

# Introduction to LUSAS Worked Examples

## Where do I start?

Start by reading this introduction in its entirety. It contains useful general information about software requirements, the worked examples available and how they are formatted, how to run LUSAS, and basic information about the LUSAS user interface.

## Software requirements

The LUSAS software version, software product (and type of that product) and any product options that are required in order to run an example will be stated in a usage box at the beginning of each worked example, like this:

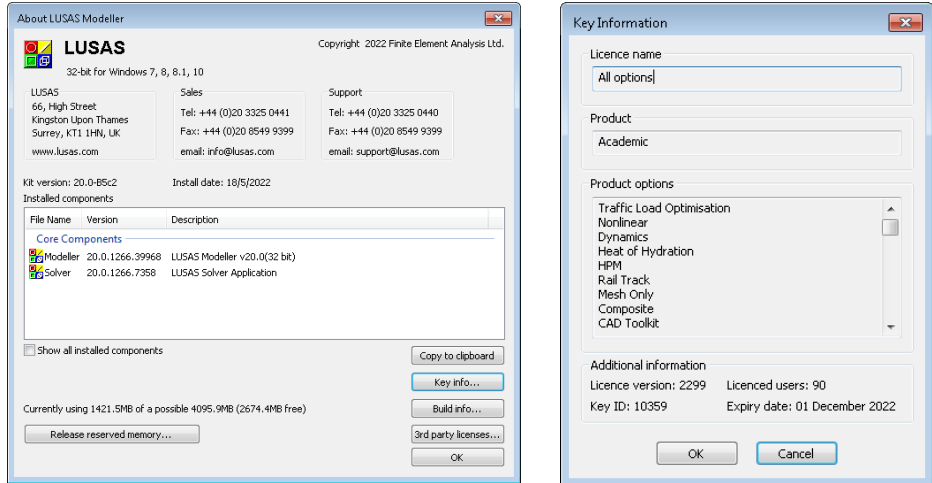
For LUSAS version:	<is stated here>
For software product(s):	<is stated here>
With product option(s):	<is stated here>
<Additional text relating to the use of the example may be stated here>	

### Notes:

- The LUSAS Academic software product will run any LUSAS modelling example provided the correct product option is selected during start-up.
- LUSAS Analyst or LUSAS Composite products can run bridge or civil modelling examples if a Bridge or Civil product option was purchased.
- Laminated composite modelling examples can be run in any software product if a Composite product option has been purchased.

### What software do I have installed?

To find out which software product(s), which type of that product, and which software options are installed and licensed for your use run LUSAS and select **Help > About LUSAS Modeller** and press the **Key Information** button. This will display a dialog that lists the facilities and options supported by your software license.



See the heading [Running LUSAS Modeller](#) for details of how to run LUSAS.

### Software and licencing limits

Access to a purchased commercial or academic software product, and any options that your organisation is licensed to use is controlled by licence codes supplied by the LUSAS licensing department.

The LUSAS Teaching and Training version may be run independently from an installed software licence by accessing the LUSAS configuration tool and choosing the ‘Teaching and training limits’ check box.

The online LUSAS Evaluation version may be run by registering to use it and providing a username and password to run it. It supports linear analysis only and has a 30 day expiration.

### Teaching and Training / Evaluation version limits

The Teaching and Training / Evaluation version limits are currently set as follows:

<b>1000</b> Nodes	<b>200</b> Points	<b>500</b> Elements	<b>3000</b> Degrees of Freedom	<b>20</b> Loadcases
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Because of the modelling and analysis limits imposed by the Teaching and Training version some examples may contain coarse mesh arrangements that do not necessarily constitute good modelling practice. In these situations these examples should only be used to illustrate the LUSAS modelling methods and analysis procedures involved and should not necessarily be used as examples of how to analyse a particular type of structure in detail.

## About the worked examples

A range of worked examples in PDF format can be individually downloaded from the LUSAS website. A zip file containing all files referenced by the worked examples will also need to be downloaded.

The examples are of varying complexity and cover different modelling and analysis procedures. They contain detailed information to guide you through the procedures involved in building a LUSAS model, running an analysis and viewing the results.

In order to become familiar with LUSAS it will benefit you to work through as many examples as possible, even if they have no direct bearing on your immediate analysis interests.

Except where mentioned, examples are written to allow modelling and analysis to be carried out with the Teaching and Training version of LUSAS or the online Evaluation version, both of which have restrictions on the size of model that can be built or analysed.

## Format of the examples

### Headings

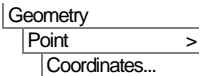
Each example contains some or all of the following main headings:

- Description** contains a summary of the example, defining geometry, material properties, analysis requirements and results processing requirements.
- Objectives** states the aims of the analysis.
- Keywords** contains a list of keywords as an aid to selecting the correct examples to run.
- Associated Files** contains a list of files that are associated with the example. These files may be used to open or build a model to skip to a certain part of an example, for instance, if you are only interested in the results processing stage, or to re-build models if you have problems with the one you have created.

- ❑ **Modelling** contains step-by-step procedures for defining the features and attribute datasets to prepare the LUSAS model file. Multiple model files are created in some of the more complex examples, and these therefore contain more than one ‘Modelling’ section.
- ❑ **Running the Analysis** contains details for running the analysis and assistance should the analysis fails for any reason.
- ❑ **Viewing the Results** contains procedures for results processing using various methods.

### Menu item selection

Menu entries to be selected in the Modeller user interface are shown as follows in this menu item ‘block’:



This implies that the **Geometry** menu should be selected from the menu bar, followed by **Point**, followed by the **Coordinates...** option.

Sometimes when a menu item is referred to in the body text of an example it is written using a bold text style. For example, the menu entry shown above would be written as **Geometry > Point > Coordinates...**

### Toolbar buttons

For certain menu items a toolbar button will also be shown to show the ‘short-cut’ option to the same command that could be used instead:



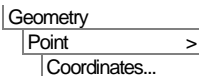
The toolbar button for the **Geometry > Point > Coordinates...** command is shown here.

### User actions

Any actions that you need to carry out are generally bulleted (an exception is when they are immediately to the right of a menu item block or a toolbar button). Any text that has to be entered is written in a **bold text** style as follows:

- Enter coordinates of **(10, 20)**.

So the selection of a typical menu item (or the equivalent toolbar button) and the subsequent action to be carried out would appear as follows:



Enter coordinates of **(10, 20)**.

Selecting the menu item, or the toolbar button shown will cause a dialog box to be displayed in which the coordinates **10, 20** should be entered.

## Filling-in dialogs

For dialogs, a bold text style is used to indicate the text that must be entered. Items to be selected from drop-down lists or radio buttons that need to be picked also use a bold text style. For example:

- In the New Model dialog enter the filename as **frame\_2d** and click the **OK** button to finish.

## Grey-boxed text

Grey-boxed text indicates a procedure that only needs to be performed if problems occur with the modelling or analysis of the example. An example follows:

### If the analysis fails...

If the analysis fails, information relating to the nature of the error encountered can be written to an output file in addition to the text output window. Any errors listed in the text output window should be corrected in LUSAS Modeller before saving the model and re-running the analysis. Note that a common mistake made when using LUSAS Modeller for the first time is to forget to assign particular attribute data (geometry, mesh, supports, loading etc.) to the model.

### Rebuilding a Model

If errors are listed that for some reason cannot be corrected, a file is provided to re-create the model information correctly, allowing a subsequent analysis to be run successfully. You may download this file from the user area of the LUSAS website.

## Modelling Units

At the beginning of each example the modelling units used will be stated something like this:

“Units used are N, m, kg, s, C throughout”

Model units are specified as part of the creation of a new model and are reported at all times in the status bar at the bottom of the Modeller window. Once set, for all dialogs with grid cells permitting dimensional input, the units expected are displayed as a tooltip when the cursor is hovered over the input cell.

## Timescale Units

Timescale units are specified as part of the creation of a new model and can be changed on the Model Properties dialog. Choosing a timescale unit dictates how time-based

values are displayed on dialogs during modelling, and how they are output when processing results

### Icons Used

Throughout the examples, files, notes, tips and warnings icons may be found. They can be seen in the left margin.



**Files.** The diskette icon is used to indicate files used or created in an example.



**Note.** A note is information relevant to the current topic that should be drawn to your attention. Notes may cover useful additional information or bring out points requiring additional care in their execution.



**Tip.** A tip is a useful point or technique that will help to make the software easier to use.



**Caution.** A caution is used to alert you to something that could cause an inadvertent error to be made, or a potential corruption of data, or perhaps give you results that you would not otherwise expect. Cautions are rare, so take heed if they appear in the example.

## Running LUSAS Modeller

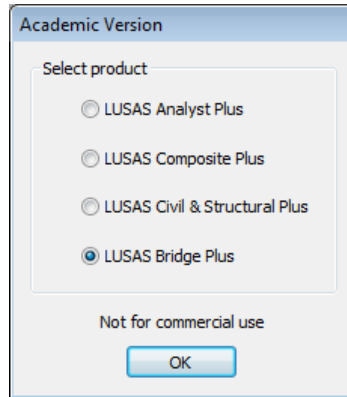
- Start **LUSAS Modeller** from the start programs menu. This differs according to the operating system in use, but typically is done by selecting:

'Start' > All Programs > LUSAS (version) > LUSAS Modeller

### Purchased commercial products

- If 'Choose licence on startup' has been previously set on the LUSAS Configuration utility Licensing tab, a licence option will need to be selected in order to run a particular LUSAS product, otherwise the software will run up automatically based upon the first entry in the Licensing table.
- The on-line help system will be displayed providing the option to read about the latest changes to the software.
- Close the on-line Help system window.

## LUSAS Academic, Teaching and Training, and Evaluation versions

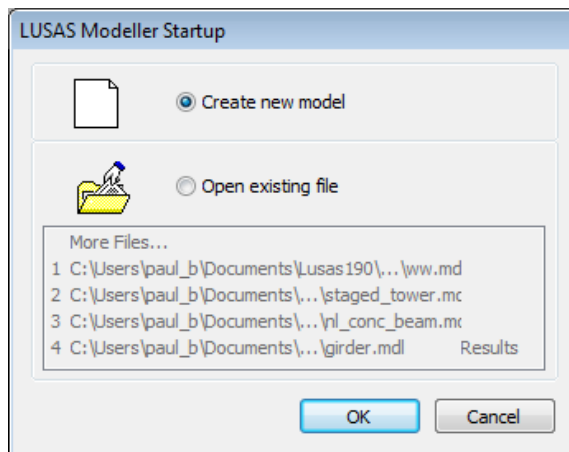


- Select a LUSAS software product appropriate for the worked example that is to be carried out and click the **OK** button.

The on-line help system will be displayed providing the option to read about the latest changes to the software.

- Close the on-line Help system window.

## Creating a new model / opening existing model



When running LUSAS for the first time the LUSAS Modeller Startup dialog will be displayed. This dialog allows either a new model to be created, or an existing model to be opened.



**Note.** When an existing model is loaded a check is made by LUSAS to see if a results file of the same name exists. If so, you have the option to load the results for the opened model.



**Note.** If an existing model is loaded, that in a previous session caused a crash to occur in LUSAS Modeller, options are provided to help you to recover your model data.

The screenshot shows the 'New Model' dialog box. It includes fields for 'File name', 'Working folder' (with 'Recent' selected and a path 'C:\Users\paul\_b\Documents\Lusas190\Projects'), 'Model properties' (Analysis type: Structural, Analysis category: <Select>, Model units: N,m,kg,s,C, Timescale units: Seconds), 'Optional' (Startup template: None, Layout grid: None), 'Title', and 'Job number'. Buttons for 'OK', 'Cancel', and 'Help' are at the bottom.

If you are creating a new model the New Model dialog will be displayed.

- Enter information and make selections for the new model and click the **OK** button.

Product specific menu entries for the selected software product in use e.g. **Bridge** or **Civil** etc will be added to the LUSAS Modeller menu bar.

## Saving model files

The worked examples as written do not generally advise you in which folder to save a model. Whilst working through examples you may wish to save your models in a user folder, but for real 'live' projects it is normally beneficial to save models in separate project folders, each named according to the individual project that will be undertaken. This can assist with backup and eventual deletion of data on a project-by-project basis.



## Creating a Model from the Supplied LPI Visual Basic Files

### Associated Files / LPI Visual Basic Scripts

Each example may reference associated files that, if directed to do so, may be loaded at the start of an example or run during the course of an example. This may include LPI Visual Basic script files (\*.lvb), spreadsheets, data files, or model files (\*.mdl)

A zip file containing all files referenced by the worked examples can be downloaded from the User Area of the LUSAS website.

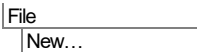
Updates to these files may be made between software releases, and if done, revised files will be made available for download from the User Area of the LUSAS website.

Some worked examples use a script to create an initial model for developing further. Other scripts are provided to help you to recover from modelling errors that you may have made and are unable to correct

If results processing and not the actual modelling of an example is only of interest to you, some LPI Visual Basic files (\*.lvb) that are provided will allow you to quickly build a model for analysis.

Proceed as follows to create a model from the relevant VBS file supplied:

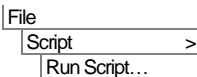
### Creating a New Model



Start a new model file.

- Enter a file name of **<enter file name>**
- Use the default **User-defined** working folder.
- Ensure an Analysis type of **<enter analysis category>** is set.
- Click the **OK** button.

**Note.** There is no need to enter any other new model details when the intention is to run a script to build an initial model, since the contents of the script will overwrite any other settings made.



Select the file **<example\_name\_modelling.lvb>** located in the folder in which you downloaded, unzipped and saved any associated example files from the LUSAS website.



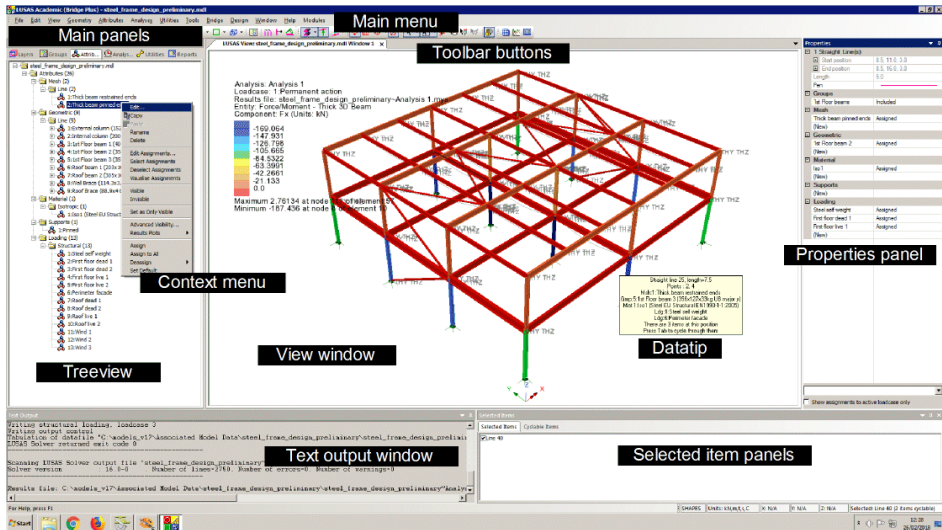
**Note.** Scripts that create models automatically perform a **File > Save** menu command as the end.

## Introduction to LUSAS Worked Examples


Some additional modelling may need to be carried out prior to an analysis being run. See each individual worked example for details.

## The LUSAS Modeller User Interface

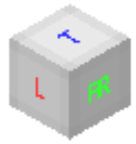
The image below shows the principal user interface components of LUSAS Modeller.



### View window







- ❑ A **View window** shows the model according to user-defined settings made elsewhere on the user interface. Multiple view windows may be set-up, and each may show the model from a different angle, using different visualization options, with or without results.
- ❑ The image in a view window is built up from several drawing **Layers** as listed in the Layers  Treeview (see Main Panels below). Each layer draws over the top of the one before it.
- ❑ A **Datatip** provides model-related information about whatever is under the cursor.
- ❑ A **Tool tip** reports on uses of toolbar buttons or expected input for grid cells in dialogs etc.

- ❑ An optional **View axis cube** shows model orientation at all times and allows orienting the model to a chosen view. Note that the worked examples do not generally include or refer to this axis cube.



### Main panels

Each of the main panels has its own **Treeview** showing a list of objects of a particular type. There are panels of Layers, Groups, Attributes, Analyses, Utilities and Reports. Each object in a Treeview has its own functionality. This can be invoked using its own context menu, the main menu or the toolbar buttons. In summary:

- ❑ The **Layers**  Treeview controls the display of model data and results data to a view window. Each drawing layer is responsible for drawing one particular aspect of this data such as geometry, mesh, and attributes layers for instance.
- ❑ The **Groups**  Treeview is used to store selected user-defined collections of objects (geometry, nodes or elements) under a collective name.
- ❑ The **Attributes**  Treeview is used to store named collections of data that may be attached (assigned) to the model geometry, such as the element type and discretisation on the geometry; section properties and thicknesses; the materials used; how the model is supported or restrained; and how the model is loaded.
- ❑ The **Analyses**  Treeview shows all analyses that have been defined including loadcases, eigenvalues, results, and control chapters. Also in this treeview are post-processing concepts such as combinations and envelopes.
- ❑ The **Utilities**  Treeview contains utility items used in the definition of model geometry or attributes, or to control an analysis, or to provide a particular functionality, such as to define a load combination or produce a report for example.
- ❑ The **Reports**  Treeview contains a named reports, each of which is made up of multiple chapters. Chapters may be defined to view modelling information, results, screenshots and similar.

### Other main panels

Two main panels provide details of properties and associativity for selected objects. The panels are hidden until accessed by a selecting a feature/object and choosing the relevant context menu item for that feature/object. They can also be made visible by selecting the View > Main Panels menu item. The panels can be docked, and separate tabs are provided for each panel when done. Double-clicking a docked window will isolate it again. The panels are:

- ❑ **Properties** - displays the current properties of selected geometry features (points, lines, surface, volumes) and selected mesh objects (nodes, edges, elements, faces). See [Properties Panel](#) for more information.
- ❑ **Hierarchy** - shows the **merge** status, and lists the higher and lower order features/objects of a single selected geometry feature or mesh object. The type and feature number of the selected feature is shown.

### Context menus

- ❑ A **Context menu** (displayed by pressing the right-hand mouse button with an object selected) provides access to additional functionality such as editing of data, control of visibility, visualisation of assignments, and selective control of results plotting on selected attributes. Context menus are provided for objects selected in the View Window, and most items in the various Treeview panels.

### Selection Panels

- ❑ **Selected Items** This panel can be viewed using the View> Selection Panels > Selection menu item. Once visible it will contain a list of all currently selected items which may then be individually deselected.
- ❑ **Selection Memory** This panel can be viewed using the View> Selection Panels > Memory menu item. Once visible it will contain a list of all items currently in Selection Memory which may then be individually deselected.
- ❑ **Cyclable Items** This panel can be viewed using the View> Selection Panels > Cyclable Items menu item. Once visible it will contain a list of all cyclable items. Where multiple items could possibly be selected by the same mouse click, cycling is the process of stepping through those items one at a time. An item can then be individually selected or deselected.
- ❑ **Visible items** This panel can be viewed using the View> Selection Panels > Visible Items menu item. Once opened it contains details of all visible items selected in the view window.

### Text Output Window

- ❑ The **Text Output Window** provides continuous feedback during a modelling or analysis process, and includes errors, warnings and progress messages. When an error message or warning relating to a particular object is written to the text output window, extra information is sometimes available by double-clicking on that line of text.

### Status bar


- ❑ The **Status Bar** displays progress messages and help text during a modelling session, the model units, the current cursor position in model units (if the model

is displayed in an orthogonal plane) and the item or number of items in the current selection. A view of the model can be obtained by pressing one of the primary axes shown in the status bar.

### General notes

Within each View window, and within each Treeview, there is a current selection. In a View window several objects can be selected at the same time. In a Treeview there can only be one object selected at a time, and all commands are assumed to apply to it. Main menu and toolbar commands apply to whichever window was most recently clicked, either a View window or a Treeview panel.

Some items within a Treeview support drag and drop functionality. Typically, this will move them, copy them, or connect them together within the treeview.

Dragging an attribute from the  Treeview onto selected objects in the View window assigns the selected attribute to the selected objects in that window.

All the menus, toolbars, tree frame, text window, status bar and other similar windows can be resized, moved, made visible or invisible, and docked or separated from the main program window. LUSAS Modeller will remember their new location for the next time the program is run. Additional customization is possible - see the Modeller Reference Manual for details.

### Getting Help

LUSAS contains a comprehensive Help system. The Help consists of the following:

Most dialogs include a **Help** button which provides information specific to that dialog.

Selecting **Help > Help Topics** from the main menu provides access to all the Help files.



If the Help Contents, the Help Index and the Search facility are not shown when a help page is first displayed pressing the Show button will show these tabs in the HTML Help Window.

