P. A. HILTON LTD.



INSTRUCTION MANUAL

HSTS Structures Software Package

Index

LABORATORY TECHNIQUE	7
SAFETY IN THE LABORATORY	7
SUCCESS IN THE LABORATORY	
DESIGN OF EXPERIMENTAL MODELS	
SOURCES OF RESISTANCE	-
REPEATABILITY OF READINGS	
AFTER SALES SERVICE	-
DISCLAIMER	9
INTRODUCTION	.10
SYSTEM REQUIREMENTS OF HOST COMPUTER (NOT SUPPLIED)	.11
SOFTWARE INSTALLATION – NEW INSTALL	
WINDOWS 8 NOTES:	.23
STARTING THE SOFTWARES:	.24
COMMON SOFTWARE OCCURRENCES	.26
OFFLINE & ONLINE MODE	
ONLINE MODE WITH HDA200	
DATA FILE CONTENTS.	
IMPORTING DATA FILES INTO SPREADSHEET SOFTWARE	
HST2S – SIMPLE SUSPENSION BRIDGE	
SOFTWARE WINDOW	
OPERATING THE SOFTWARE	
OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS	
ONLINE MODE	
HST3S – PLASTIC BENDING OF BEAMS	
SOFTWARE WINDOW	
OPERATING THE SOFTWARE	
OFFLINE MODE	
HDA200 CHANNEL SETTINGS AND CONNECTIONS	
ONLINE MODE	
HST4S – THREE HINGED ARCH	.47
SOFTWARE WINDOW	.47
OPERATING THE SOFTWARE	.50
OFFLINE MODE	.50
HDA200 CHANNEL SETTINGS AND CONNECTIONS	
	.54
DATA FILE CONTENTS	
HST5S – TWO HINGED ARCH	
SOFTWARE WINDOW	
OPERATING THE SOFTWARE	
OFFLINE MODE	.59

HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE DATA FILE CONTENTS	63
HST7S – DEFLECTION OF FRAMES	65
SOFTWARE WINDOW OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE DATA FILE CONTENTS	68 73 74
HST9S – SHEAR FORCE IN A BEAM	
SOFTWARE WINDOW OPERATING THE SOFTWARE OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE DATA FILE CONTENTS.	78 79 82 83
HST10S – BENDING MOMENTS IN A BEAM	
SOFTWARE WINDOW OPERATING THE SOFTWARE OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE	89 89 92 93
DATA FILE CONTENTS	94
DATA FILE CONTENTS	
HST11S – CONTINUOUS & INDETERMINATE BEAMS SOFTWARE WINDOW OPERATING THE SOFTWARE OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE DATA FILE CONTENTS SYMMETRIC/ASYMMETRIC SOFTWARE SCREEN OFFLINE MODE – SYMMETRIC/ASYMMETRIC ONLINE MODE – SYMMETRIC/ASYMMETRIC ONLINE MODE	95 .100 .100 .104 .105 .106 .107 .109 .112 .113
HST11S – CONTINUOUS & INDETERMINATE BEAMS SOFTWARE WINDOW OPERATING THE SOFTWARE. OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE DATA FILE CONTENTS SYMMETRIC/ASYMMETRIC SOFTWARE SCREEN . OFFLINE MODE – SYMMETRIC/ASYMMETRIC. ONLINE MODE – SYMMETRIC/ASYMMETRIC. ONLINE MODE DATA FILE CONTENTS. HST12S – DEFLECTION OF CURVED BARS.	95 .100 .100 .104 .105 .106 .107 .109 .112 .113 .114
HST11S – CONTINUOUS & INDETERMINATE BEAMS SOFTWARE WINDOW OPERATING THE SOFTWARE OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE DATA FILE CONTENTS SYMMETRIC/ASYMMETRIC SOFTWARE SCREEN OFFLINE MODE – SYMMETRIC/ASYMMETRIC ONLINE MODE – SYMMETRIC/ASYMMETRIC ONLINE MODE	95 .100 .100 .104 .105 .106 .107 .109 .112 .113 .114 .114 .116 .116 .119 .120
HST11S – CONTINUOUS & INDETERMINATE BEAMS SOFTWARE WINDOW OPERATING THE SOFTWARE OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE DATA FILE CONTENTS SYMMETRIC/ASYMMETRIC SOFTWARE SCREEN OFFLINE MODE – SYMMETRIC/ASYMMETRIC ONLINE MODE DATA FILE CONTENTS HST12S – DEFLECTION OF CURVED BARS SOFTWARE WINDOW OPERATING THE SOFTWARE OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE	95 .100 .100 .104 .105 .106 .107 .109 .112 .113 .114 .114 .116 .116 .119 .120 .121 .121

HDA200 CHANNEL SETTINGS AND CONNECTIONS	128
HST16S – REDUNDANT TRUSS	131
SOFTWARE WINDOW – PART 1	134 136 136 139 142 143
HST17S – FORCES IN A TRUSS (RESOLUTION)1	145
SOFTWARE WINDOW	147 148 152 153 154
HST19S – PIN JOINTED FRAMEWORKS1	
SOFTWARE WINDOW – ROOF TRUSS	157 157 158 161 164 165
HST20S – BENDING STESS IN A BEAM1	168
SOFTWARE WINDOW	170 170 174 175
HST21S – UNSYMMETRICAL BENDING1	177
SOFTWARE WINDOW	180 180 183 184
HST22S – TORSION OF RODS & TUBES	186
SOFTWARE WINDOW	

OFFLINE MODE HDA200 CHANNEL SETTINGS AND CONNECTIONS ONLINE MODE DATA FILE CONTENTS	192 193
HST29S – SHEAR CENTRE1	195
SOFTWARE WINDOW – CHANNEL SPECIMEN ONLY	197 199 199 202 204 205
HST31S – SUSPENSION CABLE	207
SOFTWARE WINDOW	209
HST33S – BEAM STIFFNESS & CARRY OVER FACTORS	211
SOFTWARE WINDOW	213 213
HST35S – STRAIN MEASUREMENT FOR STRUCTURES	218
SOFTWARE WINDOW – PART 1	221 223 227 230 230 231 232 233 234
HST40S – TWO DIMENSIONAL BENDING	235
SOFTWARE WINDOW – CHANNEL SPECIMEN ONLY	238 238 241 242
HST42S – FORCES IN A TRUSS (SECTIONS)	244
SOFTWARE WINDOW	246 246

ONLINE MODE	250
DATA FILE CONTENTS	
HST45S – BUCKLING OF STRUTS	252
SOFTWARE WINDOW	252
OPERATING THE SOFTWARE	254
OFFLINE MODE	254
HDA200 CHANNEL SETTINGS AND CONNECTIONS	257
ONLINE MODE	258
DATA FILE CONTENTS	260
CONTACT DETAILS	261

LABORATORY TECHNIQUE

Safety in the Laboratory

The principal hazards in using apparatus that demonstrates the static and dynamic performance of associated theorems and the assumptions involved are where rotary or linear motion occurs and where the handling of loose heavy items, for example weights, is part of the procedure.

Of the loose items the heavier weights must be regarded as the most dangerous objects. Should one of these fall onto the feet of those around the apparatus the potential for damage is present. Hence it is recommended that cast iron weights be handled carefully and when moving and placing the heavier ones (say 10 N upward) on load hangers this should be regarded as a two handled operation. It is surprisingly easy to spill a complete stack of weights off a hanger when adding a further one.

In addition to weights there are some heavy parts that have to be interchanged during some experiments and a similar approach using two hands where required is suggested. It may also be both sensible and necessary for two people to take part in changes to the apparatus.

Success in the Laboratory

Work in the laboratory depends on understanding, observation and skill. In the first place a good understanding of the performance, and limitations, of experimental models is needed. To know about the theory involved is useful but not essential. In the second place keen observation leads to better results and avoidance of mechanical mistakes. Lastly, the way in which students handle the apparatus can influence the accuracy and speed of the work.

To help students gain experience and improve their experimental technique a range of information is offered in the following notes. Bear in mind that in the world of real engineering it is often necessary to check the performance of new designs using the methods and instruments of laboratory experiments.

Design of Experimental Models

The purpose of each experiment is to illustrate an item of structural theory, or to show how well simplifying assumptions in the applied mathematics correspond to actual behaviour. This often requires the model to exaggerate the behaviour of a real structure.

In order to achieve specific objectives each experiment has a particular arrangement best suited to the theoretical requirement. These arrangements of the apparatus are described in the Construction Appendix, where included, of each experimental Instruction Manual. Before starting an experiment students should read through the Instruction Manual and be prepared to follow the recommended procedure. Increased deflections are usually achieved by using very flexible models. The stiffness depends on **EI** or **EA** so a change of material from steel ($E = 205 \text{ kN/mm}^2$) to aluminium (E about 1/3 E for steel) or a plastic (E about 1/80 E for steel) is a solution. The alternative is to use thin steel beams with a low **I**.

One disadvantage experimentally is that friction in bearings may affect displacements and force measurements. The other is that large changes in dimension (geometry) of models must be accommodated if possible.

Results can be improved by using stiffer models and larger loads, but this reduces visual effects such as curvature of beams.

Sources of Resistance

A knife-edge can simulate a frictionless pin or bearing, but horizontal and rotational movements demand ball bearings. These are packed with grease and fitted with shields to keep out dust and grit. Hence ball bearings have some torsional restraint, which affects forces in the order of magnitude 1 N. This shows up as a difference in readings for loading and unloading.

Pin joints in trusses are also subject to friction, which increases in proportion to the loading.

Repeatability of Readings

The ability to obtain accurate and repeatable experimental results is generally a matter of care and technique. Of course it helps to know the sources of error and to recognise when the apparatus contributes to the variability of readings.

Frictional variation can be minimised by using vibration. The extent of the friction can be observed by first increasing and then decreasing an applied load by hand to get the difference in readings. Tapping the frame on which the experiment is mounted will reduce the variation.

Cast iron weights for loading must always be applied gently. A load suddenly added will instantaneously apply twice its static value. Although weights are hand finished there is a manufacturing tolerance of $\pm \frac{1}{2}$ %. This may affect linearity in experimental readings.

After Sales Service

We, P.A. Hilton Ltd, attach considerable importance in being able to retain the confidence and goodwill of our clients in offering an effective after sales service. Every effort is made to answer client's correspondence within 48 Hours and to provide a rapid follow up of spares and replacement parts by maintaining comprehensive stocks of components usually available ex-stock.

Each product manufactured by P.A. Hilton Ltd., is tested under operating conditions before dispatch. However, should our clients encounter any difficulty in operating or maintaining a Hilton product we would ask that as a first step they contact the Hilton representative in their country or, in the absence of a local representative, communicate direct to P.A. Hilton Ltd.

In the extreme case, a problem may arise in the operation of equipment that could seriously disrupt a teaching or research schedule. In such circumstances rapid advice from the manufacturers is desirable and we wish our clients to know that Hiltons' will accept from them a transfer charge telephone call from anywhere in the world.

We ask our clients to treat this service as an emergency service only and to use it sparingly and wisely. Please do be aware of the time differences that may exist and, before making a telephone call, make notes of the problem you wish to describe. English is a preferred language. Our telephone number is +44 (0)1794 388382 and the telephone is normally manned between 0800 and 1700 hrs GMT Monday to Friday. Advance notice of an impending telephone call by Fax or email would be appreciated.

Fax: +44 (0)1794 388129 Email: sales@p-a-hilton.co.uk

Disclaimer

All brand and/or product names are trademarks of their respective owners. Specifications and external appearance are subject to change without notice. The colour of the actual product may vary from the colour shown in this manual. The images in this manual are representatives of the product and slight differences in detail may appear.

Copyright © 2019 P.A.Hilton Limited. All rights reserved. This instruction manual, its contents and/or layout may not be modified and/or adapted, copied in part or in whole and/or incorporated into other works without the prior written permission of P.A.Hilton Limited. Hi-Tech Education[™] is a registered trade mark of P.A.Hilton Limited.

The Results given in this Manual are to be used only as a guide for the calculations given in the experiments. The results should not be considered as correct. All machines are different and are tested in different ambient conditions.

HSTS STRUCTURES SOFTWARE PACKAGE

INTRODUCTION

The HSTS Structures software package contains all available experiment softwares for P.A.Hilton Ltd Structures Softwares.

The software allows the end user to fulfil the following key elements:

- 1. Simulation of some elements of the hardware experiment
- 2. Run the software in conjunction with the hardware experiment and hence compare actual results with theoretical
- 3. Obtain theoretical results
- 4. Run the software on-line (connected to hardware) or completely off-line (not connected to hardware)
- 5. Adjust parameters outside the scope and range of the hardware experiment
- 6. Store data and manipulate it afterwards
- 7. Enhances the users experience of the hardware

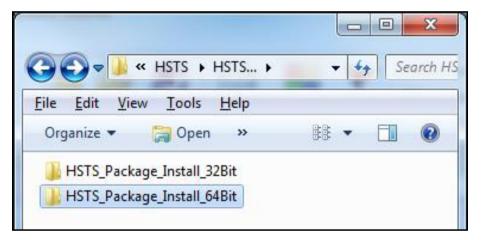
SYSTEM REQUIREMENTS of HOST COMPUTER (NOT SUPPLIED)

The minimum system requirements for the Hitech Structures Experiment software are as follows:

- Windows 8 and 8.1 (32 & 64 bit)
- Windows 7
- Windows 7 Service Pack 1
- Windows Vista Service Pack 1
- Windows XP Service Pack 3
- Recommended Minimum: Pentium 1 GHz or higher with 512 MB RAM or more
- 850MB minimum disk space for x86
- 2GB minimum disk space for x64
- VGA Monitor capable of at least 16-bit color at 1024 x 768 resolution
- USB1.1 or USB2 for data acquisition connection.
- Powered USB port(s) if possible

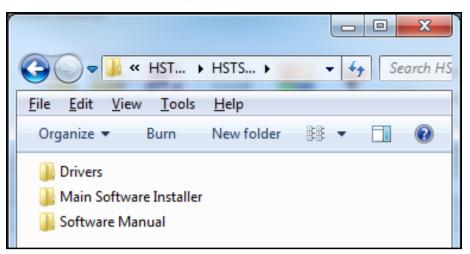
SOFTWARE INSTALLATION – NEW INSTALL

1. On the Media disc (or other format) supplied for the Experiment software you will have two folders as shown below:.



- 2. Depending on the operating system being used these folders will contain all the necessary installation files and manual.
- 3. Double click the relevant folder.

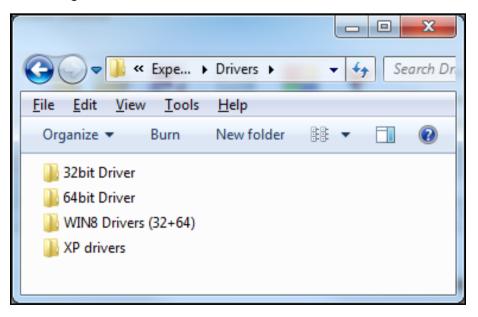
4. You will then see the following folders within this folder.



5. The **Main Software Installer** folder contains the application, as the example below shows:

G v KST V Main So v	Search Mc
<u>F</u> ile <u>E</u> dit <u>V</u> iew <u>T</u> ools <u>H</u> elp	
Organize 🔻 Burn New folder 🗄 🖽	• 🔳 🔞
Name	Date modified
🔀 HST_Package_Install_64Bit	30/09/2014 16:01

- 6. The **Software manual** folder will contain this manual.
- 7. The **Drivers** folder will contain all necessary drivers and information to assist with installing the software.



8. Enter the **Main Software Installer** folder and double click the application. The following screen will appear:



9. Click on Run.

Setup - HST Software Package		
	Welcome to the HST Software Package Setup Wizard	
	This will install HST Software Package version 1.1.0 on your computer.	
	It is recommended that you close all other applications before continuing.	
P·A·Hilton Ltd	Click Next to continue, or Cancel to exit Setup.	
	Next > Cancel	

10. Click **<u>Next>></u>** and the following screen will appear:

Setup - HST Software Package	
Select Destination Location Where should HST Software Package be installed?	
Setup will install HST Software Package into the following folder.	
To continue, click Next. If you would like to select a different folder, click	Browse.
C:\Program Files\P A Hilton Ltd\HST Softwares	Browse
At least 250.5 MB of free disk space is required.	
< Back Next >	Cancel

11. Click **<u>Next>></u>** and the following screen will appear:

号 Setup - HST Software Package	
Select Start Menu Folder Where should Setup place the program's shortcuts?	
Setup will create the program's shortcuts in the following Start N	Ienu folder.
To continue, click Next. If you would like to select a different folder, click	Browse.
P A Hilton Ltd\HST Softwares	Browse
•	
< <u>B</u> ack Next >	Cancel

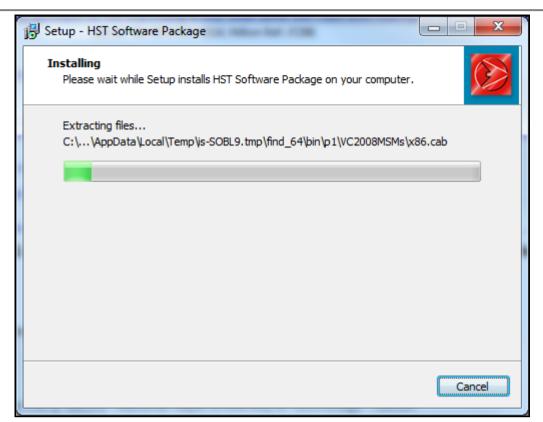
12. Click <u>**Next>>**</u> and the following screen will appear:

	🖞 Setup - HST Software Package
	Select Additional Tasks Which additional tasks should be performed?
	Select the additional tasks you would like Setup to perform while installing HST Software Package, then click Next.
	Core Application:
	Install Find Interface (Labview)
	☑ Install All HST Softwares (Labview)
	Required drivers:
	Install USB drivers (CCS Driver)
1	
	< <u>B</u> ack <u>N</u> ext > Cancel

13. Click **<u>Next>></u>** and the following screen will appear:

🔁 Setup - HST Software Package	
Ready to Install Setup is now ready to begin installing HST Software Package on your compute	er.
Click Install to continue with the installation, or click Back if you want to review change any settings.	v or
Destination location: C:\Program Files\P A Hilton Ltd\HST Softwares Start Menu folder: P A Hilton Ltd\HST Softwares Additional tasks: Core Application: Install Find Interface (Labview) Install All HST Softwares (Labview) Required drivers: Install USB drivers (CCS Driver)	*
< <p>Kack Install</p>	Cancel

14. Click Install and the following will appear:



15. The following screen will appear:

HFI_L64_V1-1-0_ENG	
Destination Directory Select the primary installation directory.	
All software will be installed in the following locations. To install software into a different location, click the Browse button and select another directory.	
Directory for HFI_L64_V1-1-0_ENG C:\Program Files\P A Hilton Ltd\HFI_L64_V1-1-0_ENG\	Browse
Directory for National Instruments products C:\Program Files\National Instruments\	Browse
<< <u>B</u> ack <u>Next>></u>	<u>C</u> ancel

16.Click <u>N</u>ext>>:

U HFI_L64_V1-1-0_ENG	- • ×
Destination Directory Select the primary installation directory.	
All software will be installed in the following locations. To install software into a different location, click the Browse button and select another directory.	
Directory for HFI_L64_V1-1-0_ENG C:\Program Files\P A Hilton Ltd\HFI_L64_V1-1-0_ENG\ Brow	wse
Directory for National Instruments products C:\Program Files\National Instruments\ Brov	wse
<< Back Next >>	<u>C</u> ancel

17. From the following screen make sure the top option is selected and then press **<u>N</u>ext >>**:

HFI_L64_V1-1-0_ENG
License Agreement You must accept the licenses displayed below to proceed.
NI IVI
NATIONAL INSTRUMENTS SOFTWARE LICENSE AGREEMENT
INSTALLATION NOTICE: THIS IS A CONTRACT. BEFORE YOU DOWNLOAD THE SOFTWARE AND/OR COMPLETE THE INSTALLATION PROCESS, CAREFULLY READ THIS AGREEMENT. BY DOWNLOADING THE SOFTWARE AND/OR CLICKING THE APPLICABLE BUTTON TO COMPLETE THE INSTALLATION PROCESS, YOU CONSENT TO THE TERMS OF THIS AGREEMENT AND YOU AGREE TO BE BOUND BY THIS AGREEMENT. IF YOU DO NOT WISH TO BECOME A PARTY TO THIS AGREEMENT AND BE BOUND BY ALL OF ITS TERMS AND CONDITIONS, CLICK THE APPROPRIATE BUTTON TO CANCEL THE INSTALLATION PROCESS, DO NOT INSTALL OR USE THE SOFTWARE, AND RETURN THE SOFTWARE WITHIN THIRTY (30) DAYS OF RECEIPT OF THE SOFTWARE (WITH ALL ACCOMPANYING WRITTEN MATERIALS. ALONG WITH THEIR CONTAINERS) TO THE PLACE YOU OBTAINED.
The software to which this National Instruments license applies is HFI_L64_V1-1-0_ENG.
I accept the above 2 License Agreement(s).
I do not accept all these License Agreements.
<< <u>B</u> ack Next >> <u>C</u> ancel

18. The following screen will appear. Click <u>**Next>>**</u>.

HFI_L64_V1-1-0_ENG	
Start Installation Review the following summary before continuing.	
Adding or Changing • HFI_L64_V1-1-0_ENG Files • NI-VISA 5.4 Run Time Support	
Click the Next button to begin installation. Click the Back button to change the installation settings.	
Save File << Back Next >> Cancel	

19. Progress will now be made as shown by the screen below:

U HFI_L64_V1-1-0_ENG	100	
Overall Progress: 2% Complete		
Copying new files		
	< <p><< <u>B</u>ack <u>N</u>ext >></p>	Cancel

20. Upon completion of the install the following will appear:

HFI_L64_V1-1-0_ENG	
Installation Complete	
The installer has finished updating your system.	
~~	Back Next >> Einish

21. Press **<u>N</u>ext >>** and the following will appear:

HFI_L64_	V1-1-0_ENG
٩	You must restart your computer to complete this operation. If you need to install hardware now, shut down the computer. If you choose to restart later, restart your computer before running any of this software.
	Restart Shut Down Restart Later

22. Press the *red cross* in the top right hand corner of the above window. The following will now appear:



23. Press <u>N</u>ext >>:

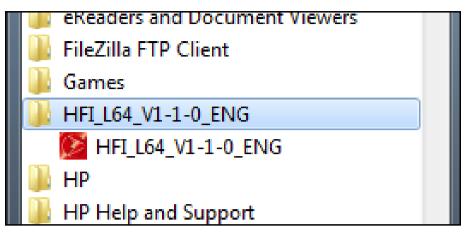
USB Driver - P.A. Hilton Ltd		
	Congratulations! You finished installing your device drivers.	
	The device driver installation wiz machine but did not find any dev	
	Driver Name	Status
		Not needed (No device for updat Not needed (No device for updat
< <u>B</u> ack Finish Cancel		

24. Press Finish.

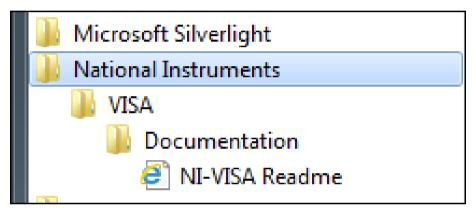
25. The following will appear. Restart.



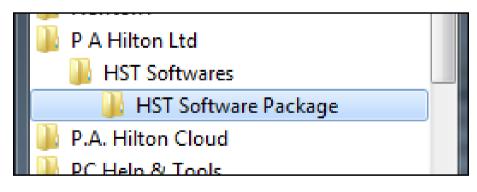
- 26. You should find that you host computer will now have the following installed:
- a. Find Interface:



b. National Instruments software



c. Main Software



WINDOWS 8 NOTES:

You MUST disable Driver Signature Enforcement before the driver will install on Windows 8.

To do this, follow the below instructions:

- a) Hover the mouse over the right hand side of the screen, and select "Settings"
- b) Click on the "Power" button.
- c) You should see 3 options, hold 'Shift' on the keyboard and click "Restart"
- d) The computer will now take a few minutes to reboot
- e) From the menu that appears, click "Troubleshoot"
- f) From the next menu, click "Advanced Options"
- g) From the new menu, click "Startup Settings"
- h) Now click the "Restart" button
- i) The computer will now completely reboot, this will take a few minutes
- j) A new menu should appear, you can't use the mouse on this one so you have to hit the number '7' on the keyboard
- k) The computer will now boot automatically into Windows 8, this has disabled the driver signature enforcement so the driver will install successfully.

NOTE: Don't worry, the next time the computer is shut down, the driver signature enforcement is automatically re-enabled so there are no security concerns.

To update from old driver to new:

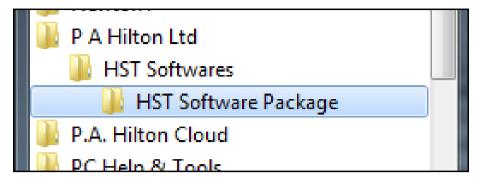
Note: Make sure the USB device is plugged in at this point.

Note 2: If you're running Windows 8, please see the other text file first, "WINDOWS 8 NOTES".

- I) Open "Control Panel" as normal.
- m) Under the "Hardware and Sound" category should be "Device Manager", click that.
- n) In Device Manager, find the "Ports" category.
- o) You should see your plugged in device under this category, with a COM port number, right click on it.
- p) Select "Update Driver Software".
- q) Select "Browse my computer for driver software".
- r) Browse to the folder (WIN8 Drivers (32+64)) where the driver files are stored.
- s) Click "Next".
- t) The driver should now go through and update.

STARTING THE SOFTWARES:

1. From the Start Menu select the **HST Software Package** folder as shown below:

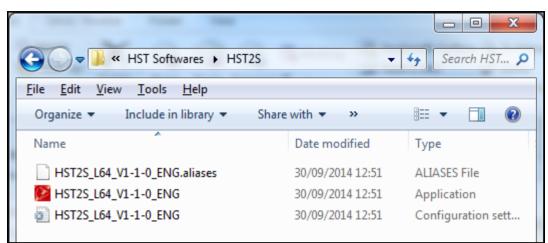


2. The following will appear:

			51
HST2S	04/	12/2014 09:16	File folder
🔒 HST3S	04/	12/2014 09:16	File folder
HST4S	04/	12/2014 09:16	File folder
HST5S	04/	12/2014 09:16	File folder
HST7S	04/	12/2014 09:16	File folder
📕 HST8S	04/	12/2014 09:16	File folder
📕 HST9S	04/	12/2014 09:16	File folder
HST10S	04/	12/2014 09:16	File folder
HST11S	04/	12/2014 09:16	File folder
HST12S	04/	12/2014 09:16	File folder
HST13S	04/	12/2014 09:16	File folder
HST16S	04/	12/2014 09:16	File folder
HST17S	04/	12/2014 09:16	File folder
📕 HST19S	04/	12/2014 09:16	File folder
HST20S	04/	12/2014 09:16	File folder
🐌 HST21S	04/	12/2014 09:16	File folder
HST22S	04/	12/2014 09:16	File folder
HST29S	04/	12/2014 09:16	File folder
HST31S	04/	12/2014 09:16	File folder
🔋 🛯 📕 HST33S	04/	12/2014 09:16	File folder
HST35S	04/	12/2014 09:16	File folder
HST40S	04/	12/2014 09:16	File folder
HST42S	04/	12/2014 09:16	File folder
HST45S	04/	12/2014 09:16	File folder
unins000.dat	04/	12/2014 09:16	DAT File
🔂 unins000	04/	12/2014 09:08	Application

These are the software folders.

3. Open a folder, say HST2S, and you will be presented with the following.



4. Click on the application and after 5-10seconds the following screen will appear:

Simple Suspension Bridge
HST2S Simple Suspension Bridge
Uniformed Distributed Load (UDL)
No of Pairs 0 Theoretical
HDA200 Connected ? Bridge Span, L 0 m
Data File New Append
Cable Tensions
Left Hand TL Right Hand TR
T _L T _R Actual 0 0
0 Theoretical 0 0

5. This will be a common theme for all softwares.

Common Software occurrences

For all softwares certain aspects will be common, and hence are listed here for reference:

OFFLINE & ONLINE MODE

▶ hst2s_v3.vi	
Simple Suspension Bridge	
HST2S Simple Suspension Bridge	HDA 200
Uniformed Distributed Load (UDL)	
No of Pairs 0	Theoretical
	/m
HDA200 Connected ? Bridge Span, L 0 n	n New Tare
Data File New Ap	opend
Cable Tension	ns
Left Hand T _L	Right Hand TR
	0
0 Theoretical 0	0

1. You will notice that in the middle of the software screen is the following small window message:

Ð	
HDA200 Cor	nnected ?
Yes	No

2. If you wish to run the software in conjunction with the hardware then the HDA200 needs to be connected to the host computer and found using the find_HDA200 software (see HDA200 Installation Software Procedure Manual-xx.doc). By pressing the button 'YES' from the pop up window above you are then permitting the software to connect to the HDA200 Interface and to obtain true values from the hardware. We will call this 'ON-LINE'.

3. When the 'YES' button is pressed the following will appear in the top right hand corner of the software screen:



This denotes the software is working in 'ONLINE' mode.

- 4. If you wish to run the software completely remote from the hardware (OFF-LINE) then simply press the '**NO**' button when the pop up window appears above.
- 5. When the 'NO' button is pressed the following will appear in the top right corner of the software screen:



This denotes the software is working in 'OFFLINE' mode.

6. Depending on what mode you are running in you will then see the following software windows in the screen of the host computer:

ist2s_v3.vi	
Simple Suspension Bridge	
HST2S Simple Suspension Bridge	HITTECH E D U C A T I O N
	Uniformed Distributed Load (UDL)
1 1	No of Pairs 0
	UDL Value, w 0 N/m
	Bridge Span, L 0 m
	Data File New Oppend
	Data File New Append
	Cable Tensions
\land	Left Hand TL Right Hand TR
	Actual 0
0	Theoretical 0

OFFLINE MODE (Example only)

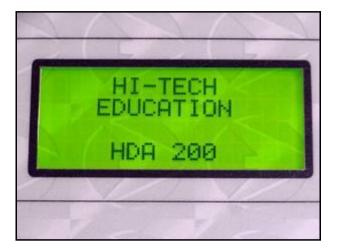
ONLINE MODE (Example only)

imple Suspension Bridge				
HST2S Simple Suspension Bridge	HI-TE EDUCAT			HDA 200
	Uniformed Distribu	ted Load (UDL)		
	No of Pa			Theoretical
	UDL Valu	e, w 0	N/m	Calc
	Bridge S	pan, L 0	m	New
	L			Tare
	Data File	New 🗌 i	Append	LOG
A		Cable Tensi	ons	
\cap		Left Hand TL	Right Hand	TR
	Actual	0	0	
0	Theoretical	0	0	

ONLINE MODE with HDA200

1. Connect the HDA200 to the power supply and host computer and at the same

time keep you finger pressed down onto the upper button. The following screen will appear:

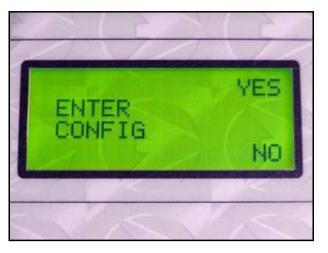


2. The next screen will appear.

Setup HST2	for	ОК
	1	CHANGE

3. If the experiment number is not present in the screen above then press the button next to the words CHANGE. Press the button until the experiment number that you require appears

4. Press the button next to the word SELECT. The next screen will appear.



5. Press the button next to the word NO and the following screen will appear.



6. Press the button next to the word USB and the following screen will appear



7. Start the software and when the pop window appears asking if the HDA200 is connected, press the 'YES' button.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

The data is as follows:

B HST2S_V3_test file_5_3_10_	pji_online.t 🔳 🗖 🔀
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp	
Theoretical Left 2	.00 0.00 0.00

The information will then repeat itself depending on how many test points have been logged.

IMPORTING DATA FILES INTO SPREADSHEET SOFTWARE

The data file can be imported into spreadsheet software such as EXCEL. From the spreadsheet it is then possible to arrange the data into a format of your choosing.

To do this follow the procedure listed below (this procedure uses Excel as the spreadsheet software):

- 1. Open the spreadsheet software and have a new worksheet open.
- 2. Open the data file from the location that it is saved within.
- 3. You will be shown the following window:

Text Import Wizard - Si	ep 1 of 3			? 🛛
OTTANIA AND AND AND AND AND AND AND AND AND AN	t, or choose the da est describes your acters such as cor	ata type that b data: nmas or tabs s	est describes your data. eparate each field. ces between each field.	
Start import at row:	1	File <u>o</u> rigin:	437 : OEM United States	~
Preview of file 5:\HITECH(P 117/02/2009D15:18: 2 Beam Length D900 3 Cut Section D300.	22	ental Software	H5T95\TextFile.txt.	
4 V1 D5.00 5 V2D0.00				
	Car	cel <	Back Next >	inish

- 4. Press the **<u>Next >**</u> button.
- 5. The following screen will appear:

Delmiters			
Isp [Semicolon Comma	Treat consecutive delimiters as one Text gualifier:	
17/02/2009 Beam Length Cut Section W1 W2	15:18:22 900 300.00 5.00 0.00		~

- 6. Press the <u>Next > button</u>.
- 7. The following screen will appear:

This screen lets yo the Data Format.	u select each column and set	Column data	10 C C C C C C C C C C C C C C C C C C C		
	s numeric values to numbers, date and all remaining values to text.	Olext	DMY	~	
		O Date:	import colur	nn (skip)	
-	vanced				_
Data greview General	General				٦.
Data greview General 17/02/2009	General 15:18:22 900				7
Ceneral 17/02/2009 Beam Length Cut Section	General 15:18:22 900 300.00				
Cata greview Ceneral 17/02/2009 Beam Length	General 15:18:22 900				

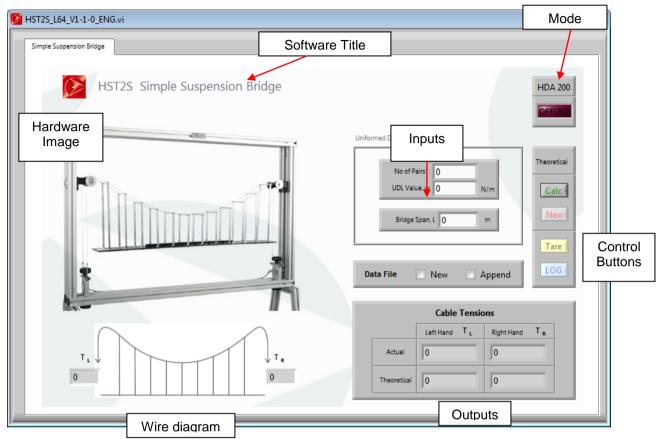
- 8. Press <u>Finish</u>.
- 9. The data will now be imported into the work sheet of the spreadsheet software and will allow further manipulation.

10. Alternatively simply open a fresh worksheet in the spreadsheet software and drag and drop the text file into the worksheet. It will be laid out as shown below. You may have to adjust the column widths to ensure all values are visible.

E E	[Eile Edit ⊻iew Insert Fç elp	ymat <u>T</u> ools <u>D</u> ata	Window	0
	🐸 🖬 🖪 🖨 🖪 🕄 🖏	9 13 13 13 13.	3 1	
10	• B I = = = =	11 A .		1
1.000				
			Changes	
	A1 🔫 🏂 04/	03/2010		
	A	В	C	1
1	04/03/2010			
2	Beam Support	Simply Support		
3	Beam Material	Black Mild Steel		
4	Yield Stress	338		
5	Beam Width	20		
6	Beam Depth	5		
7	Plastic Section Modulus	125		
8	Beam Support Span	600		
9	Theoretical Plastic Moment	42250		
10	Actual results			
11	N	0.1		
12	mm	0		
13	Actual results			
14	N	-24.9		
15	mm	-3.23		
16	Actual results			
17	N	-50.7		
18	mm	-6.17		
19	Contract a second and a second second second second			
20	N	-75.6		
21	mm	-9.27		
100 March 100	Actual results			
23	N	-100.3		
24	mm	-12.79		
25	Actual Plastic Moment	42000		
26	→ M\HST3S_V1_test file	1 30°		1

HST2S – SIMPLE SUSPENSION BRIDGE

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **No. of Pairs:** These are the number of pairs of UDL bars being placed onto the bridge deck.
- **UDL value, w:** This is the value of the UDL bars being added to the bridge deck.
- **Bridge span, L:** Enter the value of the bridge deck span. This value is in metres.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Left Hand, TL</u>: The actual and theoretical cable tension for the left hand end of the suspension bridge. These are also displayed on the wire diagram. In offline mode only the theoretical value will appear.
- <u>Right Hand, T_R</u>: The actual and theoretical cable tension for the left hand end of the suspension bridge. These are also displayed on the wire diagram. In offline mode only the theoretical value will appear.

<u>Control buttons</u>: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **<u>CALC</u>**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **NEW**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this button or the append button, not both.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the **.exe** files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Enter 1000 in the arch span input box.
- 4. Enter 200 in the arch rise input box.
- 5. Select Point from the type of load drop down menu.
- 6. Enter 50 in the single point load, W input box.
- 7. Choose 0.500 as the span fraction.

8. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

No of Pa UDL Valu		N/m	Theoretica Calc
Bridge Sj	pan, L 1	m	New
15			Tare
Data File		Append	LOG
Data File	New 🗍 /	Append	LOG
Data File	New . /		LOG
Data File			
Data File	Cable Tensi	ons	

- 9. The theoretical cable tensions will be presented on the hardware image also.
- 10. The TARE button, although live will not operate in offline mode.
- 11. Press the NEW button
- 12. Tick the Data File NEW box.
- 13. Right click on the graph and choose clear graph. Repeat this for the graph on the graph tab also.
- 14. Press CALC.
- 15. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.				? 🗵
Save jn	🗁 HST9S		*	0000.	
My Recent Documents	HST95_V1.ak	ases e			
My Documents My Computer	File name: Save as type:	TextFile.tx All File.(*.*)		× (OK. Cancel

- 16. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 17. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

HST2S_V3_test file_5_3_	10_pji_offline.t 🔳 🗖 🔀
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp	
05/03/2010 12:55: Number of Pairs UDL Value, w 12.50 Bridge Span, L Theoretical Left Theoretical Right	32 2 1.00 20.00 20.00

- 18. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 19. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 20. In the OFFLINE mode the LOG button will be greyed out.
- 21. When finished with the software shut the software down.
- 22. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Load Cell	Force 1	17	
Load Cell	Force 2	18	

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

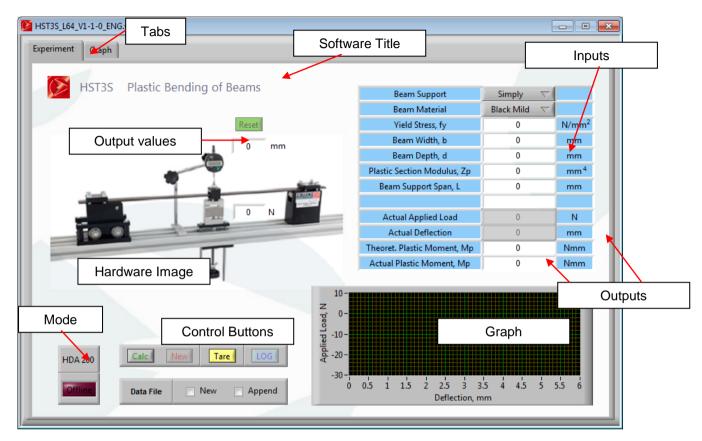
Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:

▶ hst2s_v3.vi		
Simple Suspension Bridge		
HST2S Simple Suspension Bridge	HHTECH EDUCATION	HDA 200
40000	Uniformed Distributed Load (UDL)	
(F ® n	No of Pairs 2	Theoretical
	UDL Value, w 12.5 N/m	Calc
	Bridge Span, L 1 m	New
	Data File 🗹 New 🗌 Append	
	Cable Tensions	
	Left Hand TL Right Hand	TR
	Actual -20 -20.2	
-20 -20.2	Theoretical 20 20	
		,

- 1. In 'ONLINE' mode you will notice that the actual cable tensions are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 2. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 3. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 4. Tick the data file option required.
- 5. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 6. The input parameters will then be saved to the data file.
- 7. Press the LOG button to store the actual values to the data file.
- 8. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 9. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.
- 10. The graph will be drawn automatically each time the actual applied load and hence actual applied torque are changed.

HST3S – PLASTIC BENDING OF BEAMS

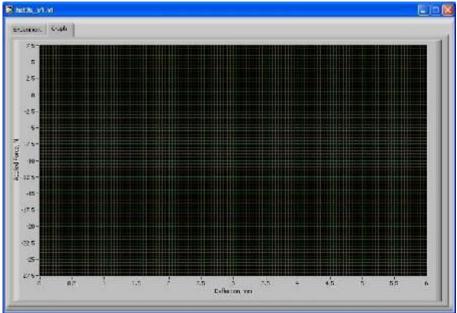
SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>**Hardware image:**</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

<u>**Tabs:**</u> The main experiment software is on the tab labelled experiment. A larger version of the graph is displayed when the graph tab is pressed (see image below):



Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Beam support:** Choose from the drop down list between simply supported, propped cantilever, fixed. This links in with the elements of the hardware experiment.
- **Beam material:** This is fixed at Black Mild Steel which is the material supplied with the hardware experiment.
- <u>Yield Stress, fy</u>: Enter the yield stress of the black mild steel. This is typically 338 N/mm².
- **Beam width, b**: Enter the beam width in millimetres.
- **Beam height, d**: Enter the beam height in millimetres.
- **Plastic section modulus, Zp**: This value is calculated automatically.
- **Beam support span, L**: Enter the support span in millimetres.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Actual Applied Load</u>: This is the actual applied load from the hardware itself via the HDA200. This value is also displayed on the hardware image.
- <u>Actual Deflection</u>: This is the actual dial gauge value from the hardware. It has the units of millimetres. This value is also displayed on the hardware image.
- <u>Theoret. Plastic Moment, Mp</u>: This is the theoretically calculated plastic moment based on the geometry given.
- <u>Actual Plastic moment, Mp</u>: This is the actual plastic moment based on the actual results obtained from the hardware.

<u>**Control buttons</u>**: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:</u>

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this button or the append button, not both.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

<u>Graph:</u> Each time a load position is set and the LOG button pressed the graph will be plotted. Each point will be added to the graph. The same graph is displayed on the graph tab. To clear the graph simply right click the cursor on the graph and choose clear chart.

<u>Rest:</u> The dial gauge supplied with the hardware apparatus will have a limited measuring range. When the maximum range of the dial gauge is reached during a test, this reset button can be pressed, the dial gauge then manually zeroed using the front buttons on the dial gauge display, and then the test resumed. Any new values of deflection will be added to the last value saved prior to the reset button being pressed. This then allows measurements up to 50mm to be taken.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select 'Simply support' in the beam support drop down list.
- 4. Enter 338 in the yield stress, fy input box.
- 5. Enter 20 in the beam width, b input box.
- 6. Enter 5 in the beam height, d input box.
- 7. The plastic section modulus will be calculated automatically.
- 8. Enter 600 in the beam support span, L input box.
- 9. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Beam Support	Simply Support 🦷	
Beam Material	Black Mild Steel 😽	
Yield Stress, fy	338	N/mm ²
Beam Width, b	20	mm
Beam Depth, d	5	mm
Plastic Section Modulus, Zp	125	mm ⁴
Beam Support Span, L	600	mm
Actual Applied Load	0	N
Actual Deflection	0	mm
Theoret. Plastic Moment, Mp	42250	Nmm
Actual Plastic Moment, Mp		Nmm

- 10. The theoretical plastic moment in the first output box. The actual plastic moment will not appear because the actual applied load and actual deflection are greyed out because you are in 'OFFLINE' mode.
- 11. Press the NEW button
- 12. Tick the Data File NEW box.
- 13. Press CALC.

14. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.				? 🔀
Save jn	🗁 HST9S		*	0000	•
My Recent Documents	Instruction M HST95_V1.ali HST95_V1.ex HST95_V1.ini	ases e			
My Documents					
My Computer					
	File name:	TextFile.tx		~	ОК
My Network	Save as type:	All Files (*.*)		~	Cancel

- 15. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 16. The input and output data will now be saved in the data file created. To prove this open the text file in **NOTEPAD** that you have just created from its location and check the contents. It should look similar to the image below.

Eile Edit Format Yiew Help		
04/03/2010 15:01:19 Beam Support Simply Suppo Beam Material Black Mild S Yield Stress 338.00 Beam width 20.00 Beam Depth 5.00		~
Plastic Section Modulus	125.00	
Beam Support Span 600. Theoretical Plastic Moment	42250.00	

- 17. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 18. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 19. In the OFFLINE mode the LOG button will be greyed out.
- 20. When finished with the software shut the software down. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Load cell	Force 1	17	
Dial Gauge	Dial gauge 1	28	0.01mm

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

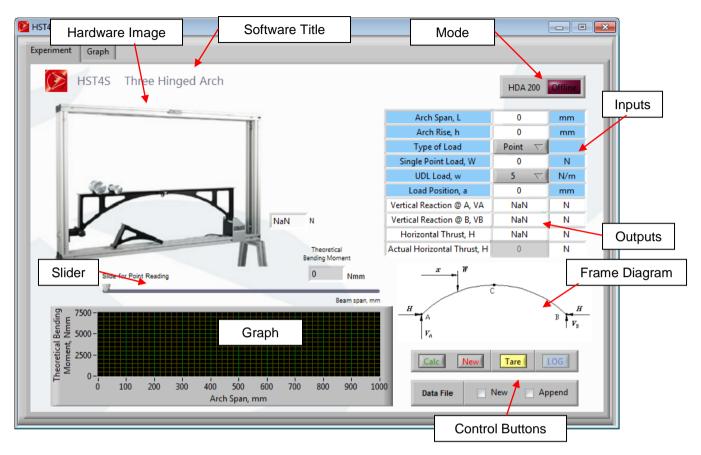
Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 1. In 'ONLINE' mode you will notice that the actual applied load and deflection are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 2. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 3. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 4. Tick the data file option required.
- 5. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 6. The input parameters will then be saved to the data file.
- 7. Press the LOG button to store the actual values to the data file.
- 8. Incrementally change the load position from NONE right through to -100mm, and at each increment press the LOG button.
- 9. The graph will be drawn automatically at each load position point, but you must follow the load position points in turn otherwise the graph will appear incorrect and the actual shear centre will not be correct.

HST4S – THREE HINGED ARCH

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- Arch Span, L: This is the span of the arch. On the hardware this is 1000mm. It has the units of millimetres (mm).
- <u>Arch Rise, h:</u> This is the rise of arch. On the hardware this is 200mm. It has the units of millimetres (mm).
- **<u>Type of load</u>**: the user can select from 'POINT' load or 'UDL' load. The 'UDL' load stands for uniformly distributed load.
- <u>Single Point Load, W</u>: When the user selects the type of load as a 'POINT' load then the value of the 'POINT' load can be input here. It has units of Newton (N).
- <u>UDL Load w</u>: When the user selects the type of load as 'UDL' then the value of the 'UDL' can be selected from the drop down list. It has the units of N/m.
- Load Position, a: This is input by the user between 0 and 1000mm. It has the units of millimetres (mm).

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical. Again the format of the columns is the same as the inputs except that the central column is automatically updated depending on the inputs chosen and cannot be adjusted via the keyboard.</u>

The outputs available are as follows:

- Vertical Reaction @ A, VA: This is the theoretical vertical reaction at A based on the input parameters chosen. It has the units of Newton's (N).
- Vertical Reaction @ B, VB: This is the theoretical vertical reaction at B based on the input parameters chosen. It has the units of Newton's (N).
- **Horizontal Thrust, H**: This is the theoretical value of horizontal thrust based on the input parameters selected. It has units of Newton's (N). When in OFFLINE mode this value of horizontal thrust will appear in the text box in the bottom right hand corner of the hardware image.
- Actual Horizontal Thrust, H: This is the actual value of horizontal thrust from the hardware itself. It has units of Newton's (N). When in ONLINE mode this value of horizontal thrust will appear in the text box in the bottom right hand corner of the hardware image. This value will be greyed out when in OFFLINE mode.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated.
- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from any strain gauges and load cell channels which are being used in the software.
- **LOG**: When the end user wishes to record any data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

Frame Diagram: This represents a schematic of the hardware arrangement and is a cross reference for the inputs. This will not be present on all experiment softwares.

<u>**Graph**</u>: If present it is possible to view the theoretical bending moment diagram for the parameters chosen. This will be created when the CALC button is pressed.

<u>Slider:</u> To view the theoretical bending moment values along the arch span, the user can move this slider across the arch span at various positions. The value of the bending moment at this position will then appear in the text box in the top right hand corner above the slider.

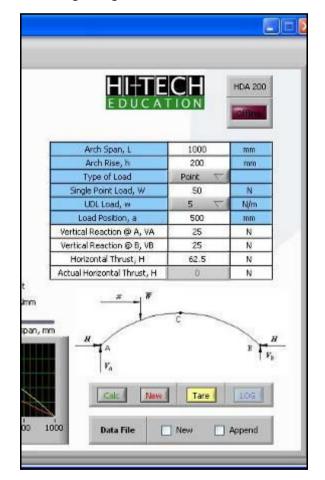
OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

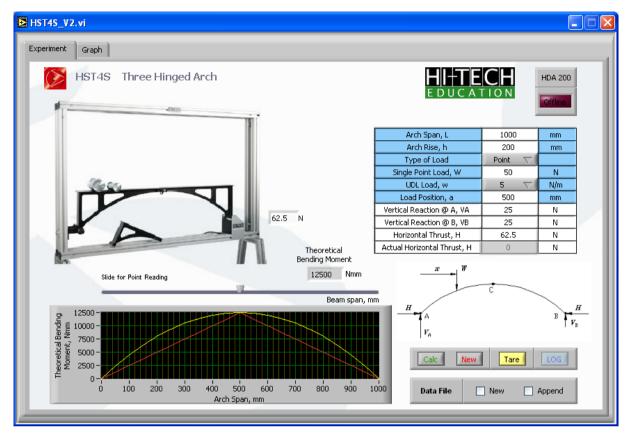
It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Enter 1000 in the Arch Span input box.
- 4. Enter 200 in the Arch Rise input box.
- 5. Choose Point Load form the Type of Load drop down list.
- 6. Enter 50 in the Single Point Load, W input box.
- 7. Enter 500 in the Load position input box. The screen should now have inputs that look like the following image:



8. Press the CALC button and the values will appear in the output boxes, on the hardware image, the bending moment graph created and moving the slider to mid span will show the bending moment at this point on the arch as shown in the image below:



- 9. There will be no value for the **Actual Horizontal Thrust**, **H** as the software has been chosen to run in OFFLINE mode.
- 10. Right click in the graph display and choose clear chart. This then clears the chart for a new diagram to be created. If you do not clear the chart new graphs will be appended to this existing graph.
- 11. Tick the Data File NEW box.
- 12. Press CALC.

13. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.					? 🔀
Save jn:	🔁 HST9S		~	G 😰	📂 🛄 •	
My Recent Documents	Instruction Ma HST95_V1.alia HST95_V1.exe HST95_V1.exe	ises				
Desktop						
My Documents						
My Computer						
	File <u>n</u> ame:	TextFile.txt			✓	OK
My Network	Save as <u>t</u> ype:	All Files (*.*)			~ (Cancel

- 14. Either rename the default name of TextFile.txt or keep this default name. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 15. A new bending moment graph will appear and the same values appear in the output boxes.
- 16. The input and output data will now be saved in the data file created.
- 17. Press the NEW button, and then tick the Data File APPEND box. Press CALC and then choose the same data file as created previously. The current input and output data will now be appended to this file without overwriting the original data.
- 18. Locate this text file and open in NOTEPAD to see the format and information that it is being saved.
- 19. If you wish to change the inputs then simply clear the graphs, change the input, choose whether to create a new data file or append to an existing file and then press CALC.
- 20. In the OFFLINE mode the NEW and TARE buttons although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 21. When finished with the software shut the software down.
- 22. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Load cell	Force 1	17	

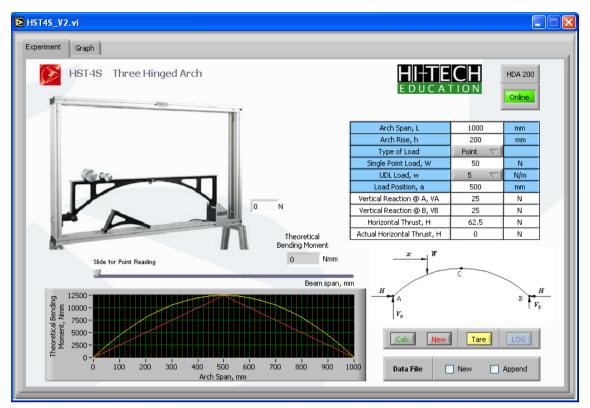
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. You will notice that the **Actual Horizontal Thrust**, **H** output line is now live and not greyed out.
- 3. You will now see the actual value of the horizontal thrust coming from the hardware within this output box. To zero this reading simply press the TARE button. You may have to press it again if the reading does not return to zero.
- 4. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the **Actual Horizontal Thrust**, **H** value with the theoretical value.
- 5. If you wish to save the data into the existing data file or a new data file then press the NEW button. The value in the **Actual Horizontal Thrust**, **H** output box will change due to the fact that the software is not retrieving the actual value from the hardware.
- 6. Clear the graph if necessary.
- 7. Tick the data file option required.
- 8. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 9. The current input and output values will then be saved to the data file.
- 10. Press the NEW button when you need to change a value of one of the inputs.
- 11. Change the input parameter.
- 12. Clear the graph if necessary.
- 13. Choose whether to create a new data file or append to an existing file.
- 14. Press CALC and the new outputs will be created along with a graph.
- 15. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for the HST4S:

File Edit Format Vi								
07/10/2009 Arch Span Arch Rise Single Point Lo UDL Load Load Position Vertical React Vertical React Horizontal Thru 0.00 0.00 50.00 38.00 100.00 72.00 150.00 102.00 250.00 128.00 250.00 128.00 250.00 198.00 400.00 198.00 400.00 198.00 650.00 198.00 650.00 198.00 650.00 198.00 650.00 198.00 650.00 198.00 650.00 198.00 700.00 168.00 700.00 168.00 700.00 150.00 850.00 128.00 850.00 128.00 850.00 128.00 850.00 128.00 950.00 38.00 1000.00 0.00 900.00 72.00 950.00 38.00 1000.00 0.00 97/10/2009 Arch Span Arch Rise Single Point Lo UDL Load Load Position	16:37:20 1000.00 200.00 200.00 500.00 500.00 500.00 107 VA 25.00 107 VA 25.00 107 VB 25.00 1275	125.00 1 250.00 4 500.00 4 625.00 4 7500.00 4 8750.00 1 10000.00 1 1250.00 1 1250.00 1 1250.00 1 1250.00 1 1250.00 1 1250.00 1 1250.00 2 1875.00 4 2125.00 2 2250.00 1	375.00 L625.00 L750.00 468.75 400.00 318.75 225.00 L18.75		618.75 625.00 618.75 600.00 1056.25 1225.00 0.00 0.00 0.00 0.00 0.00 0.00		0.00 0.00 0.00 0.00 0.00	
Vertical React' Vertical React' Horizontal Thr 50.00 38.00 100.00 72.00 150.00 102.00 200.00 128.00 250.00 150.00 300.00 168.00	on VA 25.00 Ion VB 25.00	125.00 1 250.00 1 375.00 1 500.00 4	0.00 L18.75 225.00 318.75 100.00 168.75 750.00	0.00 6.25 25.00 56.25 100.00 156.25 525.00	0.00 0.00 0.00 0.00 0.00 0.00 225.00	0.00		

The data is as follows:

Date and time. Arch span input value from software. Arch Rise input value from software. Single Point Load value from software UDL Load (even if the software is not being run with UDL selected) from software Load Position from software Vertical Reaction VA from software Vertical Reaction VB from software Horizontal Thrust

There are 8 columns shown in the data file of which two are important:

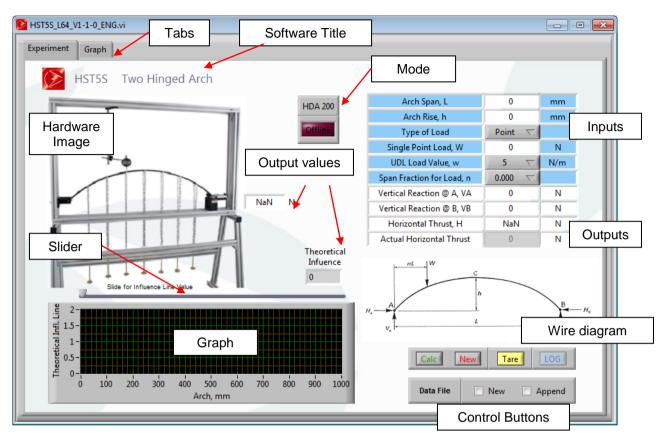
Column 1: Beam span increments (mm)

Column 4: Bending Moment values across the beam span for the particular input parameters chosen.

All data appended to this file will be saved in this data file and can be viewed.

HST5S – TWO HINGED ARCH

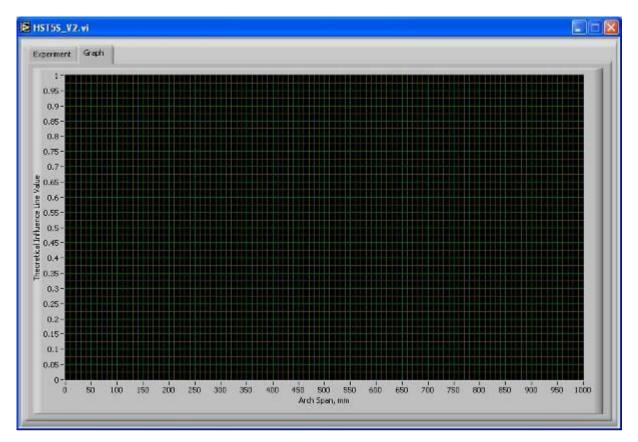
SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>**Hardware image:**</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

<u>**Tabs:**</u> The tabs at the top allow the main software screen to be shown and also a larger version of the graph. The following image shows the graph on this tab.



Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- Arch Span, L: Input the span of the arch in millimetres.
- Arch rise, h: Input the rise of the arch in millimetres.
- **<u>Type of Load</u>**: Select from the drop down list the type of load you require. The options are Point or UDL.
- **Single Point Load, W**: If the type of load chosen is POINT then enter the value of the point load here in Newton's.
- <u>UDL Load Value, w</u>: If UDL is chosen for the type of load select the value of the UDL from the drop down list.
- **Span Fraction for Load, n:** Select the fraction of the span where the load is being applied from the drop down list. These fractions are the same as on the hardware experiment.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Vertical Reaction @ A, VA</u>: This is the theoretical reaction at the left hand end of the arch in Newton's.
- <u>Vertical Reaction @ B, VB</u>: This is the theoretical reaction at the right hand end of the arch in Newton's.
- Horizontal Thrust, H: This the calculated theoretical value of horizontal thrust based on the parameters given above.
- Actual Horizontal Thrust: This the actual horizontal thrust from the hardware. When in offline mode this value will be greyed out.

<u>Control buttons:</u> these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this button or the append button, not both.
- <u>Data file APPEND</u>: If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.
- <u>Slider:</u> The influence line for the arch can be obtained by moving the slider horizontally across the span of the arch. The graph produced reflects also the influence line of the arch for the particular loading applied. The influence line value is displayed in the output box near the hardware image.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

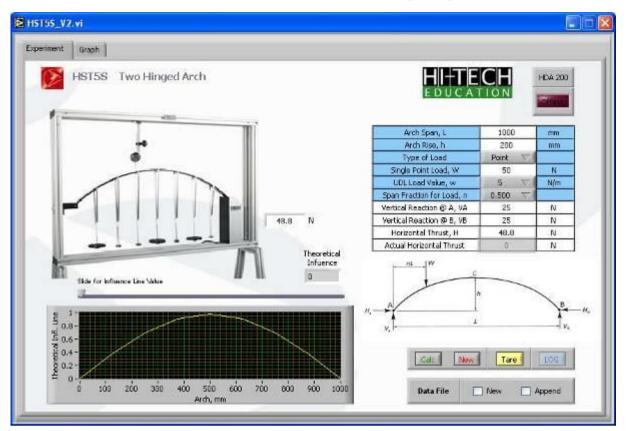
It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the **.exe** files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Enter 1000 in the arch span input box.
- 4. Enter 200 in the arch rise input box.
- 5. Select Point from the type of load drop down menu.
- 6. Enter 50 in the single point load, W input box.
- 7. Choose 0.500 as the span fraction.
- 8. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Arch Span, L	1000	mm
Arch Rise, h	200	mm
Type of Load	Point 🤝	
Single Point Load, W	50	N
UDL Load Value, w	5 🗸	N/m
Span Fraction for Load, n	0.500 🤝	1.1.5
Vertical Reaction @ A, VA	25	N
Vertical Reaction @ B, VB	25	N
Horizontal Thrust, H	48.8	N
Actual Horizontal Thrust	0	N

9. The complete screen should look like the following image:



- 10. The theoretical horizontal thrust will be presented on the hardware image also.
- 11. The TARE button, although live will not operate in offline mode.
- 12. Press the NEW button
- 13. Tick the Data File NEW box.
- 14. Right click on the graph and choose clear graph. Repeat this for the graph on the graph tab also.
- 15. Press CALC.

16. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.				? 🛛
Save in	HST95		~	0000	•
My Recent Documents	instruction M HST95_V1.ak HST95_V1.ex HST95_V1.ex	ases e			
My Documents					
My Computer					
	File name:	TextFile.txt		~	ОК
My Network	Save as type:	Al Fic: (*.*)		*	Cancel

- 17. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 18. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

HST5S_V2_test file_5_3_10	_pji_off 📮 🗖 🔀
Eile Edit Format View Help	
05/03/2010 10:41:44 Arch Span 1000.00 Arch Rise 200.00 Single Point Load Span Fraction 0.500 Vertical Reaction 2 Horizontal Reaction 2	50.00 25.00 25.00 48.80

19. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.

- 20. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 21. In the OFFLINE mode the LOG button will be greyed out.
- 22. When finished with the software shut the software down.
- 23. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

	HDA200	HDA200	
Sensor/Transducer	Connector	Channel	Resolution
	Number	number	
Load Cell	Force 1	17	
Dial Gauge	Dial Gauge 1	28	0.01mm

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

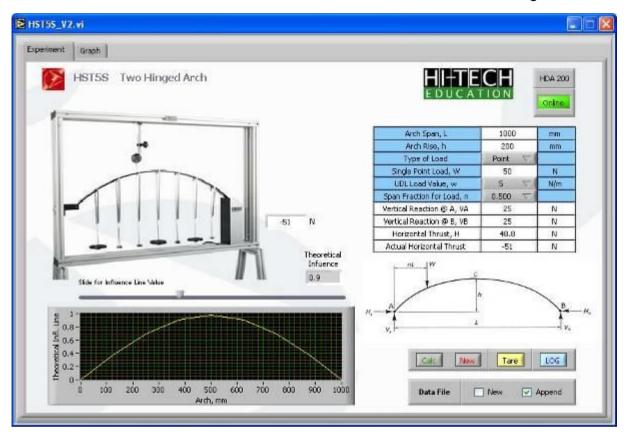
NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the actual horizontal thrust is no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 4. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 5. Tick the data file option required.
- 6. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 7. The input parameters will then be saved to the data file.
- 8. Press the LOG button to store the actual values to the data file.
- 9. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 10. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

11. The graph will be drawn automatically each time the actual applied load and hence actual applied torque are changed.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

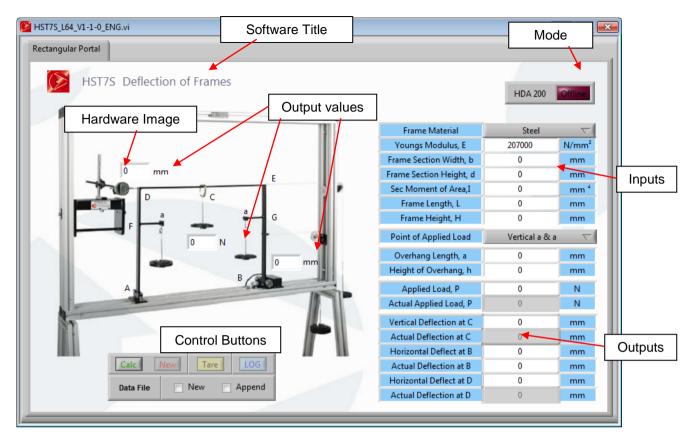
The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed. The data is as follows:

Eile Edit Format View Help		
05/03/2010 11:00 Arch Span 1000.0	:34	1
Arch Rise 200.0		
Single Point Load	50.00	
Span Fraction 0.000		
Vertical Reaction Horizontal Reaction	0.00	
HULIZUNCAI INFUSC	0.00	
0.000 0.000 0.125 0.379		
0.250 0.696		
0.375 0.904		
0.500 0.977		
0.625 0.904		
0.750 0.696 0.875 0.379		
1.000 0.000		
Actual results		
Horizontal Thrust	-50.9	
Actual results Horizontal Thrust	-50.9	
05/03/2010 11:02	.52	
Arch Span 1000.0	00	
Arch Rise 200.00	0	
Single Point Load		
Span Fraction 0.500 Vertical Reaction	35.00	
Vertical Reaction Horizontal Reaction	25.00 25.00	
Horizontal Reaction Horizontal Thrust	48.80	
0.000 0.000	835.0000	
0.125 0.379		
0.250 0.696		
0.375 0.904 0.500 0.977		
0.625 0.904		
0.750 0.696		
0.875 0.379		
1.000 0.000		
Actual results		

The information will then repeat itself depending on how many test points have been logged.

HST7S – DEFLECTION of FRAMES

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>**Hardware image:**</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Frame Material:** The user can choose the frame material. Choices range from steel, aluminium and brass. When a material is chosen the young's modulus is automatically chosen and displayed in the input box below.
- **Frame Section Width, b:** This is the width of the frame section material. Typically this will be 25mm. It has the units of millimetres (mm).
- **<u>Frame Section Height, d</u>**: This is the height of the frame section material. Typically this is 8mm. It has the units of millimetres (mm).
- Sec Moment of Area, I: This is the value of the second moment of area, which is a calculated value using the values of b and d from above. It has the units of mm⁴.
- **<u>Frame Length, L</u>**: This is the value of the length of the frame from the centre line of one side to the centreline of the other side. This is typically 600mm. It has the units of millimetres (mm).
- <u>Frame Height, H</u>: This is the height of the frame from the knife edge and roller bearing centre line to the centreline of the top horizontal member. This is typically 450mm. It has the units of millimetres (mm).
- Point of Applied Load: This is a drop down list of options for the position of the applied load to the frame. The options are vertical a & a, vertical C only, horizontal E only, horizontal E & G. You select which load option depending in which part of the hardware experiment you are running.
- **Overhang Length, a**: This is the length of the overhang for the rectangular portal frame. It is labelled a to be consistent with the hardware instruction manual. It has the units of millimetres (mm).
- <u>Height of Overhang, h</u>: This is the height of the overhang for the rectangular portal frame. It is labelled h to be consistent with the hardware instruction manual. Typically this value will be 300mm. It has the units of millimetres (mm).
- <u>Applied Load, P</u>: This is the value of the applied load which is being applied at the option chosen in the Point of Applied Load input above. The units of this parameter are Newton (N).
- Actual Applied Load, P: This is the value of the applied load being added to the frame by the user when running the software in ONLINE mode ONLY. When running in OFFLINE mode this input box will be greyed out. It has the units of Newton (N).

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical. Again the format of the columns is the same as the inputs except that the central column is automatically updated depending on the inputs chosen and cannot be adjusted via the keyboard.</u>

The outputs available are as follows:

- Vertical Deflection at C: this is theoretical value of the vertical deflection at point C on the rectangular frame. It has the units of millimetres (mm).
- Actual Deflection at C: When in ONLINE mode this is the actual value of the vertical deflection of point C on the rectangular frame. It has the units of millimetres (mm). NB: IN ORDER TO COMPARE THE ACTUAL RESULTS WITH THEORETICAL IT IS IMPORTANT THAT THE INPUTS OF THE SOFTWARE ARE SET TO THE SAME VALUES AS THE HARDWARE ARRANGEMENT. IF NOT THEN A COMPARISON IS NOT ACHIEVABLE.
- Vertical Deflection at B: this is theoretical value of the vertical deflection at point C on the rectangular frame. It has the units of millimetres (mm).
- Actual Deflection at B: When in ONLINE mode this is the actual value of the vertical deflection of point C on the rectangular frame. It has the units of millimetres (mm).
- Vertical Deflection at D: this is theoretical value of the vertical deflection at point C on the rectangular frame. It has the units of millimetres (mm).
- Actual Deflection at D: When in ONLINE mode this is the actual value of the vertical deflection of point C on the rectangular frame. It has the units of millimetres (mm).

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated.
- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from any strain gauges and load cell channels which are being used in the software.
- **LOG**: When the end user wishes to record any data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- **Data File NEW:** This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

<u>Output Values</u>: These values are the key output values from the hardware. They have been placed within the hardware image near the area they represent to give a guide to the end user.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose the frame material to be steel. The young's modulus should now be automatically selected from here.
- 4. Enter 25 in the section width input box.
- 5. Enter 8 in the section height input box.
- 6. Enter 600 in the frame length input box.
- 7. Enter 450 in the frame length input box.
- 8. Choose vertical C only for the point of load.
- 9. Enter 50 in the Applied Load input box. The screen should now have inputs that look like the following image:

Frame Material	Steel 🗸	1
Youngs Modulus, E	207000	N/mm ²
Frame Section Width, b	25	mm
Frame Section Height, d	8	mm
Sec Moment of Area, I	0	mm 4
Frame Length, L	600	mm
Frame Height, H	450	mm
Point of Applied Load	Vertical Conly 🗸	
Overhang Length, a	0	mm
Height of Overhang, h	0	mm
Applied Load, P	50	N
Actual Applied Load, P	0	N
Vertical Deflection at C	0	mm
Actual Deflection at C	0	mm
Horizontal Deflect at B	0	mm
Actual Deflection at B		mm
Horizontal Deflect at D	0	mm
Actual Deflection at D	0	mm

10. Press the CALC button and the values will appear in the output boxes and on the hardware image as shown in the image below:



- 11. There will be no values for the Actual Applied Load, P; Actual Deflection at C and Actual Deflection at D as the software has been chosen to run in OFFLINE mode.
- 12. Press the NEW button.
- 13. Tick the Data File NEW box.
- 14. Press CALC.
- 15. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

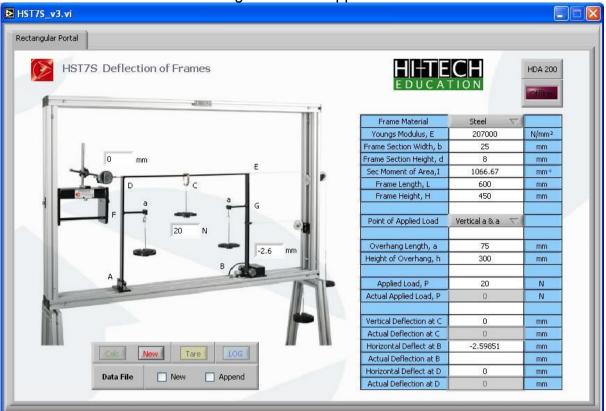
Select a data fi	le to write.				? 🗙
Savejn:	🔁 HST9S		V () 🌶 📂 🛄 .	
My Recent Documents	instruction Ma HST95_V1.alia HST95_V1.exi HST95_V1.exi HST95_V1.ini	ases			
My Documents					
My Computer					
	File <u>n</u> ame:	TextFile.txt		~	ОК
My Network	Save as <u>t</u> ype:	All Files (*.*)		~	Cancel

- 16. Either rename the default name of TextFile.txt or keep this default name. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 17. The input and output data will now be saved in the data file created.
- 18. Press the NEW button again, and then untick the Data File NEW box and then tick the Data File APPEND box. Press CALC and then choose the same data file as created previously. The current input and output data will now be appended to this file without overwriting the original data.
- 19. Locate this text file and open in NOTEPAD to see the format and information that it is saving.
- 20. If you wish to change the inputs then simply press the NEW button, change the input, choose whether to create a new data file or append to an existing file and then press CALC.
- 21. In the OFFLINE mode the NEW and TARE buttons although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 22. Press the NEW button.
- 23. Now select the *vertical a & a* option from the point of applied load list.
- 24. Enter 75 in the overhang length input box.
- 25. Enter 300 in the overhang height input box.

26. Enter 20 in the applied load input box. The screen should look like the following:

Frame Material	Steel 🗸	
Youngs Modulus, E	207000	N/mm ²
Frame Section Width, b	25	mm
Frame Section Height, d	8	mm
Sec Moment of Area,I	1066.67	mm 4
Frame Length, L	600	mm
Frame Height, H	450	mm
Point of Applied Load	Vertical a & a 🗸 🗸	
Overhang Length, a	75	mm
Height of Overhang, h	300	mm
Applied Load, P	20	N
Actual Applied Load, P	0	N
Vertical Deflection at C	1.01902	mm
Actual Deflection at C	0	mm
Horizontal Deflect at B	-4.5856	mm
Actual Deflection at B		mm
Horizontal Deflect at D	0	mm
Actual Deflection at D	0	mm

27. Choose whether to create a new or append to a data file and then press the CALC button. The following screen will appear.



- 28. You will notice that the horizontal deflection only now appear at point B on the frame. This is because the load point a & a are linked with the deflection point B.
- 29. By applying the same procedure from list item 22 above it is possible to change the point of applied load which will then give the deflection values at point D also.
- 30. The software has been designed to follow the hardware instruction manual so please refer to this for further details.
- 31. When finished with the software shut the software down.
- 32. You can continue to adjust the inputs and see what outputs are

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

	HDA200	HDA200	
Sensor/Transducer	Connector	Channel	Resolution
	Number	number	
Load cell	Force 1	17	
Load cell	Force 2	18	
Dial Gauge	Dial gauge 1	28	0.01mm
Dial Gauge	Dial gauge 2	29	0.01mm

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

NB: ENSURE THAT ALL DIAL GAUGES ARE ATTACHED TO THE HDA200. THE DEFLECTION VALUES WILL NOT APPEAR IN THE SOFTWARE SCREEN IF THE DIAL GAUGES HAVE NOT BEEN CONNECTED.

- 1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button.
- 2. You will notice that the *Actual Applied Load, P; Actual Deflection at C* and *Actual Deflection at D* output lines are now live and not greyed out.
- 3. Repeat the same process with the ONLINE mode as the OFFLINE mode as detailed above.
- 4. Zero the dial gauges.
- 5. Load the hardware experiment as outlined in the hardware instruction manual. You should then be able to compare the actual values with the theoretical values.
- 6. If you wish to save the data into the existing data file or a new data file then tick the appropriate box.
- 7. Press the CALC button and you will be prompted to create a new data file or append to the existing file, depending on the option chosen.
- 8. The current input and output values will then be saved to the data file.
- 9. Press the NEW button when you need to change a value of one of the inputs.
- 10. Change that input.
- 11. Choose whether to create a new data file or append to an existing file.
- 12. Press CALC and the new outputs will be created.
- 13. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for the HST7S:

📕 TextFile.txt - Notepad		
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp		
08/10/2009 09:36:3 Point of Applied Load Modulus E 207000. Frame Section Width Frame Section Height Second Moment of Area Frame Length 600.00 Frame Height 450.00 Overhang Length 0.00 Height of Overhang	vertical C only 00 25.00 8.00	~
Applied Load 50.00 08/10/2009 09:38:3 Point of Applied Load Modulus E 207000. Frame Section Width Frame Section Height Second Moment of Area Frame Length 600.00 Frame Height 450.00 Overhang Length 0.00 Height of Overhang	Vertical C Only 00 25.00 8.00	
Applied Load 50.00	0.00	>

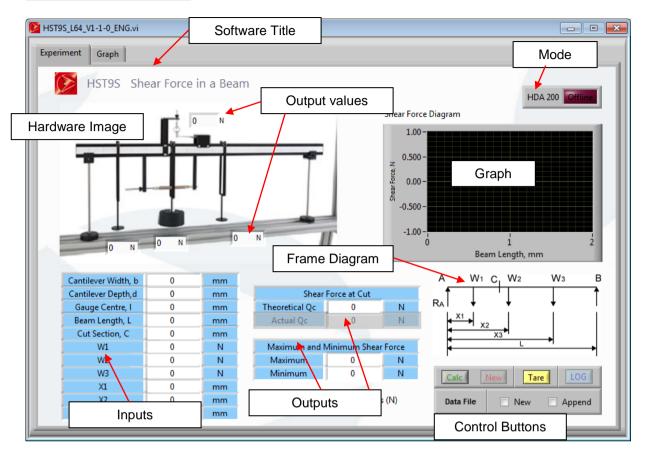
The data is as follows:

Date and time. Point of load chosen. Modulus of Elasticity, E of material chosen Frame section width chosen Frame section height chosen Second Moment of Area calculated Frame length chosen Frame height chosen Overhang length chosen Height of overhang chosen

All data appended to this file will be saved in this data file and can be viewed.

HST9S – SHEAR FORCE in a BEAM

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Beam Length:** this is the total beam length or the span of the supports. In the hardware manual this will be 900mm. It has the units of millimetres (mm).
- <u>**Cut section:**</u> This is the position of the cut section on the beam. On the hardware this is 300mm. It has the units of millimetres (mm).
- <u>W1</u>: this is value of the load applied to the weight hanger W1 with units of Newton's (N). Refer also to the frame diagram within the software window.
- <u>W2</u>: this is value of the load applied to the weight hanger W2 with units of Newton's (N). Refer also to the frame diagram within the software window.
- <u>W3</u>: this is value of the load applied to the weight hanger W3 with units of Newton's (N). Refer also to the frame diagram within the software window.
- <u>X1</u>: this is the horizontal position of W1 from the left hand support A. It has the units of millimetres (mm). Refer also to the frame diagram within the software window.
- <u>X2</u>: this is the horizontal position of W2 from the left hand support A. It has the units of millimetres (mm). Refer also to the frame diagram within the software window.
- <u>X3</u>: this is the horizontal position of W2 from the left hand support A. It has the units of millimetres (mm). Refer also to the frame diagram within the software window.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical. Again the format of the columns is the same as the inputs except that the central column is automatically updated depending on the inputs chosen and cannot be adjusted via the keyboard.</u>

The outputs available are as follows:

- **Theoretical Qc**: this is theoretical value of the shear force at the cut section based on the loadings of W1, W2 and W3 and the positions X1, X2 and X3. It has the units of Newton's (N).
- Actual Qc: When in ONLINE mode this is the actual value of shear from the hardware. It has the units of Newton's (N). NB: IN ORDER TO COMPARE THE ACTUAL RESULTS WITH THEORETICAL IT IS IMPORTANT THAT THE INPUTS OF THE SOFTWARE ARE SET TO THE SAME VALUES AS THE HARDWARE ARRANGEMENT. IF NOT THEN A COMPARISON IS NOT ACHIEVABLE.
- **Maximum**: This is the calculated maximum shear force based on the input parameters selected. This value is calculated and is used within the shear force diagram within the software screen. It has units of Newton's (N).
- **Minimum**: This is the calculated minimum shear force based on the input parameters selected. This value is calculated and is used within the shear force diagram within the software screen. It has units of Newton's (N).

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated.
- <u>**TARE**</u>: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from any strain gauges and load cell channels which are being used in the software.
- **LOG**: When the end user wishes to record any data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

Frame Diagram: This represents a schematic of the hardware arrangement and is a cross reference for the inputs. This will not be present on all experiment softwares.

<u>Graph</u>: If present it is possible to view data that is being captured or logged from the software. In this particular experiment the Shear Force diagram will be drawn based on the inputs chosen. You will also notice that in the top left corner of the software screen is a tab with Graph text written. Pressing this tab will bring up a new screen showing exactly the same graph as on the main software window.

<u>Output Values</u>: These values are the key output values from the hardware. They have been placed within the hardware image near the area they represent to give a guide to the end user.

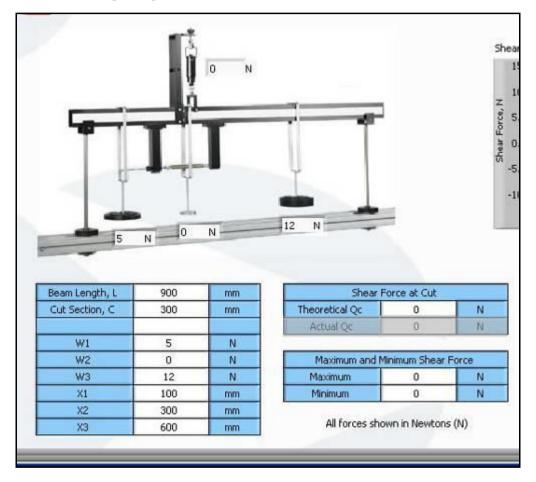
OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

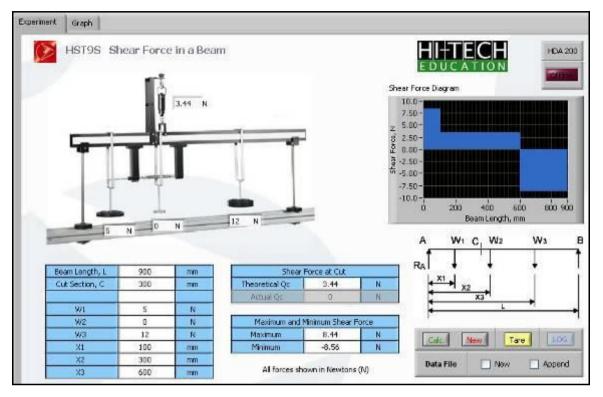
OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Enter 900 in the beam length input box.
- 4. Enter 300 in the cut section input box.
- 5. Enter 5 in the W1 input box.
- 6. Leave the value of W2 as zero.
- 7. Enter 12 in the W3 input box.
- 8. Enter 100 in the X1 input box
- 9. Enter 300 in the X2 input box.
- 10. Enter 600 in the X3 input box. The screen should now have inputs that look like the following image:

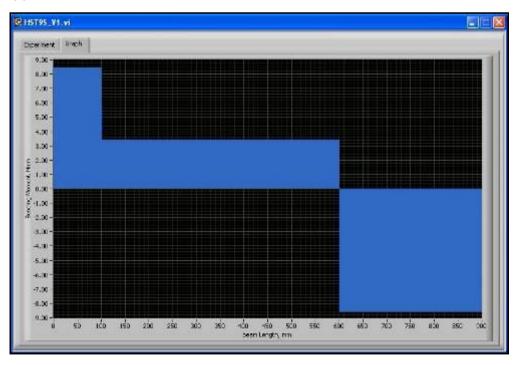


11. The values of W1, W2 and W3 will be seen in the output values on the hardware image.

12. Press the CALC button and the values will appear in the output boxes, on the hardware image and a shear force diagram will appear as shown in the image below:



- 13. There will be no value for the *Actual Qc* as the software has been chosen to run in OFFLINE mode.
- 14. Press the graph tab in the top left of the software screen and the following will appear:



15. This diagram will be a replica of the diagram on the main software window.

- 16. Return to the main software window by pressing on the experiment tab in the top left of the software window.
- 17. Right click in the graph display and choose clear chart. This then clears the chart for a new diagram to be created. If you do not clear the chart new graphs will be appended to this existing graph. Repeat this for the main graph window.
- 18. Tick the Data File NEW box.
- 19. Press CALC.
- 20. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	e to write.					? 🔀
Save jn:	C HST9S		•	00	📂 🛄 •	
My Recent Documents Desktop	instruction Manual HST95_V1.aliases HST95_V1.exe HST95_V1.ini					
My Documents						
My Computer						
	File <u>n</u> ame: Text	File.txt			~	ОК
My Network	Save as type: All Fi	les (*.*)			~	Cancel

- 21. Either rename the default name of TextFile.txt or keep this default name. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 22. A new shear force diagram will appear and the same values appear in the output boxes.
- 23. The input and output data will now be saved in the data file created.
- 24. Clear the graph again, and then tick the Data File APPEND box. Press CALC and then choose the same data file as created previously. The current input and output data will now be appended to this file without overwriting the original data.
- 25. Locate this text file and open in NOTEPAD to see the format and information that it is saving.

- 26. If you wish to change the inputs then simply clear the graphs, change the input, choose whether to create a new data file or append to an existing file and then press CALC.
- 27. In the OFFLINE mode the NEW and TARE buttons although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 28. When finished with the software shut the software down.
- 29. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Strain	Strain1	1	

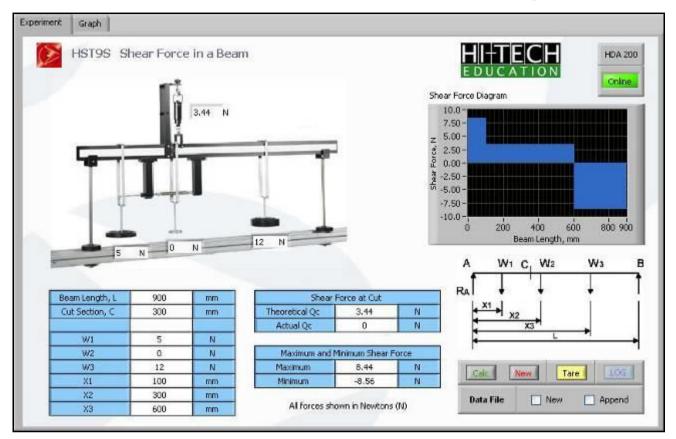
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. You will notice that the Actual Qc output line is now live and not greyed out.
- 3. You will now see the actual value of the shear force coming from the hardware within the Actual Qc output box. To zero this reading simply press the TARE button. You may have to press it again if the reading does not return to zero.
- 4. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual Qc value with the theoretical value.
- 5. If you wish to save the data into the existing data file or a new data file then press the NEW button. The value in the Actual Qc output box will change due to the fact that the software is not retrieving the actual value from the hardware.
- 6. Clear the graph.
- 7. Tick the data file option required.

- 8. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 9. The current input and output values will then be saved to the data file.
- 10. Press the NEW button when you need to change a value of one of the inputs.
- 11. Change the input.
- 12. Clear the graphs.
- 13. Choose whether to create a new data file or append to an existing file.
- 14. Press CALC and the new outputs will be created along with a graph.
- 15. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for the HST9S:

🖪 TextFile.txt - I	otepad	
Eile Edit Format	ljew Help	
L7/02/2009 Beam Length Cut Section W1 5.00 W2 0.00 W3 12 X1 100 X2 300 X3 600 0 8.44 1 8.44 2 8.44 4 8.44 5 8.44 4 8.44 5 8.44 6 8.44 7 8.44 10 8.44 11 8.44 12 8.44 10 8.44 11 8.44 12 8.44 13 8.44 13 8.44 14 8.44 15 8.44 15 8.44 15 8.44 15 8.44 16 8.44 17 8.44 19 8.44 19 8.44 19 8.44 20 8.44 21 8.44 22 8.44 23 8.44 23 8.44 24 8.44 25 8.44 25 8.44 26 8.44 27 8.44 28 8.44	15:18:22 900 300.00	
28 8.44		

The data is as follows:

Date and time. Beam length input value from software. Cut section input value from software. W1 value from software W2 value from software W3 value from software X1 value from software X2 value from software X3 value from software

The next two columns relate to the data from the shear force diagram.

The left hand column are incremental points going across the beam length starting at 0 (zero) and ending at the beam length stated in the input, i.e. 900mm.

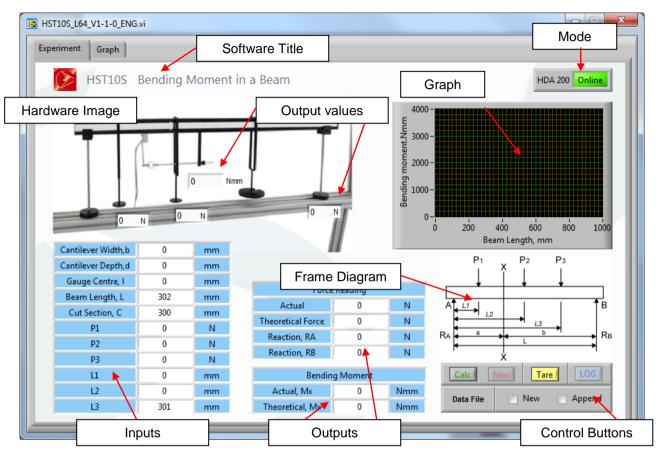
The right hand column is the shear force value going across the beam length for each increment. You will notice that the first and last values in this column are the same as the maximum and minimum shear force values shown in the output boxes of the software window.

Scrolling down these columns will also show the shear force value at the cut section.

All data appended to this file will be saved in this data file and can be viewed.

HST10S - BENDING MOMENTS in a BEAM

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image:</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- <u>Cantilever Width:</u> This is the width of the strain gauged cantilever on the hardware. This is nominally 9.525mm but will need to be measured from the hardware. It has the units of millimetres (mm).
- <u>Cantilever Depth</u>: This is the depth of the strain gauged cantilever on the hardware. This is nominally 3.175mm but will need to be measured from the hardware. It has the units of millimetres (mm).
- <u>Gauge Centre</u>: This is the distance from the centre line of the strain gauge on the cantilever to the centreline of the hole in the free end of the cantilever. This is nominally 48mm but will need to be measured from the hardware. It has the units of millimetres (mm).
- <u>Beam Length</u>: this is the total beam length or the span of the supports. In the hardware manual this will be 900mm. It has the units of millimetres (mm).
- <u>**Cut section:**</u> This is the position of the cut section on the beam. On the hardware this is 300mm. This input is fixed at 300mm. It has the units of millimetres (mm).
- <u>P1</u>: this is value of the load applied to the weight hanger P1 with units of Newton's (N). Refer also to the frame diagram within the software window.
- <u>P2</u>: this is value of the load applied to the weight hanger P2 with units of Newton's (N). Refer also to the frame diagram within the software window.
- <u>P3</u>: this is value of the load applied to the weight hanger P3 with units of Newton's (N). Refer also to the frame diagram within the software window.
- <u>L1</u>: this is the horizontal position of P1 from the left hand support A. It has the units of millimetres (mm). Refer also to the frame diagram within the software window. This input is fixed between 0 and 299mm.
- <u>L2</u>: this is the horizontal position of P2 from the left hand support A. It has the units of millimetres (mm). Refer also to the frame diagram within the software window.
- <u>L3</u>: this is the horizontal position of P3 from the left hand support A. It has the units of millimetres (mm). Refer also to the frame diagram within the software window. This input is fixed between 301 and 900mm

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical. Again the format of the columns is the same as the inputs except that the central column is automatically updated depending on the inputs chosen and cannot be adjusted via the keyboard.</u>

The outputs available are as follows:

- Actual: this is the actual force reading from the hardware. It has the units of Newton's (N).
- **Theoretical Force**: This is theoretical value of the bending force at the cut section based on the loadings of P1, P2 and P3 and the positions L1, L2 and L3. It has the units of Newton's (N).
- **Reaction RA**: This is a theoretical value for the reaction at support A based on the value of the loads and their positions on the beam. It has the units of Newton's (N).

Reaction RB: This is a theoretical value for the reaction at support B based on the value of the loads and their positions on the beam. It has the units of Newton's (N).

- Actual Mx: When in ONLINE mode this is the actual value of the bending moment from the hardware. It has the units of Newton millimetres (Nmm). NB: IN ORDER TO COMPARE THE ACTUAL RESULTS WITH THEORETICAL IT IS IMPORTANT THAT THE INPUTS OF THE SOFTWARE ARE SET TO THE SAME VALUES AS THE HARDWARE ARRANGEMENT. IF NOT THEN A COMPARISON IS NOT ACHIEVABLE.
- **Theoretical Mx**: This is the theoretical value of the bending moment for the hardware arrangement. It has the units of Newton millimetres (Nmm).

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **<u>CALC</u>**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated.
- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from any strain gauges and load cell channels which are being used in the software.
- **LOG**: When the end user wishes to record any data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

Frame Diagram: This represents a schematic of the hardware arrangement and is a cross reference for the inputs. This will not be present on all experiment softwares.

<u>**Graph</u>**: If present it is possible to view data that is being captured or logged from the software. In this particular experiment the bending moment diagram will be drawn based on the inputs chosen. You will also notice that in the top left corner of the software screen is a tab with Graph text written. Pressing this tab will bring up a new screen showing exactly the same graph as on the main software window.</u>

<u>Output Values</u>: These values are the key output values from the hardware. They have been placed within the hardware image near the area they represent to give a guide to the end user.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

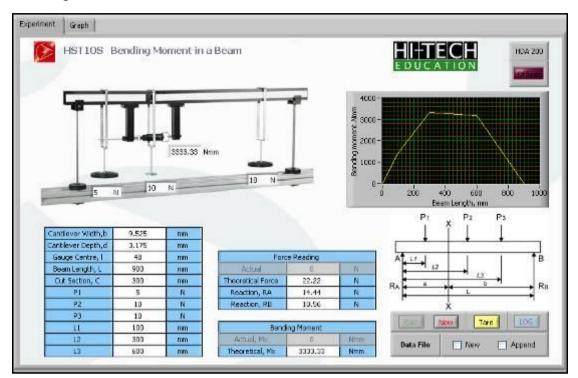
It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

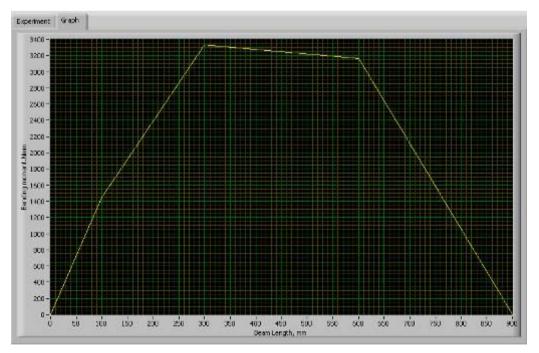
- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. You will notice that there a number of the input and output boxes with the letters NaN shown. This is because there have been no values input or output since starting up the software. These will be removed once values have been input.
- 4. Enter 9.525 in the cantilever width input box.
- 5. Enter 3.175 in the cantilever depth input box.
- 6. Enter 48 in the gauge centre input box.
- 7. Enter 900 in the beam length input box.
- 8. Enter 300 in the cut section input box.
- 9. Enter 5 in the P1 input box.
- 10. Enter 10 in the P2 input box.
- 11. Enter 10 in the P3 input box.
- 12. Enter 100 in the L1 input box
- 13. Enter 300 in the L2 input box.
- 14. Enter 600 in the L3 input box. The screen should now have inputs that look like the following image:

	-	-		-17
5 1		3333.33 M	Vmm	
Cantilever Width,b	9,525	mm		
Cantilever Width,b Cantilever Depth,d	9,525 3.175	mm mm		
			Forc	e Reading
Cantilever Depth,d	3.175	mm	Forc	e Reading
Cantilever Depth,d Gauge Centre, I	3.175 48	mm mm		
Cantilever Depth,d Gauge Centre, I Beam Length, L	3.175 48 900	mm mm mm	Actual	0
Cantilever Depth,d Gauge Centre, I Beam Length, L Cut Section, C	3.175 48 900 300	mm mm mm	Actual Theoretical Force	0 22.22
Cantilever Depth,d Gauge Centre, I Beam Length, L Cut Section, C P1	3.175 48 900 300 5	mm mm mm N	Actual Theoretical Force Reaction, RA	0 22.22 14.44
Cantilever Depth,d Gauge Centre, I Beam Length, L Cut Section, C P1 P2	3.175 48 900 300 5 10	mm mm mm N N	Actual Theoretical Force Reaction, RA Reaction, RB	0 22.22 14.44 10.56
Cantilever Depth,d Gauge Centre, I Beam Length, L Cut Section, C P1 P2 P3	3.175 48 900 300 5 10 10	mm mm mm N N N N	Actual Theoretical Force Reaction, RA Reaction, RB	0 22.22 14.44

- 15. The values of P1, P2 and P3 will be seen in the output values on the hardware image.
- 16. Press the CALC button and the values will appear in the output boxes, on the hardware image and a bending moment diagram will appear as shown in the image below:



- 17. There will be no value for the *Actual Force* and *Actual Mx* output boxes as the software has been chosen to run in OFFLINE mode.
- 18. Press the graph tab in the top left of the software screen and the following will appear:



- 19. This diagram will be a replica of the diagram on the main software window.
- 20. Return to the main software window by pressing on the experiment tab in the top left of the software window.
- 21. Tick the Data File NEW box.
- 22. Press CALC.
- 23. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.				? 🔀
Savejn:	🔁 HST9S		• (3 🕸 📂 🛄-	
My Recent Documents	Instruction Mar HST95_V1.alia: HST95_V1.exe HST95_V1.ini	ses			
Desktop					
My Documents					
My Computer					
	File <u>n</u> ame:	T extFile.txt		~	ОК
My Network	Save as <u>type</u> :	All Files (*,*)		*	Cancel

- 24. Either rename the default name of TextFile.txt or keep this default name. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 25. A new diagram will appear and the same values appear in the output boxes.
- 26. The input and output data will now be saved in the data file created.
- 27. Tick the Data File APPEND box. Press CALC and then choose the same data file as created previously. The current input and output data will now be appended to this file without overwriting the original data.
- 28. Locate this text file and open in NOTEPAD to see the format and information that it is saving.
- 29. If you wish to change the inputs then simply change the input, choose whether to create a new data file or append to an existing file and then press CALC.
- 30. In the OFFLINE mode the NEW and TARE buttons although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 31. When finished with the software shut the software down.
- 32. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Strain	Strain 1	1	

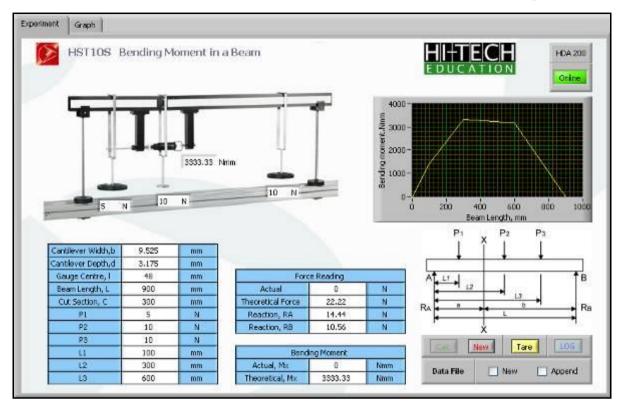
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. You will notice that the *Actual* force and *Actual Mx* output line is now live and not greyed out.
- 3. You will now see the actual value of the bending force coming from the hardware within the *Actual* force output box. To zero this reading simply press the TARE button. You may have to press it again if the reading does not return to zero.
- 4. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the *Actual Mx* value with the theoretical value.
- 5. If you wish to save the data into the existing data file or a new data file then press the NEW button. The value in the *Actual Mx* output box will change due to the fact that the software is not retrieving the actual value from the hardware.
- 6. Tick the data file option required.
- 7. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 8. The current input and output values will then be saved to the data file.
- 9. Press the NEW button when you need to change a value of one of the inputs. 10. Change the input.
- 11. Choose whether to create a new data file or append to an existing file.
- 12. Press CALC and the new outputs will be created along with a graph.
- 13. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for the HST9S:

🖡 TextFile - Notepad				
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u>	<u>l</u> elp			
Cantilever Width,b Cantilever Depth,d Gauge Centre, 1 48. Beam Length 900	0 mm 0.00 mm 44 Nmm 33 Nmm			

The data is as follows:

Date and time.

Cantilever width input value from software Cantilever depth input value from software Gauge centre input value from software Beam length input value from software. Cut section input value from software. P1 value from software P2 value from software P3 value from software L1 value from software L2 value from software L3 value from software

The next two columns relate to the data from the bending moment diagram.

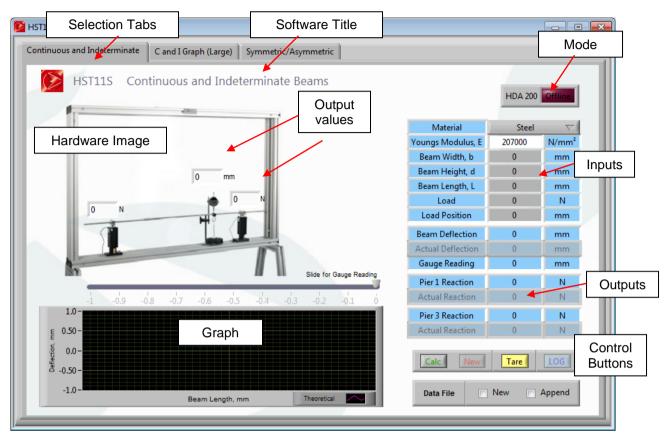
The left hand column are incremental points going across the beam length starting at 0 (zero) and ending at the beam length stated in the input, i.e. 900mm. The right hand column is the bending moment value going across the beam length for each increment.

You will see the bending moment value at the cut section.

All data appended to this file will be saved in this data file and can be viewed.

HST11S – CONTINUOUS & INDETERMINATE BEAMS

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

<u>Material</u>: The user can choose the frame material. Choices range from steel, aluminium and brass. When a material is chosen the young's modulus is automatically chosen and displayed in the input box below.

- **Beam Width, b:** This is the width of the beam. Typically this will be 25mm. It has the units of millimetres (mm).
- **Beam Height, d**: This is the height of the beam. Typically this is 3 or 5mm. It has the units of millimetres (mm).
- **Beam Length**, L: This is the length (or span) of the beam. It has the units of millimetres (mm).
- **Frame Height, H**: This is the height of the frame from the knife edge and roller bearing centre line to the centreline of the top horizontal member. This is typically 450mm. It has the units of millimetres (mm).
- Load: This is the value of the applied load on the beam. It has the units of Newton (N)
- <u>Load Position</u>: This is position of the load along the beam. This will have a value that is in between the beam length (or span). It has the units of millimetres (mm).

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical. Again the format of the columns is the same as the inputs except that the central column is automatically updated depending on the inputs chosen and cannot be adjusted via the keyboard.</u>

The outputs available are as follows:

- **Beam Deflection**: This is the theoretical beam deflection value at the point of loading. This is a calculated value. It has the units of millimetres (mm).
- <u>Actual Deflection</u>: This is the actual value of the beam deflection coming from the dial gauge attached to the hardware. It has the units of millimetres (mm).
- <u>Gauge Reading</u>: A slide is available along the top of the graph. This slider traverses the beam span and allows the end user to get an idea of the beam deflection at whatever position along the beam span. This will enable the maximum beam deflection to be monitored also. As the slider moves so does this value. It has the units of millimetres (mm).
- **Pier 1 Reaction**: This is the theoretical value for the reaction at pier 1. The hardware will have the piers labelled. This value will depend on the magnitude and value of the load. It has the units of Newton's (N).
- Actual Reaction: This is the actual value of the reaction at pier 1 coming from the hardware itself. It has the units of Newton's (N).
- **Pier 3 Reaction**: This is the theoretical value for the reaction at pier 3. The hardware will have the piers labelled. This value will depend on the magnitude and value of the load. It has the units of Newton's (N).
- Actual Reaction: This is the actual value of the reaction at pier 3 coming from the hardware itself. It has the units of Newton's (N).

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

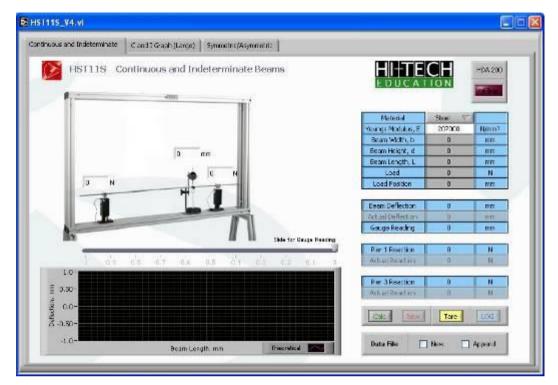
- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated.
- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from any strain gauges and load cell channels which are being used in the software.
- **LOG**: When the end user wishes to record any data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

<u>Slider:</u> To view the deflection at a particular point along the beam, other than at the load point, this slider will allow this. By moving it across the beam span the deflection can then be read off from the *Gauge reading* output box.

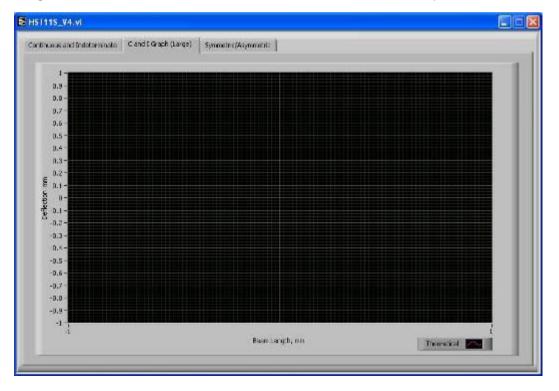
<u>Output Values</u>: These values are the key output values from the hardware. They have been placed within the hardware image near the area they represent to give a guide to the end user.

<u>Selection Tabs</u>: To operate another element of the HST11S experiment or show the graph the selection tabs at the top of the screen can be chosen.

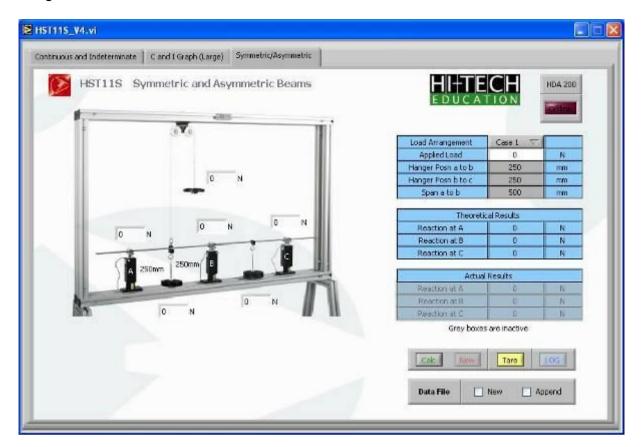
Selecting the first tab (labelled Continuous and Indeterminate) will bring up the software screen for the Continuous and Indeterminate Beam as shown below:



Selecting the second tab (labelled C and I Graph (Large)) will bring up the larger version of the graph shown on the Continuous and Indeterminate software screen. This graph represents the displacement of the beam for the magnitude and position of loading chosen. This will be created when the CALC button is pressed.



Selecting the third tab (Symmetric/Asymmetric) will bring up the software screen for the symmetric and asymmetric part of the hardware experiment as shown in the image below.



OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

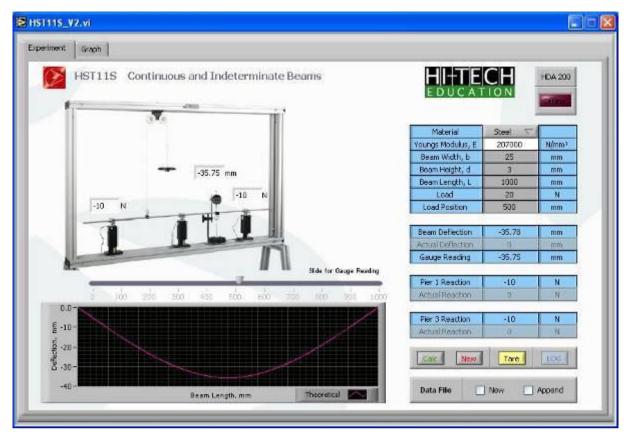
It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Enter 25 in the beam width input box.
- 4. Enter 3 in the beam height input box.
- 5. Enter 1000 in the beam length input box.
- 6. Enter 20 in the load input box.
- 7. Enter 500 in the load position input box. The screen should now have inputs that look like the following image:

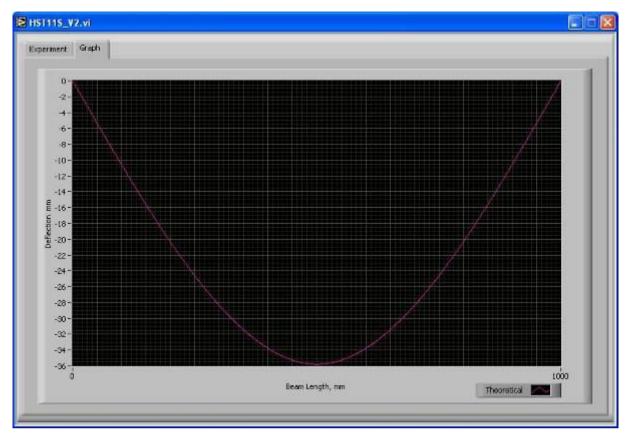
Material	Steel 🔽	
Youngs Modulus, E	207000	N/mm ²
Beam Width, b	25	mm
Beam Height, d	3	mm
Beam Length, L	1000	mm
Load	20	N
Load Position	500	mm
Beam Deflection	-35.78	mm
Actual Deflection	0	mm
Gauge Reading	-35.75	mm
Pier 1 Reaction	-10	N
Actual Reaction	0	N
Pier 3 Reaction	-10	N
		N

8. Press the CALC button and the values will appear in the output boxes, on the hardware image and a graph will be drawn as shown in the image below:



- 9. There will be no value for the *Actual Deflection and Actual Reactions* as the software has been chosen to run in OFFLINE mode.
- 10. Move the slider from left to right. You will see the value of the gauge reading change both in the output box in the table and on the hardware image. This shows the deflection of the beam at the position at the which the slider is located.

11. Press the graph tab in the top left of the software screen and the following will appear:



- 12. This diagram will be a replica of the graph on the main software window.
- 13. Return to the main software window by pressing on the experiment tab in the top left of the software window.
- 14. Right click in the graph display and choose clear chart. This then clears the chart for a new diagram to be created. If you do not clear the chart new graphs will be appended to this existing graph. Repeat this for the main graph window.
- 15. Press the NEW button. You will be prompted to clear charts. Do this.
- 16. Tick the Data File NEW box.
- 17. Press CALC.

18. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	ile to write.	? 🔀
Save jn:	🔁 HST9S 💽 🕝 🔊 🛤	•
My Recent Documents	Instruction Manual HST95_V1.aliases HST95_V1.exe HST95_V1.ini	
Desktop		
My Documents		
My Computer		
	File <u>n</u> ame: TextFile.txt	ОК
My Network	Save as type: All Files (*.*)	Cancel

- 19. Either rename the default name of TextFile.txt or keep this default name. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 20. A new graph will appear and the same values appear in the output boxes.
- 21. The input and output data will now be saved in the data file created.
- 22. Press the NEW button, clear the graphs, and then tick the Data File APPEND box. Press CALC and then choose the same data file as created previously. The current input and output data will now be appended to this file without overwriting the original data.
- 23. Locate this text file and open in NOTEPAD to see the format and information that it is saving.
- 24. If you wish to change the inputs then simply press the NEW button, clear the graphs, change the input, choose whether to create a new data file or append to an existing file and then press CALC.
- 25. In the OFFLINE mode the NEW and TARE buttons although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 26. When finished with the software shut the software down.
- 27. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Load cell	Force 1	17	
Load cell	Force 2	18	
Load cell	Force 3	19	
Dial Gauge	Dial gauge 1	28	0.01mm
Dial Gauge	Dial gauge 2	29	0.01mm
Dial Gauge	Dial gauge 3	30	0.01mm

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

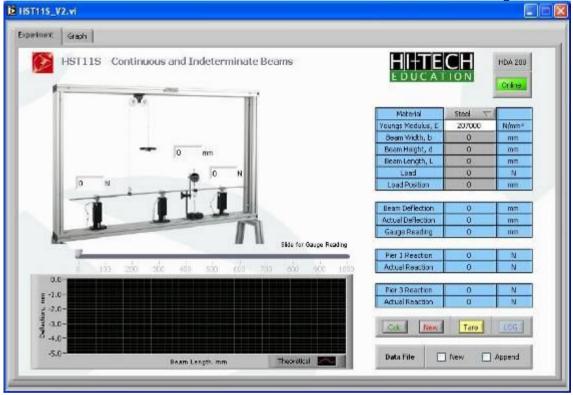
If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

NB: BEFORE RUNNING THE SOFTWARE IN ONLINE MODE MAKE SURE THERE IS A SINGLE DIAL GAUGE CONNECTED INTO DIAL GAUGE CHANNEL1 AND THE REACTION PIERS 1 and 3 CONNECTED INTO CHANNEL 17 AND 19 OF THE HDA200.

THIS EXPEIRMENT WILL UNDERTAKE PARTS 1 and 2 OF THE HARDWARE INSTRUCTION MANUAL.

14. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 1. You will notice that there are no greyed out boxes on this screen.
- 2. You will now see the actual value of the dial gauge deflection and pier reactions coming from the hardware. To zero the reaction pier readings simply press the TARE button. You cannot tare the dial gauge readings with this button. You will have to tare the dial gauges using their front panel buttons.
- 3. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with the theoretical values.
- 4. If you wish to save the data into the existing data file or a new data file then press the NEW button.
- 5. Clear the graph.
- 6. Tick the data file option required.
- 7. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 8. The current input and output values will then be saved to the data file.
- 9. Press the NEW button when you need to change a value of one of the inputs.

- 10. Change the input.
- 11. Clear the graphs.
- 12. Choose whether to create a new data file or append to an existing file.
- 13. Press CALC and the new outputs will be created along with a graph.
- 14. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in spreadsheet software.

The image below shows the typical data at the start of the data file for the HST11S:

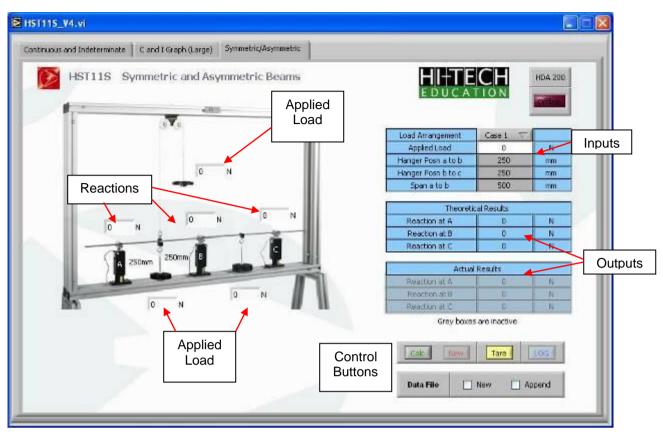
The data is as follows:	TextFile.txt - Notepad	
Date and time. Modulus of elasticity of beam material chosen from software.	Ele Edit Format View Help 09/10/2009 11:43:39 Modulus 207000 width 25.00 Height 3.00 Length 1000.00	
Beam width input value from software. Beam height input value from software	Load 20 Position 500 0 0.00 1 -0.11 2 -0.21 3 -0.32	
Beam length (or span) input value from software Load input value from	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	
software Position of load from software	11 -1.18 12 -1.29 13 -1.40 14 -1.50 15 -1.61	
The next two columns are described as follows:	16 -1.72 17 -1.82 18 -1.93 19 -2.04 20 -2.15 21 -2.25	
Column 1 : Beam span in increments of 1mm. The lowest value will be zero (0) and the maximum value will be whatever value of beam length has been chosen from the software.	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	
Column 2: Beam		M

deflection values for the particular beam span it relates to.

From these two columns it is possible to recreate the beam deflection shape.

All data appended to this file will be saved in this data file and can be viewed.

SYMMETRIC/ASYMMETRIC Software Screen

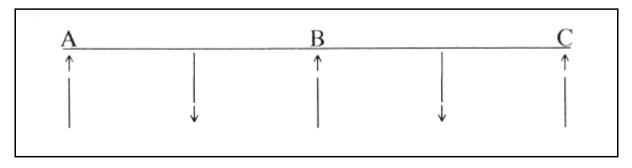


In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

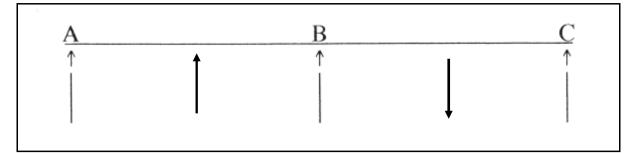
The inputs available are as follows:

- **Load Arrangement:** The user can choose the load arrangement from the drop down list. Three options are presented; Case 1; Case 2; Case 3.

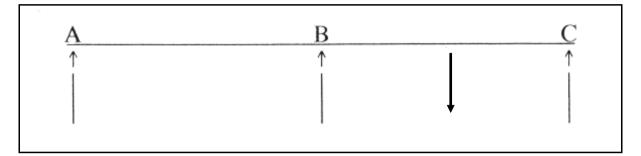


Case 1:

Case 2:



Case 3:



The difference between the load arrangements are the position and orientation of the applied load each time.

As each case is chosen the loading shown on the hardware image will also be seen to change. The value of the load shown is the same as the value entered in the applied load input box.

- **Applied Load:** This is the value of the applied load added to the relevant hanger for the case chosen.
- <u>Hanger Posn a to b</u>: This is the distance form the reaction pier A to the load hanger which is situated between reaction pier A and B from. This is a fixed value and not editable. It has the units of millimetres (mm).
- <u>Hanger Posn b to c</u>: This is the distance from the reaction pier B to the load hanger which is situated between reaction pier B and C. This is a fixed value and not editable. It has the units of millimetres (mm).
- <u>Span a to b</u>: This is the distance between the reactions piers A and B and also B and C. This is a fixed value and not editable. It has the units of millimetres (mm).

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical. Again the format of the columns is the same as the inputs except that the central column is automatically updated depending on the inputs chosen and cannot be adjusted via the keyboard.</u> The outputs available are as follows:

Theoretical Results. Offline mode only.

- **<u>Reaction at A</u>**: This is the value of the reaction from reaction pier A. It has the units of Newton's (N).
- **<u>Reaction at B</u>**: This is the value of the reaction from reaction pier A. It has the units of Newton's (N).
- <u>Reaction at C</u>: This is the value of the reaction from reaction pier A. It has the units of Newton's (N).

Actual Results. Online mode only.

- **<u>Reaction at A</u>**: This is the value of the reaction from reaction pier A. It has the units of Newton's (N).
- **<u>Reaction at B</u>**: This is the value of the reaction from reaction pier A. It has the units of Newton's (N).
- <u>Reaction at C</u>: This is the value of the reaction from reaction pier A. It has the units of Newton's (N).

OFFLINE MODE – Symmetric/Asymmetric

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose Case 1 from the drop down list.
- 4. Enter 20 in the applied load input box.
- 5. Press the CALC button. The screen should now have inputs that look like the following image:

	Case 1 🗸	Load Arrangement
N	20	Applied Load
mm	250	Hanger Posn a to b
mm	250	Hanger Posn b to c
mn	500	Span a to b
	al Results	Theoretic
N	6.25	Reaction at A
N	27.5	Reaction at B
N	6.25	Reaction at C
	Results	Actual
N	0	Reaction at A
N	0	Reaction at B
N	0	Reaction at C

6. The main software screen should look like the following:

51115_¥4.vi					
ontinuous and Indeterminate	C and I Graph (Large)	Symmetric/Asymmetric			
MST11S Sy	mmetric and Asy	ymmetric Beams	HI-TE		HDA 200
1	070		Load Arrangement	Case 1 🖵	
			Appled Load	20	N
	0		Hanger Posn a to b	250	mm
			Hanger Posn b to c	250	mm
			Span a to b	500	mm
		6.2 N	Theoreti	cal Results	
6.2	27.5	N (0.2 N	Reaction at A	6.25	N
0.2	1	- 2	Reaction at B	27.5	N
	1.1	C	Reaction at C	6.25	N
) A ²⁵	0mm 250mm B		Actua	Results	
			Reattion at A	e	N
4		20 N	Reaction at 8	D	N
1000	20 N		Readion at C	0	N
			Grey boxes	s are inactive	
			Data File	Tare	os.

- 7. There will be no value for the Actual results reactions as the software has been chosen to run in OFFLINE mode.
- 8. You will notice on the hardware image that the applied load is shown in the two boxes underneath the hardware image and the reactions shown next to the relevant reaction pier.
- 9. Press the NEW button.
- 10. Tick the Data File NEW box.
- 11. Press CALC.

12. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	e to write.			? 🔀
Save jn:	C HST9S	· 3	1 🖻 🛄	•
My Recent Documents	Instruction Manual HST95_V1.aliases HST95_V1.exe HST95_V1.ini			
Desktop				
) My Documents				
My Computer				
	File <u>n</u> ame: TextFile.txt		~	ОК
My Network	Save as type: All Files (*,*)		*	Cancel

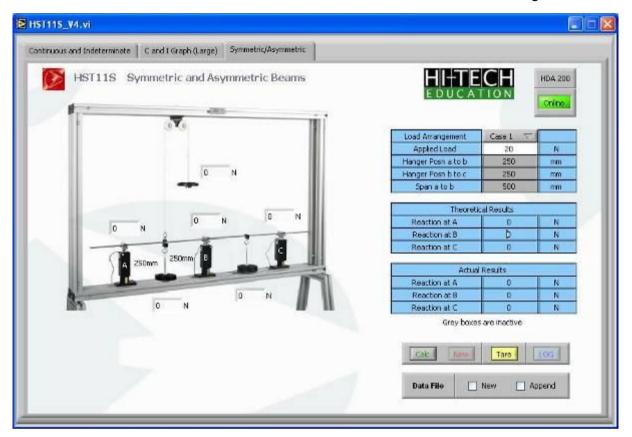
- 13. Either rename the default name of TextFile.txt or keep this default name. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 14. A new graph will appear and the same values appear in the output boxes.
- 15. The input and output data will now be saved in the data file created.
- 16. Press the NEW button, clear the graphs, and then tick the Data File APPEND box. Press CALC and then choose the same data file as created previously. The current input and output data will now be appended to this file without overwriting the original data.
- 17. Locate this text file and open in NOTEPAD to see the format and information that it is saving.
- 18. If you wish to change the inputs then simply press the NEW button, clear the graphs, change the input, choose whether to create a new data file or append to an existing file and then press CALC.
- 19. In the OFFLINE mode the NEW and TARE buttons although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 20. When finished with the software shut the software down.
- 21. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

ONLINE MODE

NB: BEFORE RUNNING THE SOFTWARE IN ONLINE MODE MAKE SURE THERE ARE NO DIAL GUAGES SELECTED AND THE REACTION PIERS 1, 2 and 3 ARE CONNECTED INTO CHANNELS 17, 18 AND 19 RESPECTIVELY OF THE HDA200.

THIS EXPEIRMENT WILL UNDERTAKE PART 10 OF THE HARDWARE INSTRUCTION MANUAL.

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. You will notice that there are no greyed out boxes on this screen.
- 3. You will now see the actual values of the reactions coming from the hardware. To zero the reaction pier readings simply press the TARE button.
- 4. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with the theoretical values.
- 5. If you wish to save the data into the existing data file or a new data file then press the NEW button.
- 6. Clear the graph.
- 7. Tick the data file option required.
- 8. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 9. The current input and output values will then be saved to the data file.
- 10. Press the NEW button when you need to change a value of one of the inputs.
- 11. Change the input.

- 12. Clear the graphs.
- 13. Choose whether to create a new data file or append to an existing file.
- 14. Press CALC and the new outputs will be created along with a graph.
- 15. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

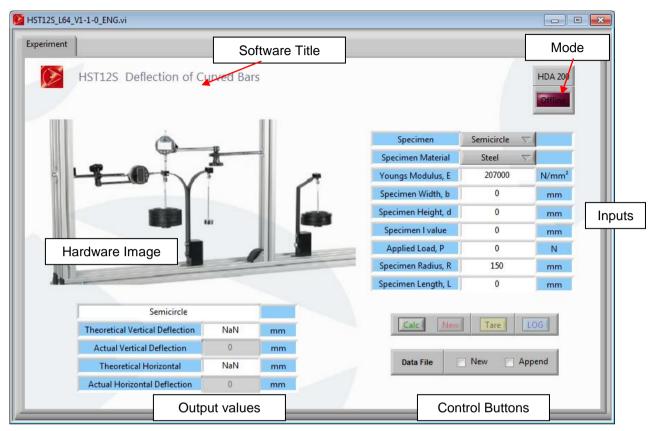
The data file created contains information that is useful in allowing the end user to further manipulate the data in spreadsheet software.

The image below shows the typical data at the start of the data file for the HST11S:

The data is as	📕 test file 11_5_10.txt - Notepad	
follows:	<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp	
Date and time. Software version Selection tab Load arrangement Applied load Theoretical Results Actual Results From these two columns it is possible to recreate the beam deflection shape.	ElleEditFormatYiewHelp11/05/201013:47:27S/WVer:HST11S_V4SymmeBeamsLoad20.00NLoadarrangementCaseAppliedLoad20.00NPosn.a/b250.00mmPosn.b/c250.00mmSpana/b500.00mmTheoreticalresultsReaction at A6.25NReactionat C6.25NNReactionat C-23.7ReactionAReactionat C-11.711/05/201013:51:01S/WVer:HST11S_V4SymmeBeamsLoad20.00NLoadarrangementCaseAppliedLoad20.00NPosn.a/b250.00mm	etric and Asymmetric 1 Symmetric etric and Asymmetric 2 Symmetric
to this file will be saved in this data file and can be viewed.	Theoretical results Reaction at A -10.00 N Reaction at B 0.00 N Reaction at C 10.00 N Actual results Reaction at A -24.8 Reaction at B -0.3 Reaction at C -14.1 11/05/2010 13:51:55 S/W Ver: HST11S_V4 Symme Beams	etric and Asymmetric 3 Asymmetric •

HST12S – DEFLECTION of CURVED BARS

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image:</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Specimen Tabs: This software allows the channel and semicircle specimens to be presented.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Specimen:** Choose the specimen type. Choices are Semicircle, SemiC bracket, quadrant, single davit, double davit and bent davit.
- **Specimen material:** Choose the specimen material.
- Young's Modulus, E: This changes automatically with the material choice.
- **Specimen Width**, **b**: Enter the specimen width in millimetres.
- **Specimen Height, d**: Enter the specimen height in millimetres.
- **Specimen I value**: This is the calculated theoretical second moment of area for the specimen based on the details entered above.
- **Applied Load, P**: Enter the applied load to the specimen in Newton's.
- **Specimen Radius, R**: Depending on the specimen chosen this value will change automatically.
- **Specimen Length, L**: Depending on the specimen chosen this value will change automatically.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Theoretical Vertical Deflection</u>: This is the calculated theoretical vertical deflection for the specimen chosen based on the geometry and loading entered.
- <u>Actual Vertical Deflection</u>: This is the actual vertical deflection from the hardware via the HDA200. In offline mode this value will be greyed out.
- **<u>Theoretical Horizontal Deflection</u>**: This is the calculated theoretical horizontal deflection for the specimen chosen based on the geometry and loading entered.
- <u>Actual Horizontal Deflection</u>: This is the calculated theoretical Horizontal deflection for the specimen chosen based on the geometry and loading entered. In offline mode this value will be greyed out.

<u>Control buttons</u>: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **<u>CALC</u>**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this button or the append button, not both.
- <u>Data file APPEND</u>: If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select the specimen.
- 4. Select the specimen material. The E value will change automatically.
- 5. Enter 25 in the specimen width input box.
- 6. Enter 3 in the specimen height input box.
- 7. Enter 20 in the applied load input box.
- 8. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Specimen	Semicircle 🗸 🗸	
Specimen Material	Steel 💎	
Youngs Modulus, E	207000	N/mm ²
Specimen Width, b	25	mm
Specimen Height, d	3	mm
Specimen I value	56.25	mm
Applied Load, P	20	N
Specimen Radius, R	150	mm
Specimen Length, L	0	mm

You will notice that the specimen radius is already filled in. This is the relevant dimension for the semi-circle specimen.

9. The complete screen should look like the following image:

<u>ی</u>						
periment						
м м	T12S Deflection of Curved	Bars		HI-T EDUC		HDA 200
	¢-+			Spectmen	Semiarcle 🗸	
	S AL			Spedmen Material	Steel 🤝	
		- 11	~	Youngs Modulus, E	207000	N/mm2
				Specimen Width, b	25	1007
100				Speamen Height, d	3	nom
10.01	10	- 14		Specimen I value	56.25	mm
		- 10		Applied Load, P	20	N
			4	Specimen Radius, R	150	mm
121				Spedmen Length, L	0	mm
h	Semithicle Theoretical Vertical Deflection Actual Vertical Deflection Theoretical Vergental Deflection	9.11 0 11.59		Cat: Now		221
	Theoretical Horizonital Defiection	11.59	Jon.	Data File	New Apper	net i i
	Actual Horizontal Deflection	D	mm	Datathe	Tracia Tubbe	

- 10. The theoretical deflections will be shown in the output boxes. The actual deflections will be greyed out. This is because you are in 'OFFLINE' mode.
- 11. Press the NEW button
- 12. Tick the Data File NEW box.
- 13. Press CALC.

14. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.					? 🛛
Save jn	🗁 НՏТ95		*	000	• 🖽 •	
My Recent Documents Desktop	Instruction Mi HST9S_V1.ali HST9S_V1.ex HST9S_V1.ini	ases e				
My Documents						
My Computer						
	File name:	TextFile.bd		~		ОК
My Network	Save as type:	All Files (*.*)		~	Ca	incel

- 15. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 16. The input and output data will now be saved in the data file created. To prove this open the text file in **NOTEPAD** that you have just created from its location and check the contents. It should look similar to the image below.

HST12S_V3_test file_pji_8	_3_10_o1	fline_se	
<u>Fi</u> le <u>E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp			
08/03/2010 12:35:2 Software Version Specimen Semicir Material Steel Modulus 207000 N/mm2 width 25.00 mm Height 3.00 mm I Value 56.25 mm Applied Load 20.00 Radius 150.00 mm Length 0.00 mm Vertical Deflect Horizontal Deflect	HST125_	_V3 mm mm	

- 17. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 18. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 19. In the OFFLINE mode the LOG button will be greyed out.
- 20. When finished with the software shut the software down.
- 21. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Vertical Dial Gauge	Dial gauge 1	28	0.01mm
Horizontal Dial Gauge	Dial gauge 2	29	0.01mm

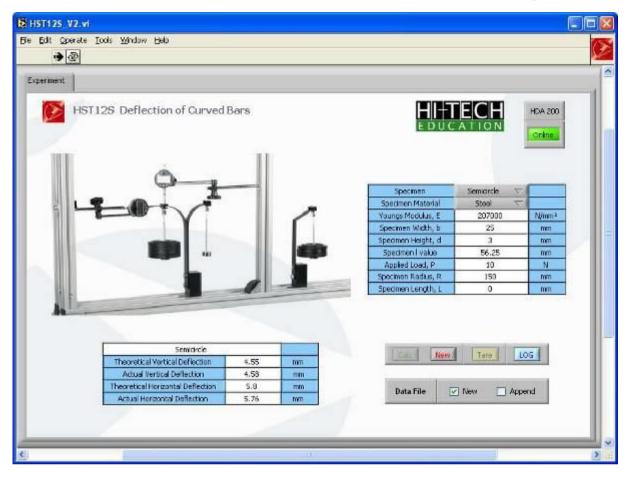
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the actual deflection values are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 4. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 5. Tick the data file option required.
- 6. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 7. The input parameters will then be saved to the data file.
- 8. Press the LOG button to store the actual values to the data file.
- 9. Incrementally change the load position from NONE right through to -100mm, and at each increment press the LOG button.
- 10. The graph will be drawn automatically at each load position point, but you must follow the load position points in turn otherwise the graph will appear incorrect and the actual shear centre will not be correct.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed at each load position increment:

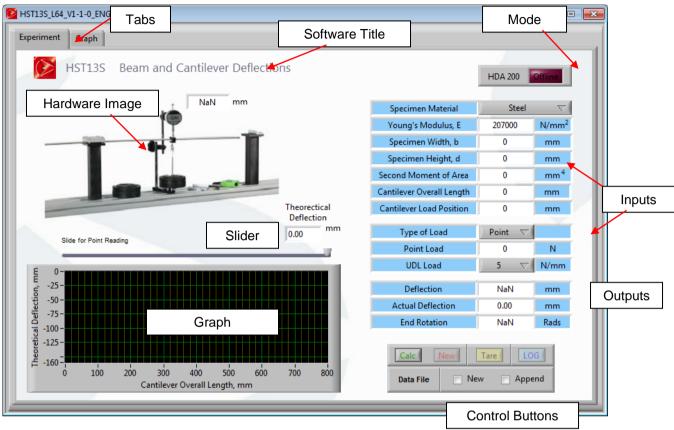
The data is as follows:

HST12S_V2_test file_5_3 File Edit Format View Help	_10_pji_online 🔳 🗖 🔀
05/03/2010 12:15:4 Specimen Semicin Modulus 207000 width 25.00 Height 3.00 1 value 56.25	15 rcle
Vertical Deflect Horizontal Deflect	4.55 5.80
Actual results Vertical Deflection Horizontal Deflection	4.58 5.76
	2

The information will then repeat itself depending on how many test points have been logged.

HST13S – BEAM and CANTILEVER DEFLECTIONS

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Specimen Tabs: This software allows the channel and semicircle specimens to be presented.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Specimen Material:** Choose the specimen material from the drop down list.
- Young's Modulus, E: This changes automatically with the choice of material.
- **Specimen Width, b**: Enter the specimen width in millimetres.
- **Specimen Height, d**: Enter the specimen height in millimetres.
- **Specimen Width, b**: Enter the specimen width in millimetres.
- <u>Second Moment of Area:</u> This is a calculated value based on the geometry given above.
- **<u>Cantilever overall Length</u>**: Enter the length of the cantilever from its tip to where it protrudes from it clamp in millimetres.
- <u>**Cantilever Load Position:**</u> Enter the position at which the load is applied to the cantilever.
- **<u>Type of Load</u>**: Choose from Point or UDL from the drop down list.
- **Point Load:** If point load chosen for the type of load enter the value of the point load in Newton's.
- **<u>UDL Load</u>**: If UDL is chosen for the type of load, enter the value of the UDL here in Newton's.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- **Deflection:** This is the theoretical deflection calculated from the parameters given earlier in millimetres.
- Actual Deflection: This is the actual dial gauge value from the hardware. It has the units of millimetres. In offline mode this will show a value of zero (0).
- **End Rotation**: This is theoretical end rotation.

<u>Control buttons</u>: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **<u>CALC</u>**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **NEW**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this button or the append button, not both.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

<u>Graph:</u> Each time a load position is set or another parameter changed a graph is drawn of the curvature of the cantilever. The same graph is created within the screen from the graph tab.

<u>Slider:</u> When the graph is created, the slider can be moved horizontally along the length of the cantilever to see the theoretical deflection at any point.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

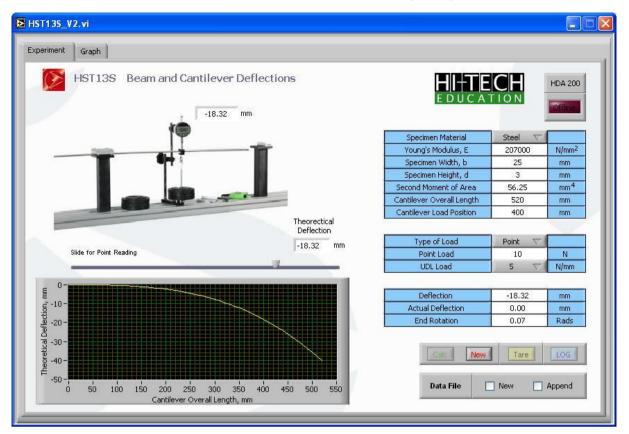
It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE – CHANNEL SPECIMEN

- 1. Load the experiment software by double clicking the **.exe** files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose Steel.
- 4. Enter 25 in the width, b input box.
- 5. Enter 3 in the height, d input box.
- 6. Enter 520 in the cantilever overall length input box.
- 7. Enter 400 in the cantilever load position input box.
- 8. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

7	Steel 💎	Specimen Material
N/mm	207000	Young's Modulus, E
mm	25	Specimen Width, b
mm	3	Specimen Height, d
mm"	56.25	Second Moment of Area
mm	520	Cantilever Overall Length
mm	400	Cantilever Load Position
_]	+
-	Point 🤝	Type of Load
N	10	Point Load
N/mr		
-	10	Point Load
N/mr	10 5 \(\not\)	Point Load UDL Load

9. The complete screen should look like the following image:



- 10. The theoretical deflection and end rotation will be shown in the first output box. Also note that the actual deflection and end rotation will be zero (0). This is because you are in 'OFFLINE' mode.
- 11. Press the NEW button.
- 12. Tick the Data File NEW box.
- 13. Press CALC.

14. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Save in:	🗁 HST9S		*	ODD	·
My Recent Documents	Instruction M HST9S_V1.ai HST9S_V1.e: HST9S_V1.e:	iases xe			
ly Documents					
My Computer	File name:	TextFile.tx		~	OK.
		Provide State Stat		~	Cancel

- 15. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 16. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

HST13S_V2_testfile_pji_8_3_10_point_offline.txt 🔳	
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp	
08/03/2010 17:04:28	^
Software Version HST135_V2 Material Steel	
Material steel Youngs Modulas 207000.00 N/mm2	
Specimen Width 25.00 mm	
Specimen Height 3.00 mm	
Second Moment of Area 56.25 mm4	
overall Length 520.00 mm	
Load Position 400.00 mm Point Load 10.00 N	
0.00 0.00	
10.00 0.00	
20.00 -0.00	
30.00 -0.01	1
40.00 -0.02	
50.00 -0.04 60.00 -0.06	
70.00 -0.10	
80.00 -0.15	
90.00 -0.21	
100.00 -0.29	
110.00 -0.38	
120.00 -0.49 130.00 -0.63	
140.00 -0.79	
150.00 -0.97	100 10
160.00 -1.17	
170.00 -1.41	
180.00 -1.67	
190.00 -1.96	

- 17. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 18. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 19. In the OFFLINE mode the LOG button will be greyed out.
- 20. When finished with the software shut the software down.
- 21. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

	HDA200	HDA200	
Sensor/Transducer	Connector	Channel	Resolution
	Number	number	
Dial Gauge	Dial gauge 1	28	0.01mm
Dial Gauge	Dial gauge 2	29	0.01mm
Dial Gauge	Dial gauge 3	30	0.01mm

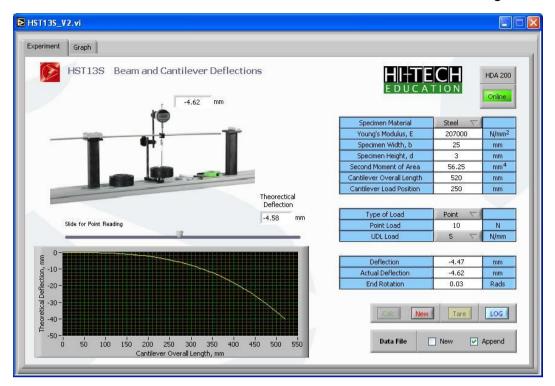
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

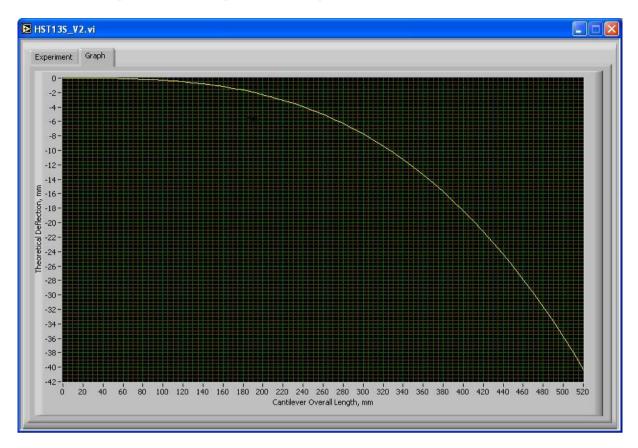
ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the actual deflection and end rotation are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 4. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 5. Tick the data file option required.
- 6. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 7. The input parameters will then be saved to the data file.
- 8. Press the LOG button to store the actual values to the data file.
- 9. The graph will be drawn automatically at each change of load position.

10. An image of the main graph on the graph tab is shown below



DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed at each load position increment:

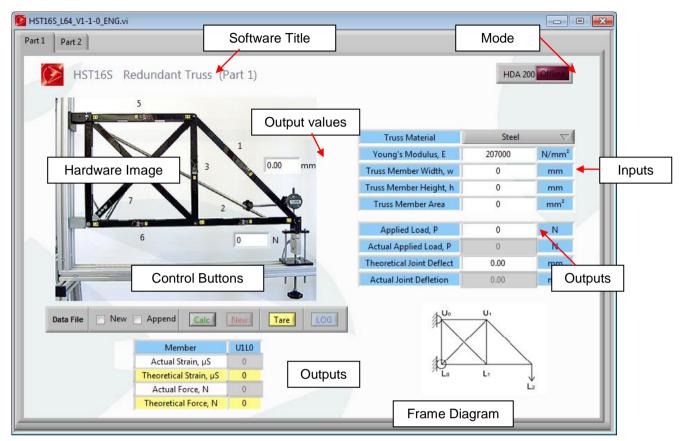
The data is as follows:

B HST135_V2	2_testfile_pji_	8_3_10_po	int_offline.txt	
<u>File E</u> dit F <u>o</u> rma	at ⊻iew <u>H</u> elp			
08/03/2010 Software Ve Material	17:04: rsion Steel	28 HST135_	_V2	^
Youngs Modu Specimen Wi	las 207000	0.00 mm	N/mm2	
Specimen He		3.00	mm	
Second Mome	nt of Area	56.25	mm4	
Overall Len	igth 520.00			
Load Positi Point Load	on 400.00 10.00) mm N		
		N		
10.00 0.0				
20.00 -0.				
30.00 -0.	A			
40.00 -0. 50.00 -0.				
60.00 -0.				
70.00 -0.	177177			
80.00 -0.				
90.00 -0.				
100.00 -0. 110.00 -0.				
120.00 -0.				
130.00 -0.				
140.00 -0.				
150.00 -0.				
160.00 -1. 170.00 -1.				
180.00 -1.				
190.00 -1.				

The information will then repeat itself depending on how many test points have been logged.

HST16S – REDUNDANT TRUSS

SOFTWARE WINDOW - Part 1



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Truss Material:** Choose the material which the truss members are made from. This varies between acrylic, aluminium, steel, stainless steel and brass.
- Young's Modulus, E: Depending on the material chosen above, will depend on what value is selected here. These values are defaults and cannot be changed.
- <u>Truss Member Width, w</u>: This is the value of the horizontal width of each member. Nominally this is 10mm. This value is entered via the keyboard of the host computer.
- **Truss Member Height, h**: This is value of the vertical depth of each member. Nominally this is 25mm. This value is entered via the keyboard of the host computer.
- **Truss Member Area**: This is a calculated value of the nominal cross sectional area of each truss member. It cannot be changed as it is a calculated value.
- <u>Applied Load, P</u>: This is the value of the applied force to the truss. It is entered by the end user via the keyboard. It can be used when comparing actual with theoretical values. This value will appear on the hardware image.
- <u>Actual Applied Load, P</u>: This is value of the applied load from the hardware itself. This value comes via the HDA200, and will only appear when the HDA200 is connected in 'ONLINE' mode.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- **<u>Theoretical Joint Deflect</u>**: This is the calculated theoretical joint deflection for part 1 of the hardware experiment. This value will appear on the hardware image.
- <u>Actual Joint Deflection</u>: This is the actual joint deflection for part 1 of the hardware experiment.

Table underneath the hardware image.:

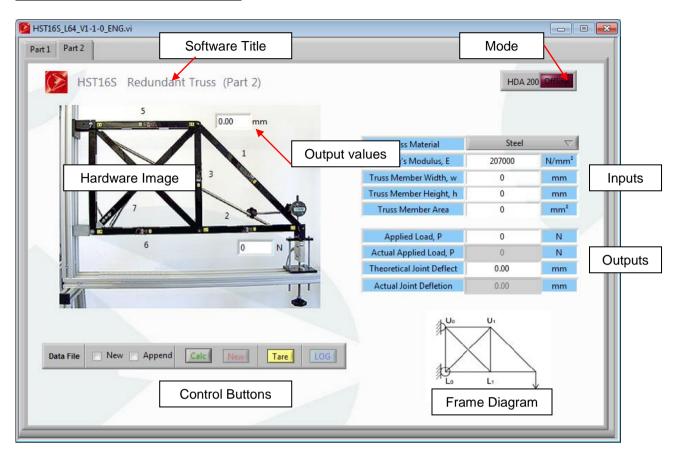
- <u>Actual Strain</u>: This is the actual strain from the redundant truss member only via the HDA200. In offline mode this value will be greyed out.
- **<u>Theoretical Strain</u>**: This is the theoretical strain from the redundant truss member only.
- <u>Actual Force</u>: This is the actual force value calculated from the actual strain values form the hardware for the redundant member only.
- **<u>Theoretical Force</u>**: This is the theoretical force calculated from the theoretical strain for the redundant member only.

<u>Control buttons:</u> these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from the hardware which are being used in the software.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- <u>Data File NEW:</u> This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

Frame Diagram: This represents a schematic of the hardware arrangement and is a cross reference for the inputs. This will not be present on all experiment softwares.

SOFTWARE WINDOW - Part 2



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>**Hardware image:**</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Truss Material:** Choose the material which the truss members are made from. This varies between acrylic, aluminium, steel, stainless steel and brass.
- Young's Modulus, E: Depending on the material chosen above, will depend on what value is selected here. These values are defaults and cannot be changed.
- <u>**Truss Member Width, w**</u>: This is the value of the horizontal width of each member. Nominally this is 10mm. This value is entered via the keyboard of the host computer.
- <u>**Truss Member Height, h**</u>: This is value of the vertical depth of each member. Nominally this is 25mm. This value is entered via the keyboard of the host computer.
- **<u>Truss Member Area</u>**: This is a calculated value of the nominal cross sectional area of each truss member. It cannot be changed as it is a calculated value.
- <u>Applied Load, P</u>: This is the value of the applied force to the truss. It is entered by the end user via the keyboard. It can be used when comparing actual with theoretical values. This value will appear on the hardware image.
- <u>Actual Applied Load, P</u>: This is value of the applied load from the hardware itself. This value comes via the HDA200, and will only appear when the HDA200 is connected in 'ONLINE' mode. In offline mode this value will be greyed out.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- **<u>Theoretical Joint Deflect</u>**: This is the calculated theoretical joint deflection for part 1 of the hardware experiment. This value will appear on the hardware image.
- <u>Actual Joint Deflection</u>: This is the actual joint deflection for part 1 of the hardware experiment. In offline mode this value will be greyed out.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from the hardware which are being used in the software.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.

- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

Frame Diagram: This represents a schematic of the hardware arrangement and is a cross reference for the inputs. This will not be present on all experiment software.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

<u>OFFLINE MODE – Part 1</u>

- 1. Load the experiment software by double clicking the **.exe** files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose ACRYLIC from the drop down menu list.
- 4. Enter 10 in the width, w input box.
- 5. Enter 25 in the height, h input box.
- 6. The truss member area will be calculated automatically
- 7. Enter 100 in the Applied Force, F input box.
- 8. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Truss Material	Acrylic 🗸 🦷	-
Young's Modulus, E	2500	N/mm ²
Truss Member Width, w	10	mm
Truss Member Height, h	25	mm
Truss Member Area	250	mm ²
	2000	200000
Applied Load, P	100	N
Applied Load, P		N

9. The complete screen should look like the following image:

1 Part 2					
HST16S Redundant Tru	ss (Part 1)		HITECH EDUCATION	HDA 20	00 Offline
5			Truss Material	Steel	~1
	1		Young's Modulus, E	207000	N/mm ²
8 4	3	0.00 mm	Truss Member Width, w	0	mm
			Truss Member Height, h	0	mm
	20		Truss Member Area	0	mm²
	No. of Concession, Name		Applied Load, P	0	N
6	0	N	Actual Applied Load, P	0	N
(† L		- And	Theoretical Joint Deflect	0.00	mm
10		T	Actual Joint Defletion	0.00	mm
Member	lc New U1L0	Tare	, uo	U,	
Actual Strain,			15		1
Theoretical Strai Actual Force,	P		La		¥ L2
Theoretical Ford	ALC: NOT ALC				

- 10. The applied load value and theoretical joint deflection will be shown in the small output value next to the load cell of the hardware image. Also note that the actual applied load and the actual joint deflection are greyed out. This is because you are in 'OFFLINE' mode.
- 11. Tick the Data File NEW box.
- 12. Press CALC.
- 13. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	ile to write.				? 🛛
Save jr:	😂 HST9S		~	0000	0-0
My Recent Documents Desktop	Instruction M HST95_V1.ali HST95_V1.ex HST95_V1.ini	ases e			
My Documents					
My Computer	No.				
	File name:	TextFile.bd		~	ОК
My Network	Save as type:	All Files (*.*)		~	Cancel

- 14. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 15. The input and output data will now be saved in the data file created. To prove this open the text file in **NOTEPAD** that you have just created from its location and check the contents. It should look similar to the image below.

B HST16S_34_test file_pji_8_3_10_off	fline_par 🔳 🗖	×
Eile Edit Format View Help		
08/03/2010 12:00:02 Software Version HST165_Y Part 1 Material Acrylic Young's Modulus, E 2500 Truss Member width, w 10.00 Truss Member Height, h 25.00 Truss Member Area 250.00 Applied Load, P 100.00 N Theoretical Joint Deflect Theoretical Strain U1L0 -118.50 Theoretical Force U1L0 -74.06	N/mm2 mm mm mm2 0.6475 mm	(2)

- 16. If you wish to change the inputs then simply press change the input parameter (change applied force to 20N from 10N), press the data file NEW button to clear it, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 17. In the OFFLINE mode the NEW and TARE buttons although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 18. When finished with the software shut the software down.
- 19. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

OFFLINE MODE – Part 2

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose ACRYLIC from the drop down menu list.
- 4. Enter 10 in the width, w input box.
- 5. Enter 25 in the height, h input box.
- 6. The truss member area will be calculated automatically/
- 7. Enter 100 in the Applied Force, F input box.
- 8. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Truss Material	Acrylic 🔨	7
Young's Modulus, E	2500	N/mm ²
Truss Member Width, w	10	mm
Truss Member Height, h	25	mm
Truss Member Area	250	mm ²
	VC242.0.000	and the second second
Applied Load, P	100	N
Applied Load, P Actual Applied Load, P	100 0	N
		-

9. The complete screen should look like the following image:

Part 2			
HST16S Redundant Truss (Part 2)	HITECH EDUCATION	HDA 20	00 Offline
	Truss Material	Steel	∇
	Young's Modulus, E	207000	N/mm ²
8 4 3	Truss Member Width, w	0	mm
	Truss Member Height, h	0	mm
	Truss Member Area	0	mm²
	Applied Load, P	0	N
6 0 N	Actual Applied Load, P	0	N
	Theoretical Joint Deflect	0.00	mm
I.	Actual Joint Defletion	0.00	mm
Data File New Append Calc New Tare LOG	U. L.]

- 10. The applied load value and theoretical joint deflection will be shown in the small output value next to the load cell of the hardware image. Also note that the actual applied load and the actual joint deflection are greyed out. This is because you are in 'OFFLINE' mode.
- 11. Tick the Data File NEW box.
- 12. Press CALC.
- 13. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	ile to write.				? 🛛
Save jn:	😂 HST9S		~	0 🕫 📴 🖽 -	
My Recent Documents Desktop	Instruction M H5T95_V1.alk H5T95_V1.ex H5T95_V1.ini	ases 6			
My Documents					
My Computer					
	File name:	TextFile.bd		~	OK
My Network	Save as type:	All Files (*.*)		~	Cancel

- 14. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 15. The input and output data will now be saved in the data file created. To prove this open the text file in **NOTEPAD** that you have just created from its location and check the contents. It should look similar to the image below.

HST165_34_test file_pji_8	_3_10_of	fline_part.	🗖 🗖 🔜
File Edit Format View Help			
08/03/2010 12:05:4 Software Version Part 2 Material Acrylic	HST165_		<u></u>
Young's Modulus, E Truss Member Width, W Truss Member Height, h Truss Member Area Applied Load, P 100.00	25.00 250.00	N/mm2 mm mm mm2	
Theoretical Joint Defle	ct	0.2112	mm
			9

- 16. If you wish to change the inputs then simply press change the input parameter (change applied force to 20N from 10N), press the data file NEW button to clear it, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 17. In the OFFLINE mode the NEW and TARE buttons although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 18. When finished with the software shut the software down.
- 19. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

	HDA200	HDA200	
Sensor/Transducer	Connector	Channel	Resolution
	Number	number	
Load cell	Force 1	17	
Dial Gauge	Dial gauge 1	28	0.01mm
Truss Member 1	Strain 1	1	
Truss Member 2	Strain 2	2	
Truss Member 3	Strain 3	3	
Truss Member 4	Strain 4	4	
Truss Member 5	Strain 5	5	
Truss Member 6	Strain 6	6	
Truss Member 7	Strain 7	7	

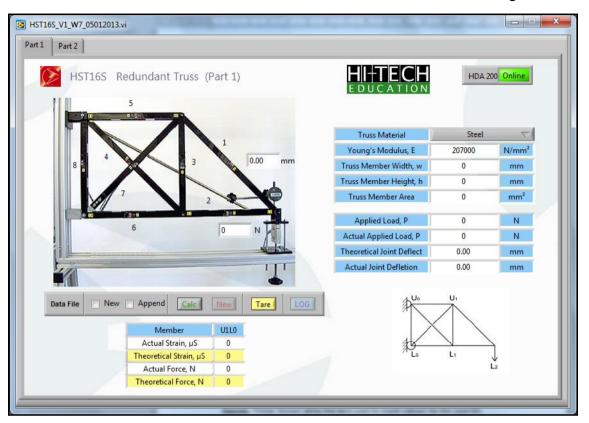
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the actual applied load, deflection, and strains are not greyed out. These values will now start to change as they come in from the HDA200.
- 3. The strains and applied load will not be zero. To zero these readings simply press the TARE button. You may have to press it again if the reading does not return to zero. The deflection values will not zero. These have to be zeroed on the front of the dial gauge itself.
- 4. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 5. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 6. Tick the data file option required.
- 7. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 8. The current theoretical input and output values will then be saved to the data file.
- 9. Press the LOG button to store the actual values to the data file.
- 10. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 11. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

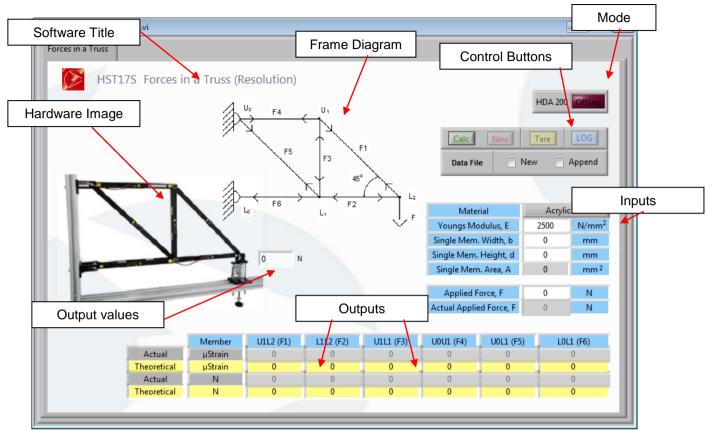
The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

HST165_34_test file_pji_8 File Edit Format View Help	3_10_on	line_par	. 🗖 🗖 🛛
08/03/2010 12:09:22 Software Version Part 1 Material Acrylic	? HST165_\	vi	4
Young's Modulus, E Truss Member Width, w Truss Member Height, h Truss Member Area Applied Load, P 100.00	25.00 250.00	mm mm	
Theoretical Joint Deflec Theoretical Strain U1LO Theoretical Force U1LO Actual results	rt -118.50 -74.06	N	mm
U1L0 -112.00 µS Aplied Load, P -100.90 Joint Deflection	N	n mm	
			9

The information will then repeat itself depending on how many test points have been logged.

HST17S – FORCES in a TRUSS (RESOLUTION)

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image:</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- <u>Material:</u> Choose the material which the truss members are made from. This varies between acrylic, aluminium, steel, stainless steel and brass.
- Young's Modulus, E: Depending on the material chosen above, will depend on what value is selected here. These values are defaults and cannot be changed.
- <u>Single Mem. Width, b</u>: This is the value of the horizontal width of each member. Nominally this is 10mm. This value is entered via the keyboard of the host computer.
- **Single Mem. Height, d**: This is value of the vertical depth of each member. Nominally this is 25mm. This value is entered via the keyboard of the host computer.
- **<u>Single Mem. Area, A</u>**: This is a calculated value of the nominal cross sectional area of each truss member. It cannot be changed as it is a calculated value.
- **Applied Force, F**: This is the value of the applied force to the truss. It is entered by the end user via the keyboard. It can be used when comparing actual with theoretical values.
- Actual Applied Force, F: This is value of the applied load from the hardware itself. This value comes via the HDA200, and will only appear when the HDA200 is connected in 'ONLINE' mode.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Member</u>: Each truss member joint is given a letter/number designation. The column headers to the right of this output title detail the truss member with the relevant joints. This also ties in with the frame diagram.
- Actual µStrain: This is the actual strain value from the hardware itself. It will only appear when the HDA200 is connected and the software is run in 'ONLINE' mode. It has the unit of microstrain.
- **Theoretical µStrain:** This is the calculated theoretical strain using the input parameters given. These value will appear when running in 'OFFLINE' or 'ONLINE' mode. It has the unit of microstrain.
- Actual Force: This is the calculated actual force based on the actual strain values from the hardware. These values will only appear when the HDA200 is connected in 'ONLINE' mode. It has units of Newton's (N).
- **Theoretical Force:** This is the calculated force based on the theoretical strain values. It has units of Newton's (N).

<u>Control buttons:</u> these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from the hardware which are being used in the software.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- <u>Data File **NEW**</u>: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- <u>Data file **APPEND**</u>: If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

Frame Diagram: This represents a schematic of the hardware arrangement and is a cross reference for the inputs. This will not be present on all experiment softwares.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

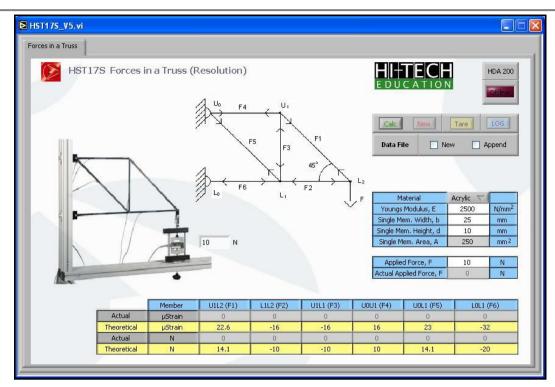
It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose the material from the drop down menu list.
- 4. Enter 25 in the width, b input box.
- 5. Enter 10 in the height, d input box.
- 6. Enter 10 in the Applied Force, F input box.
- 7. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

	1		
Data File	<u> </u>	ew 🗌 /	Append
Materia	al	Acrylic 🤝	
Youngs Mode	ulus, E	2500	N/mm ²
Youngs Modi Single Mem. V		2500 25	N/mm ² mm
Single Mem. V	Vidth, b		-
Single Mem. V	Vidth, b eight, d	25	mm
Single Mem. V Single Mem. H	Vidth, b eight, d Area, A	25 10	mm mm

8. The complete screen should look like the following image:



- 9. The applied force value will be shown in the small output value next to the load cell of the hardware image. Also note that the actual applied force in the input parameters and the actual strain and actual force of the outputs are greyed out. This is because you are in 'OFFLINE' mode.
- 10. Tick the Data File NEW box.
- 11. Press CALC.
- 12. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.					? 🔀
Save jn:	C HST9S		~	G 🕫	•111 🍯	
My Recent Documents	Instruction Ma HST95_V1.alia HST95_V1.exe HST95_V1.exe	ses				
Desktop My Documents						
My Computer						
	File <u>n</u> ame:	TextFile.txt			*	ОК
My Network	Save as <u>type</u> :	All Files (*.*)			~	Cancel

- 13. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 14. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

TextFile.txt - No	tepad		
File Edit Format Vie	w Help		
21/07/2009 Youngs Modulus, Mem Width, b Mem Height, d Mem Area, A	25.00 mm 10.00 mm 250.00 mm2		>
Applied Force, (F1) 22.63 (F2) -16.00 (F3) -16.00 (F4) 16.00 (F5) 22.63 (F6) -32.00 (F1) 14.14 (F2) -10.00 (F3) -10.00 (F4) 10.00	µStrain µStrain µStrain µStrain µStrain N N N	Ν	
(F4) 10.00 (F5) 14.14 (F6) -20.00	N N N		

15. If you wish to change the inputs then simply press change the input parameter (change applied force to 20N from 10N), press the data file NEW button to clear it, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.

16. The data file should now have the new data saved into it and look like the following:

📕 TextFile.txt - Notepad		
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp		
21/07/2009 10:45:14 Youngs Modulus, E Mem width, b 25.00 Mem Height, d 10.00 Mem Area, A 250.00	4 2500.00 mm mm mm2	N/mm2 🔷
Applied Force, F (F1) 22.63 µStrain (F2) -16.00 µStrain (F3) -16.00 µStrain (F4) 16.00 µStrain (F5) 22.63 µStrain (F6) -32.00 µStrain (F1) 14.14 N (F2) -10.00 N (F3) -10.00 N (F3) -10.00 N (F4) 10.00 N (F5) 14.14 N (F6) -20.00 N 21/07/2009 10:54:00	10.00	Ν
Youngs Modulus, E Mem Width, b 25.00 Mem Height, d 10.00 Mem Area, A 250.00	2500.00 mm mm mm2	N/mm2
AppliedForce, F(F1)45.25µStrain(F2)-32.00µStrain(F3)-32.00µStrain(F4)32.00µStrain(F5)45.25µStrain(F6)-64.00µStrain(F1)28.28N(F2)-20.00N(F3)-20.00N(F4)20.00N(F5)28.28N(F6)-40.00N	20.00	Ν

- 17. In the OFFLINE mode the NEW and TARE buttons although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 18. When finished with the software shut the software down.
- 19. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

	HDA200	HDA200	
Sensor/Transducer	Connector	Channel	Resolution
	Number	number	
Load cell	Force 1	17	
Truss Member 1	Strain 1	1	
Truss Member 2	Strain 2	2	
Truss Member 3	Strain 3	3	
Truss Member 4	Strain 4	4	
Truss Member 5	Strain 5	5	
Truss Member 6	Strain 6	6	
Truss Member 7	Strain 7	7	

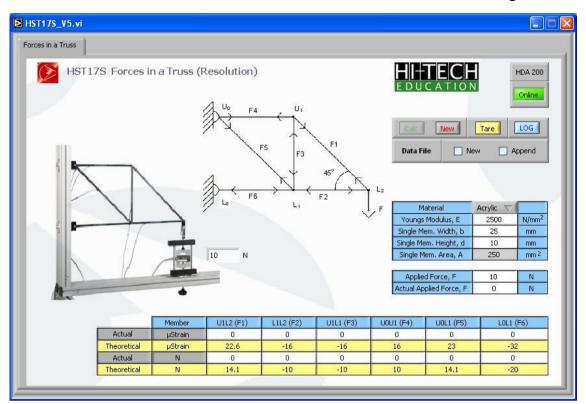
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the Actual applied force, actual strain and actual force lines are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. These values will not be zero. To zero this reading simply press the TARE button. You may have to press it again if the reading does not return to zero.
- 4. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 5. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 6. Tick the data file option required.
- 7. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 8. The current theoretical input and output values will then be saved to the data file.
- 9. Press the LOG button to store the actual values to the data file.
- 10. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 11. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

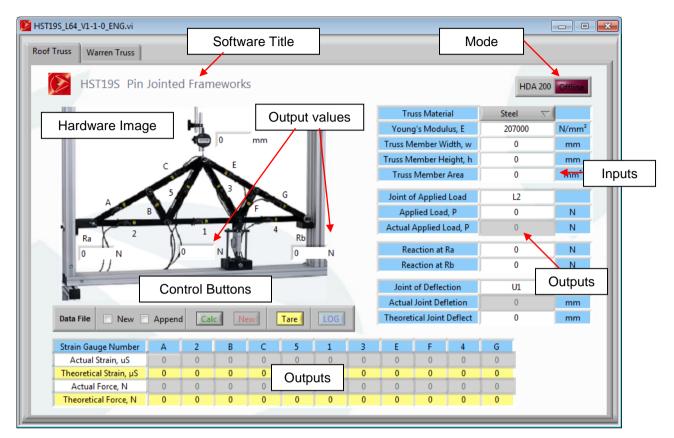
The data is as follows:

📕 new hda200 test 20_7_09.txt - Notepad 🗐 🗖 🔀	
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp	
20/07/2009 15:53:33 Youngs Modulus, E 2500.00 N/mm2 Mem Width, b 10.00 mm Mem Height, d 25.00 mm Mem Area, A 250.00 mm2	Date and time. E value Width b Height d
Applied Force, F 12.20 N (F1) 27.61 µStrain (F2) -19.52 µStrain (F3) -19.52 µStrain	Area A Force Theoretical Strains
(F4) 19.52 µstrain (F5) 27.61 µstrain (F6) -39.04 µstrain (F1) 17.25 N (F2) -12.20 N (F3) -12.20 N	Theoretical Forces
(F4) 12.20 N (F5) 17.25 N (F6) -24.40 N Actual results (F1) 37.00 µStrain (F2) -24.00 µStrain (F3) -24.00 µStrain	Actual Strains
(F4) 24.00 µStrain (F5) 37.00 µStrain (F6) -50.00 µStrain (F1) 23.12 N (F2) -15.00 N (F3) -15.00 N	Actual Forces
(F4) 15.00 N (F5) 23.12 N (F6) -31.25 N Applied Force 12.10 N 20/07/2009 15:55:00 Youngs Modulus, E 2500.00 N/mm2 Mem Width, b 10.00 mm	Actual Applied Force
Mem Height, d 25.00 mm Mem Area, A 250.00 mm2 Applied Force, F 12.20 N	

The information will then repeat itself depending on how many test points have been logged.

HST19S – PIN JOINTED FRAMEWORKS

SOFTWARE WINDOW – Roof Truss



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image:</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- <u>**Truss Material:**</u> Choose the material which the truss members are made from. This varies between acrylic, aluminium, steel, stainless steel and brass.
- <u>Young's Modulus, E:</u> Depending on the material chosen above, will depend on what value is selected here. These values are defaults and cannot be changed.
- <u>**Truss Member Width**, w</u>: This is the value of the horizontal width of each member. Nominally this is 10mm. This value is entered via the keyboard of the host computer.
- <u>**Truss Member Height, h**</u>: This is value of the vertical depth of each member. Nominally this is 25mm. This value is entered via the keyboard of the host computer.
- **<u>Truss Member Area</u>**: This is a calculated value of the nominal cross sectional area of each truss member. It cannot be changed as it is a calculated value.
- Joint of Applied Load: This is the joint at which the applied load will be added. As default this is set at L2 and cannot be changed.
- <u>Applied Load, P</u>: This is the value of the applied force to the truss. It is entered by the end user via the keyboard. It can be used when comparing actual with theoretical values. This value will appear on the hardware image.
- **<u>Reaction at Ra</u>**: The theoretical reaction at Ra as calculated by the software.
- **Reaction at Rb**: The theoretical reaction at Rb as calculated by the software.
- **Joint of Deflection**: This is the default joint at which deflection will be taken from the hardware. This cannot be changed.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Actual Applied Load, P</u>: This is value of the applied load from the hardware itself. This value comes via the HDA200, and will only appear when the HDA200 is connected in 'ONLINE' mode.
- <u>Actual Joint Deflection</u>: This is the actual joint deflection for part 1 of the hardware experiment.
- <u>Theoretical Joint Deflect</u>: This is the calculated theoretical joint deflection for part 1 of the hardware experiment. This value will appear on the hardware image.

Table underneath the hardware image.:

- <u>Actual Strain</u>: This is the actual strain from the redundant truss member only via the HDA200. In offline mode this value will be greyed out.
- **<u>Theoretical Strain</u>**: This is the theoretical strain from the redundant truss member only.
- <u>Actual Force</u>: This is the actual force value calculated from the actual strain values form the hardware for the redundant member only.
- **<u>Theoretical Force</u>**: This is the theoretical force calculated from the theoretical strain for the redundant member only.

<u>Control buttons:</u> these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from the hardware which are being used in the software.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

<u>SOFTWARE WINDOW – WARREN TRUSS</u>

The Warren truss tab will gain access to the Warren Truss element of this software. Everything is exactly the same as per the Roof Truss above, except for the hardware image, and the option to choose either U0 or U1 for the joint of deflection.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE – ROOF TRUSS

- 1. Load the experiment software by double clicking the **.exe** files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose ACRYLIC from the drop down menu list.
- 4. Enter 10 in the width, w input box.
- 5. Enter 25 in the height, h input box.
- 6. The truss member area will be calculated automatically.
- 7. Enter 200 in the Applied Force, F input box.
- 8. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Truss Material	Acrylic 🔨	
Young's Modulus, E	2500	N/mm
Truss Member Width,	10	mm
Truss Member	25	mm
Truss Member Area	250	mm²
Joint of Applied Load	L2	
Applied Load, P	200	N
Actual Applied Load,	0	N
Reaction at Ra	66.67	N
Reaction at Rb	133.33	N
Joint of Deflection	U1	
Act. Joint Deflection	0	mm
Theoretical Joint	0.5248	mm

9. The complete screen should look like the following image:

HST19S_V1_W7_180										_				X
Roof Truss Warre	n Truss													
HDA 200 Offline HDA 200 Offline														
								Trus	s Materia	al	Acrylic	∇		1
				_				Young	s Moduli	us, E	2500		N/mm²	1
			0.5248	mm	- 1				ember W		10	_	mm	
					- 1			Trus	s Membe	er	25		mm	
			E					Truss N	/lember /	Area	250		mm²	
	0		3	NG.				Joint of	Applied	Load	L2			
A 1					G			Applied Load, P 200		200		N		
	В	1		F				Actual A	Applied L	.oad,	0	_	Ν	
Y	2	Y 1	+	4		11		Read	tion at R	la	66.67		N	
Ra		0			Rb			Reac	tion at R	b]	133.33		Ν	
66.67	N	200	N		133.3	3 N		Joint o	f Deflect	ion	U1]
	,	-						Act. Joi	nt Deflec	tion	0		mm	
-			Ť					Theor	retical Joi	int	0.5248		mm	
Data File New Append Calc New LOG														
Strain Gauge			В	С	5	1	3	E	F	4	G			
Actual Stra	-		0	0	0	0	0	0	0	0	0			
Theoretical St		-	0	-133.3	0	115.5	230.9	-266.7	0	230.9	-266.7			
Actual For			0	0	0	0	0	0	0	0	0			
Theoretical F	orce, N 3-21	3.3 184.8	0	-213.3	0	184.8	369.5	-426.7	0	369.5	-426.7			

- 10. The applied load value and theoretical joint deflection will be shown in the small output value next to the load cell of the hardware image. Also note that the actual applied load and the actual joint deflection are greyed out. This is because you are in 'OFFLINE' mode.
- 11. Press NEW
- 12. Tick the Data File NEW box.
- 13. Press CALC.
- 14. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

😰 Select a data f	ile to write.	10(2)	×
Save <u>i</u> n:	→ HST195_V1_W7_18062012	g 🌶 🖻 🛄 -	
Recent Places Desktop Libraries Computer	Name HST19S_V1_W7_18062012.aliases HST19S_V1_W7_18062012 HST19S_V1_W7_18062012 TextFile	18/06/2012 12:41 A 18/06/2012 12:41 A 18/06/2012 12:41 C	ype LIASES F pplicatic onfigura ext Docu
Network	<		•
	File name: TextFile Save as type: All Files (*.*)		OK ancel

- 15. Either rename the default name of TextFile.txt or keep this default name. It's up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 16. The input and output data will now be saved in the data file created. To prove this open the text file in **NOTEPAD** that you have just created from its location and check the contents. It should look similar to the image below.

TextFile2 - Notepad	
<u>File Edit Format View H</u> elp	
20/08/2012 10:00:30 Roof Truss	*
	00 N/mm2 00 mm
Truss Member Height, h 25.	00 mm
Joint of Applied Load L2).00 mm2
Applied Load, P 200.00 N Reaction at Ra 66.67 N	
Reaction at Rb 133.33 N Joint U1	
Theoretical Joint Deflect	0.5248 mm
A -133.33 μStrain 2 115.47 μStrain	
B 0.00 µStrain C -133.33 µStrain	
C -133.33 µStrain 5 0.00 µStrain 1 115.47 µStrain 3 230.94 µStrain E -266.67 µStrain F 0.00 µStrain	
3 230.94 µstrain	
4 230.94 µStrain G -266.67 µStrain	
	·

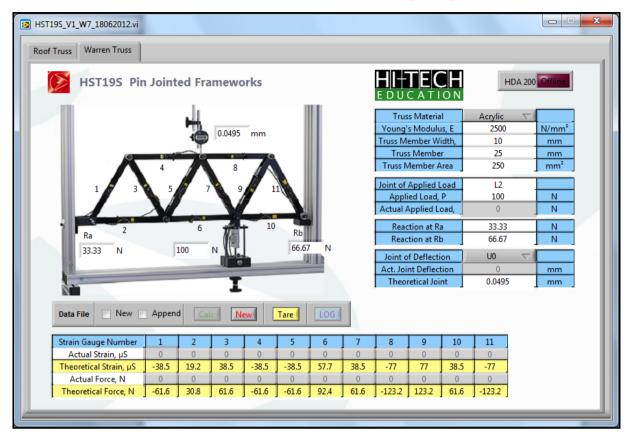
- 17. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file NEW button to clear it, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 18. In the OFFLINE mode the TARE button although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 19. When finished with the software shut the software down.
- 20. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

OFFLINE MODE – WARREN TRUSS

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose ACRYLIC from the drop down menu list.
- 4. Enter 10 in the width, w input box.
- 5. Enter 25 in the height, h input box.
- 6. The truss member area will be calculated automatically.
- 7. Enter 100 in the Applied Force, F input box.
- 8. Choose U0 as the joint of deflection.
- 9. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Truss Material	Acrylic 🗸	
Young's Modulus, E	2500	N/mm ³
Truss Member Width,	10	mm
Truss Member	25	mm
Truss Member Area	250	mm²
Joint of Applied Load	L2	
Applied Load, P	100	N
Actual Applied Load,	0	N
Reaction at Ra	<mark>33.</mark> 33	N
Reaction at Rb	66.67	N
Joint of Deflection	7 OU	7
Act. Joint Deflection	0	mm
Theoretical Joint	0.0495	mm

10. The complete screen should look like the following image:



- 11. The applied load value and theoretical joint deflection will be shown in the small output value next to the load cell of the hardware image. Also note that the actual applied load and the actual joint deflection are greyed out. This is because you are in 'OFFLINE' mode.
- 12. Press the NEW button.
- 13. Tick the Data File NEW box.
- 14. Press CALC.
- 15. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

😼 Select a data i	file to write.	
Save <u>i</u> n:	→ HST19S_V1_W7_18062012	G 🤌 📂 🛄 -
Recent Places	Name HST19S_V1_W7_18062012.aliases HST19S_V1_W7_18062012 HST19S_V1_W7_18062012 TextFile	Date modified Type 18/06/2012 12:41 ALIASES F 18/06/2012 12:41 Applicatic 18/06/2012 12:41 Configura 15/08/2012 09:03 Text Docu
Computer Q Network	III File name: TextFile Save as type: All Files (*.*)	OK Cancel

- 16. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 17. The input and output data will now be saved in the data file created. To prove this open the text file in **NOTEPAD** that you have just created from its location and check the contents. It should look similar to the image below.

TextFile3 - Notepad		-	
<u>F</u> ile <u>E</u> dit F <u>o</u> rmat <u>V</u> iev	w <u>H</u> elp		
20/08/2012 10	0:13:55		*
Warren Truss Young's Modulus, E Truss Member Width Truss Member Heigh	h,w 25.00 ht,h 10.00	mm mm	
Reaction at Rb 60	250.00 Load L2 00.00 N 3.33 N 5.67 N	mm2	
2 19.25 µs 3 38.49 µs 4 -38.49 µs 5 -38.49 µs 6 57.74 µs 7 38.49 µs 8 -76.98 µs 9 76.98 µs 10 38.49 µs	Strain Strain Strain Strain	0.0495	mm

- 18. If you wish to change the inputs then simply press NEW, change the input parameter, press the data file NEW button to clear it, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 19. In the OFFLINE mode the TARE button although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 20. When finished with the software shut the software down.
- 21. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Load cell	Force 1	17	
Dial Gauge	Dial gauge 1	28	0.01mm
Truss Member 1	Strain 1	1	
Truss Member 2	Strain 2	2	
Truss Member 3	Strain 3	3	
Truss Member 4	Strain 4	4	
Truss Member 5	Strain 5	5	
Truss Member 6	Strain 6	6	
Truss Member 7	Strain 7	7	
Truss Member 8	Strain 8	8	
Truss Member 9	Strain 9	9	
Truss Member 10	Strain 10	10	
Truss Member 11	Strain 11	11	

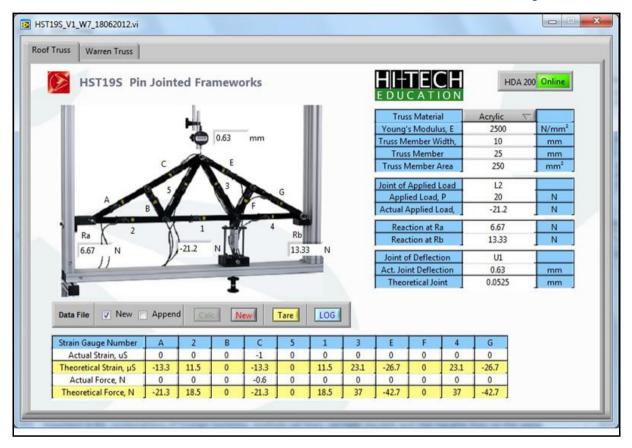
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE – ROOF TRUSS

- 1. Start the software and when the pop window appears asking if the HDA200 is connected, press the 'YES' button.
- 2. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 3. In 'ONLINE' mode you will notice that the actual applied load, deflection, force and strains are not greyed out. These values will now start to change as they come in from the HDA200.
- 4. The strains and applied load will not be zero. To zero these readings simply press the TARE button. You may have to press it again if the reading does not return to zero. The deflection values will not zero. These have to be zeroed on the front of the dial gauge itself.
- 5. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 6. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 7. Tick the data file option required.

- 8. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 9. The current theoretical input and output values will then be saved to the data file.
- 10. Press the LOG button to store the actual values to the data file.
- 11. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 12. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

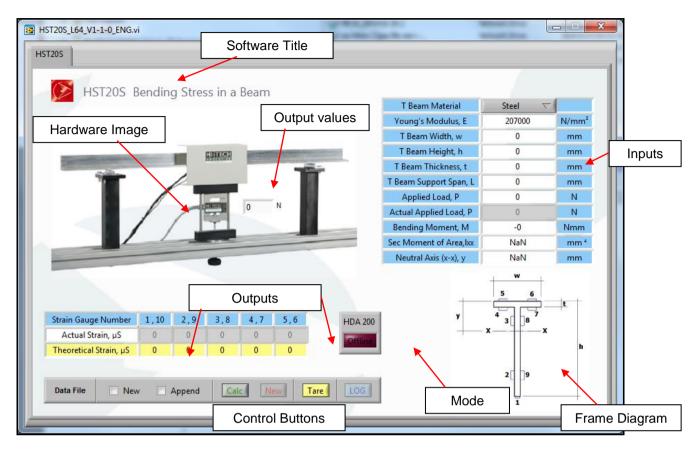
The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

TextFile - Notepad		1.00			x
<u>File Edit Fo</u> rmat	<u>V</u> iew <u>H</u> elp				
15/08/2012 Roof Truss Young's Modulus	08:31:0	5 2500	N/mm2		^
Truss Member Wid Truss Member He Truss Member Ard Joint of Applied Applied Load, P Reaction at Ra Reaction at Rb	dth, w ight, h ea d Load 20.00	10.00	mm mm		
Joint U1 Theoretical Join A -13.33 2 11.55 B 0.00 C -13.33 5 0.00	nt Defleo µStrain µStrain µStrain µStrain µStrain	ct	0.0525	mm	н
1 11.55 3 23.09 E -26.67 F 0.00 4 23.09 G -26.67 Actual populate	µStrain µStrain µStrain µStrain µStrain µStrain				
Actual results A 0.00 2 0.00 B 0.00 C -1.00 5 0.00 1 0.00 3 0.00 E 0.00 F 0.00 G 0.00	µStrain µStrain µStrain µStrain µStrain µStrain µStrain µStrain µStrain				
Actual Aplied Lo Actual Joint Def Actual results A -1.00 2 -2.00 B -2.00 C -2.00 5 -2.00 1 -2.00 3 -2.00 E -2.00 F -2.00 F -2.00 4 -3.00	oad, P	-21.20 0.63	N mm		Ŧ
					International Internationa

The information will then repeat itself depending on how many test points have been logged.

HST20S – BENDING STESS in a BEAM

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>**Hardware image:**</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- <u>**T Beam Material:**</u> Choose the specimen material. The Young's Modulus, E will change automatically depending on the material chosen.
- Young's Modulus, E: Depending on the material chosen above, will depend on what value is selected here. These values are defaults and cannot be changed.
- **<u>T Beam width, w</u>**: This is the T beam width in millimetres.
- **T Beam Height**, **h**: This is T beam height in millimetres.
- **<u>T Beam thickness, t</u>**: This is the T beam thickness in millimetres.
- **<u>T Beam support span, L</u>**: This is the T beam support span distance in millimetres..
- **Applied Load, F**: This is the value of the applied load being added to the T beam in Newton's.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Actual Applied Load, P</u>: This is the actual applied load from the hardware when running the hardware through the HDA200.
- **Bending Moment, M**: This is a calculated value based on the parameters input already.
- <u>Sec. Moment of Area, Ixx:</u> This is a calculated value and depends on the T beam geometry entered previously.
- **Neutral Axis:** This is a calculated based on the T beam geometry entered previously.
- <u>Actual Strain, με:</u> This is the actual strain from each strain gauge on the T beam.
- <u>Theoretical Strain, με</u>: This is the theoretical strain from each strain gauge on the T beam.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from the hardware which are being used in the software.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is

ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this option or append. You cannot choose both.

- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

Frame Diagram: This represents the T beam cross section, neutral axis (X-X) and the strain gauge positions.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose the material from the drop down menu list.
- 4. Enter 25 in the width, b input box.
- 5. Enter 10 in the height, d input box.
- 6. Enter 10 in the Applied Force, F input box.
- 7. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

T Beam Material	Aluminium 💎	
Young's Modulus, E	69000	N/mm ²
T Beam Width, w	25.4	mm
T Beam Height, h	50.8	mm
T Beam Thickness, t	3.175	mm
T Beam Support Span, L	800	mm
Applied Load, P	100	N
Actual Applied Load, P	0	N
Bending Moment, M	16250	Nmm
Sec Moment of Area,lxx	62828.5	mm ⁴
Neutral Axis (x-x), y	17.1	mm

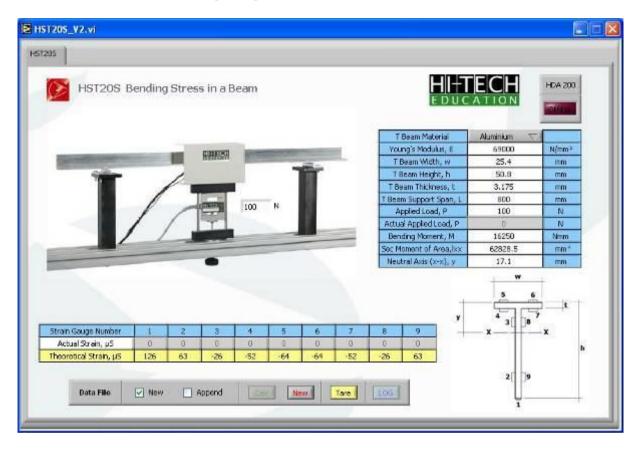
8. The complete screen should look like the following image:

COLUMN TO A COLUMNT TO A COLUMN TO A COLUMNT TO A COLUMN TO A COLUMNT TO A COLUMN TO A COLUMNT TO A COLUMNTA A COLUMNT TO A COLUMNTA A COL											
T205											
MST20S E	3ending	Stres	s in a B	eam						ECH	HDA 200
								TB	eam Material	Aluminium 1	-
Participation of the local distance of the l			*****	in the second		-		Youn	g's Modulus, E	69000	Nomm-4
the second second			CIDATED .	1000		-	Beer .	TBe	am Widthy w	25.4	anto
-		1						TBO	om Height, h	50.8	mm
				1				TBea	m Thickness, t	3.175	mm
	1			-	N			T Beam	Support Span, L	800	mm
	/	1	100	100	1			Acts	kied Load, P	100	N
	/		T					Actual	Applied Load, P	0	N
	/ /			-		-			ng Moment, M	16250	Nmm
100		-			-	-		Sec No	ment of Area, box	62628.5	mm ²
and the second se			-					Neutr	al Asis (x-x), y	17.1	mm
			•					-			
Strein Gauge Number Actual Strain, µS	1	2	3	4	5	6	7	8	9 T	w	6 7
	1 0 0						and the second	8	y 9	w	6

- 9. The applied force value will be shown in the small output value next to the load cell of the hardware image. Also note that the actual applied load and actual strain are greyed out. This is because you are in 'OFFLINE' mode.
- 10. Tick the Data File NEW box.
- 11. Press CALC.
- 12. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.					? 🔀
Save jn:	😂 НБТ95		~	00	12 🛄 -	
My Recent Documents Desktop	Instruction Ma HST95_V1.ala HST95_V1.exe HST95_V1.ini	ises				
My Documents						
My Computer						
	File name:	TextFile.bd			~	ОК
My Network	Save as lype:	All Files (*.*)			~	Cancel

- 13. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 14. The theoretical strains will now appear in the output table at the bottom of the screen as in the following image:



15. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

HST205_test file	_1_3_10_pji_offline.txt - Notepad 📃	
<u>File Edit Fo</u> rmat <u>Vie</u> r	w <u>H</u> elp	
Modulús 69000 width 25.40 Height 50.80 Thickness Support Span		(income)

- 16. If you wish to change the inputs then simply press change the input parameter (change applied force to 20N from 10N), press the data file NEW button to clear it, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 17. The data file should now have the new data saved into it and look like the following:

HST205	_test file_	1_3_10_p	ji_offline.txt	- Notepad	
Eile Edit Fg	ormat ⊻jew	Help			
	9000 r 5.40 r 0.80 r 5pan r .0ad	15:38:30 N/mm2 nm 3.175 800.00 100.00 16250.00	mm mm N	n	
Second Mo Neutral A G1 1 G2 6 G3 - G4 - G5 - G5 - G5 - G5 - G5 - G5 - G7 - G8 - G9 6 01/03/201 Modulus 6 width 2	ment of 26 26 52 64 52 52 52 52 52 52 52 52 52 52	Area 17.1 ustrain ustrain ustrain ustrain ustrain ustrain ustrain ustrain mm nm	62828.52 mm	mm4	
Thickness Support S Applied L Bending M Second Mo Neutral A G1 2 G2 1 G3 - G4 - G5 - G6 - G6 - G7 - G8 -	pan oad ment of 52 52 105 105 128 128 128	MM 3.175 800.00 200.00 32500.00 Area 17.1 UStrain UStrain UStrain UStrain UStrain UStrain UStrain	mm mm 62828.52 mm	n mm4	

- 18. In the OFFLINE mode the TARE button although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 19. When finished with the software shut the software down.
- 20. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

	HDA200	HDA200	
Sensor/Transducer	Connector	Channel	
	Number	number	
Strain Gauge 1	Strain 01	01	
Strain Gauge 2	Strain 02	02	
Strain Gauge 3	Strain 03	03	
Strain Gauge 4	Strain 04	04	
Strain Gauge 5	Strain 05	05	
Strain Gauge 6	Strain 06	06	
Strain Gauge 7	Strain 07	07	
Strain Gauge 8	Strain 08	08	
Strain Gauge 9	Strain 09	09	
Force	Force 1	17	

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look similar to the image below but not exact (example only):

HST20S Bending Stress in a Beam				
		T Beam Material	Aluminium $ abla$	
		Young's Modulus, E	69000	N/mm²
		T Beam Width, w	25.4	mm
HINGH -		T Beam Height, h	50.8	mm
		T Beam Thickness, t	3.175	mm
		T Beam Support Span, L	800	mm
CHARTER IOO N		Applied Load, P	100	N
100 N		Actual Applied Load, P	0	N
		Bending Moment, M	16250	Nmm
		Sec Moment of Area,lxx	62828.5	mm 4
		Neutral Axis (x-x), y	17.1	mm
		y	w 5 6 4 7	t
Strain Gauge Number 1,10 2,9 3,8 4,7 5,6	HDA 200	,	3 8 x x	
Actual Strain, µS 0 0 0 0 0	Online			h
Theoretical Strain, µS 0 0 0 0 0			2 9	
Data File New Append Calc New	LOG		1	
			-	

- 2. In 'ONLINE' mode you will notice that the Actual applied force and actual strains are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. These values will not be zero. To zero this reading simply press the TARE button. You may have to press it again if the reading does not return to zero.
- 4. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 5. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 6. Tick the data file option required.
- 7. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 8. The current theoretical input and output values will then be saved to the data file.
- 9. Press the LOG button to store the actual values to the data file.
- 10. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 11. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

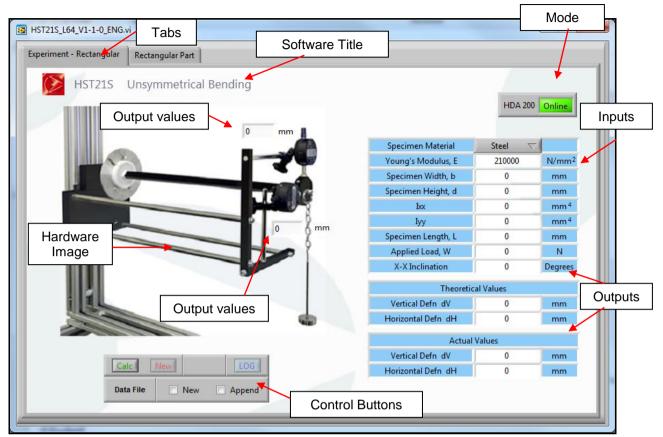
The data is as follows:

HST20 test file 2	2_7_09.tx	t - Notepad	
Eile Edit Format Vie			Tant
22/07/2009	08:37:3	3	
Modulus 69000	N/mm2		
width 25.40 Height 50.80	mm		
Thickness	3.175	mm	
Support Span	800.00	mm	
Applied Load	100.00	N	
Bending Moment	16250.0		
	f Area	62828.52	mm4
Neutral Axis	17.1	mm	
G1 126	µStrain		
G2 63	µStrain		
G3 –26	ustrain		
G4 –52	µstrain		
G5 –64	µStrain		
G6 -64	µStrain		
G7 -52	µStrain		
G8 –26 G9 63	µStrain		
G9 63 Actual results	µStrain		
G1 128	ustrain		
G2 64	µStrain µStrain		
G3 -31	ustrain		
G4 -59	uStrain		
G5 -76	ustrain		
G6 –70	ustrain		
G7 -57	ustrain		
G8 -31	ustrain		
G9 60	ustrain		
Load 0.3	N		
22/07/2009	08:40:5	2	
Modulus 69000	N/mm2		
width 25.40	mm		
Height 50.80	mm	72222970	
Thickness	3.175	mm	
Support Span	800.00	mm	
Applied Load	50.00 8125.00	N	
Bending Moment Second Moment or	f Area	Nmm 62828.52	mm4
Neutral Axis	17.1	mm	
G1 63	µStrain		
G2 32	uStrain		
G3 -13	ustrain		
64 -26	ustrain		

The information will then repeat itself depending on how many test points have been logged.

HST21S – UNSYMMETRICAL BENDING

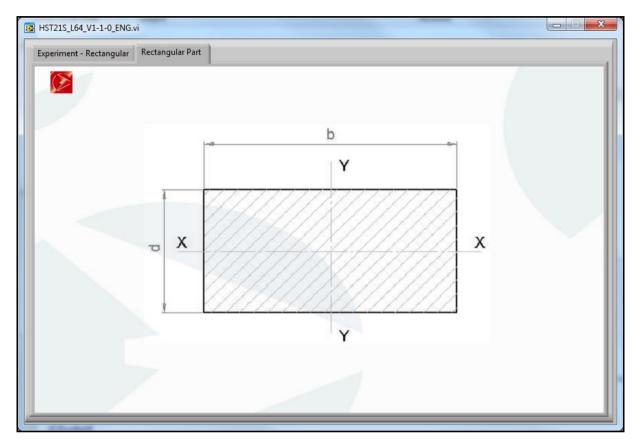
SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image:</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Tabs: This software allows the rectangular specimen only to be presented. The experiment tab is where the main software is shown. The Rectangular tab shows the actual cross section of the specimen and the dimensions that are being reference in the main software screen. The following image shows the image on this tab.



Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Specimen Material:** Choose the specimen material desired.
- Young's Modulus, E: When the material is chosen the E value is chosen automatically.
- **Specimen Width, b**: Enter the specimen width in millimetres. Refer to the rectangular tab for further details.
- **Ixx**: This value of second moment of area about the X-X axis is calculated automatically using the parameters entered. Refer to the rectangular tab for further details.

- **<u>Ivv</u>**: This value of second moment of area about the Y-Y axis is calculated automatically using the parameters entered. Refer to the rectangular tab for further details.
- **Specimen Length**: Enter the length of the specimen that protrudes from the back plate of the hardware to the point of loading.
- **Applied Load, W**: Enter the value of the applied load in Netwon's.
- X-X inclination: Enter the angular inclination of the X-X axis. This is referenced from the horizontal plane, which is zero (0) degrees. Positive angles from this plane are in the clockwise direction.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Vertical Defn, dV</u>: This the theoretical value of the vertical deflection of the free end of the specimen under the applied load and with the cross section details entered earlier.
- <u>Horizontal Defn, dH</u>: This the theoretical value of the horizontal deflection of the free end of the specimen under the applied load and with the cross section details entered earlier.
- <u>Vertical Defn, dV</u>: This the actual value of the vertical deflection of the free end of the specimen under the applied load and with the cross section details entered earlier. This value comes from the dial gauge on the apparatus.
- Horizontal Defn, dH: This the actual value of the horizontal deflection of the free end of the specimen under the applied load and with the cross section details entered earlier. This value comes from the dial gauge on the apparatus.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this button or the append button, not both.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select the specimen material. The E value will change automatically.
- 4. Enter 20 in the specimen width, b input box.
- 5. Enter 10 in the specimen height, d input box.
- 6. The Ixx and Iyy values will be calculated automatically when the CAL button is pressed.
- 7. Enter 530 in the specimen length, L input box.
- 8. Leave the value as zero (0) in the X-X inclination input box.
- 9. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Specimen Material	Steel 💎		
Young's Modulus, E	210000	N/mm 2	
Specimen Width, b	20	mm	
Specimen Height, d	10	mm	
Ixx	1666.67	mm 4	
Іуу	6666.67	mm 4	
Specimen Length, L	530	mm	
Applied Load, W	5	N	
X-X Inclination	0	Degrees	
Theoretic	al Values		
Vertical Defn_dV	-0.71	mm	
Horizontal Defn dH	0	mm	
Actual	Values		
Vertical Defn_dV	0	mm	
Horizontal Defn dH	0	mm	

10. The complete screen should look like the following image:

HST21S_L64_V1-1-0_ENG.vi			
Experiment - Rectangular Part			
HST21S Unsymmetrical Bending		HDA 200	Offline
-0.71 mm	Specimen Material	Steel 🗸	
	Young's Modulus, E	210000	N/mm ²
	Specimen Width, b	20	mm
	Specimen Height, d	10	mm
	Ixx	1666.67	mm ⁴
	Іуу	6666.67	mm ⁴
λ	Specimen Length, L	530	mm
	Applied Load, W	5	N
	X-X Inclination	0	Degrees
	Theoretic	al Values	
	Vertical Defn dV	-0.71	mm
	Horizontal Defn dH	0	mm
	Actual	Values	
	Vertical Defn dV	0	mm
Calc New LOG	Horizontal Defn dH	0	mm
Data File New Append			

- 11. The theoretical vertical and horizontal deflection for the specimen geometry input will be shown in the first output box. These values will also be shown on the hardware image. Also note that the actual vertical and horizontal deflection values are greyed out. This is because you are in 'OFFLINE' mode.
- 12. Press the NEW button
- 13. Tick the Data File NEW box.
- 14. Press CALC.
- 15. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

lect a data fi	ile to write.				2
Save jn:	🗁 HST9S		۲	0 🕫 🕑 🖽 -	
My Recent Documents Desktop	Instruction M H5T95_V1.ali H5T95_V1.ex H5T95_V1.ini	ases le			
My Documents					
	File name:	TextFile.txt		× (OK
My Network	Save as type:	All Files (*.*)		¥ [Cancel

- 16. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 17. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

B HST21S_4 test_pji_26-2-1	0.txt - No	otepad		
<u>Fi</u> le <u>E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp				
26/02/2010 15:39:4 Youngs Modulus, E width, b 20.00	210000	.00	N/mm2	~
width, b 20.00 Height, d 10.00 Ixx 1666.67 mm4	mm mm			
Iyy 6666.67 mm4 Length, L 530.00	mm			
Applied Load, W X-X Inclination 0.00	0.00 Deg	N		
Theor Vertical Defn Theor Horizontal Defn	0.ÕO 0.OO	mm mm		

- 18. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 19. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 20. In the OFFLINE mode the LOG button will be greyed out.
- 21. When finished with the software shut the software down.
- 22. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Horizontal Dial Gauge	Dial gauge 1	28	0.01mm
Vertical Dial Gauge	Dial gauge 2	29	0.01mm

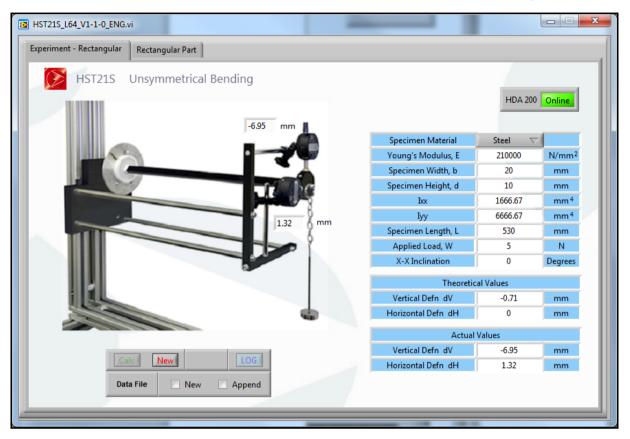
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the actual vertical and horizontal deflection values are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 4. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 5. Tick the data file option required.
- 6. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 7. The input parameters will then be saved to the data file.
- 8. Press the LOG button to store the actual values to the data file.
- 9. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 10. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.
- 11. The graph will be drawn automatically at each load position point, but you must follow the load position points in turn otherwise the graph will appear incorrect and the actual shear centre will not be correct.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

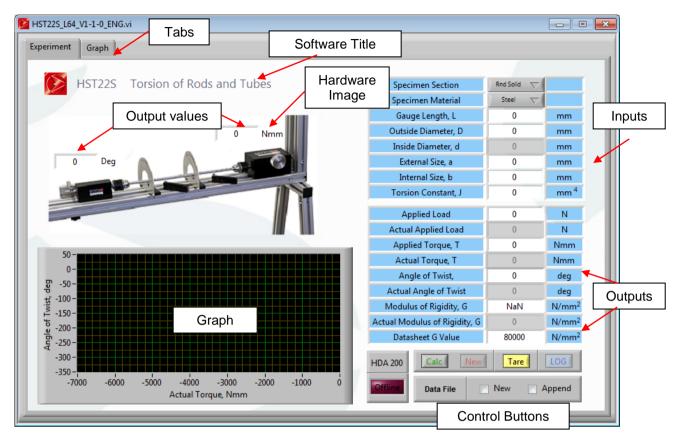
The data is as follows:

HT21S_V1 test file_1_3_1	0_pji.txt	- Notepad		
<u>File Edit Format V</u> iew <u>H</u> elp				
01/03/2010 13:17:5		2.2	200 2 0000000	~
Youngs Modulus, E	210000	.00	N/mm2	
width, b 20.00 Height, d 10.00	mm			
Ixx 1666.67 mm4	2000			
Iyy 6666.67 mm4				
Length, L 530.00	mm			
Applied Load, W	5.00	N		
X-X Inclination 45.00 Theor Vertical Defn	Deg -0.44	mm		
Theor Horizontal Defn	-0.27	mm		
Actual results		20078		
Vertical Defn _0.50	mm			3
Horizontal Defn -0.24	_mm			
01/03/2010 13:20:2 Youngs Modulus, E	210000	00	N/mm2	
width, b 20.00	mm	.00	N7 MITZ	
Height, d 10.00	mm			
IXX 1666.67 mm4				
Iyy 6666.67 mm4				
Length, L 530.00	mm 10.00	N		
Applied Load, W X-X Inclination 45.00	10.00 Deg	N		
Theor Vertical Defn	-0.89	mm		
Theor Horizontal Defn	-0.53	mm		
Actual results				
Vertical Defn -1.00	mm			
Horizontal Defn -0.45 01/03/2010 13:22:4	mm フ			
Youngs Modulus, E	210000	. 00	N/mm2	
width, b 20.00	mm			
Height, d 10.00	mm			
IXX 1666.67 mm4				
Iyy 6666.67 mm4 Length, L 530.00	mm			
Applied Load, W	15.00	N		
X-X Inclination 45.00	Deg			
Theor Vertical Defn	-1.33	mm		
Theor Horizontal Defn	-0.80	mm		
Actual results				
Vertical Defn –1.47 Horizontal Defn –0.63	mm			
01/03/2010 13:25:0				
Youngs Modulus, E	210000	.00	N/mm2	
width, b 20.00	mm			
Height, d 10.00	mm			
IXX 1666.67 mm4				
Iyy 6666.67 mm4 Length, L 530.00	mm			
Applied Load, W	20.00	N		
X-X Inclination 45.00	Deg	26.0		
	53574. 7 74			

The information will then repeat itself depending on how many test points have been logged.

HST22S – TORSION of RODS & TUBES

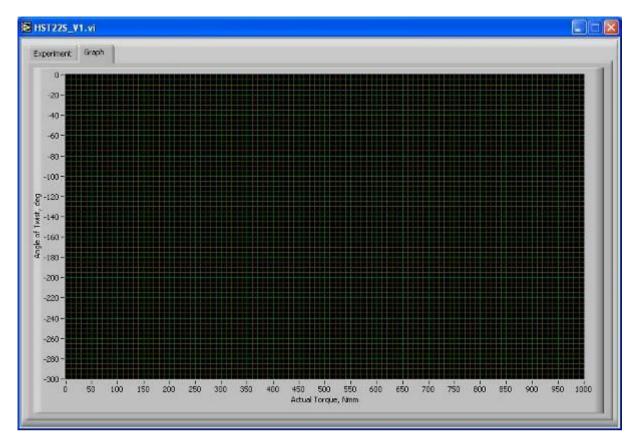
SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image:</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

<u>**Tabs:**</u> The tabs at the top allow the main software screen to be shown and also a larger version of the graph. The following image shows the graph on this tab.



Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Specimen section:** Choose the specimen section. This ranges from round solid, round hollow and square hollow.
- Specimen Material: Choose the specimen material desired.
- **Gauge Length, L:** Choose the gauge length over which the angle of twist is to be measured.
- Outside diameter, D: Enter the specimen outside diameter in millimetres.
- **Inside diameter, d**: Enter the specimen inside diameter in millimetres. This is only available for the round hollow section. If this is not chosen then this input will remain greyed out and not selectable.
- **External Size, a:** This is used for the square hollow section only. This is the length of one side of the outside length of the square hollow section in millimetres.

- Internal Size, b: This is used for the square hollow section only. This is the length of one of the inside faces of the square hollow section in millimetres.
- **Torsion Constant, J**: Depending on the specimen section chosen this value will change. It also takes into consideration the geometry of the specimen given.
- **Applied Load**: Enter the value of the applied load in Netwon's.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Actual Applied Load</u>: This the actual applied load from the force channel being used by the HDA200 which will have the load cell form the hardware attached.
- **Applied Torque, T**: This the calculated applied torque which uses the applied load value above.
- <u>Actual Torque, T</u>: This the actual applied torque value which used the actual applied load value from above.
- <u>Angle of Twist</u>: This is a theoretical value to be entered by the end user when running in offline mode. It is also the value that can be obtained from running the hardware experiment with the analogue protractors.
- <u>Actual Angle of Twist</u>: This is the actual angle of twist that comes from the hardware via the HDA200 Interface.
- Modulus of Rigidity, G: This is a theoretical calculated value.
- <u>Actual Modulus of Rigidity, G</u>: This is an actual value which uses the values entered above.
- **Datasheet G value:** Based on the material chosen this value will change accordingly. It is based on datasheet values for materials supplied with the standard hardware.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this button or the append button, not both.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select the specimen section as Rnd Solid.
- 4. Select the specimen material as Aluminium.
- 5. Enter the gauge length as 400.
- 6. Enter the outside diameter as 4.77.
- 7. The inside diameter will be greyed out.
- 8. Do not enter values for the external and internal size. They are not required for this specimen.
- 9. The J value will be calculated automatically.
- 10. Enter 6 for the applied load.
- 11. The actual applied load will be greyed out because you are in offline mode.
- 12. The applied torque will be calculated automatically.
- 13. The actual torque will be greyed out.
- 14. Enter the angle of twist as 6.2.
- 15. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Specimen Section	Rnd Solid 💎	
Specimen Material	Aluminium 🤝	
Gauge Length, L	400	mm
Outside Diameter, D	4.77	mm
Inside Diameter, d	0	mm
External Size, a	0	mm
Internal Size, b	0	mm
Torsion Constant, J	50.82	mm ⁴
Applied Load	6	N
Actual Applied Load	0	N
Applied Torque, T	390	Nmm
Actual Torque, T	0	Nmm
Angle of Twist,	6.2	deg
Actual Angle of Twist	0	deg
Modulus of Rigidity, G	28367	N/mm ²
Actual Modulus of Rigidity, G	0	N/mm ²
Datasheet G Value	26200	N/mm ²

16. The complete screen should look like the following image:

perment Graph			
HST22S Torsion of Rods and Tubes	HI-TE EDUCA		HDA 200
procession of the second se	Specimen Section	Rind Solid T	
390 Nmm	Specimen Material	Aluminium 💎	
	Gauge Length, L	400	mm
6.2 Deg	Outside Diameter, D	4.77	mm
	Inside Diameter, d	0	mm
	External Size, a	0	mm
	Internal Size, b	0	mm
	Torsion Constant, 1	50.82	mm ⁴
	Applied Load	6	N
	Actual Applied Load	0	N
50 -	Applied Torque, T	390	Nmm
	Actual Torque, T	0	Nmm
	Angle of Twist,	6.2	deg
	Actual Angle of Twist	0	deg
	Modulus of Rigidity, G	28367	N/mm ²
	Actual Modulus of Rigidity, G	0	Njmm 2
4 - 100 - 2 - 150 - 5 - 200 - ∯ - 200 - 9 - 200 -	Datasheet G Value	26200	N/mm ²
	Rev New	Tare	LOG
-350 - -7000 - 6010 - 5000 - 4000 - 3000 - 2000 - 1030 0 Actual Torque, Nmm	Data File	New 🔲	Append

- 17. The angle of twist and Applied torque will be presented on the hardware image also.
- 18. The TARE button, although live will not operate in offline mode.
- 19. Press the NEW button
- 20. Tick the Data File NEW box.
- 21. Press CALC.
- 22. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	ile to write.				? 🛛
Save in	🗁 HST9S		*	000	·
My Recent Documents	Instruction M H5195_V1.al K5195_V1.el H5195_V1.el H5195_V1.ini	ases le			
My Documents					
	File game:	TextFile tx		~	ОК
My Network	Save as type:	All Files (*.*)		~	Cancel

- 23. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 24. The input and output data will now be saved in the data file created. To prove this open the text file in **NOTEPAD** that you have just created from its location and check the contents. It should look similar to the image below.

HST225_9 TextFile 26_2_	_09.txt - Notepad	
Eile Edit Format View Help		
Angle of Twist 5.20 Modulus of Rigidity 26/02/2009 08:47:	28185.21 34	^
Specimen Section Specimen Material Gauge Length 400.00	Round Solid Aluminium	
Outside Diameter Inside Diameter	4.77 0.00	
External Size 0.00 Internal Size 0.00 Applied Load 6.00 Applied Torque 390.00 Angle of Twist 6.20		
Mođulus of Rigidity 26/02/2009 08:47:	28367.05 59	
Specimen Section Specimen Material Gauge Length 400.00	Round Solid Aluminium	
Outšide Diameter Inside Diameter	4.77 0.00	
External Size 0.00 Internal Size 0.00 Applied Load 7.10 Applied Torque 461.50		

- 25. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 26. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 27. In the OFFLINE mode the LOG button will be greyed out.
- 28. When finished with the software shut the software down.
- 29. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

	HDA200	HDA200	
Sensor/Transducer	Connector	Channel	
	Number	number	
Load Cell	Force 1	17	
Angle	Angle 1	21	

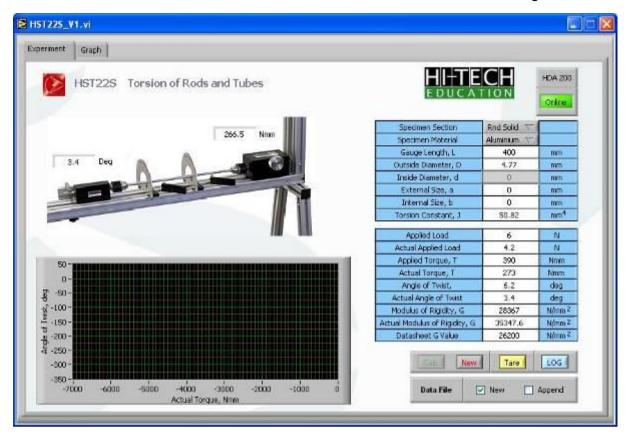
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the actual applied load, actual torque, actual angle of twist and actual modulus of rigidity are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 4. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 5. Tick the data file option required.
- 6. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 7. The input parameters will then be saved to the data file.
- 8. Press the LOG button to store the actual values to the data file.
- 9. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 10. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.
- 11. The graph will be drawn automatically each time the actual applied load and hence actual applied torque are changed.

DATA FILE CONTENTS

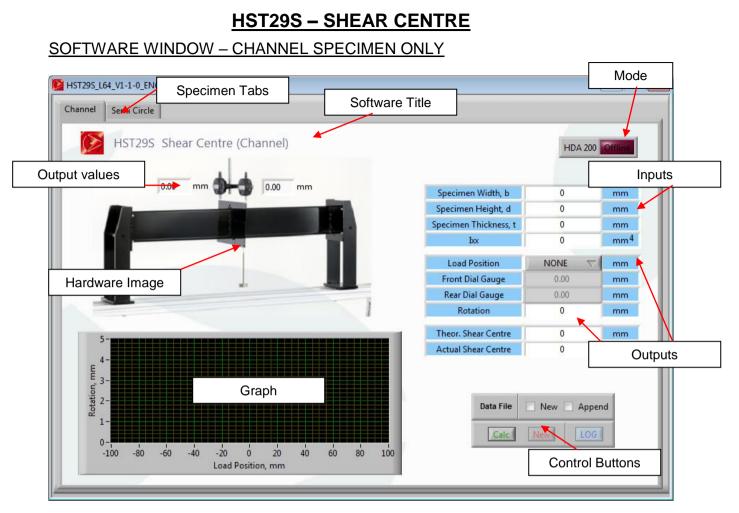
The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

The data is as follows:

HST22S_9 TextFile 26_2_0	09.txt - Notepad	
Eile Edit Format View Help		
Angle of Twist 5.20 Modulus of Rigidity 26/02/2009 08:47:3	28185.21 4	^
Specimen Section Specimen Material Gauge Length 400.00	Round Solid Aluminium	
Outside Diameter Inside Diameter External Size 0.00	4.77 0.00	
Internal Size 0.00 Applied Load 6.00 Applied Torque 390.00 Angle of Twist 6.20		
Modulus of Rigidity 26/02/2009 08:47:5	28367.05 9	
Specimen Section Specimen Material Gauge Length 400.00	Round Solid Aluminium	
Outšide Diameter Inside Diameter	4.77 0.00	
External Size 0.00 Internal Size 0.00 Applied Load 7.10 Applied Torque 461.50		

The information will then repeat itself depending on how many test points have been logged.



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Specimen Tabs: This software allows the channel and semicircle specimens to be presented.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Specimen width, b:** Choose the specimen width in millimetres.
- Specimen Height, d: Choose the specimen height in millimetres.
- **Specimen Thickness, t**: Choose the specimen thickness in millimetres.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

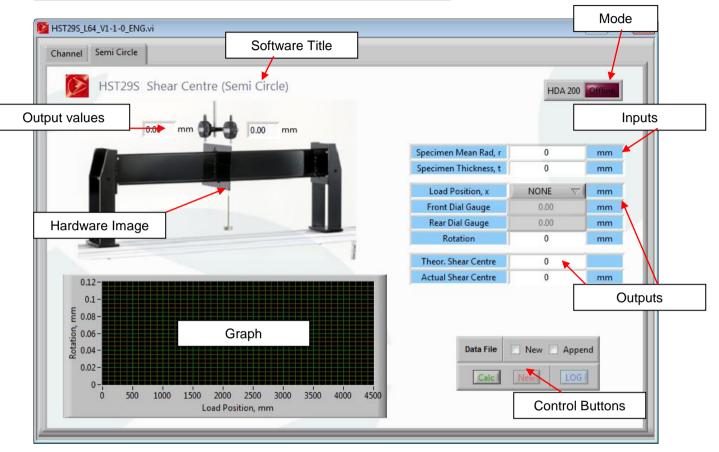
The outputs available are as follows:

- **Load Position**: The load positions are the positions at which the load is placed on the hardware (see experiment hardware manual). The options that can be chosen from the drop down list are as follows: NONE, 100, 80, 60, 40, 20, 0, -20, -40, -60, -80, -100mm. This replicates the hardware experiment.
- **Front Dial Gauge**: This is the actual dial gauge value from the hardware. This should be the dial gauge connected into channel 28 of the HDA200. It has the units of millimetres.
- **Rear Dial Gauge**: This is the actual dial gauge value from the hardware. This should be the dial gauge connected into channel 29 of the HDA200. It has the units of millimetres.
- **Rotation:** At each load position the rotation is calculated. It has units of millimetres.
- **Theoretical Shear Centre:** This is the calculated theoretical shear centre for the channel specimen based on the specimen geometry given in the inputs. It has units of millimetres.
- Actual Shear Centre: This is the actual shear centre for the channel specimen. It is calculated from the graph that is plotted at every load position point. The more points obtained the more accurate the shear centre value. It has units of millimetres.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **NEW**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- **Data File NEW:** This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this button or the append button, not both.
- <u>Data file APPEND</u>: If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

<u>Graph:</u> Each time a load position is set and the LOG button pressed the graph will be plotted of rotation against load position. Each rotation value will be added to the graph and hence a straight line should be produced. The point at which the line crosses the y-axis is the actual shear centre value of the specimen. You can clear the graph by right clicking on the graph and choosing clear graph.



SOFTWARE WINDOW - SEMICIRCLE SPECIMEN ONLY

In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image:</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

Specimen Mean Radius, r: Choose the specimen mean radius in millimetres.
 Specimen Thickness, t: Choose the specimen thickness in millimetres.

<u>Outputs</u>: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.

The outputs available are as follows:

- Load Position: The load positions are the positions at which the load is placed on the hardware (see experiment hardware manual). The options that can be chosen from the drop down list are as follows: NONE, 100, 80, 60, 40, 20, 0, -20, -40, -60, -80, -100mm. This replicates the hardware experiment.
- **Front Dial Gauge**: This is the actual dial gauge value from the hardware. This should be the dial gauge connected into channel 28 of the HDA200. It has the units of millimetres.
- **Rear Dial Gauge**: This is the actual dial gauge value from the hardware. This should be the dial gauge connected into channel 29 of the HDA200. It has the units of millimetres.
- **Rotation:** At each load position the rotation is calculated. It has units of millimetres.
- **Theoretical Shear Centre:** This is the calculated theoretical shear centre for the channel specimen based on the specimen geometry given in the inputs. It has units of millimetres.
- Actual Shear Centre: This is the actual shear centre for the channel specimen. It is calculated from the graph that is plotted at every load position point. The more points obtained the more accurate the shear centre value. It has units of millimetres.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- <u>Data File **NEW**</u>: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- <u>Data file **APPEND**</u>: If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

<u>Graph:</u> Each time a load position is set and the LOG button pressed the graph will be plotted of rotation against load position. Each rotation value will be added to the graph and hence a straight line should be produced. The point at which the line crosses the y-axis is the actual shear centre value of the specimen. You can clear the graph by right clicking on the graph and choosing clear graph.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE – CHANNEL SPECIMEN

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select the Channel specimen tab at the top of the software screen.
- 4. Enter 50 in the width, b input box.
- 5. Enter 100 in the height, d input box.
- 6. Enter 1.62 in the thickness input box.
- 7. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Specimen Width, b	50	mm
Specimen Height, d	100	mm
Specimen Thickness, t	1.62	mm
Ixx	629466.54	mm 4
Load Position	NONE 🗸	mm
Front Dial Gauge	0	mm
Rear Dial Gauge	0	mm
Rotation	0	mm
Theor. Shear Centre	16.09	mm
Actual Shear Centre	0	mm

8. The complete screen should look like the following image:

schel Semi Orde			
HST29S Shear Centre (Channel)	EDUCATION	HDA 200	office .
0 mm	Spadmen Width, b	50	com .
	Specimen Height, d	100	σm
	Specimen Thickness, t	1.62	mm
	Ixx	629466.54	mm.4
	Load Position	NONE T	mm
	Front Dial Gauge	0	mm
	Rear Dial Gauge	0	mm
0	Rotation	0	mm
	Theor, Shear Centre	16.09	mm
5-	Actual Shear Centre	0	
4- 	Data File	New Append	5
0	100		

- 9. The theoretical shear centre for the specimen geometry input will be shown in the first output box. Also note that the front and rear dial gauge values are greyed out. This is because you are in 'OFFLINE' mode.
- 10. Press the NEW button
- 11. Tick the Data File NEW box.
- 12. Press CALC.
- 13. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

ielect a data fi	ile to write.					?
Save jn	😂 HST9S		*	00	P 🛛 •	
My Recent Documents	Instruction M HST95_V1.ali HST95_V1.ex HST95_V1.ini	ases e				
My Documents						
My Computer	File pame:	TextFile.br			· (DK
My Network	Save as type:	All Files (*.*)			-	Cancel

- 14. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 15. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

Elle Edir Edular Ale	w <u>T</u> eih				
26/02/2010	12:37:2	9			~
Specimen Width, Specimen Height	b	50.00	mm		
Specimen Height	, d	100.00	mm		
Specimen Thickn			mm		
	54				
Theoretical She	ar Centr	e	16.09	mm	
Actual results	F 70				
Front Dial		mm			
Rear Dial Load Position					
	0.00				
26/02/2010					
Specimen Width.	h	50.00	mm		
Spécimen Width, Specimen Height Specimen Thickn	. d	100.00	mm		
Specimen Thickn	éss, t	1.62	mm		
IXX 629466.	54	mm4			
Theoretical She	ar Centr	e	16.09	mm	
Actual results					
	5.97	mm			
Rear Dial		mm			
Load Position		mm			
	NaN	_mm			
26/02/2010	12:42:1	2			

- 16. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 17. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 18. In the OFFLINE mode the LOG button will be greyed out.
- 19. When finished with the software shut the software down.
- 20. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

OFFLINE MODE – SEMICIRCLE SPECIMEN

- 1. Load the experiment software by double clicking the **.exe** files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select the semicircle specimen tab at the top of the software screen.
- 4. Enter 50 in the width, b input box.
- 5. Enter 100 in the height, d input box.
- 6. Enter 1.62 in the thickness input box.
- 7. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Specimen Mean Rad, r	50	mm
Specimen Thickness, t	1.62	mm
Load Position, X	NONE 🗸	mm
Front Dial Gauge	0	mm
Rear Dial Gauge	0	mm
Rotation	0	mm
Theor. Shear Centre	63.66	1
Actual Shear Centre	0	mm

8. The complete screen should look like the following image:

annel Semi Groe			_
HST29S Shear Centre (Semi Circle)	EDUCATION	HDA 200	of the state
	Specimen Mean Rad, r	50	mm
	Specimen Thickness, t	1.62	mm
	Load Position, ×	NONE T	mm
	Front Dial Gauge	0	mm
	Rear Dial Gauge	0	1700
	Rotation	0	mm
	Theor, Shear Centre	63.66	
1	Actual Shear Centre	0	mm
0.12- 0.1- § 0.08- § 0.06- § 0.04- 0.02-	Data File	New Appen	a

- 9. The theoretical shear centre for the specimen geometry input will be shown in the first output box. Also note that the front and rear dial gauge values are greyed out. This is because you are in 'OFFLINE' mode.
- 10. Press the NEW button
- 11. Tick the Data File NEW box.
- 12. Press CALC.
- 13. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

lect a data fi	le to write.				?
Save jn	🗁 HST9S		*	0000	6
My Recent Documents Desktop	Instruction M HST9S_V1.ai HST9S_V1.ea HST9S_V1.ea	iases (e			
ly Documents					
	File name:	TextFile.tx		~	OK.
My Network	Save as type:	All Files (*.*)		~	Cancel

- 14. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 15. The input and output data will now be saved in the data file created.
- 16. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 17. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 18. In the OFFLINE mode the LOG button will be greyed out.
- 19. When finished with the software shut the software down.
- 20. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Front Dial Gauge	Dial gauge 1	28	0.01mm
Rear Dial Gauge	Dial gauge 2	29	0.01mm

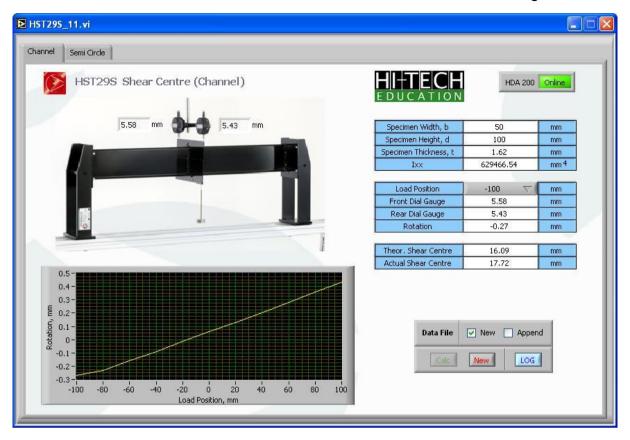
Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the front and rear dial gauge values are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 4. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 5. Tick the data file option required.

- 6. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 7. The input parameters will then be saved to the data file.
- 8. Press the LOG button to store the actual values to the data file.
- 9. Incrementally change the load position from NONE right through to -100mm, and at each increment press the LOG button.
- 10. The graph will be drawn automatically at each load position point, but you must follow the load position points in turn otherwise the graph will appear incorrect and the actual shear centre will not be correct.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed at each load position increment:

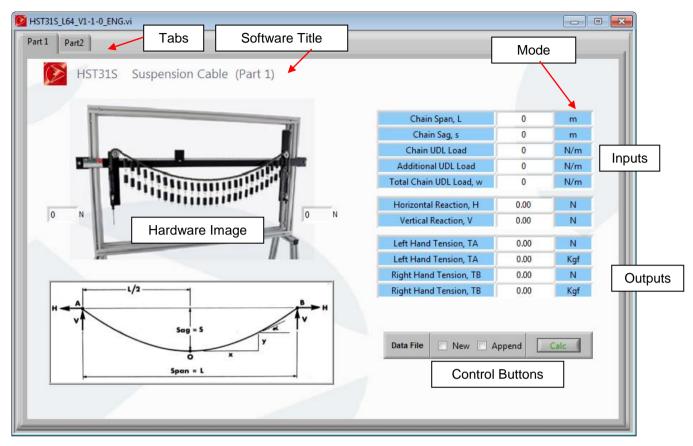
The data is as follows:

HST29S_11_test	_1_3_10_	_pji_chann	el.txt - N.	🔳	
<u>File E</u> dit F <u>o</u> rmat <u>V</u> ie	w <u>H</u> elp				
01/03/2010	13:59:5	7			~
Specimen width,		50.00	mm		
Specimen Height	. d	100.00	mm		
Specimen Thićkn	ess, t	1.62	mm		
IXX 629466.	54	mm4			
Theoretical She	ar Centr	e	16.09	mm	
Actual results					
Front Dial	5.72	mm			
Rear Dial	5.30	mm			
Load Position	0.00	mm			
Shear Centre	0.00	mm			
Actual results					
Front Dial	5.97	mm			
Rear Dial	5.12	mm			
Load Position	100.00	mm			
Shear Centre	NaN	mm			
Actual results					
Front Dial	5.93	mm			
Rear Dial	5.15	mm			
Load Position	80.00	mm			
Shear Centre	22.86	mm			
Actual results	7.7.6.7.5	100000			
Front Dial	5.88	mm			
Rear Dial	5.18	mm			
Load Position	60.00	mm			
Shear Centre	15.11	mm			
Actual results					
Front Dial	5.83	mm			
Rear Dial	5.21	mm			
Load Position	40.00	mm			
Shear Centre	12.47	mm			
Actual results	10				
Front Dial	5.80	mm			
Rear Dial	5.25	mm			
Load Position	20.00	mm			
Shear Centre	13.68	mm			
Actual results		2.000 C			
Front Dial	5.76	mm			
Rear Dial	5.28	mm			
Load Position	0.00	mm			
Shear Centre	15.01	mm			
Actual results					
Front Dial	5.72	mm			
Rear Dial	5.31	mm			
Lood Docition	20.00	101100			

The information will then repeat itself depending on how many test points have been logged.

HST31S - SUSPENSION CABLE

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>**Hardware image:**</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **<u>Chain Span, L</u>**: Enter the span of the chain in metres.
- Chain Sag, s: Enter the chain sag in metres.
- **Chain UDL Load**: Enter the Chain UDL load being applied to the chain in Newton per metres. This is the self weight of the chain.
- <u>Additional UDL Load</u>: Enter the additional UDL load that can be applied to the chain via the suspension weights supplied with the hardware.
- Total Chain UDL Load, w: This is the combined UDL load on the chain.

Outputs: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical. Again the format of the columns is the same as the inputs except that the central column is automatically updated depending on the inputs chosen and cannot be adjusted via the keyboard.

The outputs available are as follows:

- Horizontal Reaction, H: This is a calculated value in Newton's.
- Vertical Reaction, V: This is a calculated value in Newton's.
- **Left Hand Tension, TA**: This is a calculated value in Newton's.
- Left Hand Tension, TA: This is a calculated value in kilogram Force
- **<u>Right Hand Tension, TB</u>**: This is a calculated value in Newton's.
- **<u>Right Hand Tension, TB</u>**: This is a calculated value in kilogram Force

-

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

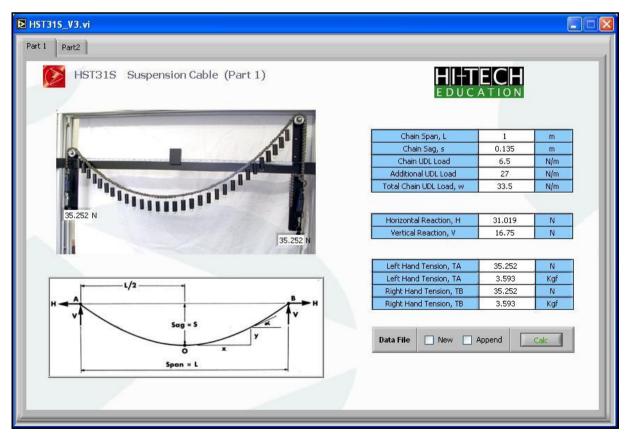
- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

OFFLINE MODE

1. Input the following parameters:

Chain Span, L	1	m
Chain Sag, s	0.135	m
Chain UDL Load	6.5	N/m
Additional UDL Load	27	N/m
Total Chain UDL Load, w	33.5	N/m
Horizontal Reaction, H	31.019	N
Vertical Reaction, V	16.75	N
Vertical Reaction, V	16.75	N
Vertical Reaction, V Left Hand Tension, TA	16.75 35.252	N
Vertical Reaction, V	16.75	N
Vertical Reaction, V Left Hand Tension, TA	16.75 35.252	N

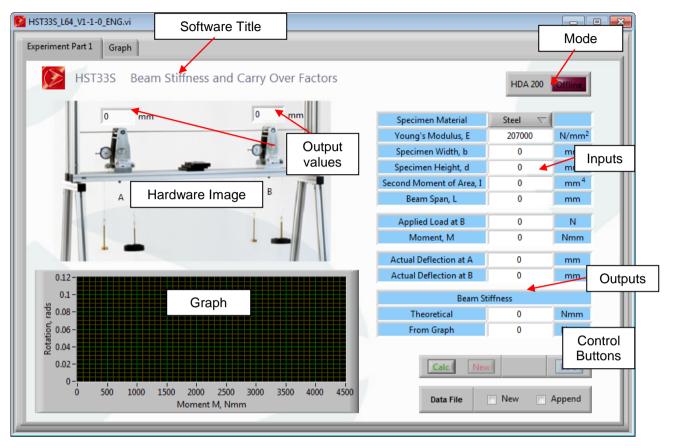
2. Press the CALC button and the software window should look like the image below:



- 3. You will now see the left and right hand tensions and reactions displayed on the screen.
- 4. Repeat the same process for the part 2 experiment on the other tab.

HST33S – BEAM STIFFNESS & CARRY OVER FACTORS

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>**Hardware image:**</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- <u>Material:</u> The user can choose the frame material. Choices range from steel, aluminium and brass. When a material is chosen the young's modulus is automatically chosen and displayed in the input box below.
- <u>Specimen Width, b:</u> This is the width of the beam. Typically this will be 25mm. It has the units of millimetres (mm).
- <u>Specimen Height, d</u>: This is the height of the beam. Typically this is 3 or 5mm. It has the units of millimetres (mm).
- Second Moment of Area, I: This is the calculated value based on the figures input for b and d above.
- **Beam span, L**: This is the span of the beam. It has the units of millimetres (mm).

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical. Again the format of the columns is the same as the inputs except that the central column is automatically updated depending on the inputs chosen and cannot be adjusted via the keyboard.</u>

The outputs available are as follows:

- **Applied Load at B**: This is the load applied at B only. It has the units of Newton (N).
- <u>Moment, M</u>: This is the calculated moment being applied at B by the applied load chosen. It is calculated using the applied load x 150mm. It has the units of Newton-millimetres (Nmm).
- <u>Actual Deflection at A</u>: This is the actual deflection reading from the dial gauge mounted on pier A. It has the units of millimetres (mm).
- Actual Deflection at B: This is the actual deflection reading from the dial gauge mounted on pier B. It has the units of millimetres (mm).
- **Theoretical**: This is the theoretical Beam Stiffness using the parameters input above. It has the units of Newton-millimetres (Nmm).
- **From Graph:** This is the actual value of beam stiffness taken from the gradient of the graph that is produced when running in ONLINE mode only.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated.
- **LOG**: When the end user wishes to record any data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- **Data File NEW:** This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is

ticked and the CALC button pressed you will be prompted to create a new data file.

- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

<u>Graph</u>: This graph is created when in ONLINE mode only. It will plot the rotation against moment. Each time the LOG button is pressed the graph will update with new points. At the top of the software screen is a tab stating GRAPH. When pressing this tab a new software window will appear with the same graph as shown in the main software window.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

NB: BEFORE RUNNING THE SOFTWARE IN ONLINE MODE MAKE SURE THERE IS A DIAL GAUGE CONNECTED INTO DIAL GAUGE CHANNEL1 and DIAL GAUGE CHANNEL 2 OF THE HDA200.

THIS EXPERIMENT WILL UNDERTAKE THE BEAM STIFFNESS ELEMENT PF PART 1 OF THE HARDWARE INSTRUCTION MANUAL.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Dial Gauge	Dial gauge 1	28	0.01mm
Dial Gauge	Dial gauge 2	29	0.01mm

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

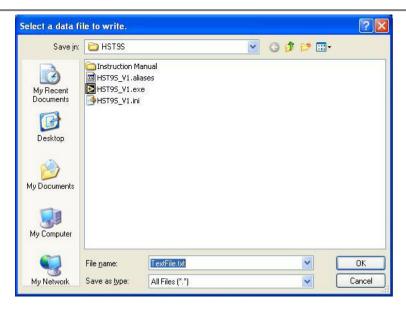
If the above channels are not set correctly then you will have to enter the configuration of the HDA200 which will require reading and following the HDA200 instruction manual.

ONLINE MODE

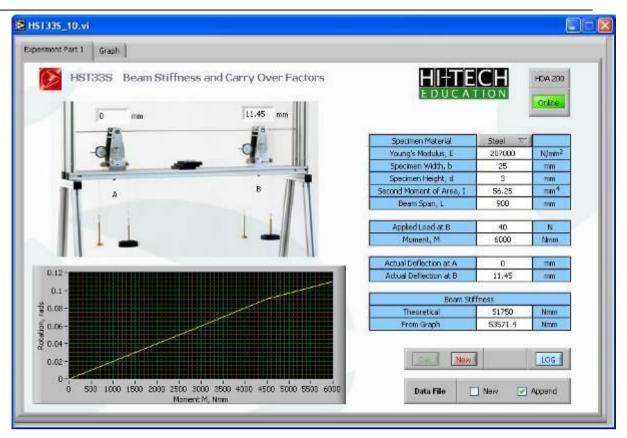
- 1. Load the experiment software by double clicking the **.exe** files supplied.
- 2. Choose 'YES' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose the beam material.
- 4. Enter 25 in the specimen width input box.
- 5. Enter 3 in the specimen height input box.
- 6. Enter 900 in the beam span input box.
- 7. Enter 0 in the Applied Load at B input box. The screen should now have inputs that look like the following image:

Specimen Material	Steel 🔽	-
Young's Modulus, E	207000	N/mm ²
Specimen Width, b	25	mm
Specimen Height, d	3	mm
Second Moment of Area, I	56.25	mm ⁴
Beam Span, L	900	mm
Applied Load at B	0	N
Moment, M	0	Nmm
Actual Deflection at A	0	mm
Actual Deflection at B	0	mm
Beam Sti	ffness	
Theoretical	51750	Nmm
From Graph	0	Nmm

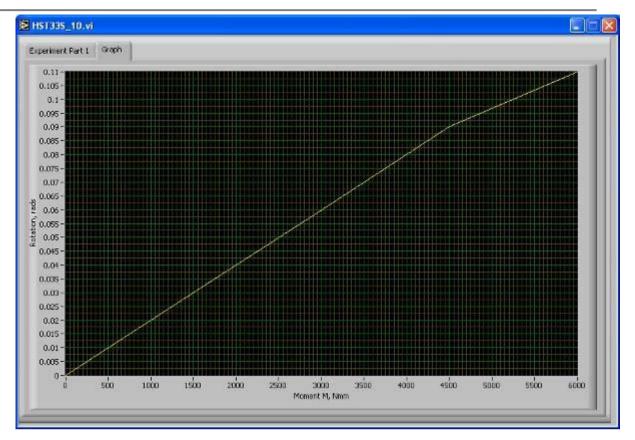
- 8. Tick the Data File NEW box.
- 9. Press CALC.
- 10. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.



- 11. Either rename the default name of TextFile.txt or keep this default name. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 12. The input and output data will now be saved in the data file created.
- 13. Press the LOG button.
- 14. Zero the dial gauges on both piers as outlined in the hardware instruction manual.
- 15. Load the hanger of Pier B with 10N. Input 10 in the Applied Load input box. The dial gauge will change accordingly following loading.
- 16. Press LOG. Both graphs should start to be plotted.
- 17. Load the hanger of pier B with 20N. Input 20 in the Applied Load Input box. The dial gauge will change accordingly following loading.
- 18. Press LOG. Both graphs should update.
- 19. Load the hanger of pier B with 30N. Input 30 in the Applied Load Input box. The dial gauge will change accordingly following loading.
- 20. Press LOG. Both graphs should update.
- 21. Load the hanger of pier B with 40N. Input 40 in the Applied Load Input box. The dial gauge will change accordingly following loading.
- 22. Press LOG. Both graphs should update.
- 23. The software screen should look the like the following image.



24. The graph page should also look like the following:



- 25. You should find that the theoretical and actual beam stiffness values appear in the bottom of the software screen.
- 26. If you wish to change the beam parameters or start the test again, then press the NEW button. Right click on both graphs and choose clear chart. This will remove the plotted points.
- 27. Change the parameters, choose whether to create a new data file or append to an existing one. Press the CALC button and start the loading process again.

HST35S – STRAIN MEASUREMENT for STRUCTURES

<u>SOFTWARE WINDOW – Part 1</u>

Part 1 Part 24 Tabs Software	Title	Mode		
HST35S Strain Measurement for Structures (Part 1)		HDA 2	00 Offline	
Output value	Specimen Material	Steel	7	
	Young's Modulus, E	207000	N/mm ²	
	Specimen Width, b	0	mm	
ο μs	Specimen Height, d	0	THE	
	Neutral Axis, y	0	mm	Inputs
	2nd Moment of Area, I	0	mm ⁴	
	Support Span, L	0	mm	
	Overhang, L1 & L2	0	mm	
	Hanger Load, F	0	N	
Hardware Image	Bending Moment, M	0	Nmm	
	Strain Gauge	a 7	7	
	Deflection, Ō	0	mm	
	Actual Deflection, δ	0	mm	Outputs
Data File New Append Calc New Tare LOG	Actual Strain	0		
	Strain Using Material Prope	rties 0	µ Strain	
Control Buttons	Strain Using Deflection Val	ues 0	µ Strain	

In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

<u>**Tabs:**</u> The two parts of this experiment are presented on two individual tabs and software screens. The two parts represent the actual hardware experiments parts also. Part 1 is shown above.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Specimen material:** Choose the material for the specimen.
- Young's Modulus, E: This changes automatically depending on the specimen material chosen.
- **Specimen width, b**: Input the width of the specimen in millimetres.
- **Specimen Height, d**: Input the height of the specimen in millimetres.
- **Neutral Axis, y**: This is calculated automatically based on the specimen height input above in millimetres.
- <u>2nd Moment of Area, I</u>: This is calculated automatically based on the specimen width and height input above.
- **Support Span, L**: Input the distance between the specimen supports in millimetres.
- **Overhang, L1 & L2**: Input the overhang distances for this specimen in millimetres.
- Hanger Load, F: Input the load applied to each hanger in Newton's.
- Bending Moment, M: This is calculated automatically in Newton-millimetres.

The specimens used in Part1 of the HST35 hardware experiment have strain gauges attached to their upper and lower surfaces. These are labelled a, b and c. Only a and b are tested here because c is a repeat of a. The drop down list for **<u>Strain Gauge</u>** allows the end user to select which strain gauges they wish to compare results with. It is possible to choose from the list a, b or a+b.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- **Deflection**, **δ**: This is the theoretical deflection at the midspan of the specimen under test in millimetres.
- <u>Actual Deflection</u>, δ: This is the actual deflection at the midspan of the specimen under test in millimetres. This will be inactive (greyed out) in offline mode only.
- <u>Actual Strain</u>: this is the actual strain readings from the hardware via the HDA200.t the coordinates chosen the theoretical bending stress is given here. It has the units of Newton's per millimetre squared. This will be inactive (greyed out) in offline mode only.
- <u>Strain using Material Properties</u>: This is the theoretical calculated strain using the material properties given above.
- <u>Strain using Deflection values</u>: This is the theoretical calculated strain using the deflection values produced above. In offline mode this will be the deflection values. In online mode this will be the actual deflection values.

<u>Control buttons</u>: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **<u>CALC</u>**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- <u>**Tare</u>**: Pressing this button in ON-LINE mode will tare, zero the actual strain gauge value.</u>
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE mode, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. The current input parameters will then be added to the data file chosen.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

NB: You will only be able to choose the New or Append options. You cannot choose both at the same time. It is one or the other.

On the hardware image itself you will see that the strain will appear to the left of the dial gauge while the deflection will appear to the right of the dial gauge. When in OFFLINE mode these values will be the theoretical values. When in ONLINE mode these values will be actual.

SOFTWARE WINDOW - Part 2

Main HST35S_L64_V1-1-0_ENG.vi Tabs Part 1 Part 24	Title	Mode		×
HST35S Strain Measurement for Structures (Part 2) Output value		HDA 200	Offine	
Oulput value	Specimen Material	Steel 🗸		
the state of the s	Young's Modulus, E	207000	N/mm ²	
	Specimen Width, b	0	mm	
ο μS	Specimen Height, d	0	mm	Inputs
	Neutral Axis, y	0	mm	
	2nd Moment of Area, I	0	mm ⁴	
	Gauge posn frm Load, L	0	mm	
	Hanger load, F	0	N	
	Bending Moment, M	0	Nmm	
Hardware Image	Actual Strain	0	u Strain	
	Strain using Material Prope	ties 0	µ Strain	
		Outputs		
Data File New Append Calc New Tare LOG	-			
Control Buttons				

In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image:</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

<u>**Tabs:**</u> The two parts of this experiment are presented on two individual tabs and software screens. The two parts represent the actual hardware experiments parts also. Part 2 is shown above.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Specimen material:** Choose the material for the specimen.
- Young's Modulus, E: This changes automatically depending on the specimen material chosen.
- **Specimen width, b**: Input the width of the specimen in millimetres.
- **Specimen Height, d**: Input the height of the specimen in millimetres.
- **Neutral Axis, y**: This is calculated automatically based on the specimen height input above in millimetres.
- <u>2nd Moment of Area, I</u>: This is calculated automatically based on the specimen width and height input above.
- <u>Gauge posn frm Load, L</u>: As this specimen is a cantilever the distance of the centreline of the strain gauge to the load position is input here in millimetres.
- Hanger Load, F: Input the load applied to each hanger in Newton's.
- Bending Moment, M: This is calculated automatically in Newton-millimetres.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- <u>Actual Strain</u>: this is the actual strain readings from the hardware via the HDA200.t the coordinates chosen the theoretical bending stress is given here. It has the units of Newton's per millimetre squared. This will be inactive (greyed out) in offline mode only.
- <u>Strain using Material Properties</u>: This is the theoretical calculated strain using the material properties given above.

<u>Control buttons</u>: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **<u>CALC</u>**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- <u>**Tare</u>**: Pressing this button in ON-LINE mode will tare, zero the actual strain gauge value.</u>
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE mode, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. The current input parameters will then be added to the data file chosen.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

NB: You will only be able to choose the New or Append options. You cannot choose both at the same time. It is one or the other.

On the hardware image itself you will see that the strain will appear to the left of the dial gauge while the deflection will appear to the right of the dial gauge. When in OFFLINE mode these values will not appear in these boxes. When in ONLINE mode these values will be actual.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

<u> OFFLINE MODE – Part 1</u>

- 1. Load the experiment software by double clicking the **.exe** files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select the Part 1 tab at the top of the software screen.
- 4. Choose steel at the material. The E value will change automatically.
- 5. Enter 25 in the specimen width input box.
- 6. Enter 3.1 in the specimen height input box.
- 7. The neutral axis and 2nd moment of area will be calculated automatically when the CALC button is pressed later.
- 8. Enter 200 in the support span, L input box.
- 9. Enter 100 in the Overhang L1 & L2 input box.
- 10. Enter 20 in the Hanger Load, F input box.
- 11. Keep the strain gauge a selected.
- 12. Enter 0.82 in the deflection input box.

13. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Specimen Material	Steel	7
Young's Modulus, E	207000	N/mm ²
Specimen Width, b	25	mm
Specimen Height, d	3.1	mm
Neutral Axis, y	1.55	mm
2nd Moment of Area, I	62.065	mm ⁴
Support Span, L	200	mm
Overhang, L1 & L2	100	mm
Hanger Load, F	20	N
Bending Moment, M	2000	Nmm
Strain Gauge	a 🔨	7
Deflection, δ	0.82	mm
Actual Deflection, δ	0	mm
Actual Strain	0	
itrain Using Material Propert	ies 241	µ Strain
Strain Using Deflection Valu	es 254	µ Strain

14. The complete screen should look like the following image:

Part 2			_
HST35S Strain Measurement for Structures (Part 1)	HITECH EDUCATION	HDA 200	Offline
4	Specimen Material	Steel 🗸	
	Young's Modulus, E	207000	N/mm ²
0 μ5	Specimen Width, b	25	mm
	Specimen Height, d	3.1	mm
	Neutral Axis, y	1.55	mm
	2nd Moment of Area, 1	62.065	mm ⁴
	Support Span, L	200	mm
	Overhang, L1 & L2	100	mm
	Hanger Load, F	20	N
	Bending Moment, M	2000	Nmm
	Strain Gauge	a $ abla black$	
	Deflection, ð	0.82	mm
	Actual Deflection, δ	0	mm
ata File New Append Calc New Tare LOG	Actual Strain	0	
	Strain Using Material Properties	241	µ Strain
	Strain Using Deflection Values	254	µ Strain

- 15. The strain using material properties and deflection values will be shown in the relevant output boxes. Also note that the actual deflection and strain values are greyed out. This is because you are in 'OFFLINE' mode.
- 16. Press the NEW button and then tick the Data File NEW box.
- 17. Press CALC.
- 18. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.					? 🛛
Save jn:	🗁 HST355_V1	Contract of the second s	~	G 🕫	• 🛄 👏	
My Recent Documents	instruction Ma HST355_V1.al HST355_V1.e HST355_V1.e HST355_V1.in	iases Ke				
My Documents						
My Computer						
	File <u>n</u> ame:	T extFile.txt			· (ОК
My Network	Save as <u>t</u> ype:	All Files (*.*)			~ (Cancel

- 19. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 20. The input and output data will now be saved in the data file created. To prove this open the text file in **NOTEPAD** that you have just created from its location and check the contents. It should look similar to the image below.

B HST35S_V1_test file_2_3_10_pji_off	line.txt -	Notepad 📘	
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp			
02/03/2010 08:43:45 PART 1	2.5		~
Young's Modulus, E 207000 Specimen width, b 25.00 Specimen Height, d 3.10	N/mm2 mm mm		
Neutral Axis,y 1.55 mm Second Moment of Area, l Support Span, L 200.00 mm	62.06	mm4	
Overhang, L1 & L2 100.00 Hanger Load, F 20.00 N	mm		
Bending Moment, M 2000.00 Strain Gauge a Deflection 0.82 mm	Nmm		
Strain using Material Propertie: µStrain	S	241.29	
Strain using Deflection Values	254.20	µStrain	
			*

- 21. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 22. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 23. In the OFFLINE mode the LOG button will be greyed out. The TARE button although live will not have any function.
- 24. When finished with the software shut the software down.
- 25. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

<u>OFFLINE MODE – Part 2</u>

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select the Part 1 tab at the top of the software screen.
- 4. Choose aluminium as the material. The E value will change automatically.
- 5. Enter 25 in the specimen width input box.
- 6. Enter 3.1 in the specimen height input box.
- 7. The neutral axis and 2nd moment of area will be calculated automatically when the CALC button is pressed later.
- 8. Enter 100 in the gauge posn frm load, L input box.
- 9. Enter 30 in the Hanger Load, F input box.
- 10. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Specimen Material	Aluminium 🔨	7
Young's Modulus, E	69000	N/mm ²
Specimen Width, b	25	mm
Specimen Height, d	3.1	000
Neutral Axis, y	1.55	rom
2nd Moment of Area, I	62.065	mm4
	(1814)-33	
Hanger load, F	100 30	mm N
Sauge posn frm Load, L Hanger load, F Bending Moment, M		
Hanger load, F	30	N

11. The complete screen should look like the following image:

HST355_V1.vi				
HST35S Strain Measurement for Structures (Part 2)	HITECH EDUCATION	HDA 200	Offine	
a_a	Specimen Material	Aluminium 🖂		
	Young's Modulus, E	69000	N/mm ²	
	Specimen Width, b	25	mm	
0 µS	Specimen Height, d	3.1	mm	
	Neutral Axis, y	1.55	mm	
	2nd Moment of Area, I	62.065	mm ⁴	
	Gauge posn frm Load, L	100	mm	
	Hanger load, F	30	Ň	
	Bending Moment, M	3000	Nmm	
	Actual Strain	0	µ Strain	
	Strain using Material Proper	ties 1085.83	µ Strain	
Data File New Append Calc New Tare LOG				

- 12. The strain using material properties value will be shown in the relevant output box. Also note that the actual strain values are greyed out. This is because you are in 'OFFLINE' mode.
- 13. Press the NEW button and then tick the Data File NEW box.
- 14. Press CALC.
- 15. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	ile to write.					? 🛛
Save jn:	🗀 HST355_V1		~	3	• 📰 🕈	
My Recent Documents	Instruction Ma	iases (e				
My Documents						
My Computer						
	File <u>n</u> ame:	TextFile.txt			▼ (ОК
My Network	Save as <u>t</u> ype:	All Files (*.*)			v (Cancel

- 16. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 17. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

HST35S_V1_test file_2_3	_10_pji_o	ffline_part	2.txt	
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp				
02/03/2010 08:54:	19			~
PART 2 Young's Modulus, E Specimen Width, b Specimen Height, d Neutral Axis,y 1.55	69000 25.00 3.10 mm	N/mm2 mm mm		
Second Moment of Area, Strain Gauge Posn from Hanger Laod, F 30.00 Bending Moment, M	1	62.06 100.00	mm4 mm	
Strain Using Material µStrain			1085.8	3
				8

- 18. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 19. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 20. In the OFFLINE mode the LOG button will be greyed out. The TARE button although live will not have any function.
- 21. When finished with the software shut the software down.
- 22. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

Part 1, Strain gauge a:

When running in online mode with strain gauge a only it is important you choose the experiment number HST35a from the menu on the HDA200 (see instruction manual). The screen on the HDA200 to choose the HST35a is shown below:



Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Strain	Strain 1	01	N/A
Dial Gauge	Dial gauge 1	28	0.01mm

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

Part 1, Strain gauge b:

When running in online mode with strain gauge a only it is important you choose the experiment number HST35b from the menu on the HDA200 (see instruction manual). The screen on the HDA200 to choose the HST35b is shown below:



Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Strain	Strain 1	01	N/A

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

Part 1, Strain gauge b:

When running in online mode with strain gauge a only it is important you choose the experiment number HST35c from the menu on the HDA200 (see instruction manual). The screen on the HDA200 to choose the HST35c is shown below:



Sensor/Transducer	HDA200 Connector Number	HDA200 Channel number	Resolution
Strain	Strain 1	1	
Strain	Strain 2	2	

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:

Part 2			
HST35S Strain Measurement for Structures (Part 1)	HITECH EDUCATION	HDA 200	Online
1	Specimen Material	Steel 🗸	
1.64 mm	Young's Modulus, E	207000	N/mm ²
-1496 µS	Specimen Width, b	25	mm
	Specimen Height, d	3.1	mm
	Neutral Axis, y	1.55	mm
	2nd Moment of Area, I	62.065	mm ⁴
	Support Span, L	200	mm
	Overhang, L1 & L2	100	mm
	Hanger Load, F	40	N
	Bending Moment, M	4000	Nmm
	Strain Gauge	a $ abla v$	
	Deflection, δ	1.64	mm
	Actual Deflection, δ	1.64	mm
I File New Append Calc New Tare LOG	Actual Strain	-1496	
	Strain Using Material Properties	483	µ Strain

- 2. In 'ONLINE' mode you will notice that the actual deflection and strain values are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 4. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 5. Tick the data file option required.
- 6. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 7. The input parameters will then be saved to the data file.
- 8. Press the LOG button to store the actual values to the data file.
- 9. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 10. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.
- 11. The graph will be drawn automatically at each load position point, but you must follow the load position points in turn otherwise the graph will appear incorrect and the actual shear centre will not be correct.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

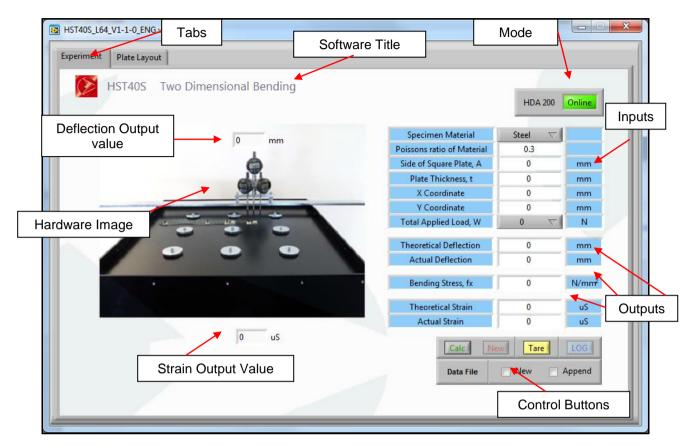
The data is as follows:

HST35S_V1_test file_2_3_10_pji_on File Edit Format View Help	une_part		
02/03/2010 09:16:54			~
PART 1 Young's Modulus, E 207000 Specimen width, b 25.00 Specimen Height, d 3.10 Neutral Axis,y 1.55 mm	N/mm2 mm mm		
Second Moment of Area, 1 Support Span, L 200.00 mm	62.06	mm4	
Overhang, L1 & L2 100.00 Hanger Load, F 40.00 N	mm		
Bending Momént, M 4000.00 Strain Gauge a Deflection 1.64 mm	Nmm		
Strain using Material Propertie	s	482.59	
Strain using Deflection Values	508.40	µStrain	
			V

The information will then repeat itself depending on how many test points have been logged.

HST40S – TWO DIMENSIONAL BENDING

SOFTWARE WINDOW – CHANNEL SPECIMEN ONLY

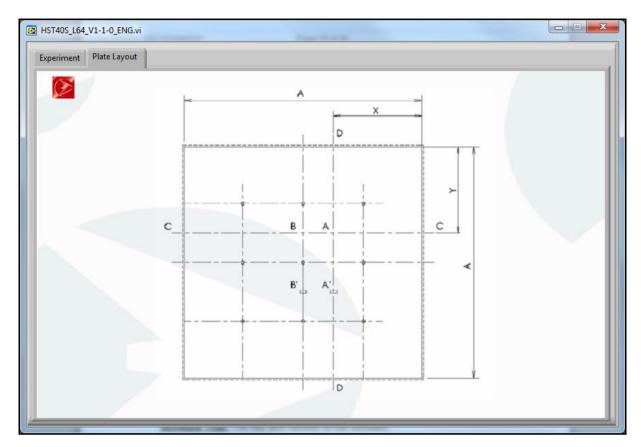


In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

<u>**Tabs:**</u> The experiment is presented on the tab labelled experiment. The tab labelled Plate layout gives the dimension references. Pressing the tab will jump between one screen and the other.

The plate layout screen is shown below.



Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- **Specimen material:** Choose the material for the specimen.
- **Poissons Ratio:** When the material is chosen, the poisons ratio changes automatically.
- **Side of square plate, A**: Input the side length of the square plate in millimetres.
- **<u>Plate thickness, t</u>**: Input the plate thickness in millimetres.
- **<u>X coordinate</u>**: Input the X coordinate of the strain gauge in millimetres.
- <u>Y coordinate</u>: Input the Y coordinate of the strain gauge in millimetres.
- **Total Applied Load, W**: Choose from the list of loads available in Newton's.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- **<u>Theoretical Deflection, A</u>**: This is the theoretical deflection at the X and Y coordinates, with units of millimetre.
- **Actual Deflection, A**: This is the actual dial gauge value from the hardware for the X and Y coordinates chosen. It has the units of millimetres.
- **Bending Stress, fx**: At the coordinates chosen the theoretical bending stress is given here. It has the units of Newton's per millimetre squared.
- <u>Theoretical Strain</u>: This is the theoretical strain at the X and Y coordinates chosen. This obviously has to be at the X and Y coordinates of the actual strain gauges on the hardware. The units are microstrain (με).
- <u>Actual Strain</u>: This is the actual strain value from strain gauge on the harware itself at the X and Y coordinates of the strain gauge chosen. It has units of microstrain (με).

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- <u>**Tare</u>**: Pressing this button in ON-LINE mode will tare, zero the actual strain gauge value.</u>
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE mode, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. The current input parameters will then be added to the data file chosen.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

<u>NB: You will only be able to choose the New or Append options. You cannot choose both at the same time. It is one or the other.</u>

On the hardware image itself you will see that the deflection will appear above the image and the strain will appear below the image. When in OFFLINE mode these values will remain zero (0). When in ONLINE mode these values will be actual.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE – CHANNEL SPECIMEN

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select the experiment tab at the top of the software screen.
- 4. Choose steel at the material. The poisons ratio will change automatically.
- 5. Enter 600 in the side of square Plate, A input box.
- 6. Enter 3.25 in the plate thickness, t input box.
- 7. Enter 220 in the X coordinate input box.
- 8. Enter 220 in the Y coordinate input box.
- 9. Choose 90 from the Total Applied Load, W drop down list.
- 10. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Specimen Material	Steel 🤝	
Poissons ratio of Material	0.3	
Side of Square Plate, A	600	mm
Plate Thickness, t	3.25	mm
X Coordinate	220	mm
Y Coordinate	220	mm
Total Applied Load, W	90 🗸	N
Theoretical Deflection, A	0.27	mm
Actual Deflection, A	0	mm
Bending Stress, fx	3.47	N/mm ²
Theoretical Strain	16.9	uS
Actual Strain	0	uS

11. The complete screen should look like the following image:

eriment Plate Layout				
HST40S	Two Dimensional Bending		HDA 200	Offline
		Specimen Material	Steel 🔽	
	0 mm	Poissons ratio of Material	0.3	
	à	Side of Square Plate, A	0	mm
		Plate Thickness, t	0	mm
	919	X Coordinate	0	mm
		Y Coordinate	0	mm
		Total Applied Load, W	0	N
		Theoretical Deflection	0	mm
		Actual Deflection	0	mm
		Bending Stress, fx	0	N/mm ²
		Theoretical Strain	0	uS
		Actual Strain	0	uS
	0 uS	Calc		LOG
		Data File	New 📄	Append

- 12. The theoretical deflection and strain and bending stress will be shown in the relevant output boxes. Also note that the actual deflection and strain values are greyed out. This is because you are in 'OFFLINE' mode.
- 13. Press the NEW button and then tick the Data File NEW box.
- 14. Press CALC.
- 15. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data fi	le to write.				? 🛛
Save jn	😂 нรтэз		*	0000	
My Recent Documents Desktop	Instruction M H5T95_V1.ali H5T95_V1.ex H5T95_V1.ex	ases e			
My Documents My Computer My Network	File name: Save as lype:	TextFie.tx All Fics (*.*)		×	DK. Cancel

- 16. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 17. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

<u> Eile Edit Format View H</u> elp			
p1/03/2010 09:24:4	1		~
Poissons Ratio 0.30			
Length of Side, a	600.00	mm	
Plate Thickness, t	3.25	mm	
X Coordinate 220.00	mm		
Y Coordinate 220.00	mm		
Total Applied Load	0.00	N	
Bending Stress, fx	0.00	N/mm2	
Theoretical Deflection	0.00	mm	
Theoretical Strain	0.0	uS	

- 18. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 19. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 20. In the OFFLINE mode the LOG button will be greyed out.
- 21. When finished with the software shut the software down.
- 22. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

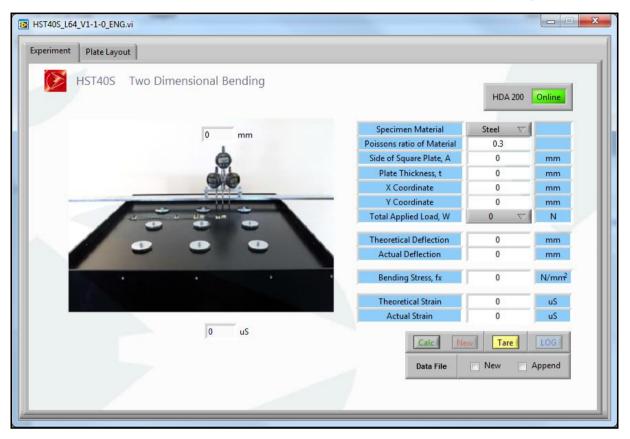
	HDA200	HDA200	
Sensor/Transducer	Connector	Channel	Resolution
	Number	number	
Strain	Strain 1	1	
Strain	Strain 2	2	
Strain	Strain 3	3	
Strain	Strain 4	4	
Dial Gauge	Dial gauge 1	28	0.01mm
Dial Gauge	Dial gauge 2	29	0.01mm
Dial Gauge	Dial gauge 3	30	0.01mm

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the actual deflection and strain values are no longer greyed out. These values will now start to change as they come in from the HDA200.
- 3. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 4. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 5. Tick the data file option required.
- 6. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 7. The input parameters will then be saved to the data file.
- 8. Press the LOG button to store the actual values to the data file.
- 9. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 10. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.
- 11. The graph will be drawn automatically at each load position point, but you must follow the load position points in turn otherwise the graph will appear incorrect and the actual shear centre will not be correct.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

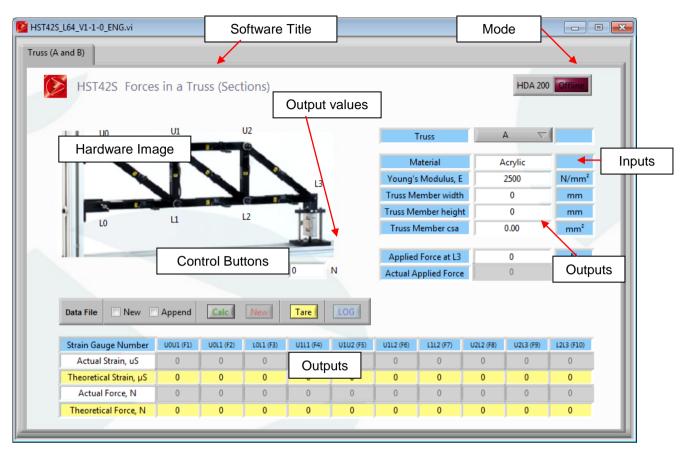
The data is as follows:

HST40S_9 test file_1_3_1	0_pji.txt -	Notepad	
<u>File E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp			
09:24:4	1		~
Poissons Ratio 0.30 Length of Side, a	600.00	mm	
Plate Thickness, t	3.25	mm	
× Coordinate 220.00	mm		
Y Coordinate 220.00 Total Applied Load	mm 0.00	N	
Bending Stress, fx	0.00	N/mm2	
Theoretical Deflection	0.00	mm	
Theoretical Strain Actual results	0.0	us	
Deflection -3.57	mm		
Strain -1430.0 Micro S	train		
Actual results Deflection 0.00	mm		
Strain 0.0 Micro S			
01/03/2010 09:30:0	3		=
Poissons Ratio 0.30 Length of Side, a	600.00	mm	
Plate Thickness, t	3.25	mm	
X Coordinate 220.00	mm		
Y Coordinate 220.00 Total Applied Load	mm 90.00	N	
Bending Stress, fx	3.47	N/mm2	
Theoretical Deflection Theoretical Strain	0.27 16.9	mm	
Actual results	10.9	us	
Deflection 0.36	mm .		
Strain -1.0 Micro S 01/03/2010 09:31:3			
Poissons Ratio 0.30	0		
Length of Side, a	600.00	mm	
Plate Thickness, t × Coordinate 220.00	3.25 mm	mm	
Y Coordinate 220.00	mm		
Total Applied Load	180.00	Ν	
Bending Stress, fx Theoretical Deflection	6.93 0.53	N/mm2 mm	
Theoretical Strain	33.8	us	
Actual results			
Deflection 0.60 Strain 1.0 Micro S	mm train		
01/03/2010 09:33:1			
Poissons Ratio 0.30			
Length of Side, a Plate Thickness, t	600.00 3.25	mm	
× Coordinate 220.00	mm	~ 1111	
Y Coordinate 220.00	mm	8	
Total Applied Load Bending Stress, fx	270.00 10.40	N N/mm2	
Theoretical Deflection	0.80	mm	
A series and the series of the series of the series series and	197530797797	3092755	

The information will then repeat itself depending on how many test points have been logged.

HST42S – FORCES in a TRUSS (SECTIONS)

SOFTWARE WINDOW



The detail of what is presented in the software window is highlighted in the above image and detailed as follows:

<u>**Hardware image:**</u> This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- <u>**Truss:**</u> choose which truss you wish to compare. Truss A and B are selectable.
- **<u>Truss Material</u>**: This is fixed for acrylic only and cannot be changed.
- Young's Modulus, E: this is fixed for the acrylic material only and cannot be changed.
- <u>Truss Member Width, w</u>: This is the value of the horizontal width of each member. Nominally this is 10mm. This value is entered via the keyboard of the host computer.
- <u>**Truss Member Height**</u>, <u>h</u>: This is value of the vertical depth of each member. Nominally this is 25mm. This value is entered via the keyboard of the host computer.
- **<u>Truss Member Area</u>**: This is a calculated value of the nominal cross sectional area of each truss member. It cannot be changed as it is a calculated value.

<u>**Outputs</u>**: These are theoretical values and actual values from the hardware based on the input parameters chosen. This is where the end user can compare actual results with theoretical.</u>

The outputs available are as follows:

- **Applied Force at L3**: This is the value of the applied force being applied at joint L3 on the hardware. It is enter by the end user via the keyboard. It can be used when comparing actual with theoretical values. In OFFLINE mode this value will appear on the hardware image near joint L3.
- <u>Actual Applied Load at L3</u>: This is the value of the applied force to the truss at joint L3, from the actual hardware itself. This will only appear in ONLINE mode, and this value will also appear on the hardware image in ONLINE mode only.

Table underneath the hardware image:

- <u>Actual Strain</u>: This is the actual strain from the truss members via the HDA200. In offline mode this value will be greyed out.
- **<u>Theoretical Strain</u>**: This is the theoretical strain from the truss members.
- **<u>Actual Force</u>**: This is the actual force value calculated from the actual strain values form the hardware for the truss members.
- **<u>Theoretical Force</u>**: This is the theoretical force calculated from the theoretical strain for the truss members.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **NEW**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.

- **<u>TARE</u>**: This button is only valid when running in ONLINE mode as when pressed it zeroes (tares) the values from the hardware which are being used in the software.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the **.exe** files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Choose which truss you wish to test.
- 4. Enter 10 in the width, w input box.
- 5. Enter 25 in the height, h input box.
- 6. The truss member area will be calculated automatically
- 7. Enter 100 in the Applied Force, F input box.
- 8. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

Truss	7 A	∇
Material	Acrylic	
Young's Modulus, E	2500	N/mm ²
Truss Member width	10	mm
Truss Member height	25	mm
Truss Member csa	250	mm²
Applied Force at L3	100	N
Actual Applied Force L3	0	N

9. The complete screen should look like the following image:

HST42S Force	es in a Tru	iss (Sec	tions)			H II E D U	TEC	H	HDA 20	0 Online
	Ui	8	U2				Truss		A 🗸	
			. 0				Material		Acrylic	
				L3		Young	i's Modulus, E	E .	2500	N/mm ²
	0	8.	(i) I/				Member widt		10	mm
	L1		L2	-			1ember heigt		25	mm
LO	LI			1		Truss	Member csa		250	mm²
				- al-						
		-				Applie	d Force at L3	3	100	N
				100	N	Actual A	pplied Force	L3	0	N
Data File 🗌 New [Append	Calc U0L1 (F2)	New LoL1 (F3)	Tare U1L1 (F4)		U1L2 (F6)	L1L2 (F7)	U2L2 (F8)	U2L3 (F9)	L2L3 (F10)
Church Course Murch on		0	0	0111 (F4)	0102 (FS)	0112(F6)	0	0212 (F8)	0213 (F9)	0
Strain Gauge Number	0.0	0	0	0	0	0			-	-
Actual Strain, uS	0	0	0	0	0	0	0			1 0
	0	0	0	0	0	0	0	0	0	0

- 10. The applied load value will be shown on the hardware image next to joint L3. Also note that the actual applied load is greyed out. This is because you are in 'OFFLINE' mode.
- 11. Press NEW
- 12. Tick the Data File NEW box.
- 13. Press CALC.
- 14. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

👿 Select a data f	ile to write.	TID(1	X
Save in:	HST19S_V1_W7_18062012 -	G 🤌 📂 🛄 -	
Recent Places Desktop Libraries Computer	Name HST195_V1_W7_18062012.aliases HST195_V1_W7_18062012 HST195_V1_W7_18062012 TextFile	Date modified 18/06/2012 12:41 18/06/2012 12:41 18/06/2012 12:41 15/08/2012 09:03	Type ALIASES F Applicatic Configura Text Docu
Network	<		۲
	File <u>n</u> ame: TextFile Save as type: All Files (*.*)	-	OK Cancel

- 15. Either rename the default name of TextFile.txt or keep this default name. It's up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 16. The input and output data will now be saved in the data file created. To prove this open the text file in **NOTEPAD** that you have just created from its location and check the contents. It should look similar to the image below.

Eile Edit Format ⊻iew Help 20/08/2012 10:00:30 Roof Truss Young's Modulus, E 2500 N/mm2 Truss Member Width, w 10.00 mm Truss Member Height, h 25.00 mm Truss Member Area 250.00 mm Truss Member Area 250.00 mm Reaction at Reaction at 6.67 N Reaction at Reaction at 6.67 N Reaction at Reaction at 6.67 N Reaction at Reaction bill 13.33 N Joint U1 Theoretical Joint Deflect 0.5248 mm A -133.33 µStrain	TextFile2 - Notepad	-	-	
Roof Truss Young's Modulus, E 2500 N/mm2 Truss Member Width, w 10.00 mm Truss Member Height, h 25.00 mm Truss Member Area 250.00 mm2 Joint of Applied Load L2 Applied Load, P 200.00 N Reaction at Ra 66.67 N Reaction at Rb 133.33 N Joint U1 Theoretical Joint Deflect 0.5248 mm A -133.33 µStrain 2 115.47 µStrain B 0.00 µStrain C -133.33 µStrain 5 0.00 µStrain 1 115.47 µStrain 3 230.94 µStrain E -266.67 µStrain F 0.00 µStrain 4 230.94 µStrain	<u>File Edit Format View H</u> elp			
Joint U1 Theoretical Joint Deflect 0.5248 mm A -133.33 µStrain 2 115.47 µStrain B 0.00 µStrain C -133.33 µStrain 5 0.00 µStrain 1 115.47 µStrain 3 230.94 µStrain E -266.67 µStrain F 0.00 µStrain 4 230.94 µStrain	Roof Truss Young's Modulus, E Truss Member Width, w Truss Member Height, h Truss Member Area Joint of Applied Load Applied Load, P 200.00 Reaction at Ra 66.67	2500 10.00 25.00 250.00 L2 N N	mm mm	*
	Joint U1 Theoretical Joint Deflec A -133.33 µStrain 2 115.47 µStrain B 0.00 µStrain C -133.33 µStrain 5 0.00 µStrain 1 115.47 µStrain 3 230.94 µStrain F 0.00 µStrain 4 230.94 µStrain		0.5248	mm
I I I I I I I I I I I I I I I I I I I	•			<u>▼</u> }

- 17. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file NEW button to clear it, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 18. In the OFFLINE mode the TARE button although live will not perform any function. The LOG button will not be live and greyed out but the data can still be stored by the use of the CALC button.
- 19. When finished with the software shut the software down.
- 20. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

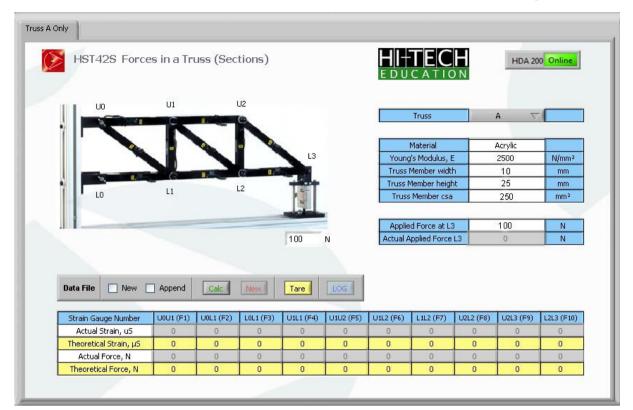
	HDA200	HDA200	
Sensor/Transducer	Connector	Channel	
	Number	number	
Strain Gauge 1	Strain 01	01	
Strain Gauge 2	Strain 02	02	
Strain Gauge 3	Strain 03	03	
Strain Gauge 4	Strain 04	04	
Strain Gauge 5	Strain 05	05	
Strain Gauge 6	Strain 06	06	
Strain Gauge 7	Strain 07	07	
Strain Gauge 8	Strain 08	08	
Strain Gauge 9	Strain 09	09	
Strain Gauge 10	Strain 10	10	
Force	Force 1	17	

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:



- 2. In 'ONLINE' mode you will notice that the actual applied load, deflection, force and strains are not greyed out. These values will now start to change as they come in from the HDA200.
- 3. The strains and applied load will not be zero. To zero these readings simply press the TARE button. You may have to press it again if the reading does not return to zero. The deflection values will not zero. These have to be zeroed on the front of the dial gauge itself.
- 4. Load the hardware experiment to the same parameters as the input boxes. You should then be able to compare the actual values with theoretical values.
- 5. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 6. Tick the data file option required.
- 7. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 8. The current theoretical input and output values will then be saved to the data file.
- 9. Press the LOG button to store the actual values to the data file.
- 10. Should you change the hardware load to a new value and you wish to change the software inputs then adjust the hardware, press NEW, adjust the software inputs to be the same as the hardware, click the data file APPEND tick box and then press CALC.
- 11. You can then continue to create new inputs and obtain new outputs depending on how you set up the hardware and by following the procedure above.

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

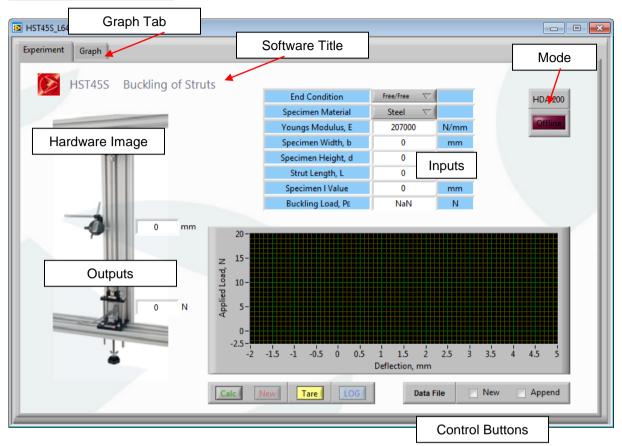
The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed:

TextFile - Notepad				x
<u>File Edit Format View H</u> elp)			
µ5/08/2012 08:31:0	5			
Roof Truss	2500			
Young's Modulus, E	2500	N/mm2		
Truss Member Width, w Truss Member Height, h		mm mm		
Truss Member Area	250.00	mm2		
Joint of Applied Load	L2			
Applied Load, P 20.00	N			
Reaction at Ra 6.67	N			
Reaction at Rb 13.33 Joint U1	N			
Theoretical Joint Defle	ct	0.0525	mm	
A -13.33 µStrain		0.0525		
2 11.55 µStrain	1			=
B 0.00 µStrain	1			
C -13.33 µStrain				
5 0.00 µStrain 1 11.55 µStrain				
1 11.55 µStrain 3 23.09 µStrain				
E -26.67 µStrain				
F 0.00 µStrain				
4 23.09 µStrain				
G -26.67 µStrain	1			
Actual results A 0.00 µStrain				
2 0.00 µStrain				
B 0.00 µStrain				
C -1.00 µStrain				
5 0.00 µStrain				
1 0.00 µStrain 3 0.00 µStrain				
3 0.00 μStrain Ε 0.00 μStrain				
F 0.00 µStrain				
4 0.00 µStrain				
G 0.00 µStrain				
Actual Aplied Load, P Actual Joint Deflection	-21.20	N		
Actual results	0.05	mm		
A -1.00 µStrain	1			
2 -2.00 µStrain	1			
B -2.00 µStrain				
C -2.00 µStrain				
5 -2.00 µStrain 1 -2.00 µStrain				
1 -2.00 µstrain 3 -2.00 µstrain E -2.00 µstrain				
	l -			
F -2.00 µStrain	1			
4 -3.00 μStrain				*
				▶
4 -3.00 µstrain				

The information will then repeat itself depending on how many test points have been logged.

HST45S – BUCKLING of STRUTS

SOFTWARE WINDOW



In either mode the details of what is presented in the software window is the same. These are highlighted in the above image and detailed as follows:

<u>Hardware image</u>: This is a true representation of the actual hardware thus ensuring consistency in viewing between software and hardware.

<u>Graph Tab:</u> This allows a larger version of the captured graph to be displayed.

Software Title: The title and number of the software.

Mode: This highlights which mode the software is in, i.e. OFFLINE or ONLINE.

Inputs: These boxes allow the end user to input values for the specific parameters listed. The blue boxes on the left hand column show the description of the input and the right hand column blue boxes show the units for these parameters. The central column is where the value is input via the keyboard. It is possible to press the TAB button on the keyboard and the cursor will jump to the next parameter.

The inputs available are as follows:

- <u>End condition:</u> Choose the end condition applied to the strut specimen. Choices are Free/Free, Fixed/Free and Fixed/Fixed.
- Specimen material: Choose the specimen material.
- Young's Modulus, E: This changes automatically with the material choice.
- **Specimen Width, b**: Enter the specimen width in millimetres.
- **Specimen Height, d**: Enter the specimen height in millimetres.
- **Strut Length**: Enter the length of the strut specimen being tested.
- **Specimen I value**: Calculated value based on the width and height of the material entered.
- **<u>Buckling Load, PE</u>**: Calculated automatically.

<u>**Outputs</u>**: These are actual values from the hardware. The end user can use these values to log them into the data file and plot a graph, thus observing the buckling load and comparing it with the theoretical value.</u>

The outputs available are as follows:

- **Deflection:** This is the actual deflection from the hardware dial gauge
- **Applied Force:** This is the actual applied force from the hardware.

Control buttons: these buttons give the end user a choice of what to do with the software and the values presented on the screen. They are described in more detail as follows:

- **CALC**: When the inputs have been set, pressing this button will calculate the theoretical outputs.
- **<u>NEW</u>**: When this button is pressed it stops background processes and allows any of the inputs to be adjusted and then recalculated. You will have to wait a short time for the background processing to finish. When finished the CALC button becomes live and the NEW button becomes inactive.
- **LOG**: When the end user wishes to record ACTUAL data from the software during ONLINE running, they can press this button and the key input and output parameters will then be logged into the data file.
- Data File NEW: This tick box is used when the end user wishes to store the input and output data to a brand new file on the host computer. When this is ticked and the CALC button pressed you will be prompted to create a new data file. You can only choose this button or the append button, not both.
- **Data file APPEND:** If a data file has already been created then ticking this box will allow data to be added to this file rather than having to create a new file.

OPERATING THE SOFTWARE

The following procedure outlines the steps required to operate the software and to obtain outputs for the inputs chosen. It is one of many variations that could be followed.

It assumes that the end user has set up the HDA200 (if necessary) and installed the software correctly and all inputs are being undertaken using the keyboard of the host computer.

OFFLINE MODE

- 1. Load the experiment software by double clicking the .exe files supplied.
- 2. Choose 'NO' when the pop up window appears asking if the HDA200 is connected.
- 3. Select the end condition as Free/Free.
- 4. Select the specimen material. The E value will change automatically.
- 5. Enter 25.08 in the specimen width input box.
- 6. Enter 1.64 in the specimen height input box.
- 7. Enter 500 in the strut length input box.
- 8. Press the CALC button with no data file tick boxes ticked. The screen should appear as follows:

End Condition	Free/Free 🗸	
Specimen Material	Steel 💎	
Youngs Modulus, E	207000	N/mm
Specimen Width, b	25.08	mm
Specimen Height, d	1.64	mm
Strut Length, L	500	mm 4
Specimen Value	9.22	mm
Buckling Load, PE	75.34	N

You will notice that the specimen I value and the buckling load, PE will be filled in.

- 9. By varying the input parameters and end conditions the user can obtain theoretical PE values for a wide variety of conditions.
- 10. Press the NEW button
- 11. Tick the Data File NEW box.
- 12. Press CALC.

13. You will then be shown the following window (the contents of this window will vary depending on the experiment running) and prompted to create a data file name in the location of your choice.

Select a data file to write.					
Save jn:	🚞 HST9S		*	0000	
My Recent Documents Desktop My Documents	Instruction Ma	ises c			
My Computer				201	
	File name:	TextFile.tx		~	ОК
My Network	Save as type:	All Files (*.*)		~	Cancel

- 14. Either rename the default name of TextFile.txt or keep this default name. Its up to you. Ensure the file extension of *.txt* remains. Once the filename and location have been chosen then press **OK**.
- 15. The input and output data will now be saved in the data file created. To prove this open the text file in *NOTEPAD* that you have just created from its location and check the contents. It should look similar to the image below.

Pinned_Pinned_500mm_offline_22-6	-11.tx 🔳 🗖 🔀
<u>File Edit Format View Help</u> 22/06/2011 11:16:49 End Condition Free / Free Specimen Material Steel Youngs Modulus 207000.00 Specimen Width 25.08 mm	N/mm
Specimen Height 1.64 mm Strut Length 500.00 mm4 Specimen 1 Value 9.22 Buckling Load 75.34 N 22/06/2011 11:18:29 End Condition Fixed / Fixed	mm
Specimen Material Steel Youngs Modulus 207000.00 Specimen Width 25.08 mm Specimen Height 1.64 mm Strut Length 500.00 mm4 Specimen 1 Value 9.22 Buckling Load 301.35 N	N/mm mm
-	7

- 16. If you wish to change the inputs then simply press the NEW button, change the input parameter, press the data file APPEND button and then press CALC. You will be given the data file to append to, choose this and then press ok.
- 17. The data file should now have the new data saved into it, AND added (appended) to the existing data.
- 18. In the OFFLINE mode the LOG button will be greyed out.
- 19. When finished with the software shut the software down.
- 20. You can continue to adjust the inputs and see what outputs are obtained by following the same process above.

HDA200 CHANNEL SETTINGS and CONNECTIONS

Prior to running this experiment software in ONLINE mode with the HDA200 you will have to make sure that the correct experiment hardware sensors/transducers are connected to the HDA200 and the correct channels are being displayed by the HDA200. Refer to the HDA200 instruction manual and use the following table as a reference also:

	HDA200	HDA200	
Sensor/Transducer	Connector	Connector Channel	
	Number	number	
Load Cell	Force 1	17	
Gauge	Dial gauge 1	28	0.01mm

Run the HDA200 in LOCAL mode to check that the above channels only are being displayed. This will then ensure that the software collects the right data from the right channels.

NB: If the dial gauges (if used) are connected but not turned on then the software and HDA200 will not display the dial gauge values and the software and HDA200 screens will wait until they are turned on. Ensure the dial gauges are turned on when running the experiment and software.

ONLINE MODE

1. Repeat the input parameters from the OFFLINE mode procedure above, press the CALC button and the software window should look like the image below:

sraph	its				
ST45S Buckling of Stru	its				
				HIHTE(HDA 200
	End Condition	Free/Free 🤝			
c 0	Specimen Material	Steel 🤝			
	Youngs Modulus, E	207000	N/mm		
	Specimen Width, b	25.08	mm		
	Specimen Height, d	1.64	mm		
	Strut Length, L	500	mm 4		
11.55 mm	Specimen Value	9.22	mm		
-	Buckling Load, PE	75.34	Ň		
-1.4 N	20- 17.5- 15- 12.5- 10- 10- 10- 10- 2.5- 0- 0- -2.5- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1	5 0 0.5	1 1 1.5 Deflection	, mm	
	Calc New Tar	LOG		Data File	New 🗌 Append
		Specimen Material Youngs Modulus, E Specimen Width, b Specimen Height, d Strut Length, L Specimen I Value Buckling Load, PE	Specimen Material Steel Youngs Modulus, E 207000 Specimen Width, b 25.08 Specimen Width, b 25.08 Specimen Width, L 500 Specimen I Value 9.22 Buckling Load, PE 75.34	Specimen Material Steel Youngs Modulus, E 207000 N/mm Specimen Width, b 25.08 mm Specimen Height, d 1.64 mm Strut Length, L 500 mm ⁴ Specimen I Value 9.22 mm Buckling Load, PE 75.34 N	Specimen Material Steel Youngs Modulus, E 207000 Specimen Width, b 25.08 Specimen Height, d 1.64 Strut Length, L 500 Specimen I Value 9.22 Buckling Load, PE 75.34 12.5 15 10 7.5 12.5 2.5 0- 2.5 2.5 0 2.5 0 2.5 1 0- 0.5 2.5 3 Deflection, mm

- 2. Load the hardware experiment as per a procedure within the HST45 instruction manual.
- 3. If you wish to save the data into a NEW or existing data file then press NEW to stop the software capturing data from the HDA200.
- 4. Tick the data file option required.
- 5. Press the CALC button and you will be prompted to create a new data file or append to the existing file. Choose the option required.
- 6. The input parameters will then be saved to the data file.
- 7. Press the LOG button to store the actual values to the data file.
- 8. A graph will start to be created as you run through the test. A data point is created on the graph each time the LOG button is pressed.
- 9. A larger version of the graph is created and can be viewed if the Graph tab is pressed.

10. An example of a graph created during online mode is as follows:

xperiment	/2.vi					
xpeninenc	Graph					
Ø	HST45S Buckling of Str	uts			HITECH EDUCATION	HDA 200
		End Condition	Free/Free 🤝	-	1	
	0	Specimen Material	Steel 💎			
		Youngs Modulus, E	207000	N/mm	1	
		Specimen Width, b	25.08	mm	1	
0.0		Specimen Height, d	1.64	mm		
		Strut Length, L	500	mm 4		
	11.55 mm	Specimen I Value	9.22	mm		
		Buckling Load, PE	75.34	N		
	-81.2 N	0		5 6 Deflection,		
		Calc New Ta	re LOG	1 1	Data File 🔽 New	Append

DATA FILE CONTENTS

The data file created contains information that is useful in allowing the end user to further manipulate the data in a spreadsheet software.

The image below shows the typical data at the start of the data file for this experiment when a new file has been created and the LOG button has been pressed at each load position increment:

The data is as follows:

Pinned_Pinned_	500mm_o	ffline_22	-6-11.tx 💶	
<u>File E</u> dit F <u>o</u> rmat <u>V</u> ie	w <u>H</u> elp			
22/06/2011 End Condition Specimen Materi Youngs Modulus Specimen Width Specimen Height Strut Length Specimen 1 Valu Buckling Load 22/06/2011 End Condition Specimen Materi Youngs Modulus Specimen Width Specimen Height Strut Length Specimen 1 Valu Buckling Load	a] 207000. 25.08 1.64 500.00 e 75.34 11:18:2 Fixed / a] 207000. 25.08 1.64 500.00 e	Free Steel 00 mm mm4 9.22 9 Fixed Steel 00 mm mm4 9.22	N/mm mm N/mm mm	

The information will then repeat itself depending on how many test points have been logged.

CONTACT DETAILS

Address:

P.A.Hilton Ltd King's Somborne Stockbridge Hampshire, SO20 6PX, United Kingdom

Telephone:

+44 (0) 1794 388382

Fax: +44 (0) 1794 388129

Web Sites:

http://www.hi-techedu.com/ or http://www.p-a-hilton.co.uk