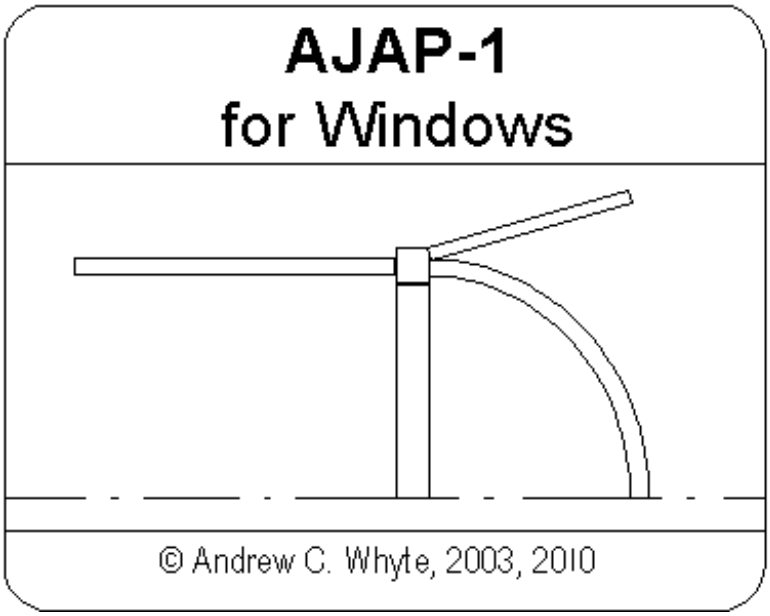
Addendum to BASIC DISCONTINUITY ANALYSIS
of Multishell Axisymmetric Junctions

by

Andrew C. Whyte



AJAP for Windows _____

by Andrew C. Whyte, BSc, MSc, CEng, M.I.Mech.E.

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1. Scope.
This addendum describes the features of the Windows version of the Axisymmetric Junction Analysis Program AJAP-1. Information on running and using this Windows version is presented, and those parts of the textbook: 'Basic Discontinuity Analysis of Multishell Axisymmetric Junctions' (reference 1) that are not relevant to the Windows version are briefly discussed in Appendix 1.

2. Introduction.
AJAP-1 is an engineering stress analysis program that will carry out a classical multishell discontinuity analysis. The program is ideal for students, academics, design engineers and stress analysts in the pressure vessel, boiler, mechanical, civil engineering and aircraft industries who require an understanding of discontinuity analysis and a means of analysing the stresses on a microcomputer.

A DOS version (version 1.3) of the program has been available for many years. A new Windows version (version 1.4) has been developed and compiled using Microsoft Visual Basic that can replace the DOS version. Note however that the DOS version is still valid and bona fide as this Windows version does not do anything different, in an engineering sense, from the DOS version.

As before the program should be used with the textbook, reference 1. It is essential that the book sections on limitations, program defaults and input data instructions be read and understood before using the program for practical applications. It should also be mentioned that when carrying out an assessment to a pressure vessel code or specification, such as BS5500 (now BS PD 5500), reference to the latest version of the code should be followed as there will have been detailed changes and additions to the code since the textbook was written.

3. Additional Features.
The main additional features of this Windows version are:

1. A Graphic User Interface.
2. A complied executable file i.e. a double click on file WINAJAP.EXE will start the program.
3. The Input data can be saved as a data file (.dat extension) for archive. The Input file can then be opened in AJAP-1 avoiding re-typing of the data.
4. The Input data and Results can be saved as an ASCII text file (.txt extension). This is useful for input to a word processor.
5. The Geometry and Result plots can be saved as a Windows bitmap file. This is useful for input to a paint program or word processor.
6. Some default parameters can be altered to give better presentation of results.

4. System Requirements.
The following are the minimum requirements:

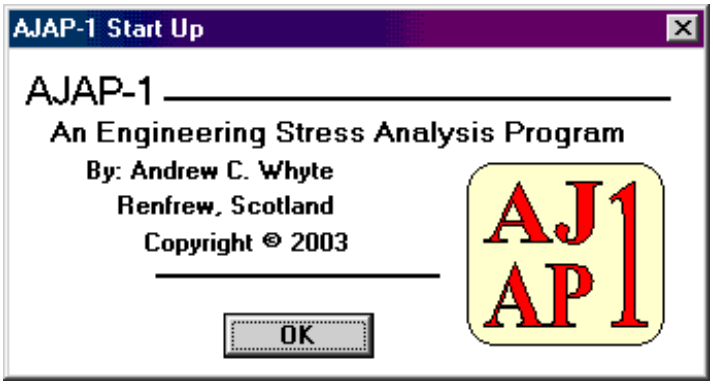
1. 386/486/Pentium based IBM PC or compatible computer
2. VGA display or higher
3. CD disk drive
4. MS-DOS with Windows 3.1 or Windows 95/Me/XP Home Edition with SP2
5. Windows compatible mouse
6. 4 MB RAM, 80 MB hard disk space if installing files to hard disk

5. Disk Contents.
This disk contains a WinAJAP folder with the following files and folders (directories). These files and folders should be kept with the WINAJAP.EXE file:

1. Files: WINAJAP.EXE, VBRUN300.DLL, CMDIALOG.VBX, COMMDLG.DLL, GRID.VBX, README.TXT, HELPFILE.TXT, EXAMPLE.DAT
2. Folders: IMAGES, EXAMPLES

Files WINAJAP.EXE, VBRUN300.DLL, CMDIALOG.VBX, COMMDLG.DLL, GRID.VBX and the folder IMAGES are essential for running the program. The EXAMPLE.DAT file is an input data file for an example project that runs automatically on start up. The EXAMPLES folder contains input data files for the examples given in reference 1.

6. Running the Program.



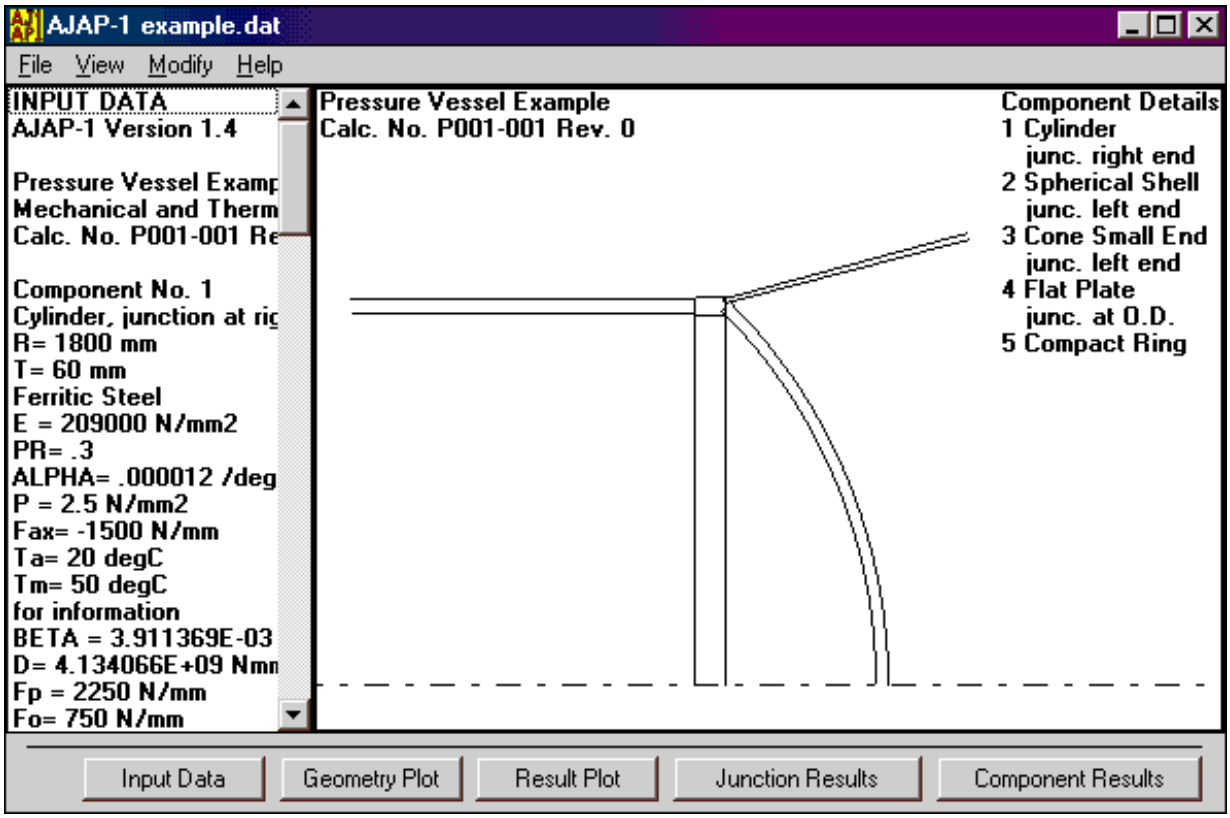
The program can be run direct from the AJAP-1 CD or can be copied to your computer's hard disk.

1. Start up Windows
2. Put the AJAP-1 CD into your PC and start-up the CD disk drive.
3. Open folder WinAJAP and double click on file WINAJAP.EXE to load and run the program. The main form will load and an example will run automatically.
4. To start a new project click on New Project from the File drop down menu and enter the information asked for.

Alternatively the folder WinAJAP should be copied to your computer's hard disk. The program can then be run by opening the WinAJAP folder and double clicking on file WinAJAP.EXE.

To uninstall AJAP-1, delete the WinAJAP folder from the hard disk.

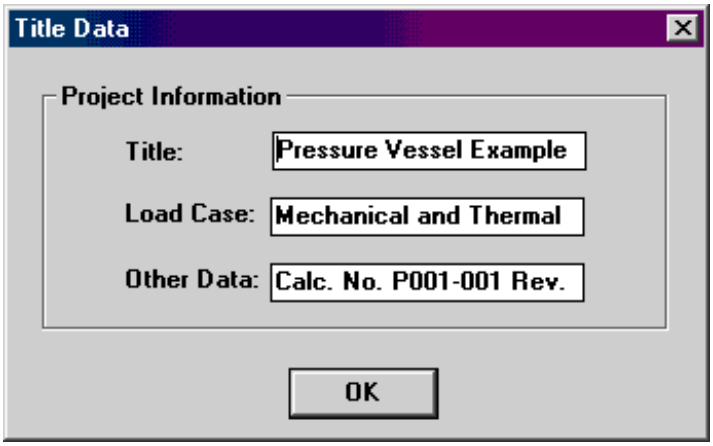
7. Input Data.
When the program is run an example project is automatically input and results run and presented. To start a new project click on New Project from the File drop down menu.



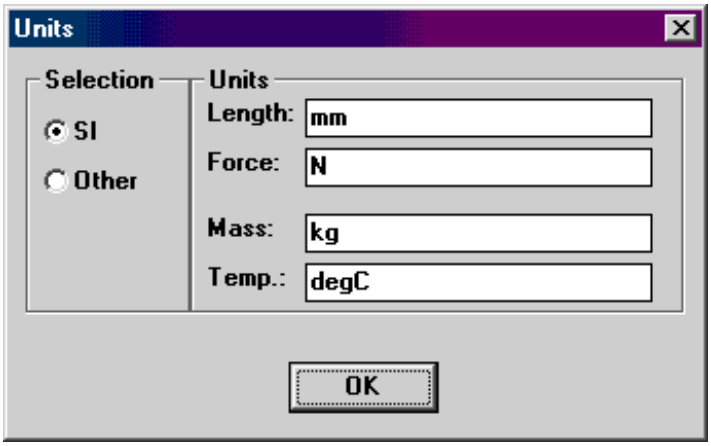
The input data is entered or selected from a series of dialog boxes. Valid geometry, material and loading data applicable to the project is essential. In many cases the sign (+ve or -ve) is important. Users are required to read and understand the input data instructions contained in reference 1. Error traps are provided for common input errors. Error message boxes will offer advice.

The following data can be input.

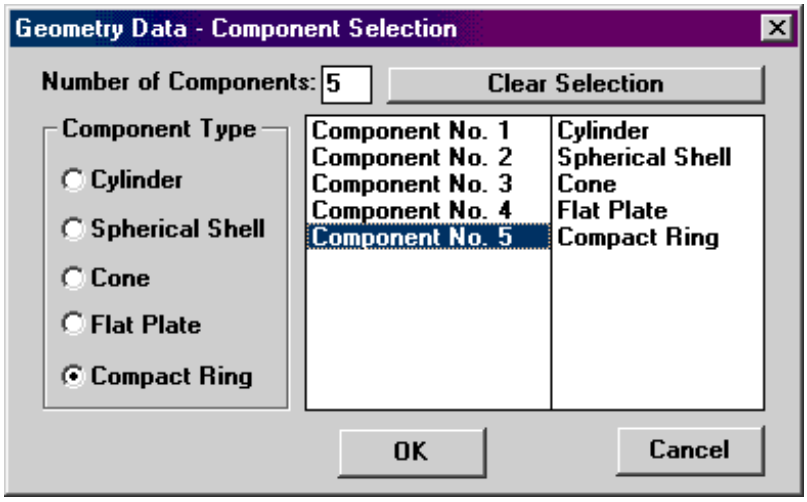
1. Title Data



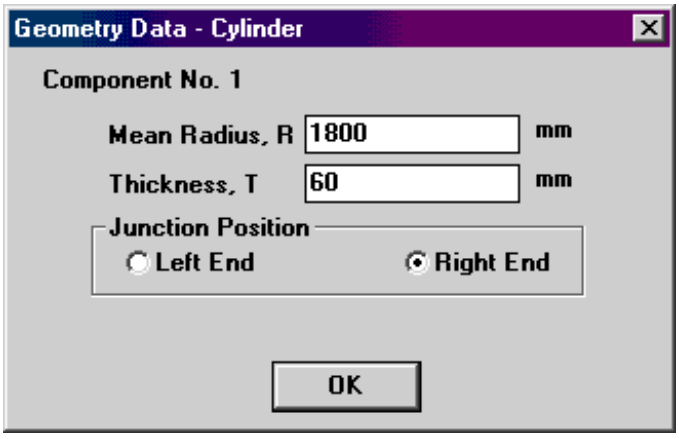
2. Units



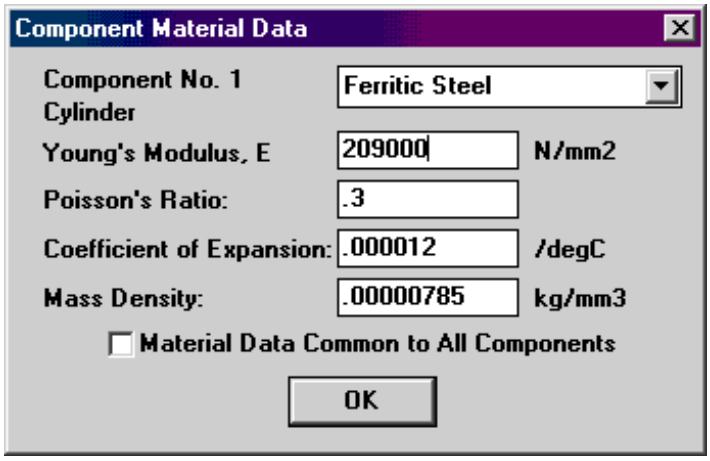
3. Geometry Data - Component Selection



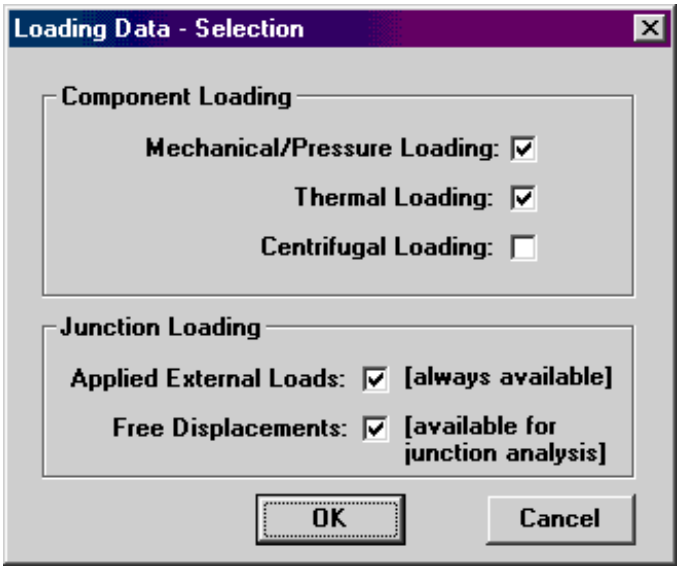
4. Geometry Data - Cylinder



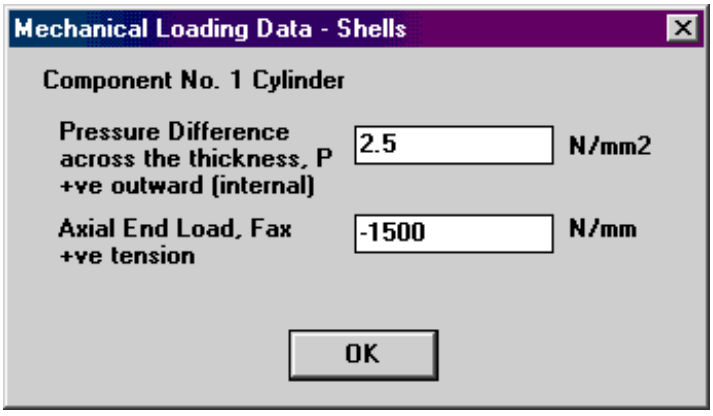
5. Material Data



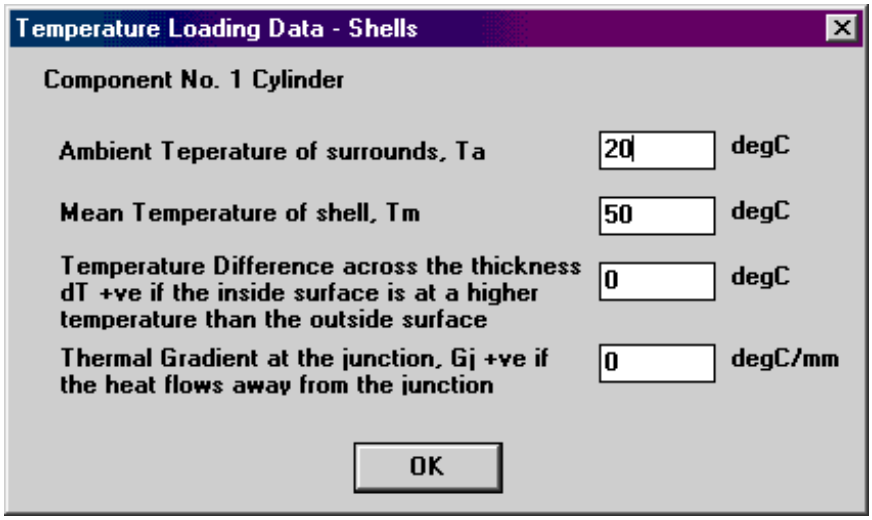
6. Loading Data - Selection



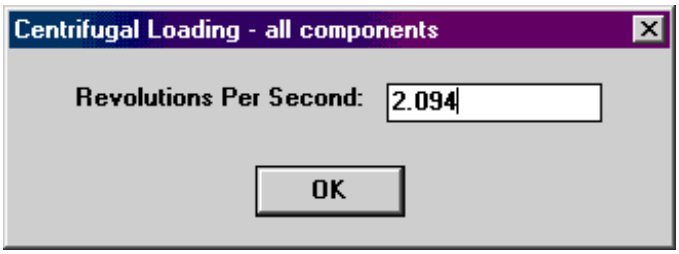
7. Loading Data - Mechanical Loads



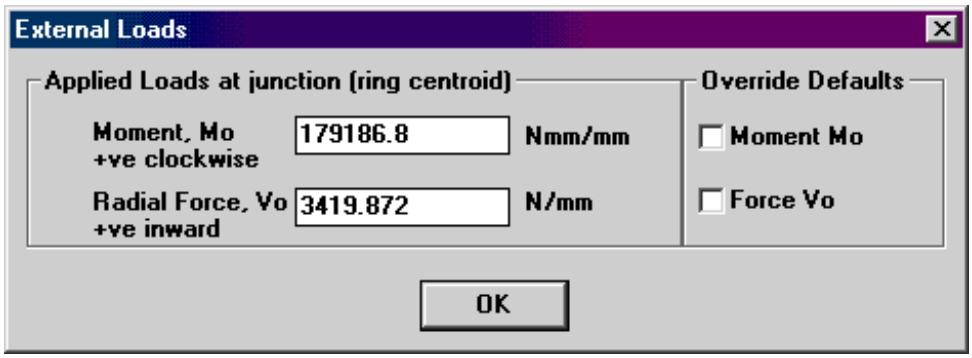
8. Loading Data - Thermal Loads

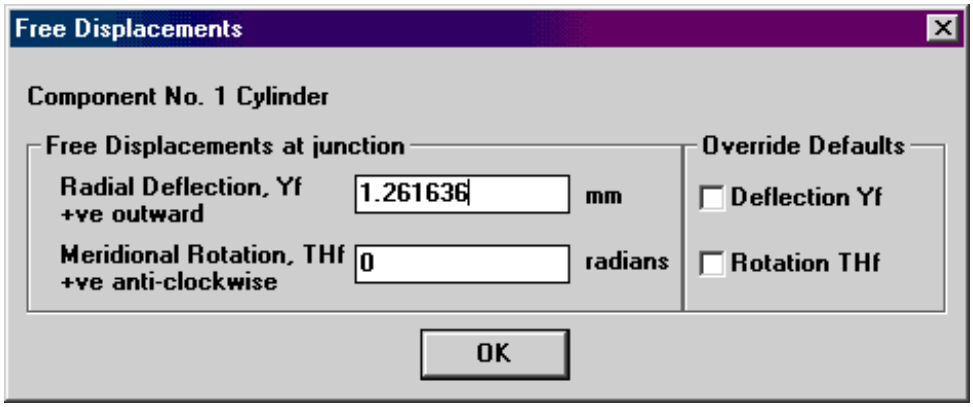


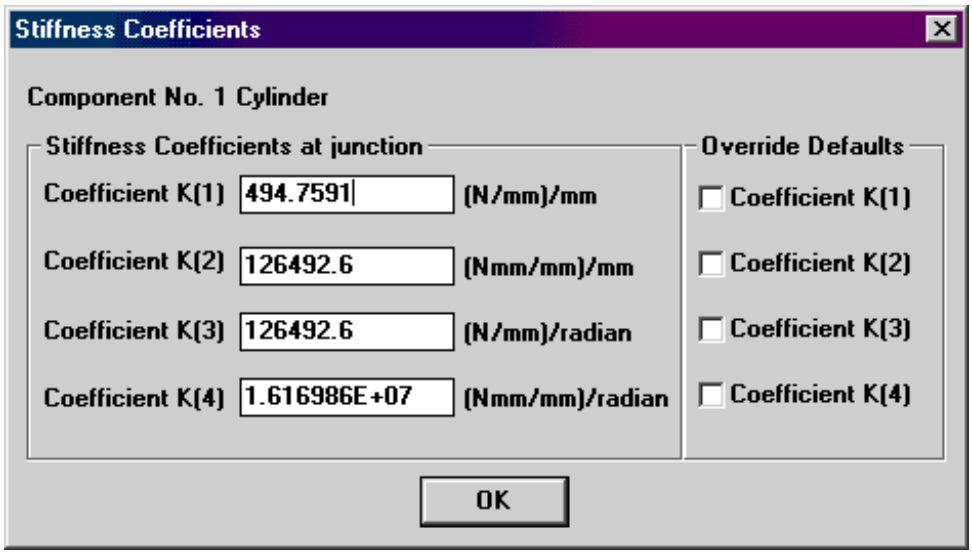
9. Loading Data - Centrifugal Loads



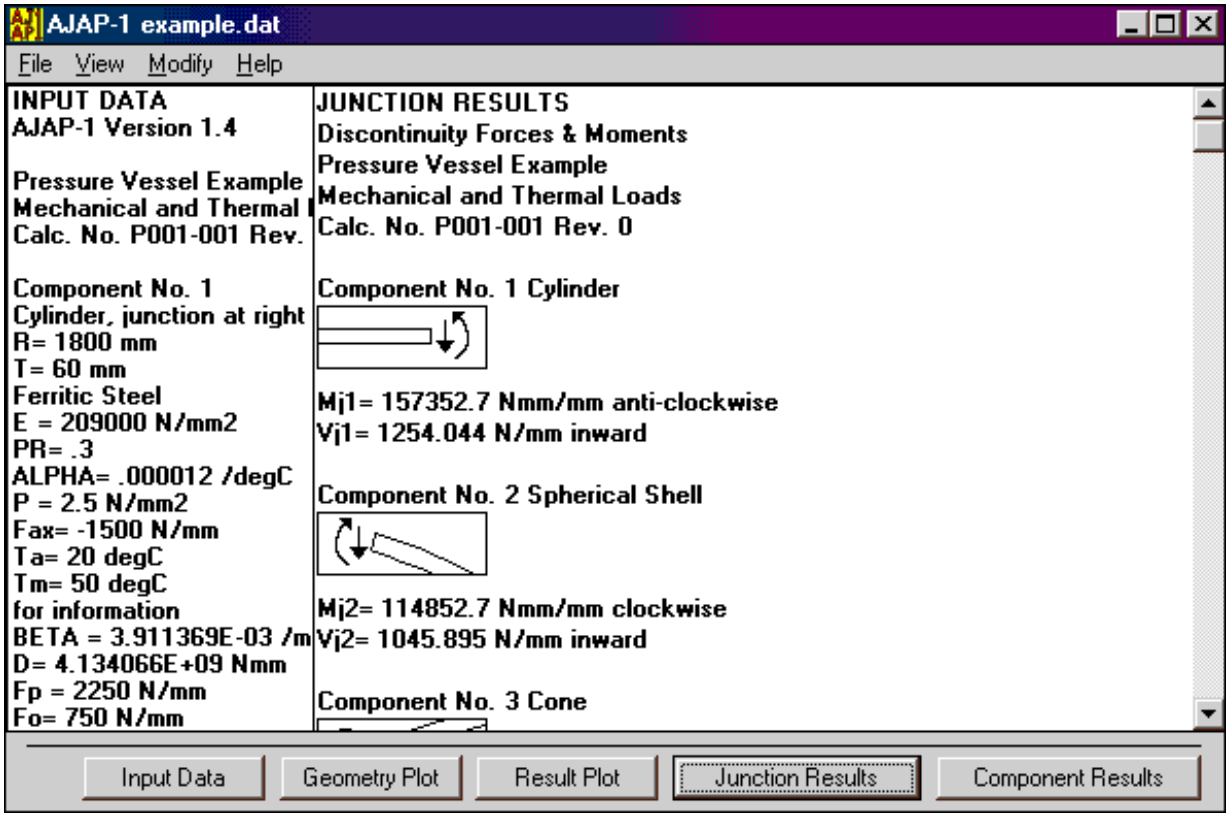
When the last of the required input data is entered, the program calculates default external loads, free displacements and stiffness coefficients. These defaults are presented in a series of dialog boxes. An option is available to allow the defaults to be altered if required.

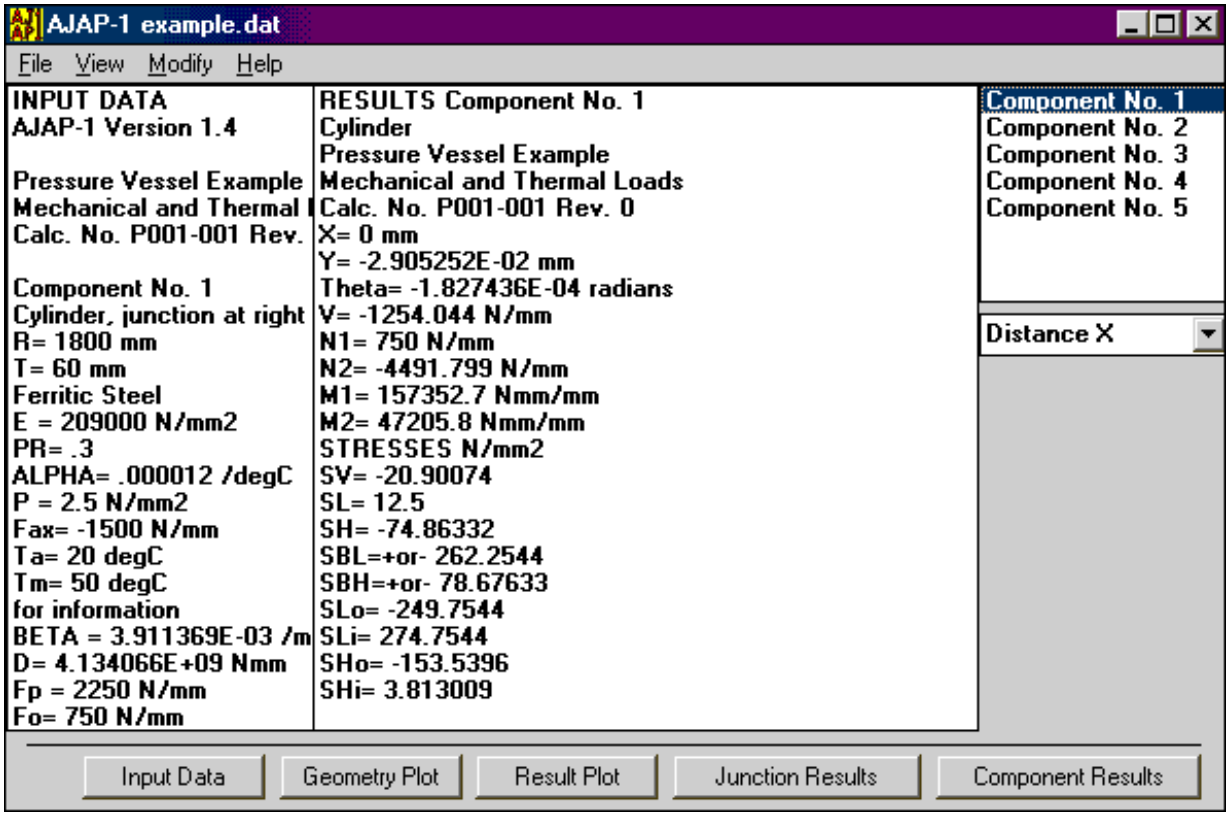


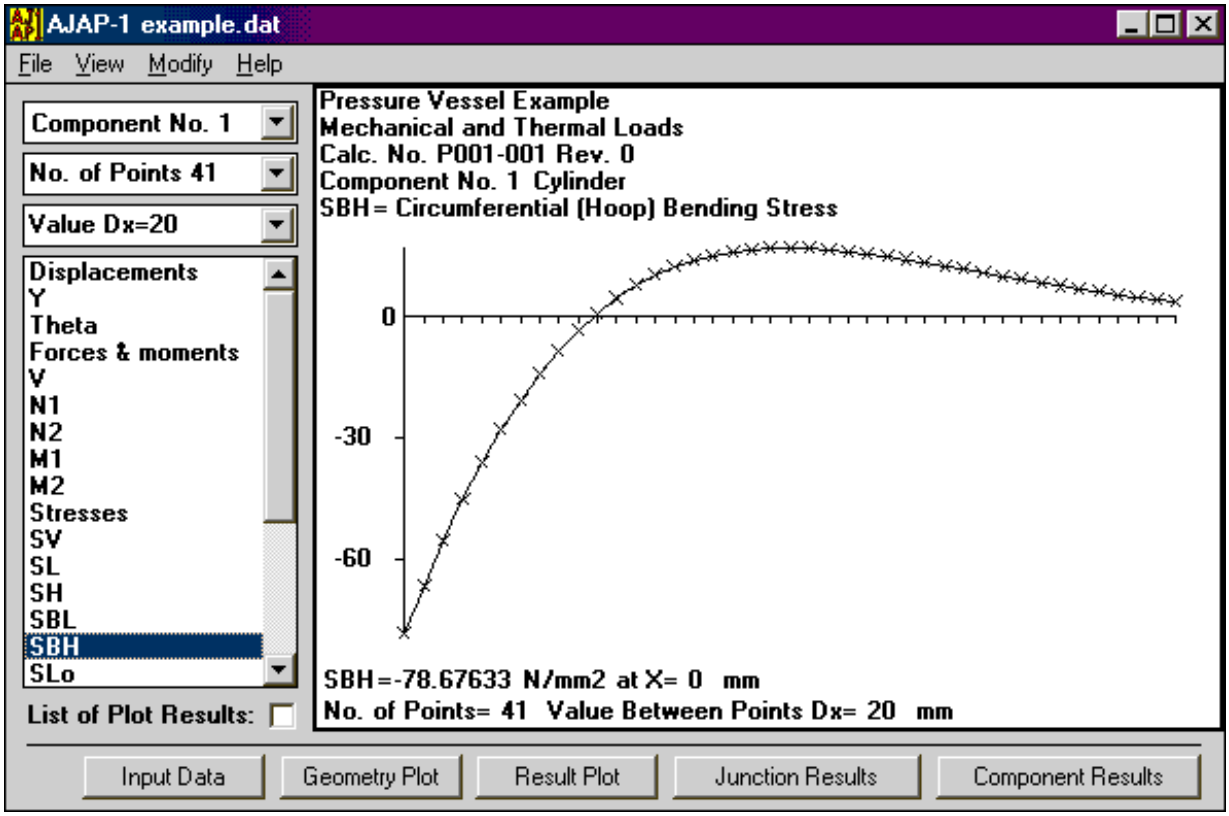




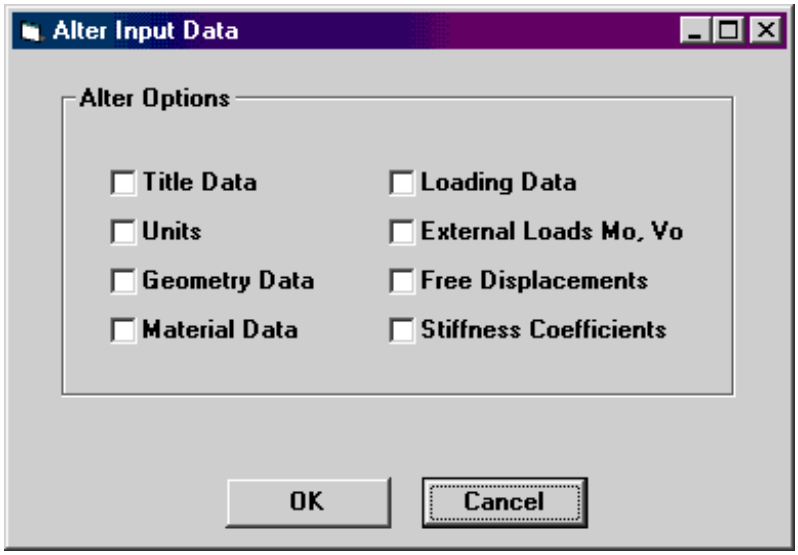
Once a valid input data set is input the program automatically presents a geometry plot. Users can then proceed to view the results.



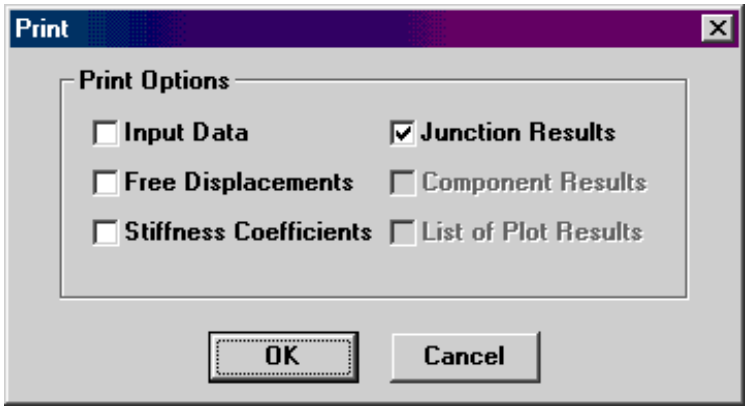

AJAP-1 example.dat
File View Modify Help
INPUT DATA
AJAP-1 Version 1.4
Pressure Vessel Example
Mechanical and Thermal
Calc. No. P001-001 Rev.
Component No. 1
Cylinder, junction at right
R= 1800 mm
T= 60 mm
Ferritic Steel
E = 209000 N/mm2
PR= .3
ALPHA= .000012 /degC
P = 2.5 N/mm2
Fax= -1500 N/mm
Ta= 20 degC
Tm= 50 degC
for information
BETA = 3.911369E-03 /m
D= 4.134066E+09 Nmm
Fp = 2250 N/mm
Fo= 750 N/mm
RESULTS Component No. 1
Cylinder
Pressure Vessel Example
Mechanical and Thermal Loads
Calc. No. P001-001 Rev. 0
X= 0 mm
Y= -2.905252E-02 mm
Theta= -1.827436E-04 radians
V= -1254.044 N/mm
N1= 750 N/mm
N2= -4491.799 N/mm
M1= 157352.7 Nmm/mm
M2= 47205.8 Nmm/mm
STRESSES N/mm2
SV= -20.90074
SL= 12.5
SH= -74.86332
SBL=+or- 262.2544
SBH=+or- 78.67633
SLo= -249.7544
SLi= 274.7544
SHo= -153.5396
SHi= 3.813009
Component No. 1
Component No. 2
Component No. 3
Component No. 4
Component No. 5
Distance X
Input Data
Geometry Plot
Result Plot
Junction Results
Component Results


AJAP-1 example.dat
File View Modify Help
Component No. 1
No. of Points 41
Value Dx=20
Displacements
Y
Theta
Forces & moments
V
N1
N2
M1
M2
Stresses
SV
SL
SH
SBL
SBH
SLo
List of Plot Results:
Pressure Vessel Example
Mechanical and Thermal Loads
Calc. No. P001-001 Rev. 0
Component No. 1 Cylinder
SBH= Circumferential (Hoop) Bending Stress
0
-30
-60
SBH=-78.67633 N/mm2 at X= 0 mm
No. of Points= 41 Value Between Points Dx= 20 mm
Input Data
Geometry Plot
Result Plot
Junction Results
Component Results

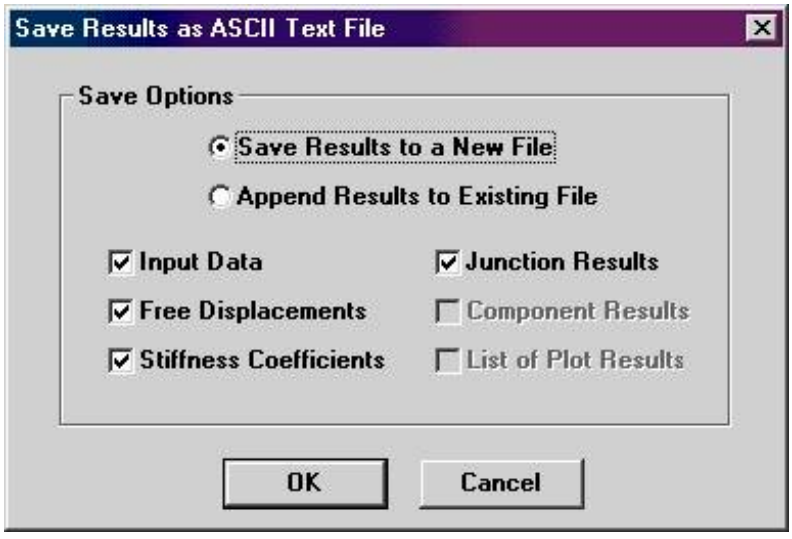
8. Modifying Input Data.
A dialog box giving options for altering the input data is available under the Modify drop down menu.



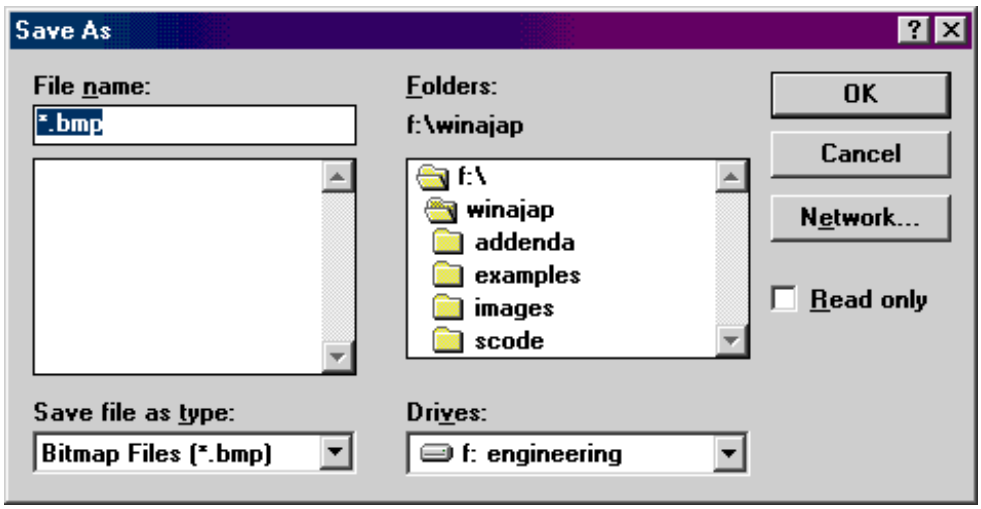
9. Printing Results.
A dialog box giving options for printing are available under the File drop down menu. A print of the geometry or results plot can also be obtained.



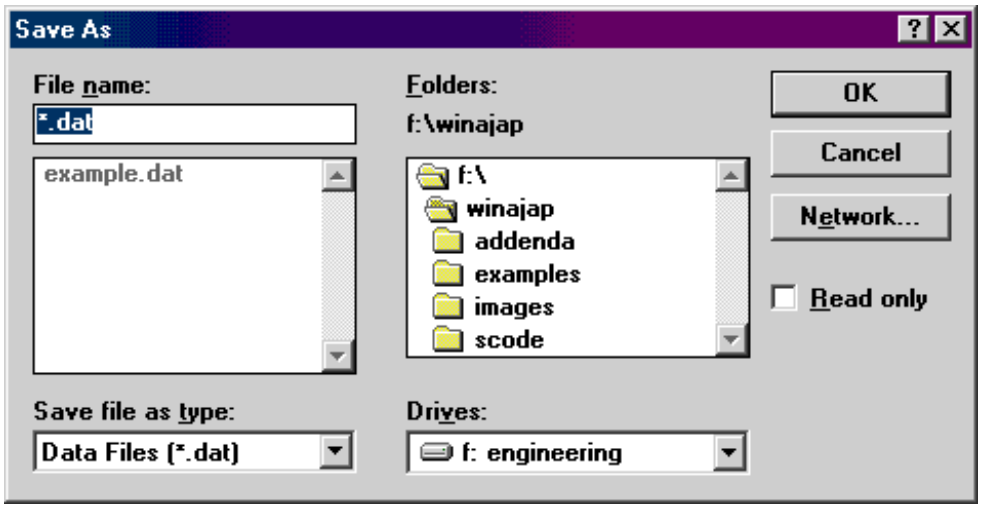
10. Saving Results.
A dialog box giving options for saving the results is available under the File drop down menu. The results can be saved as an ASCII text file (i.e. with a .txt extension).



Plots can be saved as a Windows bitmap file (i.e. with .bmp extension).

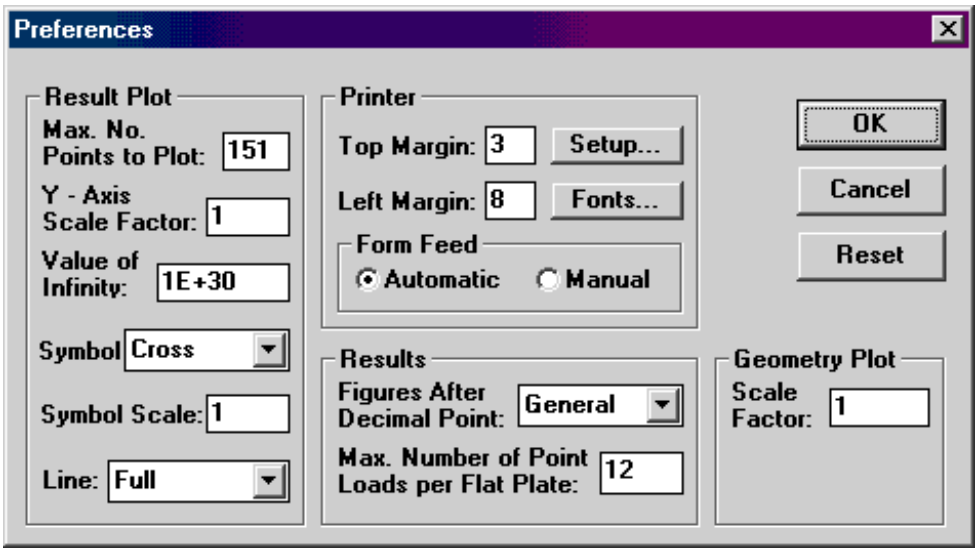


11. Saving an Input File.
To save your input data so that it can be archived and read back into AJAP-1. Use the 'Save As Input File...' option under the File drop down menu. This allows the input data to be saved as a specified data file (i.e. with a .dat extension).



12. Precision.
Calculations are carried out in double precision internally. By default the output results are displayed in general single precision format. An option is available under preferences to set the number of figures after the decimal point.

13. Preferences.
These can be accessed from the View drop down menu and provide some control over printing and presentation of results.



1. The top and left margins for printing can be set.
2. The form feed can be set to manual. This may avoid some paper wastage when printing text. The form feed can be activated from the File drop down menu.
3. The number of figures after the decimal point can be set.
4. The result plot will automatically scale the Y-axis. This works most of the time. In some cases an adjustment to the Y-axis scale factor may be beneficial.
5. The value of infinity can be set.
6. The result plot symbol, symbol scale and line type can be set.
7. The geometry plot scale factor can be adjusted.

14. Bugs.
There are no known bugs, if any come to light the author would like to know about them.

15. Limit of Liability.
The author does not guarantee that the program will function correctly in every hardware or software environment. The program has been carefully tested. All reasonable precautions have been taken to ensure that the program supplied is correct. Results have been run and compared against well known textbook and technical paper solutions. However, the author can accept no responsibility for any loss or damage as a result of the user's use of the program. The author reserves the right to revise and improve the product. This text describes the product at the time of publication and may not reflect the product at all times in the future.

16. References.

1. Whyte, Andrew C., *'Basic Discontinuity Analysis of Multishell Axisymmetric Junctions'*, Self-published 1994.

Appendix 1.

When the textbook: 'Basic Discontinuity Analysis of Multishell Axisymmetric Junctions' (reference 1) was originally written the Windows version of AJAP-1 was not available. Most of the textbook is still valid however some of the text is only applicable to the DOS version. This Appendix briefly discusses some of the text that is not applicable to the Windows version.

1. **The Computer Program**. The use of a RUNME program is not required as the Windows version is compiled into an executable file. A double click on file WinAJAP.EXE will load and run the program. The program will display at normal size for the current Windows display. The program can be maximised, minimised or closed in the usual Windows manner.

2. **Program Line Numbers**. These are mentioned throughout the textbook. They are not relevant to the Windows version, as modern versions of BASIC (like Microsoft Visual Basic) no longer require the use of program line numbers.

3. **Program Listing**. The Windows version is compiled into an executable file. The use of LIST or LLIST commands are not applicable.

4. **Component Type No**. Menu Tables 2.1(a) and (b). Due to a different system of selecting component types the Windows version does not refer to component type numbers.

5. **Input Data Instructions**. Enter the data asked for, essentially as detailed in the textbook. The Windows version uses a series of dialog boxes to allow users to enter or select data, rather than have menu number lists and screen clearing.

6. **Printer Hardware**. Control of the printer parameters, e.g. margins, fonts, print setup, orientation etc. is controlled from a Preferences dialog box from the View drop down menu.

Graphical Options. Graphics are an integral part of the Windows version. To control the screen resolution use the Windows Control Panel display settings.
