCREEN to appear.


To change a wing;

Double click a selected wing or click on the **CHANGE** button. This will cause the CHANGE WING SCREEN to appear.

To delete a wing;

Click on the **DELETE** button. You will be prompted to confirm the deletion of the wing before the delete occurs.

To print a wing;

Select a wing by clicking on a row in the table or by tabbing to a row then select PRINT from the **FILE MENU** .or click on the **PRINT**  button in the toolbar.

To exit this screen;

Click on the **CLOSE** button.

To select another screen;

Select from the **FILE** menu or click on a button in the toolbar. The function of the button will be shown on the status bar at the left side of the bottom of the screen.



ADD WING SCREEN

This screen is used to add/create a new wing design.

1. Enter the name of the new wing or tail.
2. Select the type of wing eg; wing, horizontal tail, vertical tail.
3. Select the measurement units eg; Inches or Millimetres.
4. Select the Root chord airfoil. (Inner most airfoil section - fuselage centre or junction between fuselage and wing).
5. Select the Tip chord airfoil.

All available airfoils will be listed in the drop down boxes for the airfoil selections.

For choices 2,3,4 and 5 select a setting by clicking on the down arrow at the right of each box, then scroll through the entries by moving the slider bar on the right. Finally , click on the entry you require.

If you wish to continue with the add action, click on the **ADD** button. Selecting this button will cause the WING CAD SCREEN to appear.

If you wish to exit this screen without adding a new wing , click on the **CANCEL** button.



CHANGE WING SCREEN

This screen is used to change a wing or tail design.

You may only change the following in this screen;

1. Measurement units eg; Inches or Millimetres.
2. Root chord airfoil. (Inner most airfoil section - fuselage centre or junction between fuselage and wing.
3. Tip chord airfoil.

All available airfoils will be listed in the drop down boxes for the airfoil selections.

For choices 1,2 and 3 select a setting by clicking on the down arrow at the right of each box, then scroll through the entries by moving the slider bar on the right. Finally , click on the entry you require.

If you wish to continue with the change action, click on the **CHANGE** button. Selecting this button will cause the WING CAD SCREEN to appear.

If you wish to exit this screen without changing a wing design , click on the **CANCEL** button.



WING CAD SCREEN

This screen is used to design wings or tails for model aircraft. A plan view of half of the wing or tail and end view is plotted in a scrollable window (wing window). The wing or tail end view has been simplified to speed up screen redraws. If different airfoil sections are selected for the root and tip chords, only the root chord section will be used for the plotting of each rib section. Allowing the transition of airfoil sections along the span would reduce the plotting speed of WING CAD to an unbearable speed. The plot may be increased or decreased in size by clicking on the magnify or reduce buttons in the tool bar running along the bottom of the screen. The plot may also be scrolled up and down or left and right so as to position the plot as required.

The wing design is input by either using the mouse or by entering the coordinates of the wing or tail through the keyboard. The position of the mouse pointer is shown as a dimension based on the distance from the leading edge point of the root chord of the wing. **Coordinates of the wing are entered as pairs, ie; upper coordinate (leading edge) first then lower coordinate (trailing edge).** Typically a simple tapered wing will only need two coordinate pairs. One pair for the root of the wing and one pair for the tip of the wing. If you wish to design an elliptical wing, a number of coordinate pairs will need to be entered, with a close distribution of coordinate pairs at the tip to capture the rounded tip shape.

The CAD interface provides the capability to select coordinate points with the mouse. Once selected a coordinate pair can be moved about or stretched apart to alter the shape of a wing or tail.

The Windows Calculator can be accessed from this screen to perform scaling calculations as required by clicking on the **CALCULATOR** button.

Wingfoil will calculate the wing area, aspect ratio, mean aerodynamic chord position and length, 25% mean aerodynamic chord position by selecting the appropriate button on the toolbar. The mean aerodynamic chord position (25%) can be used to determine tail sizes for adequate stability also it can be used as a guide to positioning the centre of gravity for conventional configured aircraft (non-canard). This is very useful for aircraft with swept wings. A safe centre of gravity range is typically 15% to 33% of the Mean Aerodynamic Chord of the wing (Assuming an adequate horizontal tail area has been selected). Positions further aft or forward cannot be confirmed as being safe without a proper stability analysis.

Wingfoil can also provide graphs of required tail areas for static stability for conventional configuration aircraft.

Another new feature is the capability to provide a graph of Reynolds number distribution along the semi span of a wing or tail for a range of selected speeds in air or water. This could highlight problems with sharply tapered wings which could be prone to tip stalling.

Tool Bar Functions

How To Design a Wing in WING CAD

To exit this screen click on the **CLOSE** button.

CAD stands for **Computer Aided Design**. The computer is used as a tool to enable the design of objects with a high order of accuracy. The wing, tail or airfoil designed with Winfoil is stored in the database as a series of coordinates. Calculations are made in order to scale these coordinates to any dimension required. Easy editing of these designs can be achieved by using this method.



WING CAD TOOL BAR FUNCTIONS

Listed below are each of the functions performed by buttons on the tool bar;



This button is used to redraw the wing or tail.



This button when selected will cause the ribs to be drawn when the wing or tail is redrawn.


It is recommended that this function be toggled off if your PC is low or there are a large number of ribs to be drawn. This process can be quite slow.



This button toggles on and off the visibility of the coordinates of the wing or tail. New coordinates are shown as blue spheres. Old coordinates are shown as red spheres.




This button is used to increase the size of the wing plot. Clicking on this button is the same as

increasing the **SCALE** setting by 0.1 and clicking on the  button.



This button is used to decrease the size of the wing plot. Clicking on this button is the same

as decreasing the SCALE setting by 0.1 and clicking on the  button.



This button is used to select the HORIZONTAL TAIL SIZING GRAPH. This button is not visible if the type of wing is a VERTICAL TAIL or HORIZONTAL TAIL.



This button is used to select the VERTICAL TAIL SIZING GRAPH. This button is not visible if the type of wing is a VERTICAL TAIL or HORIZONTAL TAIL.



This button is used to select the REYNOLDS NUMBER GRAPH



This button is used to perform the following calculations; wing area, wing aspect ratio, mean aerodynamic chord length and location.



This button is used to identify a coordinate pair. Click on this button then move the mouse pointer over the wing window. Click in the wing window near or on a coordinate pair

with the left mouse button. Winfoil will search for the nearest coordinate pair and will when

found, highlight the pair with a grey rectangle. The coordinate pair can then be modified

using a mouse.



This button is used to add new wing coordinates with a mouse. If the left mouse button is pushed whilst the mouse pointer in the wing window then a coordinate will be placed at that position. Clicking on the right mouse button will cancel this operation. All coordinates are

top entered as a pair, ie; a top coordinate and a bottom coordinate. Once the position of the coordinate is set, then the lower coordinate x position will be restrained by the upper coordinate x position. However you are free to vary the y position of the lower coordinate.



This button is used to end the process of coordinate addition when using a mouse to add wing coordinates.



This button is used to accept the new coordinates and redraw the wing.



This button is used to discard all changes made. All new coordinates will be deleted.



This button is used to enter wing coordinates using the keyboard. Clicking on this button will bring up the WING COORDINATES SCREEN











This button is used to select Help on this screen.




HOW TO DESIGN A WING IN WING CAD

Steps to create a new design with a mouse;

1. Select the **ADD** button in the WING LIST SCREEN .
2. Enter or select the appropriate data in the ADD WING SCREEN.
3. Click on the **ADD** button in the ADD WING SCREEN.
4. The WING CAD SCREEN will appear.
5. Input the full **SPAN** of the wing or tail in the **SPAN** box.
6. Click on the  button to turn off rib redrawing.
7. Click on the  button to start adding wing coordinates using the mouse.
8. Move the mouse pointer over the wing window and click with the left mouse button when the selected position has been achieved for a leading edge coordinate.
9. Move the mouse pointer down to add the trailing edge coordinate. Click with the left mouse button again. Remember if you wish to undo or cancel these operations , click on the right mouse button.
10. Continue to repeat steps 8 & 9 until all the necessary points have been added to define the wing or tail shape.
11. Click on the  button to end the addition of coordinates.
12. Click on the  button to accept the changes and redraw the wing or tail.
13. Enter the required number of ribs per wing half in the **RIB NO.** box. Click on the  button to redraw the wing or tail.
14. Click on the  button to perform area, aspect ratio and mac calculations.


Remember; at any time you wish to scroll or enlarge or decrease the size of the plot , either move the horizontal and vertical scroll bars either side of the wing window or click on the  button to enlarge the plot or the  button to reduce the size of the plot.

Steps to modify an existing design using a mouse;


1. Position the plot and scale such that the points which need to be modified can clearly be seen.
2. Click on the  button to identify a coordinate pair.
3. Move the mouse pointer over the wing window and click with the left mouse button near the coordinate pair you wish to modify.
4. A grey rectangle will appear framing the coordinate pair.
5. To move the coordinate pair , position the mouse pointer within the frame. Whilst holding the left mouse button down, drag the frame to the desired position, then let go of the left mouse button . This action will shift the position of the wing coordinate pair.
6. To move one of the coordinates belonging to the pair (you may only shift the coordinate up or down)

click on the grey **HANDLE** and drag it up or down to the desired position.





Either of the above actions will automatically save the changes.

To undo the change, click on the  button.



To move the entire wing or tail ;

1. Position the plot and scale such that the wing or tail root is visible. (Rib 1)
2. Click on the  button to identify a coordinate pair.
3. Move the mouse pointer over the wing window and click with the left mouse button near the wing or tail root (Rib 1).
4. A grey rectangle will appear framing the coordinate pair.
5. Position the mouse pointer within the frame. Whilst holding the left mouse button down, drag the frame to the desired position, then let go of the left mouse button . This action will shift the position of the entire wing or tail.

Steps to create a new design using keyboard data entry;

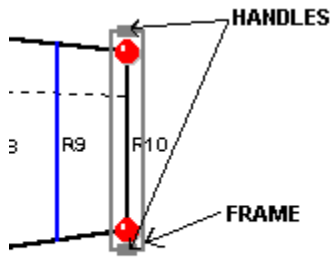
1. Select the **ADD** button in the WING LIST SCREEN .
2. Enter or select the appropriate data in the ADD WING SCREEN.
3. Click on the **ADD** button in the ADD WING SCREEN.
4. The WING CAD SCREEN will appear.
5. Input the full **SPAN** of the wing or tail in the **SPAN** box.
6. Click on the  button to turn off rib redrawing.
7. Click on the  button to show the wing coordinates screen.
8. Enter the coordinates for the coordinate pair based on the distance from the LEADING EDGE REFERENCE LINE.. Click on the **UPDATE** button to accept the coordinates.
9. Continue step 8 until all the necessary coordinates are entered, then click on the **CLOSE** button.
10. Enter the required number of ribs per wing half in the **RIB NO.** box. Click on the  button to redraw the wing or tail.
11. Click on the  button to perform area, aspect ratio and mean aerodynamic chord calculations.

Steps to modify an existing design using keyboard data entry;

1. Position the plot and scale such that the points which need to be modified can clearly be seen.
2. Click on the  button to identify a coordinate pair.
3. Click on the  button to show the wing coordinates screen.
4. Move the mouse pointer over the wing window and click with the left mouse button near the coordinate pair you wish to modify.
5. A grey rectangle will appear framing the coordinate pair and the coordinates will automatically be displayed in the WING COORDINATES SCREEN
- 6 Change these coordinates as required and click on the **UPDATE** button.
7. When finished, click on the **CLOSE** button in the WING COORDINATES SCREEN.

A **HANDLE** is a graphic object used to indicate a hook with which one can stretch an objects size by clicking and dragging.

LEADING EDGE REF LINE



TRAILING EDGE REF LINE



WING COORDINATES SCREEN

This screen is used to enter new or change existing wing or tail coordinates. This screen floats above the WING CAD SCREEN

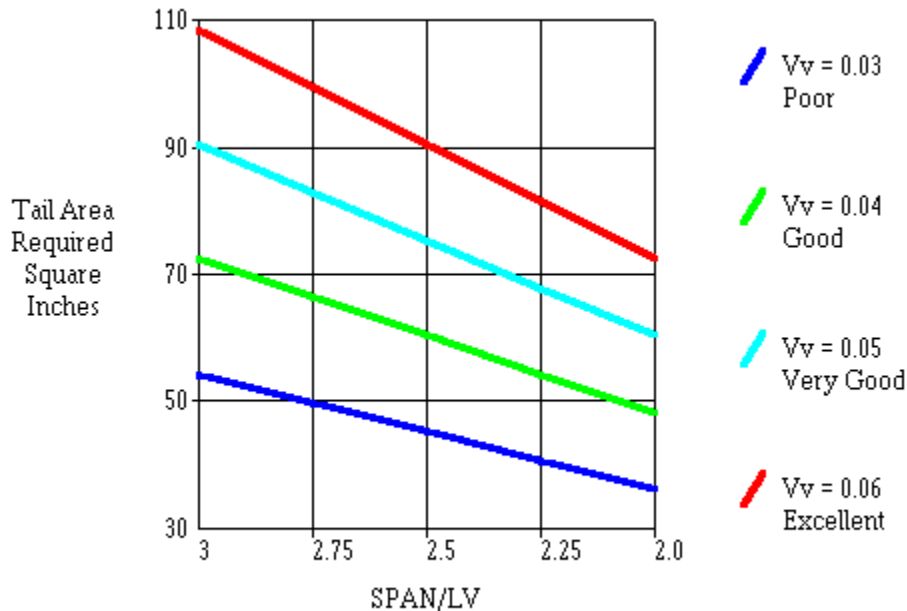
To update the coordinates click on the **UPDATE** button.

To close or exit this screen click on the **CLOSE** button.



VERTICAL TAIL SIZING GRAPH SCREEN

This screen is used to determine the vertical tail size for adequate static stability for conventionally configured aircraft.



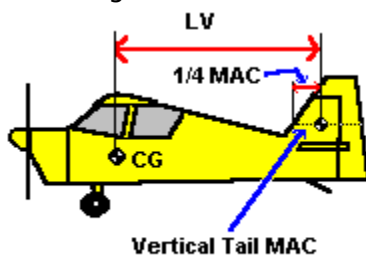
The value **Lv** is the distance from the quarter chord of the vertical tail Mean Aerodynamic Chord to the centre of gravity of the aircraft. The value **Vv** is the vertical tail volume coefficient. The higher this value is, the higher the degree of yaw stability. Typical light aircraft have a value of 0.04. The practical range is between 0.03 and 0.06.

The **Y axis** of the graph is the required vertical tail area. The **X axis** of the graph is the ratio of the wing span and **Lv**. The higher this ratio the less vertical tail area is required for a given vertical tail volume coefficient ie; a vertical tail along way from the centre of gravity of the aircraft has more effect than a similar sized tail closer to the centre of gravity.

Values may be read off the graph by clicking anywhere within the boundaries of the graph.

Repeatedly clicking on one spot will cause the value for the tail area to be shown for each of the tail volume coefficients plotted.

The diagram below shows the relationship of the dimensions.



The selection of a suitable tail area would be performed as follows;

1. Select a suitable V_v value eg; 0.04
 2. Determine the distance between the tail quarter chord of the tail MAC and the aircraft CG.
 3. Click on the graph at the value for the SPAN/ L_v . Continue to click until the value for a V_v equal to 0.04 is obtained.
- Alternatively, print out the graph and interpolate for the SPAN/ L_v and V_v equal to 0.04.

To print the graph;

Click on the **PRINT** button.

To save the graph as a bitmap picture file;

Click on the **SAVE** button.

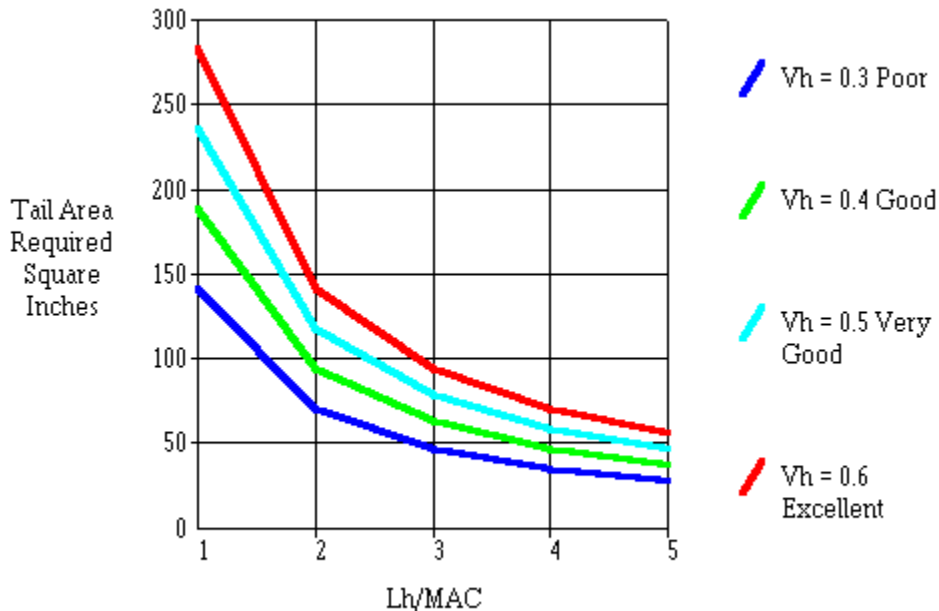
To exit this screen;

Click on the **CLOSE** button.



HORIZONTAL TAIL SIZING GRAPH SCREEN

This screen is used to determine the horizontal tail size for adequate static stability for conventionally configured aircraft.



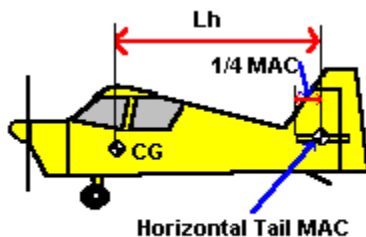
The value **Lh** is the distance from the quarter chord of the **horizontal tail Mean Aerodynamic Chord (MAC)** to the centre of gravity of the aircraft. The value **Vh** is the tail volume coefficient. The higher this value is, the higher the degree of pitch stability. Typical light aircraft have a value of 0.5. The practical range is between 0.3 and 0.6. The value **MAC** is the mean aerodynamic chord of the wing.

The **Y axis** of the graph is the required horizontal tail area. The **X axis** of the graph is the ratio of the **Lh** and the **wing MAC**. The higher this ratio the less horizontal tail area is required for a given horizontal tail volume coefficient ie; a horizontal tail along way from the centre of gravity of the aircraft has more effect than a similar sized tail closer to the centre of gravity.

Values may be read off the graph by clicking anywhere within the boundaries of the graph.

Repeatedly clicking on one spot will cause the value for the tail area to be shown for each of the tail volume coefficients plotted.

The diagram below shows the relationship of the dimensions.



The selection of a suitable tail area would be performed as follows;

1. Select a suitable **Vh** value eg; 0.4
2. Determine the distance between the tail quarter chord of the tail Mean Aerodynamic Chord (MAC) and the aircraft Centre of Gravity.
3. Click on the graph at the value for the **Lh/MAC**. Continue to click until the value for a **Vh** equal to 0.4 is obtained.

Alternatively, print out the graph and interpolate for the **Lh/MAC** and **Vh** equal to 0.4.

To print the graph;

Click on the **PRINT** button.

To save the graph as a bitmap picture file;

Click on the **SAVE** button.

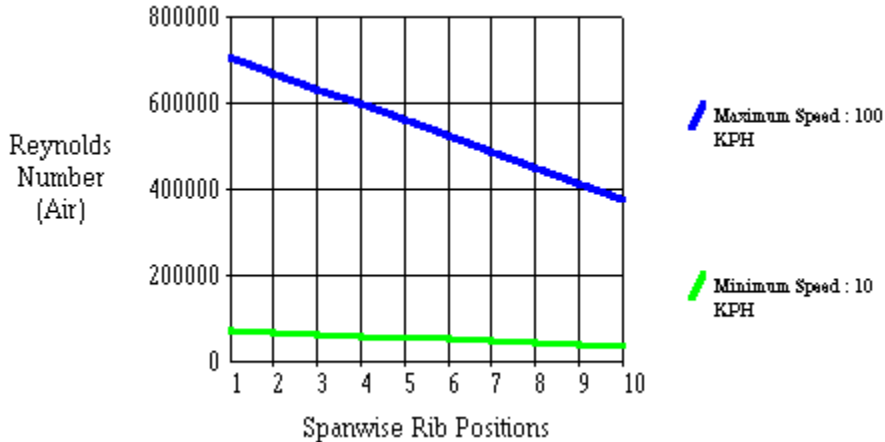
To exit this screen;

Click on the **CLOSE** button



REYNOLDS NUMBER GRAPH SCREEN

This screen is used to determine the Reynolds number distribution along the span of a wing or tail.



Graphing Steps;

1. Select a unit of measurement from KPH(Kilometres per hour), MPH (Miles per hour) and KNOTS (Nautical miles per hour).
2. Enter maximum and minimum speeds .
3. Select fluid medium from Air, Fresh Water or Salt Water.
4. Click on the **REDRAW GRAPH** button.

Clicking on the graph will cause the reading to be displayed at the bottom of this screen. Multiple clicks at the same position will toggle between the minimum and maximum speed ranges.

To print the graph;

Click on the **PRINT** button.

To save the graph as a bitmap picture file;

Click on the **SAVE** button.

To exit this screen;

Click on the **CLOSE** button



WING PANEL PRINT SELECTION

This screen is used to select how much of a wing or tail is to be printed.
A choice is provided for printing the left, right or both wing panels.

Click on the **OK** button to accept the selection.

Click on the **CANCEL** button to ignore any change and to exit this screen.

A **DXF** file is a file which meets the **Drawing Interchange Format** specifications developed by Autodesk for use with AutoCAD and other CAD programs.
AutoCAD is a trademark of Autodesk Inc.



PRINT TO DXF FILE

This option will output an airfoil or rib as a DXF file for import into other CAD programs.

The options selected in the PRINT AIRFOIL SCREEN or the PRINT WING SCREEN control the output of the DXF file.

Separate files are produced for each airfoil or rib.

You must select corresponding measurement units in the CAD program when setting up the drawing size before importing the DXF file.; eg; INCHES for INCH units and a scale of 1:1.



TECHNICAL SUPPORT

Support is available by phone or mail to the address / telephone number as stated below for Registered Users. Any serious program bugs will be fixed free of charge. In the case of specific hardware or software problems , the author may choose not to modify the program. In that case , if a problem is reported within three months after purchase , the author will refund the user's purchase price.

If you have any problems with WINFOIL please contact ;

Malcolm Hardy

Week Days After Hours (weekends anytime) on (02) 548 2982

Compuserve 100244,2132

Internet malhardy@ozemail.com.au

or write to the following address;

6 Tibooburra St

Engadine NSW 2233

Australia

Please provide information on your PC Hardware configuration; eg type 486 ,version of Windows software, AUTOEXEC.BAT & CONFIG.SYS files and error message when the fault occurred. Winfoil has extensive error trapping routines built in. If an error does occur which is trappable then a messagebox will appear with a reference to the subroutine or function , module name and error condition .



SOARTECH AIRFOILS

Soartech Airfoil coordinate data can be imported using this facility. The format of the Soartech airfoil data is the 'Eppler' format, ie; coordinates start at the trailing edge on the upper surface of the airfoil, continuing around the leading edge and back to the trailing edge along the lower surface.

A sample is shown below;

CLARK-Y

```
1.00000 0.00000  
0.99572 0.00115  
0.98296 0.00448  
0.96194 0.00972  
0.93301 0.01656  
0.89668 0.02475  
0.85355 0.03400  
0.80438 0.04394  
0.75000 0.05412  
0.69134 0.06405  
0.62941 0.07319
```

The first line is always the airfoil name . Following lines are the coordinates (x and y).

Any airfoil data which follows this format can be imported using this facility.

The data must appear in the same sequence when viewed using a text editor such as the windows Notepad (ie. carriage returns at the end of each line).

A number of airfoils supplied with the registered version of Winfoil have been obtained from the Soartech 8 Airfoils Data Disk. This disk contains data from the Princeton Low Speed Wind Tunnel

tests. A future enhancement will be the capability to import the airfoil performance data from these tests, and display Airfoil lift and drag curves for a range of Reynolds Numbers.

This data is updated regularly and can be obtained from;

SoarTech Journal
c/o H.A. (Herk) Stokely
1504 N. Horseshoe Cir
Virginia Beach
VA 23415



Price is \$12 US (US Dollars)

\$14 Elsewhere (US Dollars)

This data has been compiled for a majority of Glider airfoil sections. It is planned to be extended to cover airfoils for power flying (pylon, pattern, sport etc.) in the near future. When this data is available I will be loading this into Winfoil. I am planning to add some aerodynamic design analysis capability to Winfoil which will use this data.





COORDINATE PAIR DELETION

Deletion of a coordinate pair can be achieved by clicking on the  button. Click on this button then move the mouse pointer over the airfoil window. Click in the airfoil window near or on a coordinate pair with the left mouse button. Winfoil will search for the nearest coordinate pair and will when found , highlight the pair with a grey rectangle. Click on the  button to delete the coordinate pair.



COORDINATE PAIR MODIFICATION

Modification of a coordinate pair can be achieved by clicking on the  button. Click on this button then move the mouse pointer over the airfoil window. Click in the airfoil window near or on a coordinate pair with the left mouse button. Winfoil will search for the nearest coordinate pair and will when found, highlight the pair with a grey rectangle. To move one of the coordinates belonging to the pair (you may only shift the coordinate up or down) click on the grey HANDLE and drag it up or down to the desired position. This action will automatically save the change. To undo the change, click on the  button.

