Kubla Cubed User Manual

Version 5.12

Contents

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1

Introduction

Topics:

- Site Plans
- Existing & Proposed Levels
- Presenting Results
- Getting Started

Welcome to the Kubla Cubed user guide. Kubla Cubed is a general purpose volumetric calculation tool. It uses a cutting edge TIN based volumetric calculation engine to estimate cut & fill in a diverse range of scenarios. Innovative and powerful design tools are available to complete volume estimates for: site stripping, bulk earthworks, building pads, ponds, roads, retaining walls, stockpiles, marine dredging and many other scenarios. Whether you are doing complicated take-off from PDF drawings or comparing two surveys, Kubla Cubed has all the tools you need to get the job done.

Site Plans

Kubla Cubed has extensive tools for importing site plans into your projects. A number of different file formats are supported (.pdf, .jpg, .bmp, .tiff). You can import as many site plans as you need, switching them on and off when you need to view them.

Being able to display multiple site plans makes it much easier to complete a take-off if you have your existing and proposed elevation data on two separate drawings. You can also use the crop, move, and align tools to 'stitch' drawings together in situations where a single site plan is spread across separate pages of a document.

● Load PDF Pages or Images ● Position and Crop the Pages ● Take-off from Stitched Plan
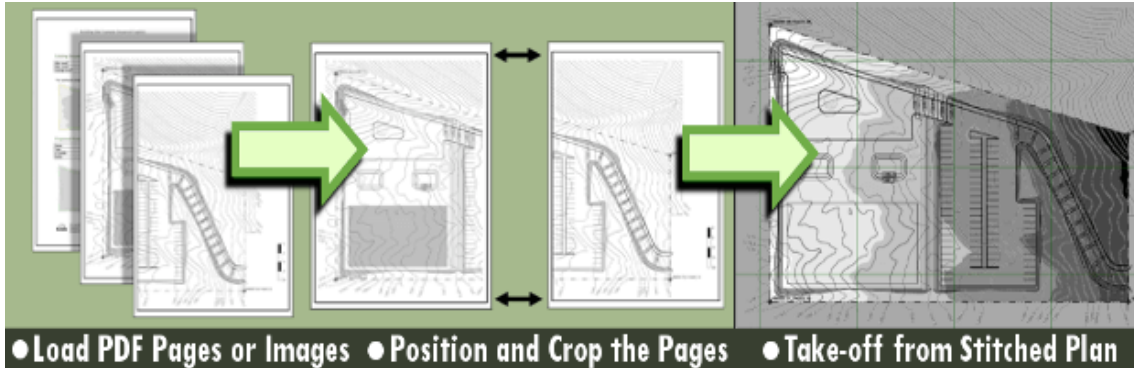
Existing & Proposed Levels

Existing ground can be defined using points, contour lines, break lines and outlines. You can draw elevation features manually over a plan or import directly from CAD, LandXML, excel or text file formats. From the elevation features an existing surface is created using a Delaunay triangulation algorithm.

In a similar manner a variety of earthworks elements can be used to define proposed terrain. Simple works like building foundations can be defined with platform and slope elements. For more complex take-off jobs a proposed surface of points, break lines, contour lines and outlines can be used. After defining proposed earthworks, the program will accurately calculate the volume of material that will need to be cut and/or filled to create the specified design. Proposed earthworks can also be separated into several 'construction phases', allowing a logical breakdown of project phasing and allowing calculations that require more than one set of proposed elevations to be compared (such such as backfilling and topsoil stripping).

Existing   +   Proposed   Cut / Fill Map
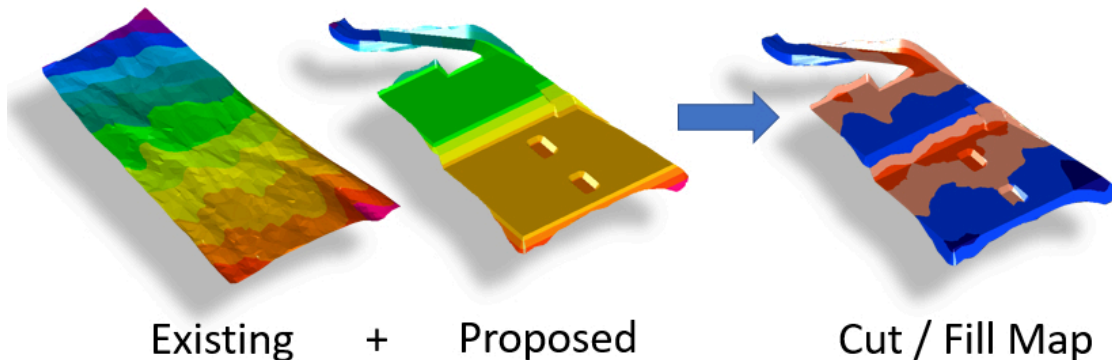
Presenting Results

Kubla Cubed contains a number of export options which can be used to export designs into a CAD or LandXML files or produce images, reports and spreadsheets for project documentation.

Getting Started

**Notes on Display Units :** Before starting it is worth making sure the display units are set to your preference. Kubla Cubed can display either metric or imperial (English) units. These will initially be set to a default value depending on the region settings of the computer. However, this setting can easily be changed by clicking **Measure** in the menu bar and then **Display Units**. For more information see the Display Units section.

The quickest way to get started with *Kubla Cubed* is to open an example file. If you click on File and then Open you will see a list of example files which you can start with. Once you have opened a file the window will appear as shown below:
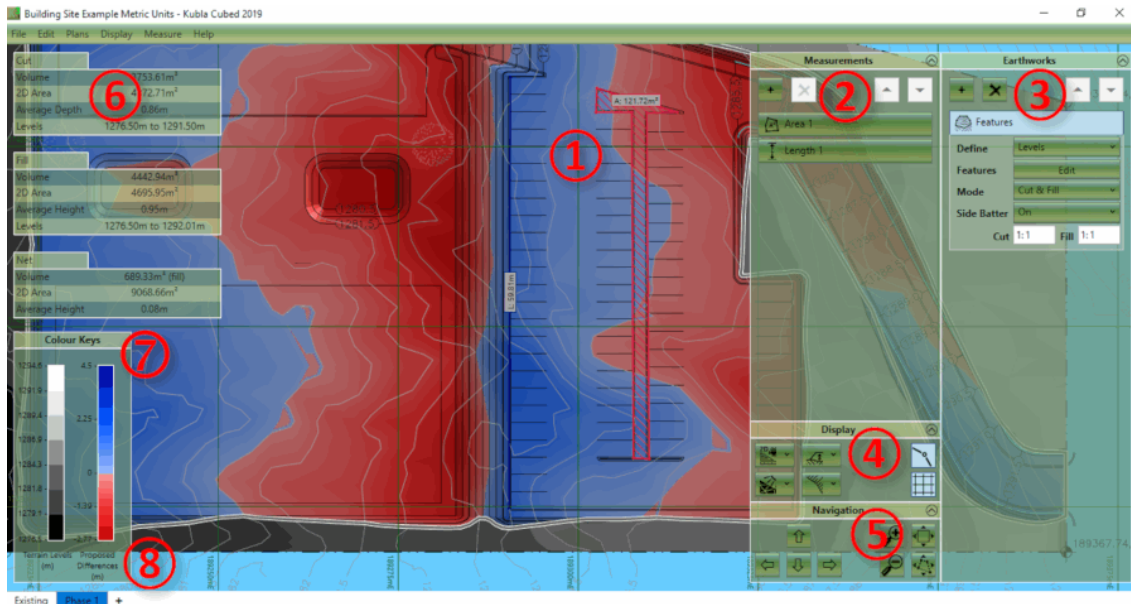
The different elements of this user interface are briefly described below:

- ① Design Area - This is the main display where the existing ground and the proposed earthworks will be displayed.
- ② Measurements Panel - This panel is used for adding, removing and editing the measurement elements (e.g lengths, areas, counts).
- ③ Earthworks Panel - This panel is used for adding, removing and editing the earthworks elements, which are combined together to create a proposed surface.
- ④ Display Panel - This panel is used for changing various display options (e.g camera controls, lighting and grid lines).
- ⑤ Navigation Panel - The controls in this panel can be used for zooming, panning and rotating (in 3D) the views.
- ⑥ The Results Panel - The results panel shows an overview of the earthworks estimation for the current phase. A more detailed analysis can be produced in a report or spreadsheet.
- ⑦ The Colour Keys These colour keys show the shading which is used to display the existing and proposed topography.
- ⑧ Construction Phases The bottom of the first tab shows the existing ground; subsequent tabs show phases of proposed earthworks.

When you are ready to start your own project the first step is to add your site plans, do this by selecting 'Add Image \PDF File' from the Plans menu (you can skip this step if working exclusively with CAD or XYZ point files). To start defining existing elevations make sure the Existing tab is selected and then in the Ground panel on the right-hand side click on the + symbol and add a Feature Surface or a Triangle Surface.

This will open a window which will allow you to define existing ground elevations or import a triangulated mesh from a file. Once you have done this you can create and edit proposed earthworks by selecting the Proposed 1 tab and adding earthworks elements such as platforms, slopes, strips or another feature surface.

Learn about Kubla Cubed site plans in our video Site Plans - Overview. Then become familiar with tools that generate earthwork estimations in the video Proposed Levels - Overview. Dive into an example project in our walkthrough videos (available on the website). Our website also has stand-alone video tutorials

Chapter

2

Site Plans

Topics:

Site plans can be loaded into *Kubla Cubed* and displayed on the screen. This allows the user to draw lines off the loaded plan, and to generally have an awareness of the location of objects in the real world.

Overview

Kubla Cubed allows you to load site plans into your project from a number of different file formats (.pdf, .jpg, .bmp, .tiff). You can import as many site plans as you need, switching them on and off when you need to view them.

Being able to display multiple site plans makes it much easier to complete a take-off if you have your existing and proposed elevation data on two separate drawings. You can also use the crop, move, and align tools to 'stitch' drawings together in situations where a single site plan is spread across separate pages of a document.

● Load PDF Pages or Images ● Position and Crop the Pages ● Take-off from Stitched Plan
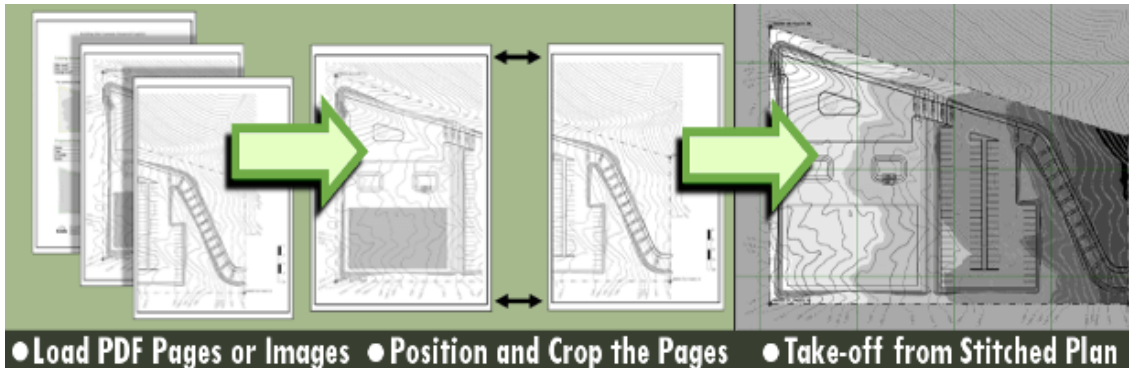
Site plans are adjusted by clicking on the Plan menu item. The menu item will appear as shown below.
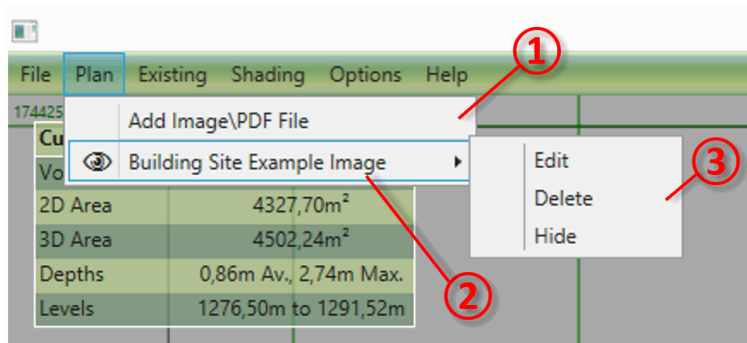
You can add as many site plans as you need to, which allows you to show a site which is presented on multiple drawings, or to show both the existing and proposed even if they are in separate drawings. The site plans are added and adjusted using the controls described below:

- ① Click here to add a new site plan. You can load site plans from pdfs or image file formats (.bmp, .jpg, .tiff)
- ② This is where the list of site plans which you can defined will be displayed.
- ③ Use this menu to edit, delete or hide existing site plans.

The Site Plans - Overview video provides a quick demonstration of options available for adding, modifying and viewing site plans.

Editing Modes

There are two modes of editing available in the software:

- Pop-In Mode. In this mode you edit items on top of the main window. The advantage of this is that it allows you to see the items you are editing on top of other project items. It also allows you to align the new items you draw with the other project items.
- Pop-Out Mode. In this mode items are edited in a seperate window and you do not see other project items behind it. Although this mode is generally less often used, it can sometimes be useful to isolate the items being edited, and remove needless clutter from the screen.

The controls that are available are the same regardless of the editing mode, although the layout of these controls is slightly different. The following three buttons are always present:

- OK. Clicking this button will apply to changes you have made to the project, and finish editing.
- Apply. Clicking this button will apply the changes you have made to the project, but allow you to continue editing. This button is not visible when editing site plans in In Screen mode, since you are already seeing the changes as applied.
- Cancel. Clicking this button will cancel the changes you have made to the project, and finish editing.

The following controls are used to switch between Pop-In and Pop-Out editing modes.

⬈	If you are using Pop-In mode you can click this icon at the top-centre of the screen to switch to Pop-Out mode.
⬋	If you are using Pop-Out mode you can click this icon at the top-right of the screen to switch to Pop-In mode.

Adding a Site Plan

To load a new site plan from a file click Plan in the menu bar and then Add Image\PDF file. You will be prompted to select the file which you want to load. If you choose a pdf file with several pages you will be prompted to choose which page to load.

After this the following window will be displayed:
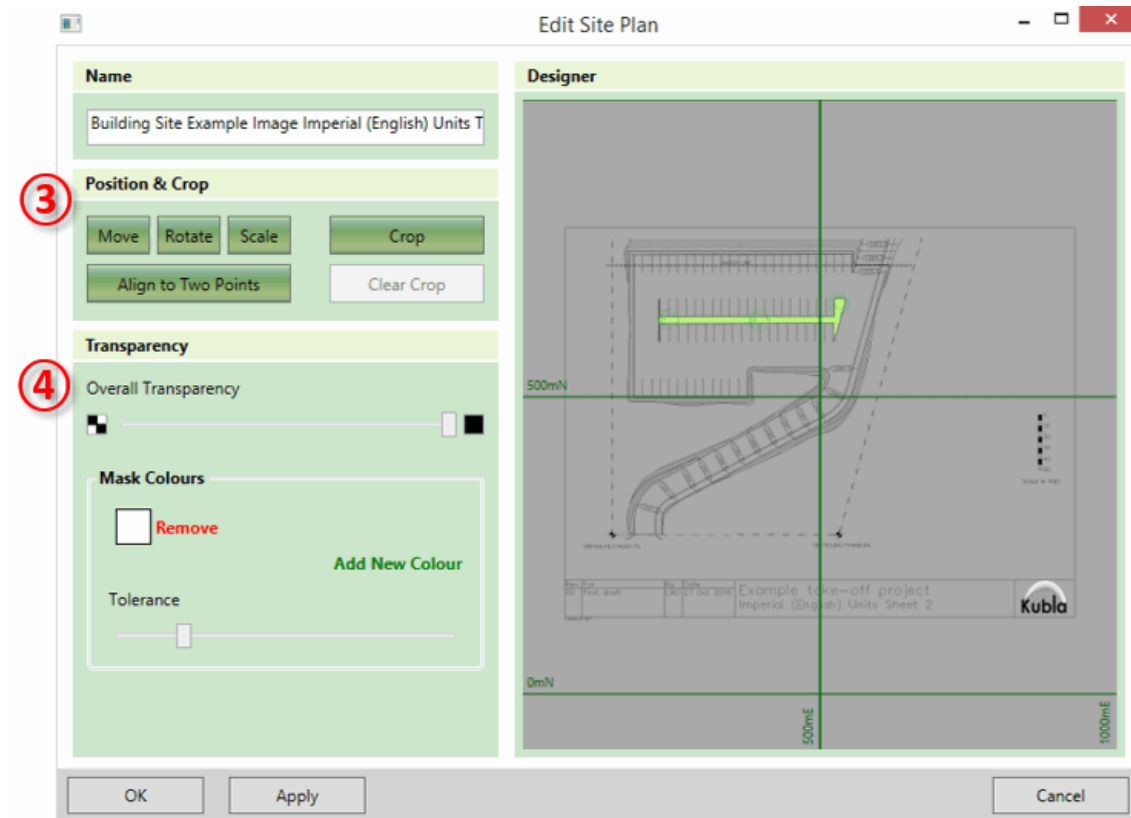
The different elements of this window are summarised below. They are described in more detail in the following sections.

- ③ This is where the position and scale of the loaded image, in the real world, will be specified. You can also choose to crop the image if you wish. This option is particularly useful for drawings which have title blocks which you want to remove
- ④ This is where transparency can be set, so that the user can see through the loaded site plan.

The setting of the image position, crop and the transparency is described further in the following sections.

Setting the Position and Cropping

The site plan is positioned into its real-world location by scaling, moving, and rotating the image as required. Alternatively, if you have two known co-ordinates on the image you can define these and the software will scale, rotate and move the image to match these two co-ordinates.
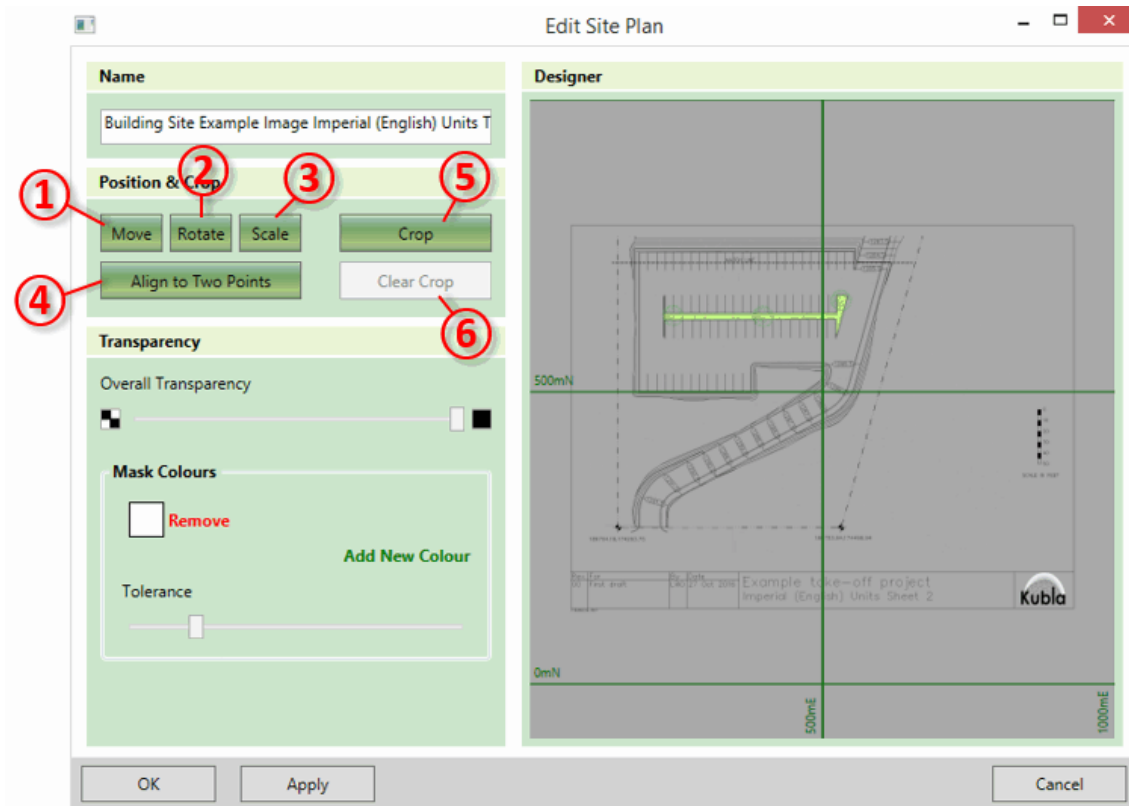
The following controls are used to define the image's position:

- ① Move

  This option allows you to move the image by defining a point on the image and then typing its position in the real world. This is useful if there is a co-ordinate defined on your image. It is important to remember that you should move the image after you have done any scaling and rotation you need to do, because these operations will cause positions on the image to change.

- ② Rotate

  This option allows you to rotate the image by defining a north reference angle on the image. This is useful if you want to show your image in a different orientation to that on the image. E.g. you want it aligned north-vertical and there is a north arrow on the image (which is not vertical)

- ③ Scale

  This option will scale the image. You can do this with one of two methods:

  1. By scale (PDF's only). Type a defined scale for the PDF, such as 1:100, or 1"=25'.
  2. By Length. Specify a length on the image and then type its length in the real world. This option is particularly useful if you have a defined length on your image. E.g. a scale bar or a marked dimension.

- ④ Align to two points

  This is the easiest option if you have two co-ordinates defined in the image. It allows you to specify the two points on the image and then type their co-ordinates in the real world. The software will then scale, move and rotate as required to match these two points.

Once you have selected one of these options, you will receive further instructions depending on the option you selected. These are described below:

- Move

    1. *Select a base point to move*

    Define the point which you want to move by clicking once in the preview.

    2. *Type or click on screen to set the new position of the base point*

    Type the location (X and Y) that you want this point to be moved to. Alternatively you can click on the screen to set the new point position to another screen location.

- Rotate

    1. *Draw the north arrow (base to tip)*

    Draw a line on the preview to define your reference north angle. Click once to start drawing the line and a second time to finish.

- Scale

    Select the option you wish to use ('By Scale' or 'By Length') and then...

    1. *Specify the new scale*

    Type the new scale for the PDF.

    ... OR ...

    1. *Draw a line along a scale guide or any other known length*

    Draw a line on the preview to define your reference length. Click once to start drawing the line and a second time to finish.

    2. *Enter the new length*

    Type the length you want the reference length to be scaled to.

- Align to two points

    1. *Select the first point to align*

    Define the position of the first reference point by clicking once in the preview.

    2. *Type or click on screen to set the new position of the first point*

    Type the location (X and Y) that you want the first point to be moved to. Alternatively you can click on the screen to set the new position to another screen location.

    3. *Select the second point to align*

    Define the position of the second reference point by clicking once in the preview.

    4. *Type or click on screen to set the new position of the second point*

    Type the location (X and Y) that you want the second point to be moved to. Alternatively you can click on the screen to set the new position to another screen location.

Once you completed the instructions on the prompts, the prompt will disappear and the image will be adjusted as you have specified.

You can also crop the site plan to remove any unnecessary borders and titles. This is done by clicking on the Crop⑤ button. You will be prompted to draw the crop rectangle on the screen. You can clear this crop by clicking on Clear Crop⑥ and you can always adjust it by clicking again on the Crop⑤ button.

We have two great videos... Site Plans - Scaling and Positioning introduces scaling e.g. 'By Length' and also relative positioning; Site Plans - Cropping shows you how to remove unwanted site plan imagery.

Setting the Transparency

When a new site plan is added to a project the white colour is removed. This means site plan documents with a white background will have the background removed leaving just the line work for take-off or reference. You can remove the default colour to restore a white background or set different colours to remove.

Sometimes when a site plan has different coloured areas you need to set multiple mask colours, one for each colour you wish to remove. There is a tolerance slider to control how strict the colour matching is.
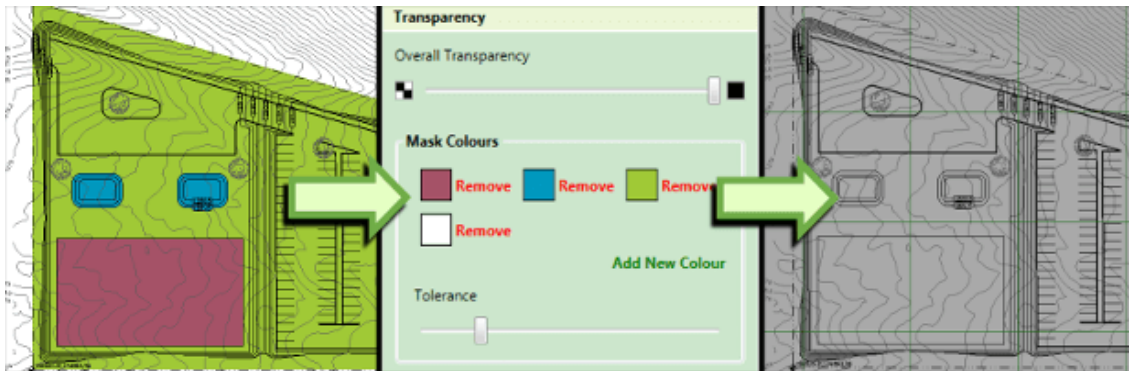
Since the site plan will be displayed on top of the existing terrain and earthworks, it is necessary to give it transparency so that it's possible to see through the plan to the layers below. In many cases the default transparency settings will be suitable. However, when the transparency needs to be adjusted this can be achieved using the controls shown below.
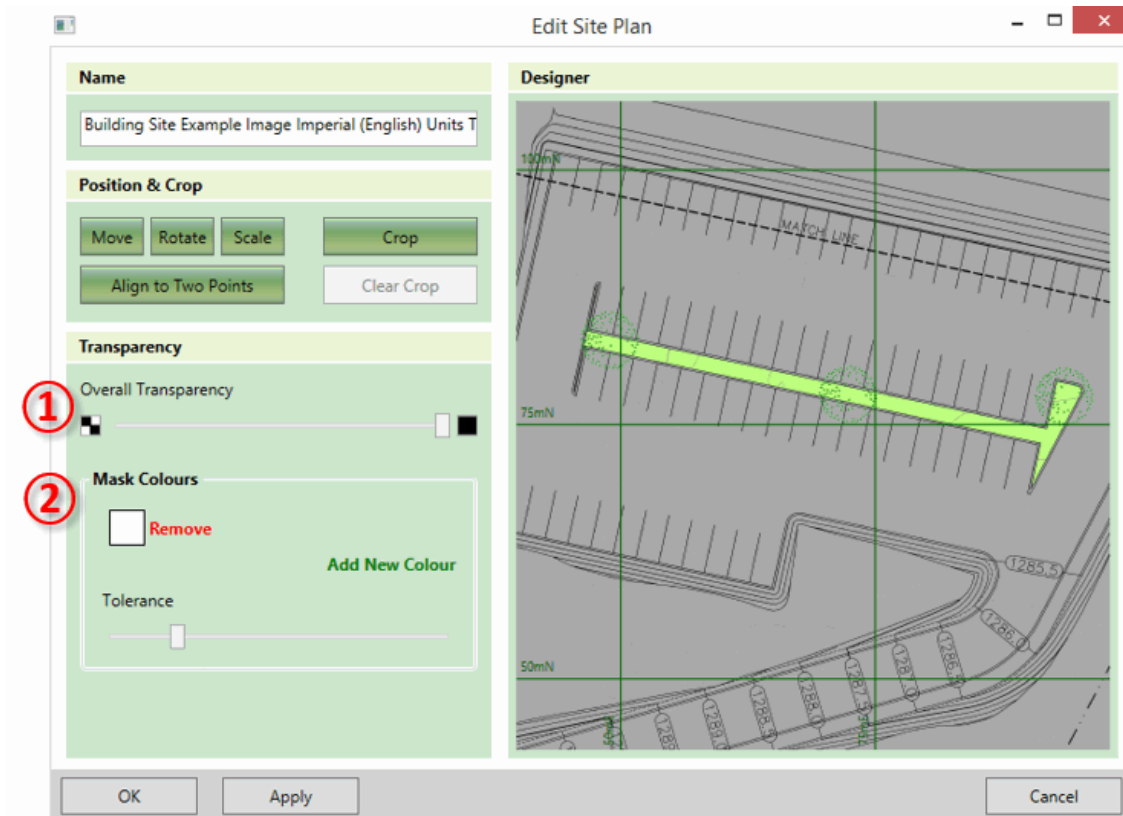
These controls work together as follows:

- ① This slider can be used to define the overall transparency to apply to the whole image. If set to its minimum (the default) there will be no overall transparency. As the slider is moved to the right the overall transparency will be increased until at the maximum value the image will completely disappear.
- ② These controls can be used to completely mask out specified colours. By default, there is a mask on white, which is the background colour for most drawings. Additional mask colours can be set by clicking add new colour and then clicking a point on the preview to select a colour. Mask colours can be changed by clicking into the colour box and selecting a new colour on the screen, and they can be removed by clicking remove.

It is possible to also remove colours which are similar to the selected mask colour(s) by adjusting the tolerance slider. If the slider is set to its minimum only exact matches on the mask colour(s) will be removed. As the tolerance value is increased more and more colours will be removed in a widening band around the specified colour(s).

An explanation for the transparent background requirement is provided in the video Site Plans - Transparency. This video also provides instructions on how apply/remove transparency further.

Chapter

3

Defining Existing Ground

Topics:

- Overview
- Feature Surface
- Triangle Surface

After defining the site plans (if you have any), the next stage is to define the existing terrain. You can define existing terrain using elevation features (points, contour lines, break lines and outlines). You can draw elevation features manually over a plan or import directly from CAD. Alternatively, you can import a mesh directly from another program or another Kubla project file.

Overview

To start defining existing elevations make sure the Existing tab is selected and then in the Ground panel on the right-hand side click on the + symbol and add a Feature Surface or a Triangle Surface.

A feature surface is used if you want to define elevations using a collection of points, contours and break lines enclosed in outlines. You would typically select this option if working with PDF files or CAD files containing points or lines. If you already have a triangulated surface created in another program select a triangle surface to import the data directly from CAD, LandXML or a Kubla Project file.
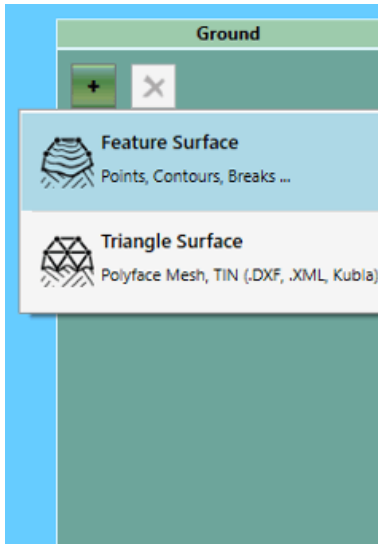
Feature Surface

NOTE: The feature surface can be edited in Pop-In or Pop-Out mode. For an explanation of these modes see Editing Modes.

The feature surface is defined by a collection of elevation features; either drawn manually on screen or loaded from a file. Any combination of the following terrain features can be used to define the terrain:

	Outlines This element is used to define the outline(s) of the feature surface. There will almost always be only one outline, but it is possible to define more than one to create several 'islands' of terrain. It is also possible to create holes in the terrain by adding internal outlines. There are also different types of Outline: • *i) Extrapolate from other Features (Default):* Takes the levels from contained elevation features that you have defined (e.g. contour lines and points). • *ii) Define Varying Levels:* Allows you to set levels for the outline which vary at each point. This can be used if you need maximum control of the surface outline elevations. • *iii) Define Fixed Level:* Allows you to set a single level for the outline, this is only used in very unique scenarios. • *iv) Use Ground Levels:* Snaps the Outline elevations to the ground. (This can only be used with a feature surface used to define proposed earthworks)
	Contour Lines Contour lines (or isolines) are used to define lines on the terrain with a fixed elevation

⊘	**Break Lines** Break lines are used to defined lines on the terrain which have a varying elevation
+++	**Point Levels** Point levels are used to define the levels for individual points in the terrain area

The properties of each feature vary depending on the feature type, but they all have a 'Tag' which can optionally be set. This is an identifier for the feature (akin to the feature's name), and it is used to help the user identify particular features.
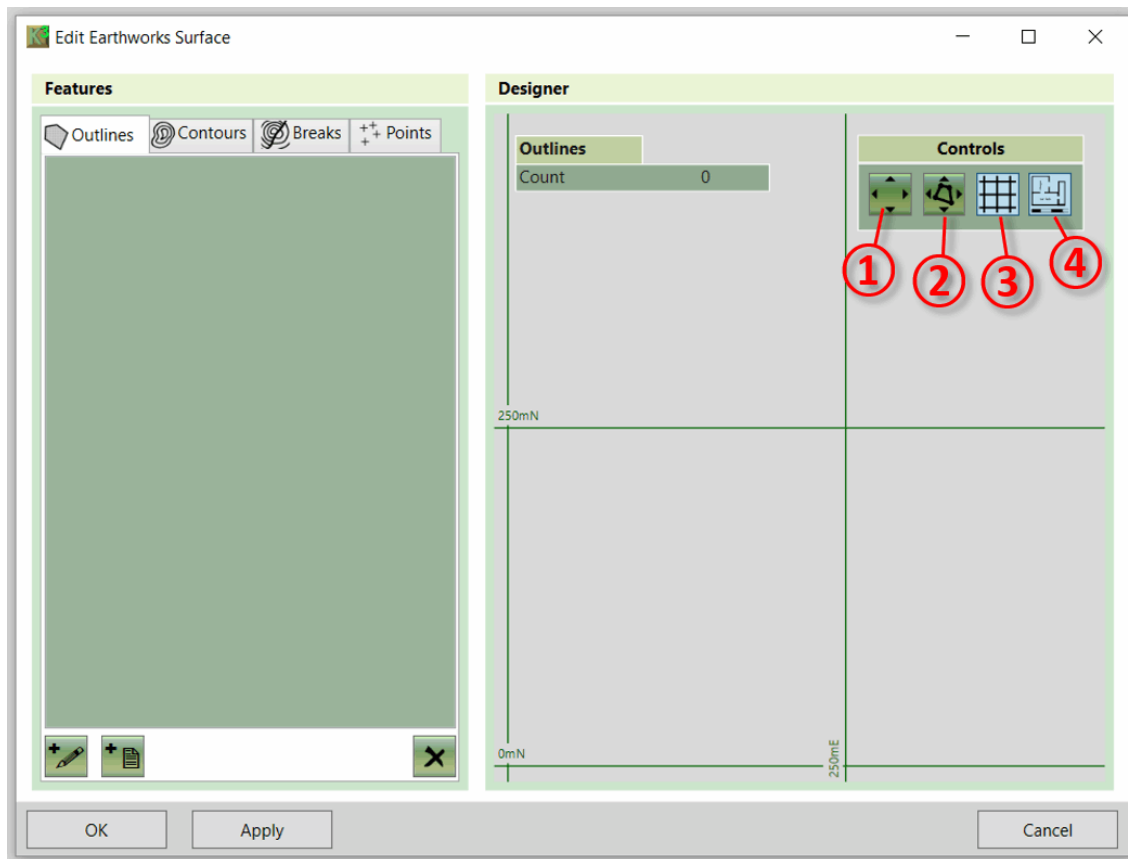
This form includes three display buttons as described below:

- ① Zoom to Extents This button zooms to designer to extents (i.e. frames all elements in the designer panel)
- ② Zoom to Selection This button zooms to designer to selected features
- ③ Toggle Grid This button toggles the grid in the designer on and off.
- ④ Toggle Site Plan This button toggles the site plan in the designer on and off.

The rest of the controls on this form are used to add, remove and edit the terrain features. They are described in detail in the following sections.

Learn how to define boundary outlines in the video Understanding Feature Surface Outlines

Adding New Features

Terrain features can be added either by drawing them manually on the designer screen, or by loading them in from a file. Outlines, Contour Lines and Break Lines can be loaded from a CAD (.dwg, .dxf) file whereas Point Levels can be loaded from either a CAD file or from an excel or text data file.

To add a new feature select the feature type that you want to create ① and then click either Add Manually ② or Add from File ③.
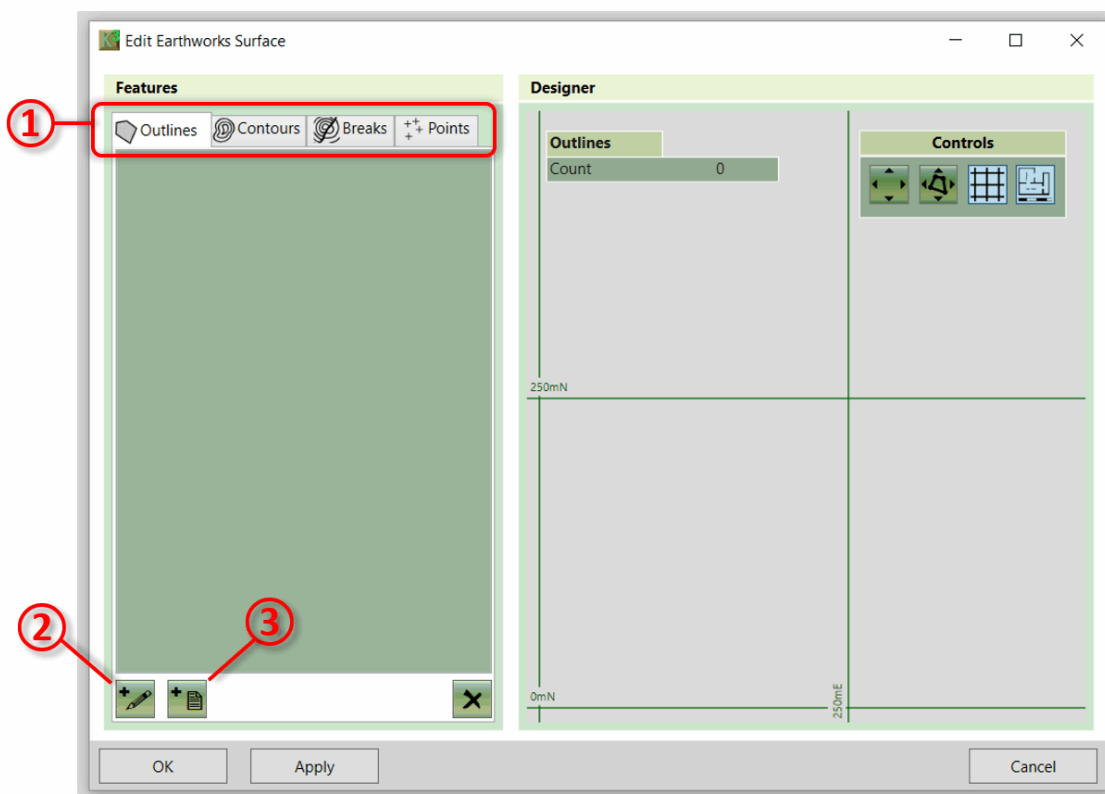
If you add a feature from file you will be prompted to select the file to open. The process to follow after this is described in the following sections.

Adding Features Manually

The process once you have clicked on the button to add a new feature manually depends on the type of feature you have selected. In all cases you draw the elements on the designer panel on the right of the screen.

- **Outlines**

    When you choose to add an outline the following prompt will appear, providing two options to create outlines.
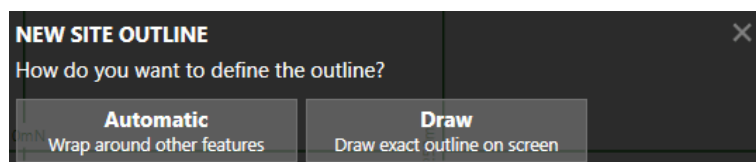
- **Automatic outline**. If you choose this option the software will automatically create outlines, based on the features that you have defined. This process is analogous to wrapping a rubber band around the features that

you have already defined to create an outline. You will be able to adjust how much this 'rubber band' is 'sucked in'.

- **Draw**. If you choose this option you will draw an exact outline on the screen. You will be provided with a number of options to set the levels for this outline:

    1. *i) Extrapolate from other Features (Default):* Takes the levels from nearby elevation features that you have defined (e.g. contour lines and points).
    2. *ii) Define Varying Levels:* Allows you to set levels for the outline which vary at each point. This can be used if you need maximum control of the surface outline elevations.
    3. *iii) Define Fixed Level:* Allows you to set a single level for the outline, this is only used in very unique scenarios.
    4. *iv) Use Ground Levels:* Snaps the Outline elevations to the ground (This can only be used with a feature surface used to define proposed earthworks)

When you choose you preferred option follow the steps to completed the outline. Once you have finished you will see the prompt below.

You can define a Tag for the Outline if you wish. Click Next to draw another Outline, or Finish to stop drawing Outlines.

- **Contour Lines**

Draw each point of the Contour Line by left clicking on the designer panel. Finish drawing the contour by right clicking, or by pressing the enter key. The following prompt will appear:

You should type the level for the Contour Line into this prompt. You can also define a Tag if you wish. Lastly if the Contour Line is a closed loop you can click the Closed checkbox. Click Next to draw another Contour Line or Finish to stop drawing Contour Lines. Note that the '...' before the 'Level' input box can be used to adjust the levels you type. E.g. if all of your levels start from an elevation of 1000 you can click on '...' and input '1000+'. You can then type, for example '26' into levels box and this will be converted into '1026'. This can save time in some take-off scenarios.

- **Break Lines**

When you choose to add a breakline, you will be prompted to click on the designer panel to define the first point position. Once you have done this you will see the following prompt.

You can define a level (Z) for the Break Line point and can also type precise X and Y values if you wish. If you prefer, you can skip typing the level and the software will interpolate it. This is useful if you have a detailed break shape where the levels are only defined at a few locations.

If you leave point levels blank, the software will fill them in with the following logic:

- Wherever the Break Line crosses another line (e.g. a contour) a point will be added to the Break Line with the same level as the crossing line.
- When crossing line points have been added, linear interpolation will be used along the Break Line to fill in any missing levels.

Click Continue to draw another breakline point or Complete to finish drawing the Break Line.

Once you have finished drawing a Break Line the following prompt will appear:

You can also define a Tag for the new Break Line if you wish. If the Break Line is a closed loop you can click the Closed checkbox. Click Next to draw another Break Line or Finish to stop drawing Break Lines.

- **Point Levels**

Draw the Point Level by left clicking on the designer panel. The following prompt will appear:

You should type the level for the Point Level into this prompt. You can also type X and Y values for precise positioning. If you wish, you can type a Tag for the Point Level. Click Next to draw another Point Level or Finish to stop drawing Point Levels. Note the comment on 'Contour Lines' above regarding the '...' in front of the level input box.

Adding Features from a CAD File

Once you have selected a CAD (.dxf, .dwg) file the following window will appear. Note that this window will only display the features that can be interpreted as a feature type you have selected. i.e.

- **Outlines:** Only closed lines will be displayed
- **Contour Lines:** Only lines will be displayed
- **Break Lines:** Only lines will be displayed
- **Points:** Only points will be displayed
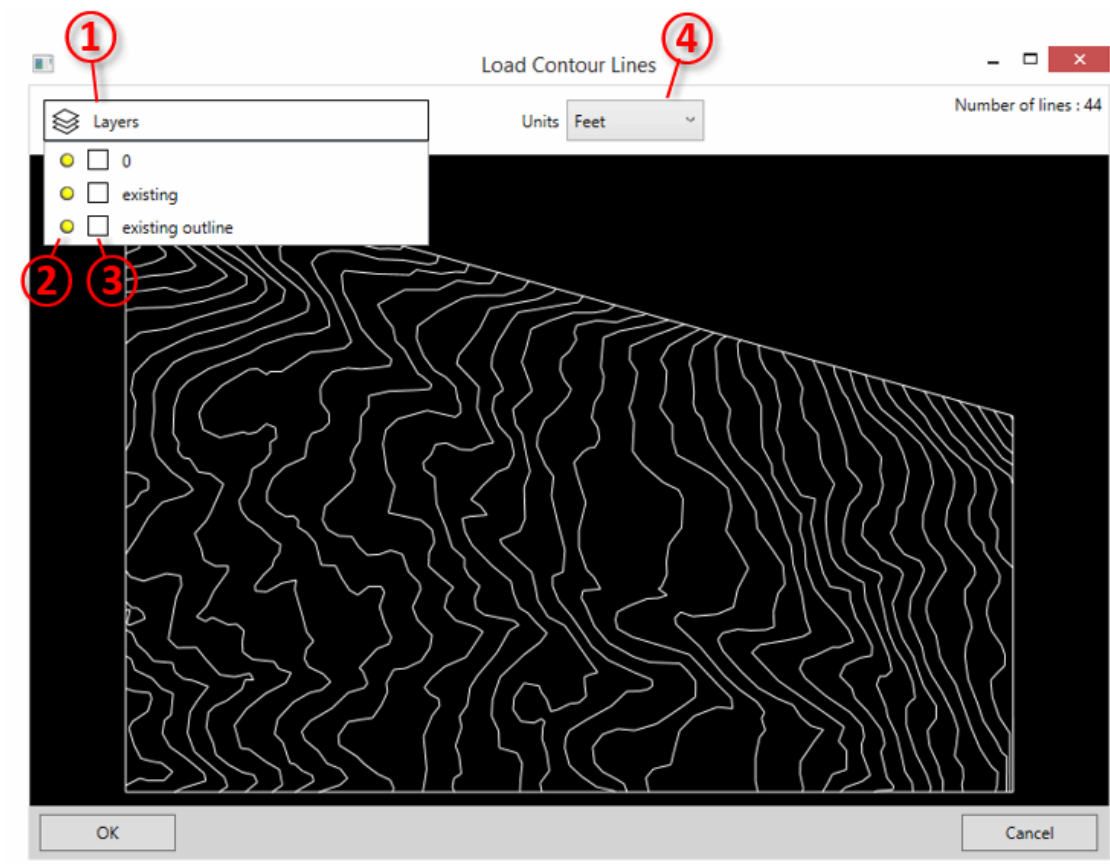
You can inspect the layers in the file by clicking on the Layers Bar ①. You can toggle each layer on and off ②. Layers which have been turned off will not be imported. You can also change the colour of layers by clicking in the colour box ③. This is purely to help identify different layers in this window, and the changes you make will not be saved into the dxf file.

The other important setting is the units of the file which can be chosen from the dropdown ④. By default, the units are set to metres if the CAD files 'insertion units' are metric and to feet if they are imperial (English units). However, the 'insertion units' variable is often set incorrectly when CAD files are saved, so it is important to check that this is as you expect.

Learn how to import contours, points and a polyface mesh in our Working with CAD Data (.dxf, .dwg, .dgn) video, which also covers CAD export.

Adding Points from a Data File

Once you have selected an excel or text file the following window will appear. In the case of an excel file, the 'File Format' section will not appear, as this is only used for defining text file formats.
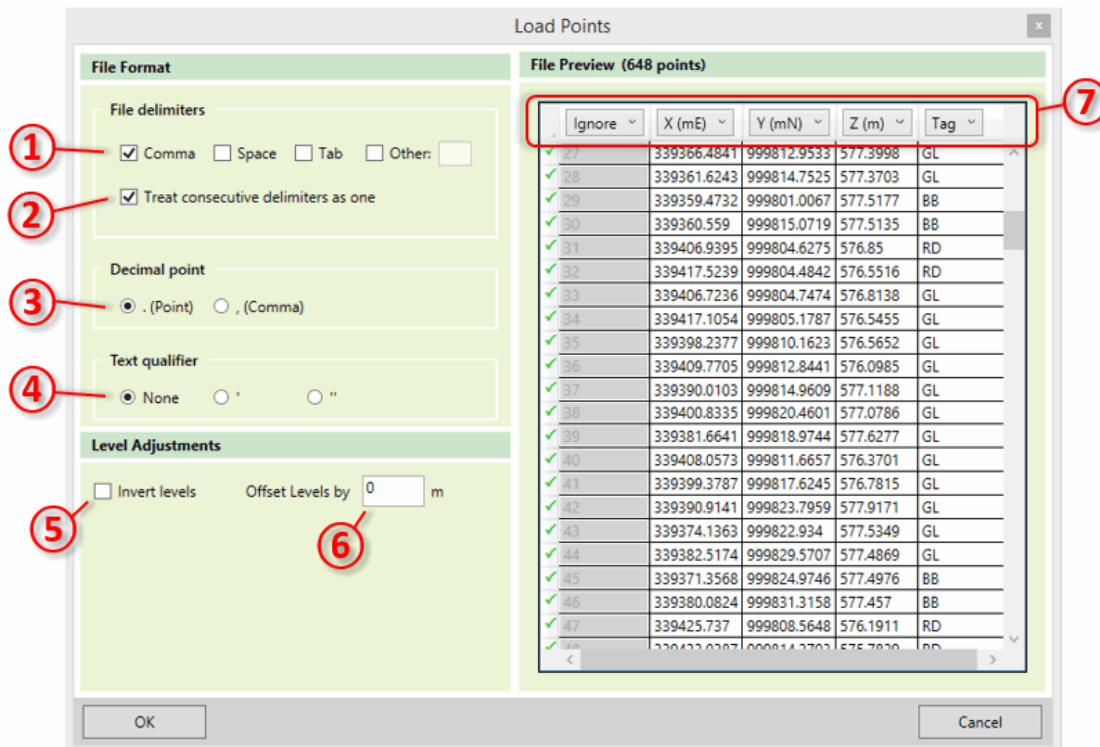
If you are using a text file it is necessary to define the file format with the controls on the left. In many cases the file will immediately show correctly in the previewer. However, if you have an unusual file format you may need to amend the details of the file format on the right side as follows:

- ① File delimiters Specify what character is used to delimit the fields in your file. Files are typically tab, comma or space delimited, but any character can be specified here by clicking Other and typing in the text box.
- ② Treat consecutive delimiters as one Specify whether several consecutive delimiters in a file line should be treated as one, or if these should be treated as several fields with empty values.
- ③ Decimal Point Specifies whether your file uses a point or a comma to denote a decimal point. This is used to deal with different conventions in different parts of the world.
- ④ Text Qualifier Specifies the character that is used on either side of a text field in the file, if your file contains text fields.

There are also some controls which can be used to adjust the levels (Z values) in the file:

- ⑤ Offset Levels by - If the points in your file are offset from the vertical datum you want to use then you can specify it here.
- ⑥ Invert Levels - *Kubla Cubed* uses upwards-positive convention for levels. If your file uses upwards-negative convention, then you can use this option to invert the values in your file so that they are suitable for *Kubla Cubed*. This option is mostly used for hydrographic surveys, which often report depths as positive values.

Finally, you must specify which columns in your file represent the X, Y, Z and Tag (if it contains tags) values for the data. This is done by clicking on the column header in the data preview ⑦ and selecting *'X'*, *'Y'*, *'Z'* or *'Tag'* from the dropdown. You can also specify *'Ignore'* if that column contains data which is not relevant.

In the video Importing Point Files (.xyz, .csv, .xls) we look at importing point files into Kubla Cubed. Point files can be used to define both the existing and proposed terrain by using a feature surface.

Editing and Deleting Elements

Elements can be selected in two ways - either by clicking the element on the list to the left of the window, or by clicking on the element in the designer panel. Note that only the current element type is selectable in the designer panel. E.g. in the example shown below only contour lines ① are selectable in the designer panel.

Multiple elements can be selected by holding down the shift key and clicking on several items.

Once features have been selected, they can be deleted by clicking on the Remove ② button.
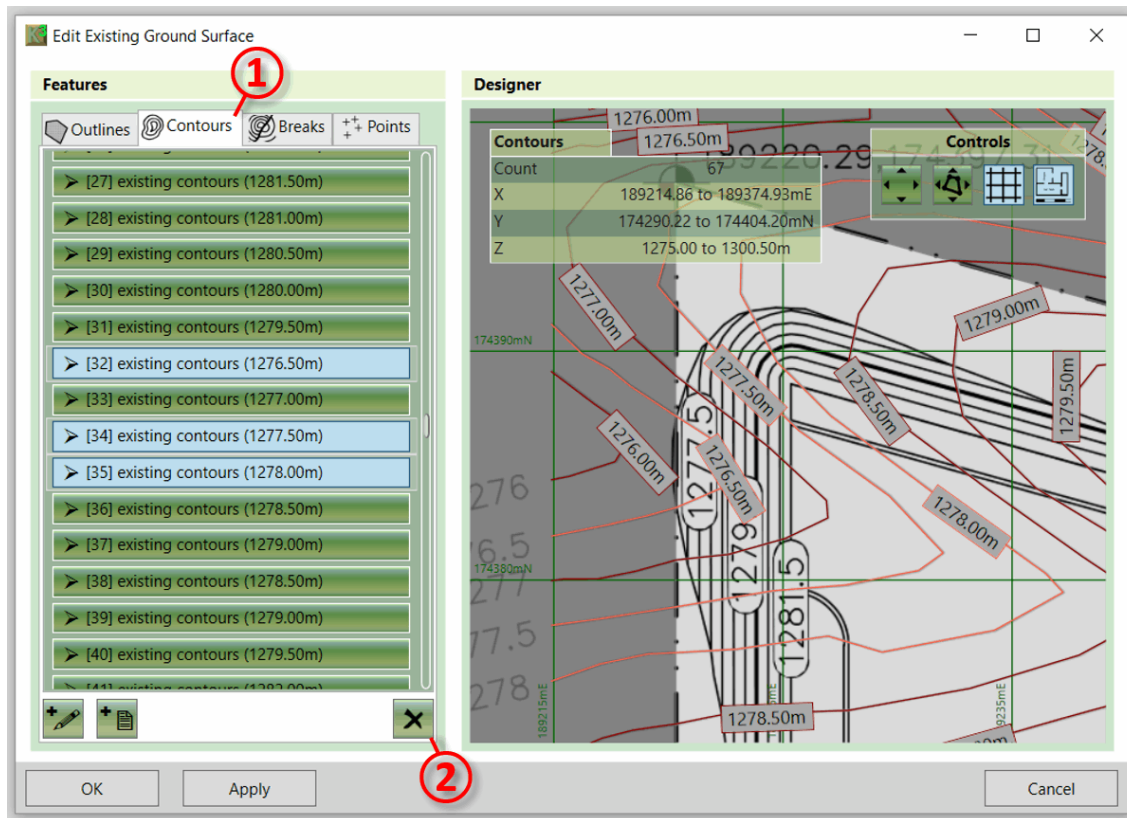
A feature can be edited by double-clicking on it in the side bar or designer panel. When you do this the feature will be expanded in the side bar, exposing its properties so that you can change them. You can now edit this feature, either by typing new values into the side panel or by dragging points and lines in the designer panel ②. Points can be added to or removed from lines by clicking on the ± button in the table ①.
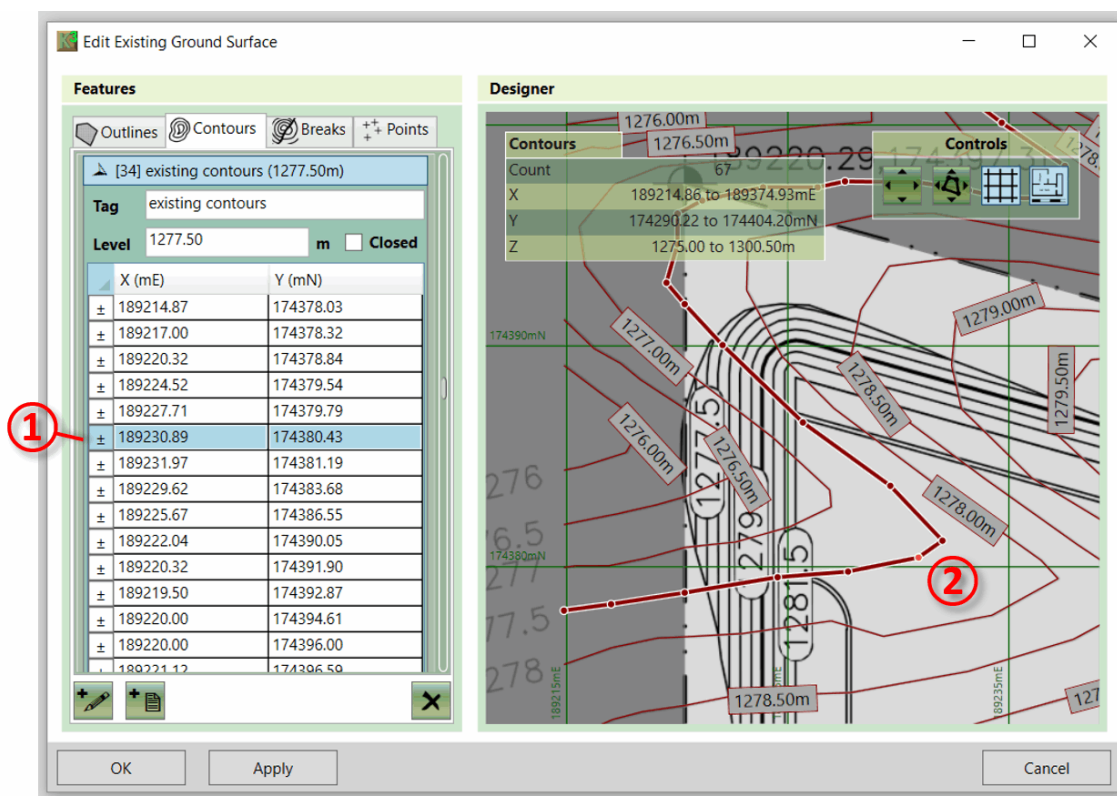
Triangle Surface

The triangle surface is defined by a group of interconnected triangles. You cannot define these triangles manually; instead they need to be imported from a program that works with triangulated models sometimes. The surfaces are sometimes referred to as Triangulated Irregular Networks (TIN), triangulations, polyface meshes and Digital Terrain Models (DTM).

The triangulations can be imported from CAD files (.dwg, .dxf), LandXML (.xml) files and Kubla Project files (.kcp). When importing from CAD files you need to select the layer that contains the polyface mesh objects, the polyface mesh objects in the selected layer will then all be merged together and imported as a single object. The LandXML and Kubla files work slightly differently as they do not have layers, instead you need to select the specific name of the surface you wish to import.

This form includes two sections:

- ① Select File Here you select the file that contains the triangulation you wish to import.
- ② Select Layer\Surface In this section you select the layer (with CAD files) or surface with LandXML and Kubla Project files.

If you are loading from a CAD (.dwg, .dxf) file this form will also have a 'units' drop-down. This is required because the units are not saved in the .dxf format, so you need to specify them when loading the file

The video Existing Levels - Triangle Surface provides a comprehensive study of the Triangle Surface and how to import triangle data.

Chapter

4

Construction Phases

Topics:

Construction phases allow you to break your project into multiple phases of work. For example, a typical earthworks project would have a strip phase and a bulk earthworks phase as a minimum.

Understanding the concept of construction phases is key to making full use of *Kubla Cubed*

Overview

In *Kubla Cubed* the tabs that run along the bottom of the screen are referred to as 'construction phases' or just 'phases'. Earthworks and measurement elements that you create will be added to the selected phase only, the volumes shown on the screen relate to the selected phase only rather than an accumulation of all volumes in the project.
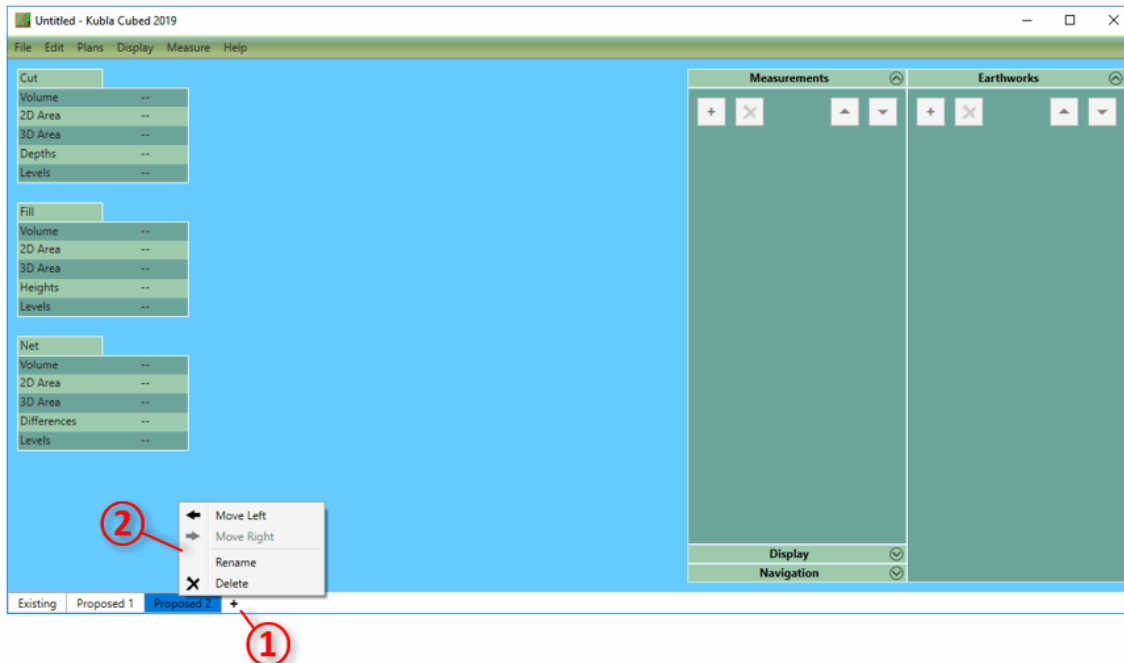
The first phase always contains the existing ground, any number of subsequent proposed phases can be created. There are two main reasons to create more than one propsed phase:

- It allows earthworks volumes and measurements to be seperated into logical sections (e.g topsoil, bulk earthworks, paving).
- It allows a new set of calculations to be completed using the proposed elevations of the previous phase as the new ground.

The second item is particularly important. Consider a backfill operation: in the first proposed phase you define a trench which cuts into the existing ground. In Kubla Cubed each phase does calculations on two surface, a ground surface (taken from the previous phase) and a proposed surface (defined with earthworks elements). In a single phase there is no way to calculate backfilling the trench as if you place earthworks over the trench it will overwrite that section of the proposed rather than calculate a seperate 'fill' volume. Earthworks elements in a single phase are combined together to create a single proposed surface they do not produce cut\fill volumes from intersecting with each other. Instead what we need to do in this scenario is to create another phase, effectively baking the result of the trench cut into the ground of the next phase. The ground of the new phase will be the proposed from the last and so it is now possible to calculate backfilling the trench as part of a seperate operation. Other common scenarios that require this are if you need to complete topsoil stripping or a demolition before bulk earthworks.
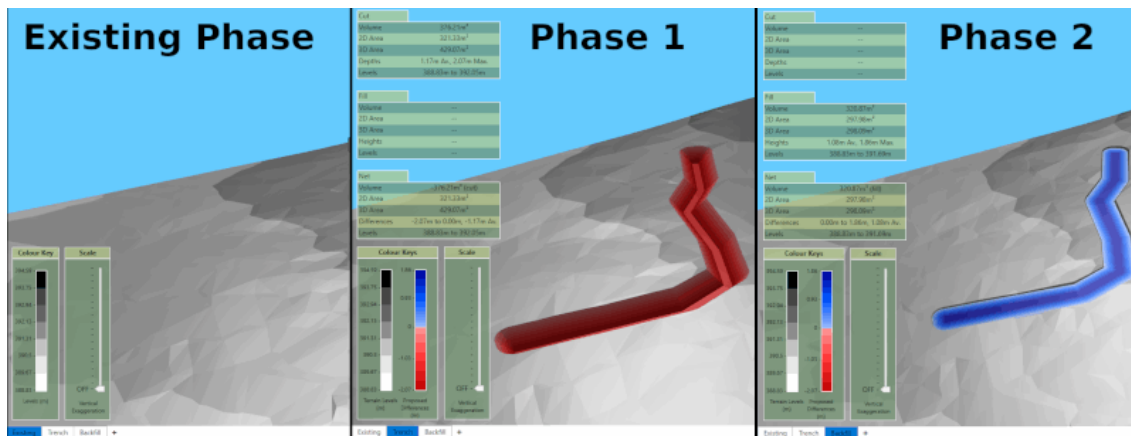
In our video Understanding Construction Phases & Calculation Order we talk about two critical concepts that must be fully appreciated to master the program.

Editing Phases

To add a new construction phase, click on the + button ① and type a name for the new phase. If you want to delete or rename a construction phase then **right click** on the tab and a menu will appear ② with these options.

Moving Phases

To move an phase one place left or right you can use the **right click** menu. You can also drag and drop phases by pressing the **left mouse** down on a phase and moving the pointer to the new position, while keeping the mouse button down until it's in the drop position.

Chapter

5

Proposed Earthworks

Topics:

Kubla Cubed provides multiple proposed elements to define proposed earthworks levels. Earthworks can be defined using a number of elements within the same phase to build up the earthworks from a number of basic elements. Alternatively, a single more complex element type may be used.

Overview

Kubla Cubed provides multiple options to define proposed earthworks levels. Some thought has to be given to the best earthworks elements to use in any given scenario. When required a number of elements can be used together to create the proposed earthworks. Earthworks elements can be divided into two groups in regard to how their elevations are defined :

- **Explicit Level Elements:** These elements are defined by explicit levels. The platform, slope, feature surface and triangle surface all fall under this catergory. If they intersect with another element and are lower in the calculation order they will effectively overwrite the element below.
- **Level Adjustment Elements:** The next type are level adjustment elements. The strip and spread elements come under this category. For these elements you do not input a level but instead a depth or height by which to adjust the existing ground or the level already defined by elements lower in the calculation order. If these elements intersect with other elements lower in the calculation order they do not overwrite them, instead they will adjust their level up or down.
- **Hybrid Elements:** The path element is a hybrid element in that you can set it to be defined by a level or by a height. When set to be defined by levels it has the properties of an explicit level element and when set to be defined by height has those of a level adjustment element.

Whenever designing a proposed surface by combining multiple eartworks elements it is important to ensure that you are confident that you have defined the level you intended. To check hover the mouse cursor over various points on your designed surface to ensure the proposed Z value is what you expected. Please see the section on cursor label for more information.

The Earthworks Panel

Each phase in a project contains an earthworks panel. This is where earthworks elements such as platforms, slopes, paths and feature surfaces can be added to the project. The earthworks elements in a panel are combined together to create a single proposed surface within a single phase.
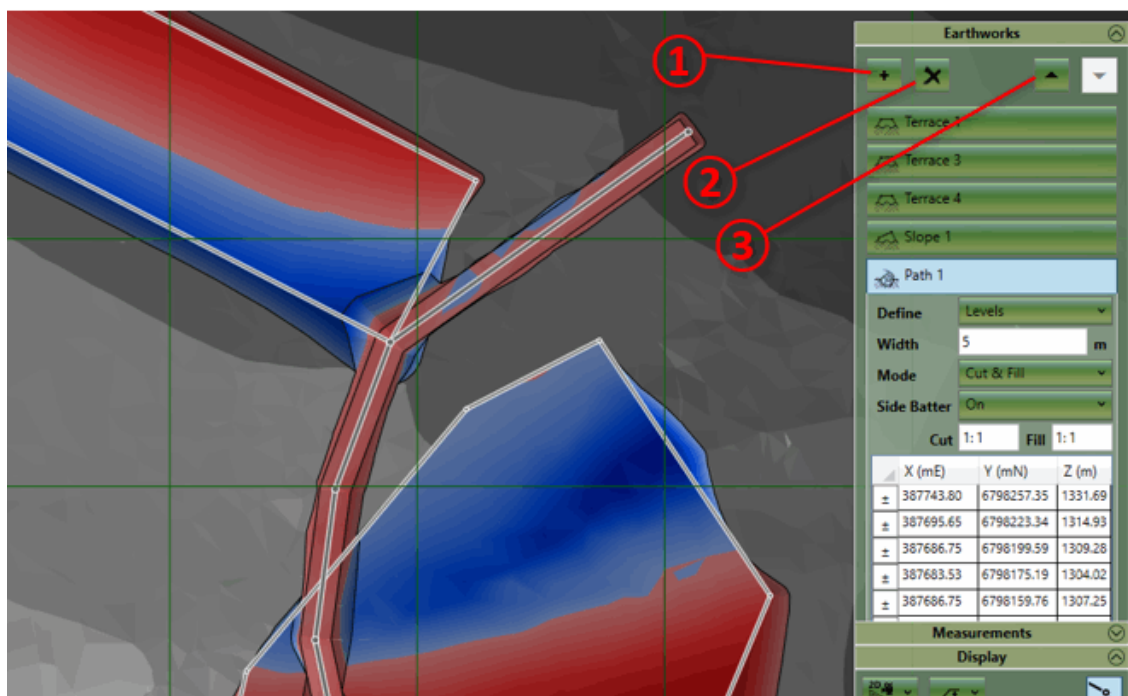
Adding Elements

New elements can be added to the earthworks panel by clicking on the + symbol ①. You will be presented with the following list of elements that you can add :
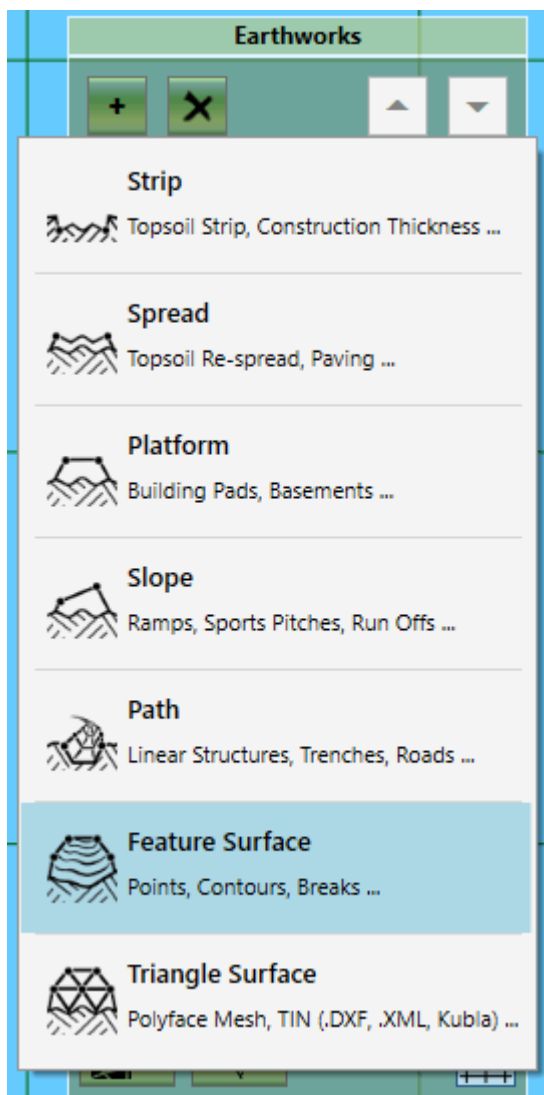
- **Strip**

  The strip element removes a specified thickness of material from a specified area of the site. This is very commonly used for stripping topsoil from the existing ground. For more information see Strip Element .

- **Spread**

  The spread element adds a specified thickness of material to a specified area of the site. This is most commonly used for paving. For more information see Spread Element .

- **Platform**

  The platform element adds a specified area with a specified elevation to the site. I.e. a flat area. This is most commonly used for defining building pads and retention ponds. For more information see Platform Element .

- **Slope**

  The slope element adds a specified area with a specified slope to the site. This is most commonly used for access ramps and run-offs. For more information see Slope Element .

- **Path**

  The path element adds a path of a specified width with a specified centreline to the site. This is most commonly used for access roads and trenches. For more information see Path Element .

- **Feature Surface**

  The feature surface element adds a surface defined with elevation 'features' (outlines, contours, break-lines and points). This is most commonly used for take-offs such as those required by contractors for bidding purposes. For more information see Feature Surface Element .

- **Triangle Surface**

  The triangle surface element is used to define a surface using a triangulation imported from another file. This is most commonly used to import data from other programs which support triangulations (TINS). For more information see Triangle Surface Element .

When you have selected an element you will be able to start drawing its boundary or centreline points in the design area. **Left click** to place a new point, **right click** or press **Enter** to complete the creation of the element. If you want to cancel the operation entirely hit **Esc** key. When adding new elements the **back space** key can be used to undo the last placed point if a mistake has been made.

Renaming Elements

After an element is created it is a good idea to give it a relevant name so it can be identified in the report (e.g building pad 1 or car park). To do this just double click on the name of the element and then overtype.

Editing Elements

Selection : Elements can be selected by **left clicking** on the title bar in the earthworks panel or by **left clicking** on there boundary or centre lines in the design area. Multiple elements can be selected by holding down **Ctrl** whilst making the selection. To unselect an element you can **right click** on it.

Edit Mode : If you double click on an element it will enter into 'edit mode', the properties of the element will be exposed and you will be able to edit the definition points of the element in the design view. To exit 'edit mode' **double left click** in empty space in the design view.

Definition Points : When an element is in 'edit mode' the definition points of the boundary or centreline can be changed. In the design view **left click** on a point and drag it to the desired position. A point can be deleted by using the **Delete** key. New points can be inserted by selecting a line and hitting the **Z** key. Points can also by edited directly in the point list in the element properties. Clicking on the top right corner of the point list allows all the points to be copied using the menu command or **Ctrl+C**. Likewise a list of points can also be pasted into the point list from another program by clicking on the top right corner and using menu paste command or **Ctrl+V.**

Properties: For information on the individual element properties refer to the relevant sections for each element.

Notes on Point Snapping : When creating or editing the definition points of a earthworks element it is possible to snap the points to other element definition points or to defined grid positions. To access the point snapping options click on the **Edit** menu and then the **Snap Points**. Here you can toggle snapping to boundary points and grid points as well as setting the interval and origin point of the grid used for snapping.

Amending the Calculation Order

You can amend the order of elements in the list by selecting an element and using the up down buttons ③. The order of earthworks becomes critically important when two or more earthworks intersect. The calculation order can change the way that the proposed surface is built and thus change the cut & fill estimate of a project. For more information refer to the calculation order section of the user guide.

Copying & Pasting

It is often useful to copy and paste elements, this can be done using **Edit** menu commands or the keyboard shortcuts (**Ctrl+C, Ctrl+V**). You can copy and paste in the same phase to duplicate an element or copy and paste to move elements to different phases.

Deleting Elements

Elements can be deleting by first selecting them and then clicking on the X button at the top of the panel ②.

Calculation Order

Note that the calculation order is only important if you have earthworks elements which intersect at different levels.
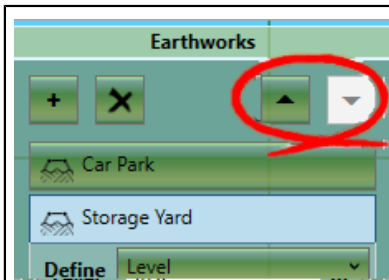
In *Kubla Cubed*, it is possible to have intersecting earthworks elements. However, this can introduce a complication since it must be specified whether the level in the intersection region will be controlled by one element or the other. This is dictated by the 'calculation order' - in effect the order that the earthworks elements are 'built' within the software.

Consider the following example, of two 'cut and fill' earthworks elements. If one element has a level of +10m and another is at +20m and they intersect, then what is the level of the resultant area where they intersect? In *Kubla Cubed* the answer is that it will be the level of the element which is lower in the calculation order.

The image below illustrates the example described above. These two elements intersect at different levels, and they are both in 'cut and fill' mode. If the element at +10m is above the element at +20m in the calculation order (left image), then the higher element will fill over the top of the lower element. However, if the calculation order of these two elements is reversed (right image) then the lower element will instead cut material out of the higher one.
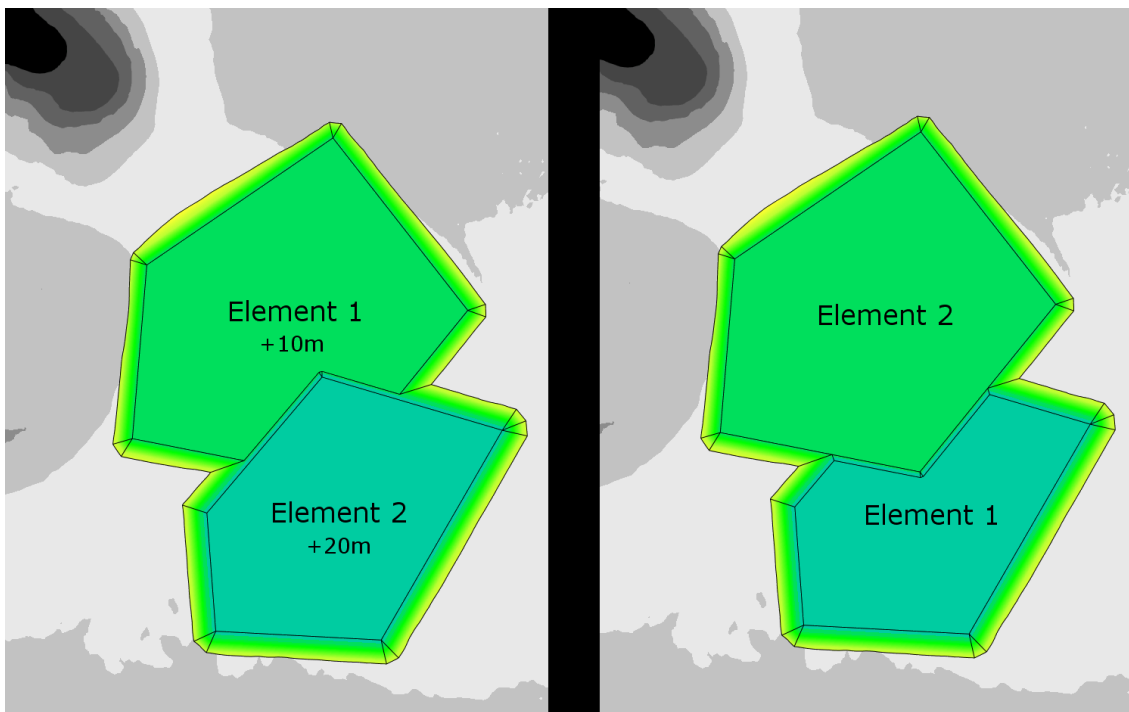
Understanding Construction Phases & Calculation Order are two topics that users must fully appreciate to master the program. These powerful concepts are studied in context through various scenarios and demos.

Topsoil Stripping

Topsoil stripping is easy to complete in Kubla Cubed using the strip element. Different strip elements can be used to define areas with different strip depths. Usually the side batter is kept at a very steep angle or turned off when defining strip areas.
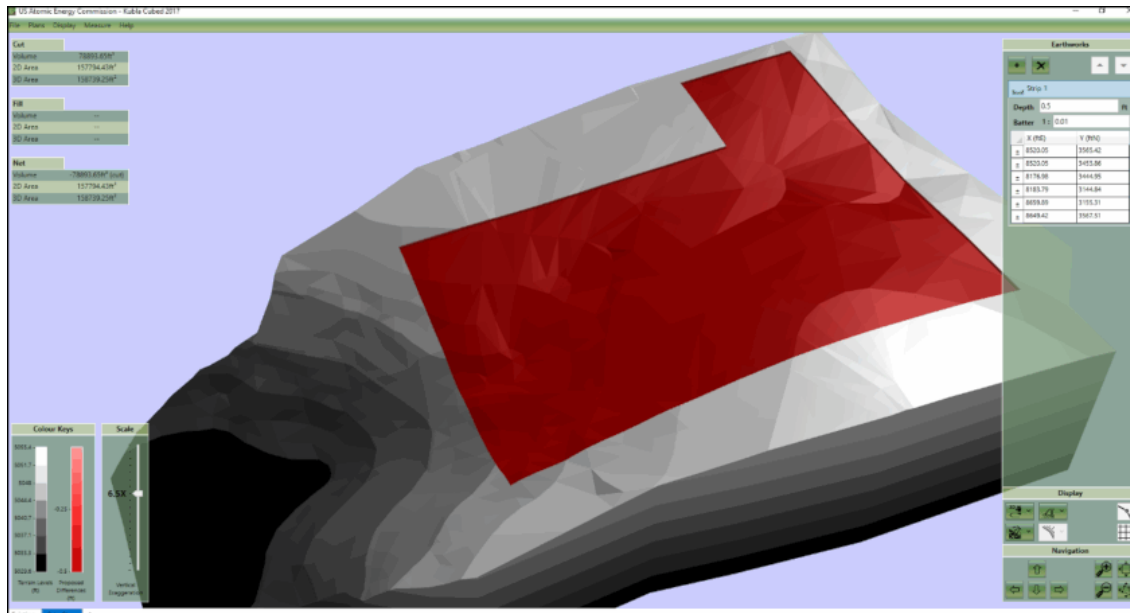
The most important thing to remember is to always have the stripping calculation completed in its own phase, and to have the bulk earthworks elevations defined in a subsequent phase. The reason for this is because on a proposed phase there is only one ground surface and one proposed surface. A comparison between the two provides the cut & fill results. With a topsoil strip we actually need three surfaces: existing ground, stripped levels and subgrade\formation levels. For this reason, we need to utilise the construction phase capabilities of Kubla Cubed to complete the multiple steps of the calculation. A new construction phase takes the proposed levels of the previous phase as the ground so in this case a new phase will calculate from the stripped levels rather than the ground levels which is exactly what we want. The same is true for backfilling or any project that requires comparison between multiple surfaces.

Notes on Intersecting Strips : Strip elements whose boundaries intersect are additive. This means that if a 1m strip intersected with a 2m strip the area of intersection would result in a 1m strip. It is recommended that point snapping is used at the same time as turning side batter off to design adjacent strip areas.

Topsoil Stripping looks at using the strip element to complete topsoil stripping operations and explains the importance of always having the strip depths defined on a different phase to subsequent earthwork elevations.

Adjusting to Subgrade \ Formation Level

Most site plans do not have the sub grade level marked. Instead they mark the final finished level (FFL) and a separate plan of surface material thickness. When estimating bulk earthworks we need to calculate to the subgrade so we need to find a way of adjusting for the subgrade in our project. There are two different techniques recommended to adjust the FFL levels to the subgrade level : the offset method and the strip method.

Notes on Terminology : In some areas of the world the term *'subgrade'* is used and others *'formation level'*. There are also a number of different terms used to refer to the the level you will be standing on when the project has finished : *'finished floor level'*, *'finished grade'* and *'final floor level'* are all used.
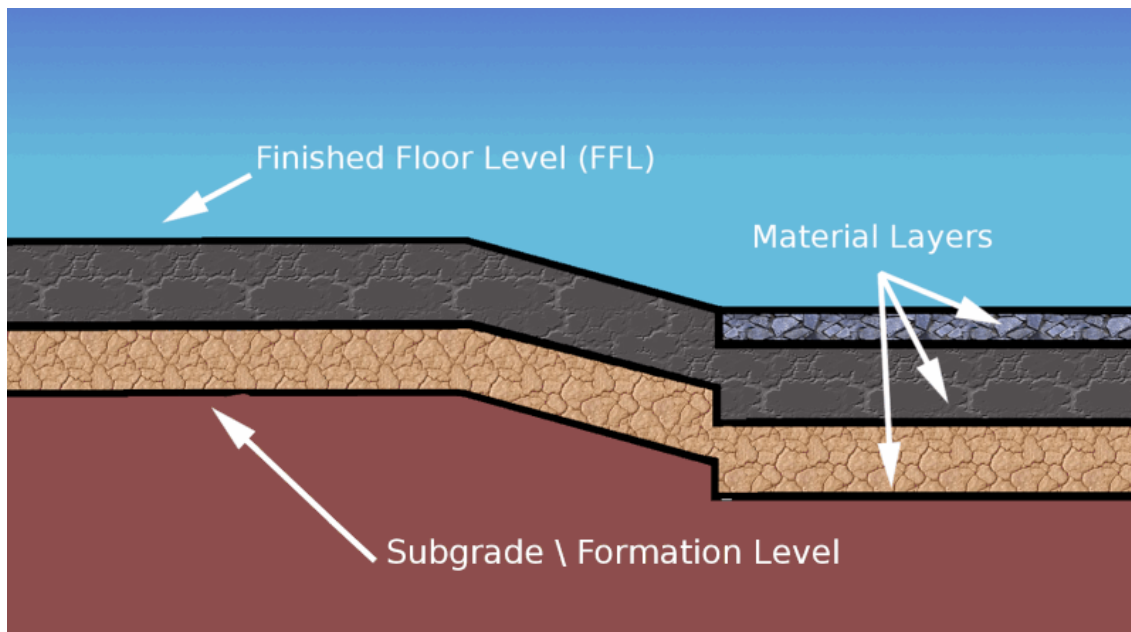
The Offset Method

The first method is called the offset method because we use the Z offset value that is available in all explicit level elements to offset an element with a negative value to make the required adjustment to the finished level. The Z offset input box is not available by default and has to be turned on by changing the define drop down in an element's properties for an option that includes an offset.
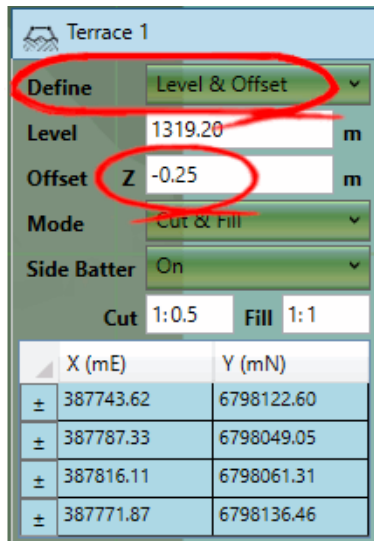
This offset method works very well when the different areas of material thickness are represented by different elements in a project. For instance if you have four building pads represented by four platforms and a car park represented by a feature surface it is easy to offset each platform and the feature surface to adjust for different material thickness values. However if the car park had different material thickness values across its surface we would run into a problem as there is only one Z offset box for the entire feature surface. We could split it up into different chunks but this can be awkward. Therefore in this scenario the strip method can be used to work around the problem.

The Strip Method

The strip method is frequently used when the proposed is defined by a single set of elevation features (contours, break lines, points). Breaking the proposed into different elements to cover different material thickness areas can be awkward and can lead to undesirable results at the boundaries of the different elements do not join seamlessly if

the elevation features were not designed to be broken up like this. In these scenarios it is usually best to use a single feature surface and draw strips over the feature surface to adjust the different areas by the required thickness.

The reason this works is because strip elements are level adjustment elements, this means they can not only adjust the level of the ground but also can be used to adjust the level of elements lower in the calculation order. When using this method we need to make sure the following rules are followed:

1. Strips must be in the same phase as the elements that define the finished level.
2. The strip elements must be below the finished level elements in the calculation order.
3. Usually the strips should have the side batter turned off.
4. Strips that intersect have a cumulative effect. It is a good idea to use snapping to make sure adjacent elements do not intersect

Adjusting to Subgrade \ Formation Level looks at adjusting the FFL levels to the subgrade level using two different techniques: the offset method and the strip method.

Earthworks Elements

Strip Element

The strip element is used to remove a fixed thickness of material from an area of the site. This element is most commonly used for stripping topsoil at the start of a project, and for making subgrade adjustments.

The properties that are exposed for the strip element are summarised below.

Strip 1 **Depth** 1.00 m **Batter** 1 : 1 ± X (mE) Y (mN) ± 131.91 -31.13 ± 146.33 25.60 ± 187.66 21.12 ± 176.45 -41.07	• **Depth** This is the depth of material that you wish to remove from the strip area. • **Side Batter** The strip boundary is joined to the ground by side slopes. The side batter (set as a ratio of vertical to horizontal) dictates the angle of these slopes. Turning side batter off will result in the strip being joined to the ground with vertical sides. • **Definition Points** These are the points which define the outline of the strip area.

Topsoil Stripping looks at using the strip element to complete topsoil stripping operations and explains the importance of always having the strip depths defined on a different phase to subsequent earthwork elevations.

Spread Element

The spread element is used to add a fixed thickness of material to an area of the site. This element is most commonly used for adding paving or topsoil.

The properties that are exposed for the spread element are summarised below.

Spread 1 Height 1.00 m Batter 1 : 1 	±	X (mE)	Y (mN)
±	173.37	77.61
±	162.04	32.75
±	223.19	21.65
±	231.21	64.62		• **Height** This is the height of material that you wish to add from the spread area. • **Side Batter** The spread boundary is joined to the ground by side slopes. The side batter (set as a ratio of vertical to horizontal) dictates the angle of these slopes. Turning side batter off will result in the spread being joined to the ground with vertical sides. • **Definition Points** These are the points which define the outline of the spread area.

Platform Element

The platform element is used to add an area with a fixed elevation to the site. This element is most commonly used for building pads.

The properties that are exposed for the platform element are summarised below.

Platform 1 Define Level Level 1295.90 m Mode Cut & Fill Side Batter On Cut 1:0.5 Fill 1:1 		X (mE)	Y (mN)
±	387534.68	6798244.12
±	387597.58	6798200.95
±	387581.59	6798182.30
±	387519.76	6798225.47		• **Define** This is the way that the platform level should be defined. Options are 'level' which uses the level specified below without modification and 'offset' which applies an offset to the level specified. The offset option is mostly used to add construction thicknesses by specifying a negative offset. • **Offset** This option is only visible if offset options are selected in the 'Define' menu. It allows you to offset the entire platform in Z. This is useful for accommodating for a construction thickness. • **Level** This is the level that the platform area should be (subject to any offset defined above). • **Mode** This is used to specify if the element should have cut, fill or both. Most commonly cut and fill will be specified. • **Side Batter** The platform boundary is joined to the ground by side slopes. The side batter (set as a ratio of vertical to horizontal) dictates the angle of these slopes. You can set differet side batter angles for side slopes that cut into the ground and for those that fill into it. Turning side batter off will result in the platform being joined to the ground with vertical sides. • **Definition Points** These are the points which define the outline of the platform area.

VIDEO TUTORIALS ▶

Provided in this video is an overview of the Platform element's options for defining a fixed, flat area of proposed ground Proposed Levels - Platform Element

Slope Element

The slope element is used to define a specified area with a uniform incline. This element is most commonly used for access ramps, sports pitches and run-offs.

The properties that are exposed for this element are summarised below.

- **Define**

  This option selects the controls you use to define the slope incline and elevation. The '3 Points' option can be used to define the plane of the slope. '3 Points & Offset' allows you to accommodate for a construction thickness. The other options are 'Arrow' and 'Arrow & Offset. Using the arrow, you can specify a single elevation and an incline angle to define the slope or two elevations and allow the software to calculate the incline angle for you (for more details see below).

- **Offset**

  This option is only visible if offset options are selected in the 'Define' menu. It allows you to offset the entire slope in Z. This is useful for accommodating for a construction thickness.

- **Levels**

  This table specifies the points with levels that define the slope.

- **Mode**

  This is used to specify if the element should have cut, fill or both. Most commonly cut and fill will be specified.

- **Side Batter**

  The slope boundary is joined to the ground by side slopes. The side batter (set as a ratio of vertical to horizontal) dictates the angle of these slopes. You can set differet side batter angles for side slopes that cut into the ground and for those that fill into it. Turning side batter off will result in the slope being joined to the ground with vertical sides.

- **Definition Points**

  These are the points which define the outline of the slope area.


Option 1: 3 Points

This option allows you to define a slope using three points. Three points explicitly define a plane. This option is more technical than the other options but can be useful if there are three elevations clearly marked on the drawing to use as reference.
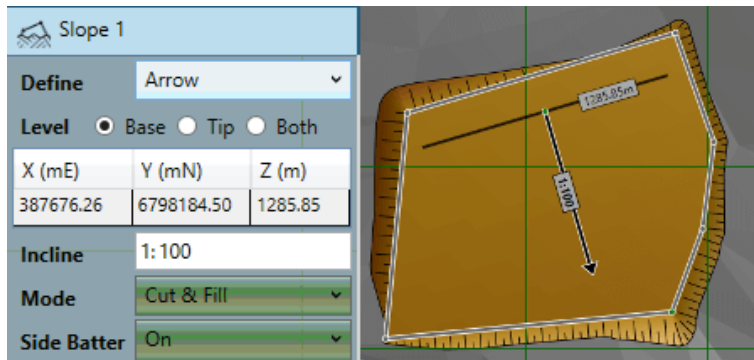
Option 2: Arrow Base

This option allows you to define the slope with a single elevation at the base, an incline angle and a direction specified by the arrow. The arrow position can be controlled by dragging the tip, shaft or base of the arrow. The length of the arrow has no effect on the slope with this option.
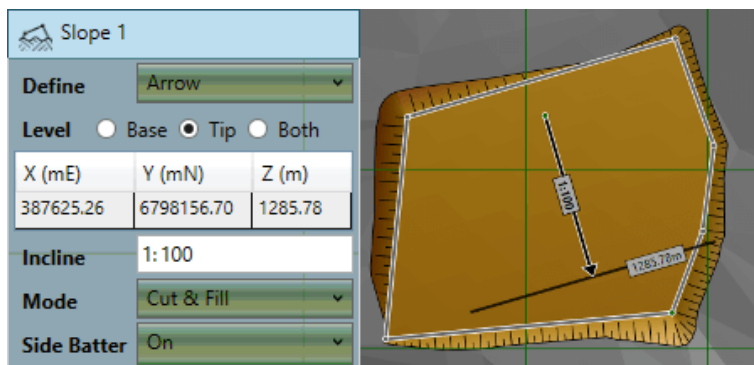
Option 3: Arrow Tip

This option is similar to using and arrow and a base elevation but instead of specifying the elevation at the base of the arrow you specify one at the tip. Again, the arrow position can be controlled by dragging the tip, shaft or base of the arrow. The length of the arrow has no effect on the slope with this option.
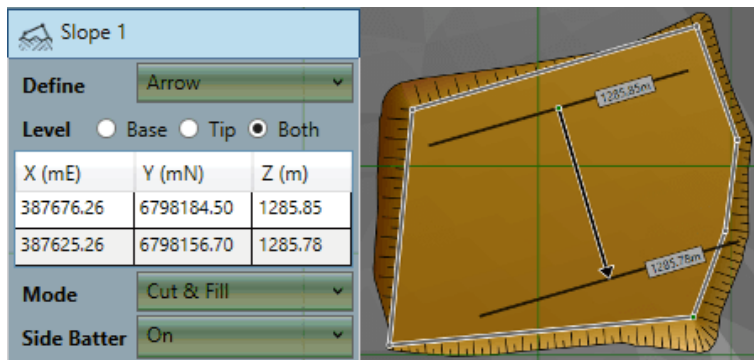
Option 4: Arrow Both

This option allows you to set the elevation of both the base and the tip of the arrow leaving the software to calculate the incline angle for you. This can be especially useful when creating ramps from one area to another when you know both elevations. You can move the arrow at the base and the incline of the ramp will adjust accordingly.

Proposed Earthworks : The Slope Element video describes slope creation by setting the angle of incline with the arrow tool, or via three values. This video will help you build ramps, run-offs and other sloping areas.

Path Element

The path element is used to define a path with a fixed width and defined levels. This element is most commonly used for roads and trenches.

The properties that are exposed for this element are summarised below.

	Path 1	
Define	Levels	
Width	1.00	m
Mode	Cut & Fill	
Side Batter	On	
Cut 1:1	**Fill** 1:1	

	X (mE)	Y (mN)	Z (m)
±	387676.22	6798233.33	1317.26
±	387662.68	6798218.34	1312.34
±	387623.02	6798172.40	1295.21
±	387620.12	6798153.05	1295.49
±	387639.46	6798076.15	1294.48

- **Define**

  This is the way that the path level should be defined. Options are 'levels' which uses the levels specified in the table below without modification, 'levels & offset' which applies an offset to the levels specified. The offset option is mostly used to add construction thicknesses by specifying a negative offset. Lastly a 'depth' option allows the path levels to be specified in terms of a height or depth above or below the existing ground. For depths negative values must be specified when using this option.

- **Offset**

  This option is only visible if offset options are selected in the 'Define' menu. It allows you to offset the entire path in Z. This is useful for accommodating for a construction thickness.

- **Width**

  This is the width of the path.

- **Mode**

  This is used to specify if the element should have cut, fill or both. Most commonly cut and fill will be specified.

- **Side Batter**

  The path boundary is joined to the ground by side slopes. The side batter (set as a ratio of vertical to horizontal) dictates the angle of these slopes. You can set differet side batter angles for side slopes that cut into the ground and for those that fill into it. Turning side batter off will result in the path being joined to the ground with vertical sides.

- **Definition Points**

  These are the points which define the outline as well as the levels (or depths) for the path. If levels & offsets are being defined, the levels entered into this table will be offset by the value specified.
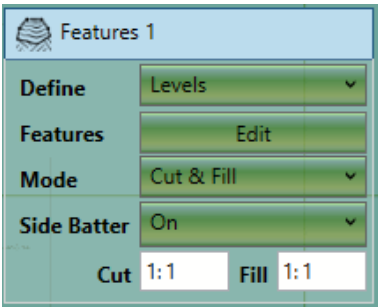
Estimates for linear structures like trenches, roads and causeways can be easily created. Learn how with the video: **Proposed Earthworks : The Path**. Please note that for more **complex roads**, we would recommend using the Feature Surface with varying level outlines and a centre line (defined by a break-line).

Feature Surface Element

The feature surface element is used to define a complex surface specified by outlines, contours, break-lines and points. This element is most commonly used for take-offs such as those needed by contractors for bidding purposes.

The properties that are exposed for this element are summarised below.

<table>
<tr>
<td>

Features 1

Define	Levels
Features	Edit
Mode	Cut & Fill
Side Batter	On
Cut	1:1	Fill	1:1

</td>
<td>

- **Define**

  This is the way that the surface levels should be defined. Options are 'levels' which uses the levels specified without modification, 'levels & offset' which applies an offset to the levels specified. The offset option is mostly used to add construction thicknesses by specifying a negative offset. Lastly a 'levels & 3d offset' option allows the surface to be adjusted in X and Y as well as in Z.

- **Offset**

  This option is only visible if offset options are selected in the 'Define' menu. It allows you to offset the entire surface in X,Y and Z. This is useful for accommodating for a construction thickness of finding a balance.

- **Features**

  The edit button will open the take-off window so that you can defined the outlines, contours, break-lines and points which define this surface. For more information on the options available in the take-off window see Feature Surface

- **Mode**

  This is used to specify if the surface should have cut, fill or both. Most commonly cut and fill will be specified.

- **Side Batter**

  The feature surface boundary is joined to the ground by side slopes. The side batter (set as a ratio of vertical to horizontal) dictates the angle of these slopes. You can set differet side batter angles for side slopes that cut into the ground and for those that fill into it. Turning side batter off will result in the feature surface being joined to the ground with vertical sides.

</td>
</tr>
</table>

Sometimes called a super element for its ability to produce the results of any other element, the 'Feature Surface' is described in the video Proposed Levels - Feature Surface .

Triangle Surface Element

The triangle surface element is used to add a triangulation into a project that has been originally created in another program (or Kubla Cubed project). The triangles cannot be edited once they are added to the project, all triangulation data needs to be imported from a file. The triangle surface supports importing data from LandXML (.xml), CAD (.dxf, .dwg) and Kubla Project files (.kcp).

The properties that are exposed for this element are summarised below.
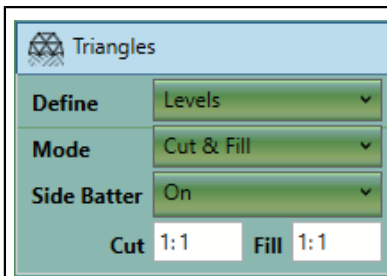
Triangles Define: Levels Mode: Cut & Fill Side Batter: On Cut 1:1 Fill 1:1	• **Define** This is the way that the triangulation levels are defined. Options are 'levels' which uses the original levels from the triangulation, 'levels & offset' which applies an offset to the levels specified. The offset option is mostly used to add construction thicknesses by specifying a negative offset. Lastly a 'levels & 3D offset' option allows the surface to be adjusted in X and Y as well as in Z. • **Offset** This option is only visible if offset options are selected in the 'Define' menu. It allows you to offset the entire surface in X,Y and Z. This is useful for accommodating for a construction thickness of finding a balance. • **Mode** This is used to specify if the surface should have cut, fill or both. Most commonly cut and fill will be specified. • **Side Batter** The triangle surface boundary is joined to the ground by side slopes. The side batter (set as a ratio of vertical to horizontal) dictates the angle of these slopes. You can set differet side batter angles for side slopes that cut into the ground and for those that fill into it. Turning side batter off will result in the triangle surface being joined to the ground with vertical sides.

VIDEO TUTORIALS ▶	• The video Existing Levels - Triangle Surface provides a comprehensive study of the Triangle Surface and how to import TIN data into your project. Triangle data can be from CAD files and other sources. LandXML files (imported via the Triangle Surface) are given dedicated coverage in our video Working with LandXML Files (.xml)

Chapter

6

Display

Topics:

You can adjust the display of your project in a number of ways, including the type of camera to use, the way to shade surface, and whether or not to display incline lines for the batter slopes.

Overview

The Display panel provides controls which are used to adjust the display of the current phase.

It is important to note that lines and site plans are not currently displayed in either of the 3d views. For this reason, all controls which relate to the display of lines will be disabled when either of the 3d cameras are selected.

	Camera Selector This dropdown allows you to choose the camera used to display the project. This is used to determine whether you are display in 2d or 3d modes. For more information see Cameras .
	Lighting Mode This dropdown allows you to choose the lighting which is used to display the project. Options include hard lighting, soft lighting and no lighting. For more information see Lighting .
	Earthworks Shading Mode *(Not in Existing Tab)* This dropdown allows you to choose the method used to shade the proposed earthworks. Options include cut & fill, levels and match existing. For more information see Earthworks Shading .
	Lines Display Mode *(Not in Existing Tab)* This dropdown allows you to choose the lines which are displayed for the proposed earthworks. Options include outlines only, outlines and include lines and no lines. For more information see Lines Display .
	Toggle Selection Lines *(Not in Existing Tab)* This dropdown allows you to choose the turn the selection lines for the earthworks elements on and off.
	Toggle Grid Lines This dropdown allows you to turn the grid lines on and off.

Cameras

There are 3 different cameras that you can use to display and navigate as described below.

When you change the cameras the controls for navigation will also change. For more information see Navigation

	Design View This option displays the project in plan view (2D) from above. You must be in this view to draw lines to create all design elements except for the surface.
	3d Orbit View This 3d view is used to orbit around the centre of the terrain, as well as to tilt the view up and down.
	3d Flyover View This 3d view is used to fly over the existing terrain and allows the user to move forward and backward and rotate the view in all directions.

Lighting

There are three different lighting options that can be used to display the existing and proposed terrain, as described below.

	Hard Lighting This option will light the terrain with hard edges. This lighting mode give a clear representation of variations in slopes throughout the terrain and is particularly useful for validating defined levels.
	Soft Lighting This option will light the terrain with smoothed edges. This can give a visually attractive representation of the terrain. However, it can also smooth hard edges in the terrain which can provide an unrealistic representation of the ground levels.
	No Lighting This option turns off all lighting. This option is useful for clear representations (particularly in 2D) which show the difference in levels by colour and where the variation in slope does not need to be visualised.

Earthworks Shading

There are three modes than can be used to shade the earthworks.

	Shade Earthworks Cut / Fill This option will colour the earthworks by cut / fill depth. It is particularly useful for visualising where the cut and fill will be highest in the project area.
	Shade Earthworks Levels This option will colour the earthworks by level with a totally independent colour scheme to that used by the existing terrain. This is useful when you need to show the earthworks levels, but you want to make a clear distinction from the existing ground.
	Match Ground Shading This option will colour the earthworks exactly the same as the existing ground so that it appears as a single surface. This mode is useful for quickly visualising what the final terrain will look like once the earthworks are completed.

Lines Display

There are three options for the display of earthworks lines as described below.

	Inline Lines This option will display the outlines of the earthworks, as well as lines indicating the direction of the batter slope.
	Outlines Only

	This option will display only the outlines for the earthworks.
OFF	**No Lines** This option will not display any lines for the earthworks.

Chapter

7

Navigation

Topics:

Navigation is done either using the mouse, the keyboard or the buttons on the navigation panel. The way the navigation works depends upon the camera you have selected for display. For more information on camera selection see Display

You can choose whether you want to navigate through each phase independently, or whether to sync navigation between phases. The best option can depend on the situation. Where each phase is focussed on different parts of the site it may be easier to navigate independently, whereas if each phase is building up parts of the same area it can be easier to sync the navigation. To toggle this setting you can click on Display and then Single Camera.

Common Controls

The following controls are the same regardless of the camera you have selected.

	Zoom In Keyboard: *'+' key* Mouse: *Scroll Wheel Forwards*
	Zoom Out Keyboard: *'-' key* Mouse: *Scroll Wheel Backwards*
	Zoom to Extents This button zooms to frame all visible items.
	Zoom to Selection This button zooms to frame the selected element.

The rest of navigation controls depend upon the camera you have selected. For more information see Navigating in Design View, Navigating with Orbit Camera and Navigating with Flyover Camera

Navigation in Design View

The following controls are available to navigate in design view, in addition to the general navigation controls described here

	Pan Right Keyboard: *'right arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Right*
	Pan Left Keyboard: *'left arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Left*
	Pan Up Keyboard: *'up arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Up*
	Pan Down Keyboard: *'down arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Down*

Navigation in Orbit View

The following controls are available to navigate in orbit view, in addition to the general navigation controls described
here

⇨	**Orbit Right** Keyboard: *'right arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Right*
⇦	**Orbit Left** Keyboard: *'left arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Left*
⇧	**Orbit Up** Keyboard: *'up arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Up*
⇩	**Orbit Down** Keyboard: *'down arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Down*

Navigation in Flyover View

The following controls are available to navigate in flyover view, in addition to the general navigation controls described here

⇨	**Move Right** Keyboard: *'right arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Right*
⇦	**Move Left** Keyboard: *'left arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Left*
⇧	**Move Forward** Keyboard: *'up arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Up*
⇩	**Move Back** Keyboard: *'down arrow' key* Mouse: *Press Scroll Wheel and Move Mouse Down*
👁	**Look Right**

	Mouse: *Press Left and Right Buttons and Move Mouse Right*
	Look Left Mouse: *Press Left and Right Buttons and Move Mouse Left*
	Look Up Mouse: *Press Left and Right Buttons and Move Mouse Up*
	Look Down Mouse: *Press Left and Right Buttons and Move Mouse Down*

All cameras are described in one video called Getting Started - Navigation. These links start the video at the camera of interest.

- Design View Camera
- 3D View Camera
- 3D Flyover Camera

Chapter

8

Ground and Earthworks Colour Schemes

Topics:

- **Overview**

The shading schemes used to display the terrain and earthworks can be amended by the user. *Kubla Cubed* comes with a number of pre-set colour tables, which have options for the user to customise them (e.g. discrete or blended shading).

It is also possible for the user to generate their own colour tables for fully customised output.

Overview
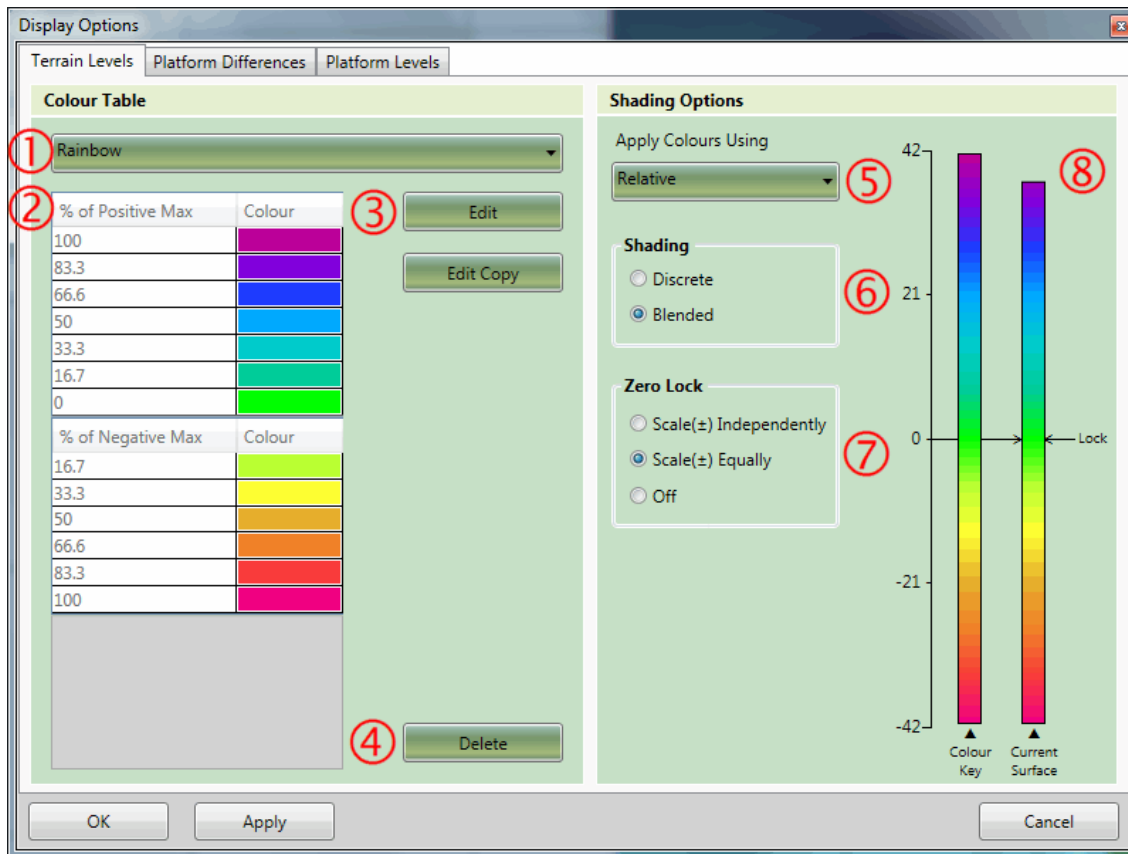
The shading schemes used to display the terrain and earthworks can be fully customised. The Display menu contains options for editing the shading schemes for terrain levels, earthworks differences and earthworks levels. Each earthworks display mode uses different shading schemes:

- Match Terrain Shading Terrain Levels.
- Shade Earthworks Levels Terrain Levels and Earthworks Levels.
- Shade Earthworks Differences Terrain Levels and Earthworks Differences.

A shading scheme is made up of a table of colours with corresponding values ②. There is a library of these colour tables to choose from and a shading scheme's colour table can be changed by selecting a different one from a drop-down box ①. You can manage the library of colour tables by deleting ④ those that are no longer needed as well as creating and amending existing ones with the Edit or Edit Copy buttons ③.

On the hand side of a shading scheme tab are options for controlling the way the colour table is applied to a surface (i.e. the existing terrain or earthworks). When you select different options the diagram ⑧ updates to show where on the surface the colours will be displayed.

Apply Colours Using ⑤ This is where the method by which the colour table is applied to the surface is chosen. The two methods are:

- Relative A shading scheme using the relative shading will scale the scheme to fully cover the surface which is being shaded. For this reason, in relative mode colour table values show as percentages. This method is useful for ensuring that the surface uses the full range of colours in the table, and it will adapt as the design is changed.
- Absolute The absolute method applies colours using the exact values in the table. This gives total control in regard to where the colours are applied on the surface. However, it does not adapt when new terrain is loaded or earthworks changes so it may need to be manually adjusted when there are significant changes.

Shading ⑥ There are two different shading options Blended and Discrete. When blended is selected the surface is shaded by smoothly interpolating between the colours in the colour table. With discrete shading colours are not blended, resulting in discrete blocks of the same colour. See the image below for an illustration of the difference between these two shading modes.

A consequence of using an absolute scheme with discrete shading is that the last colour in the table will not be used. This is because the first two values are used for the range of the first colour, the second and third for the next and so on, resulting in the last colour being redundant. In relative mode the values are adjusted to make use of all the colours in the table.
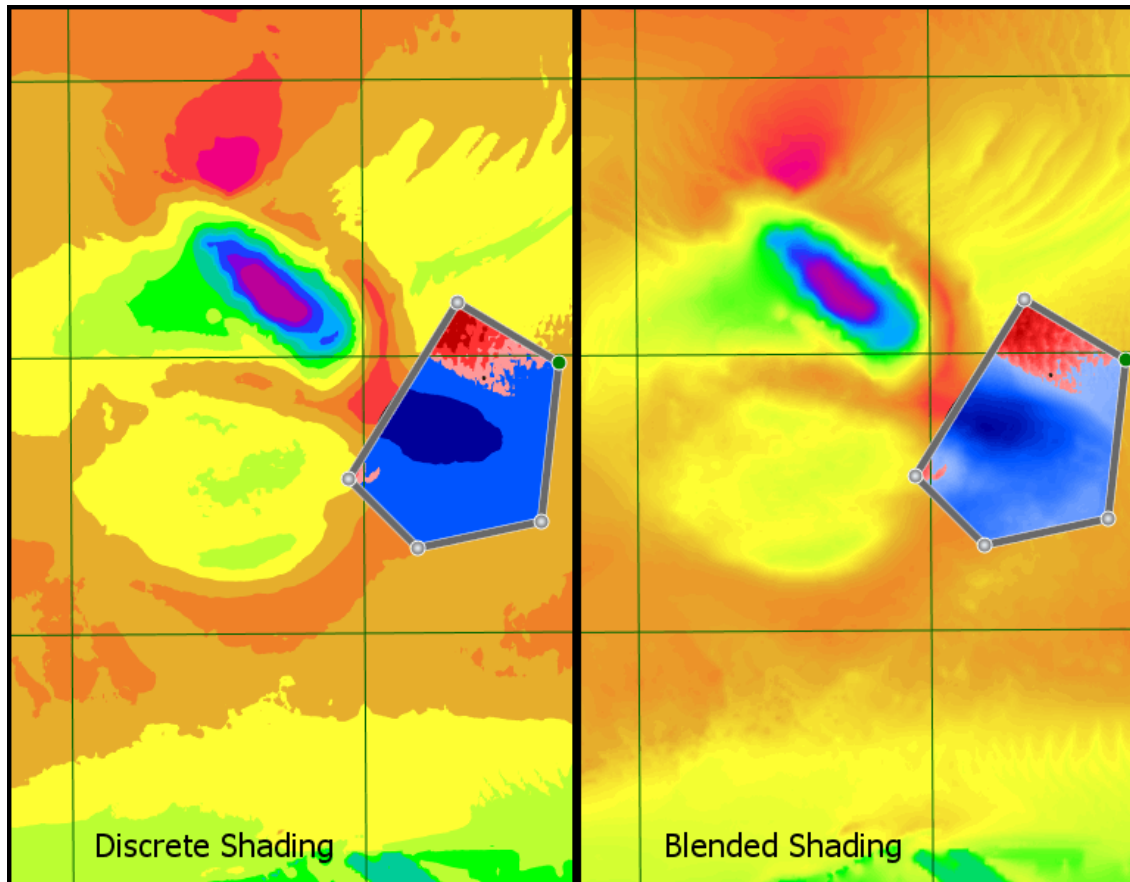
Zero Lock ⑦ It is often a requirement when shading a surface that a particular colour is locked to zero. For instance, when shading terrain you might want a colour locked at zero to indicate the difference between land and sea, or to show the areas on a platform in different colours for cut and fill (in difference shading mode). With absolute shading schemes this is simply a matter of setting a colour value to zero. However, with relative shading it is a little more complicated, as the 'zero' value will be move as it is scaled to fit the surface being shaded.

To resolve this there is a zero lock feature that locks any colour with a value of zero to zero on the surface. The two different zero lock options are:

- Scale ± Independently This scales both positive and negative values independently so that the colour table covers the entire surface. This is useful when you want to display the full range of colours in the table for maximum contrast.
- Scale ± Equally This option scales values above and below zero equally. This is useful in many situations, particularly for a cut and fill shading scheme so that you can get a feeling for the depths of cut compared to fill. However, with this option not all of the values in the table will be displayed.

Learn about the shading scheme options in our video Adjusting Shading of Surfaces which includes a demonstration on creating your own custom shading schemes.

Chapter

9

Measurements

The volume estimates in Kubla Cubed are displayed on the top left of the screen for each phase. A more detailed breakdown can be obtained when exporting a project to a spreadsheet or a report. There are also a number of different measurement tools that can be used to provide additional information to the user and others :

- **Cursor Label:** As the mouse is moved around a project the label updates in real time with information in regard to the point underneath the cursor. X and Y co-ordinates, existing\proposed elevations and cut\fill values can be displayed. The label options can be customised to show only the information you require. For more details see Cursor Label.
- **Quick Measure Tool:** By holding down the 'M' key on the keyboard whilst moving the mouse the measure tool is activated. It is used to give a linear measurement between two points much like a ruler. Options are available to copy the results of a measurement to the clipboard. For more details see Quick Measure Tool.
- **Measurements Panel:** The measurement panel allows you to add permanent measurements into your project that are saved with the project and will be included in the reports and spreadsheet outputs. This is useful for measuring paving areas, curb lengths etc... Elements are available to measure counts, lengths and areas. Also in this panel you can add a 'Volume Region' element that allows a breakdown of the cut\fill within a specific region in the earthworks estimation summary. For more details see Measurements Panel.

Mostly the cursor label and quick measure tool are for doing one-off and quick checks of elevations and scale. The measurements panel is intended mostly for permanantly recording the various non-earthworks assets on the site and reporting cut\fill in more detail.

Display Units

Kubla Cubed can display either metric or imperial (English) units. These will initially be set to a default value depending on the region settings of the computer. The inital settings can easily be changed by clicking Measure in the menu bar and then Display Units.
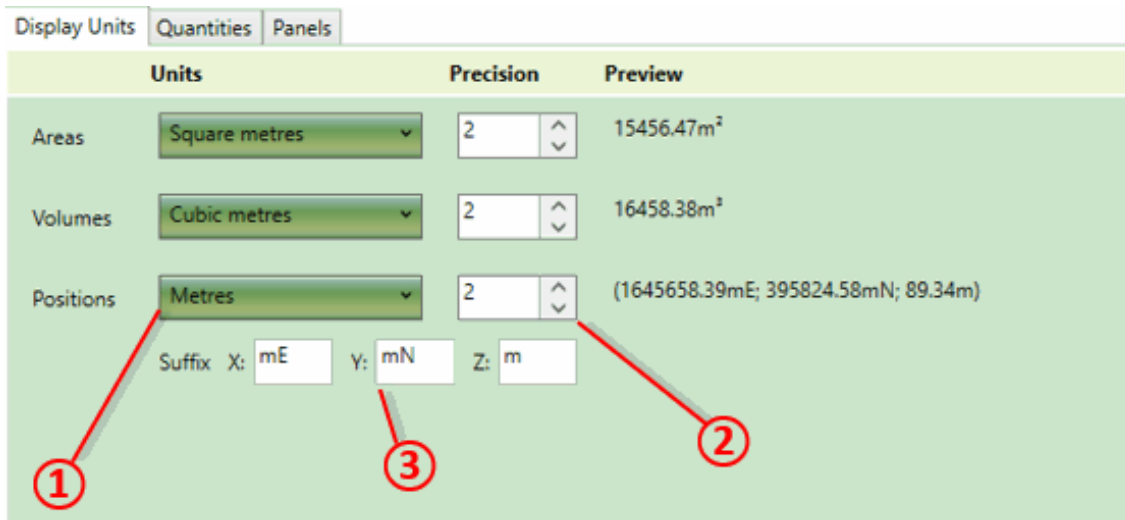
① Units For each measurement type (areas, volumes, positions) you can select the desired unit of measure. It is recommended that you do not mix imperial and metric units together. For instance if areas and volumes are set to yards, then positions should be set to feet.

② Precision For each measurement type you can also change the precision displayed in the program. It should be noted that this has no effect on the calculation engine precision just the display. The default is two decimal places which is sufficient for most earthworks projects.

③ Position Suffixes When displaying a position in the program you can customise the suffix that appears after the co-ordinates X, Y and Z. For instance you can choose for X,Y to display simply m rather than mE and mN.

Notes on Sharing Files : All Kubla files are saved with the same units internally. The display settings that can be changed in Kubla Cubed only affect the way the units are displayed to the user. They do not change how the units are saved internally. This means if you share a file with another user, the file will display correctly in whatever units they have selected as their preference. This can cause complications if a site plan is marked in different units to what the user has selected, however if this happens it is simple to synchronise the display units to match those marked on the site plan using the above options.

Application settings (not project settings) are shown in our video Getting Started - Units and Display Settings

Cursor Label

In the design area of a project a label displays information about the point on the surface underneath the cursor (e.g. X:41.23mE, Y:23.43mN, Zp:12.34m). Using the options menu, you can customise what is displayed next to the cursor. As well as showing the co-ordinates you can also choose to include the existing level (Ze), proposed level (Zp) and the cut\fill (C\F). To access the cursor options first click on the Measure menu bar and then select Cursor. Here the different available items that can be displayed in the cursor label can be turned on\off.
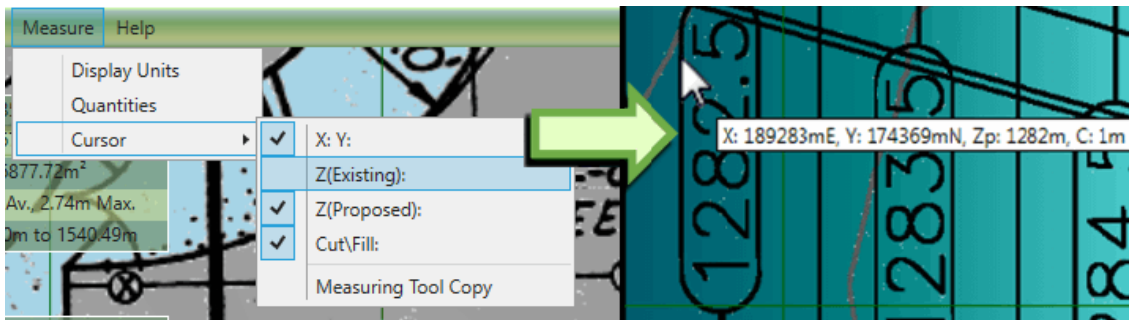
Notes on Copying the Label Contents : Sometimes there is a requirement to copy the contents of the cursor label. Of course you can simply copy it down by hand but that can be time consuming and lead to mistakes. To copy the contents of the cursor label to the clipboard make sure that Measure Tool Copy is ticked in the cursor menu. Then simply tap the M key. This will activate the quick measure tool and copy the contents to the clipboard. After copying go to a document or spreadsheet and paste either using the Edit menu of the program or using the universal Ctrl+V shortcut for pasting. For more information see Quick Measure Tool .

Quick Measure Tool

It is often necessary when creating a project to do a quick measurement of a length, this is particularly true if a site plan has been scaled or CAD data imported. Checking a known length can ensure that no mistakes have been made when scaling or when selecting the units of CAD data. To activate the quick measure tool hover the mouse over the point you want to measure from and press the M key. Whilst keeping the M key pressed move the mouse to the next point and a line between the two will be displayed with a label showing the distance. The measure tool can be used in any window where project data is displayed.

Measure Tool Copy

By default the quick measure tool displays the distance measured in a label next to the cursor. However you can copy details of each measurement to the clipboard if required. To do this you need to make sure that Measure Tool Copy is ticked in the cursor menu. Then after completing a measurement with the M key, the details of the quick measure operation will be copied to the clipboard. After copying go to a document or spreadsheet and paste either using the Edit menu of the program or using the universal Ctrl+V shortcut for pasting.
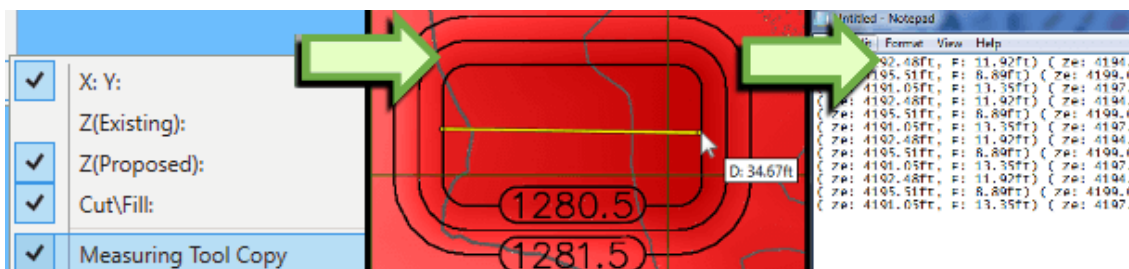
The Measurements Panel

Each phase in a project contains a measurements panel. This is where additional measurements such as counts, lengths, areas and cut\fill in specific regions can be added to the project. There is no requirement to add any elements to the measurements panel as a lot of data is reported in the standard report. However some supplementary measurements are often required in addition to the standard information.
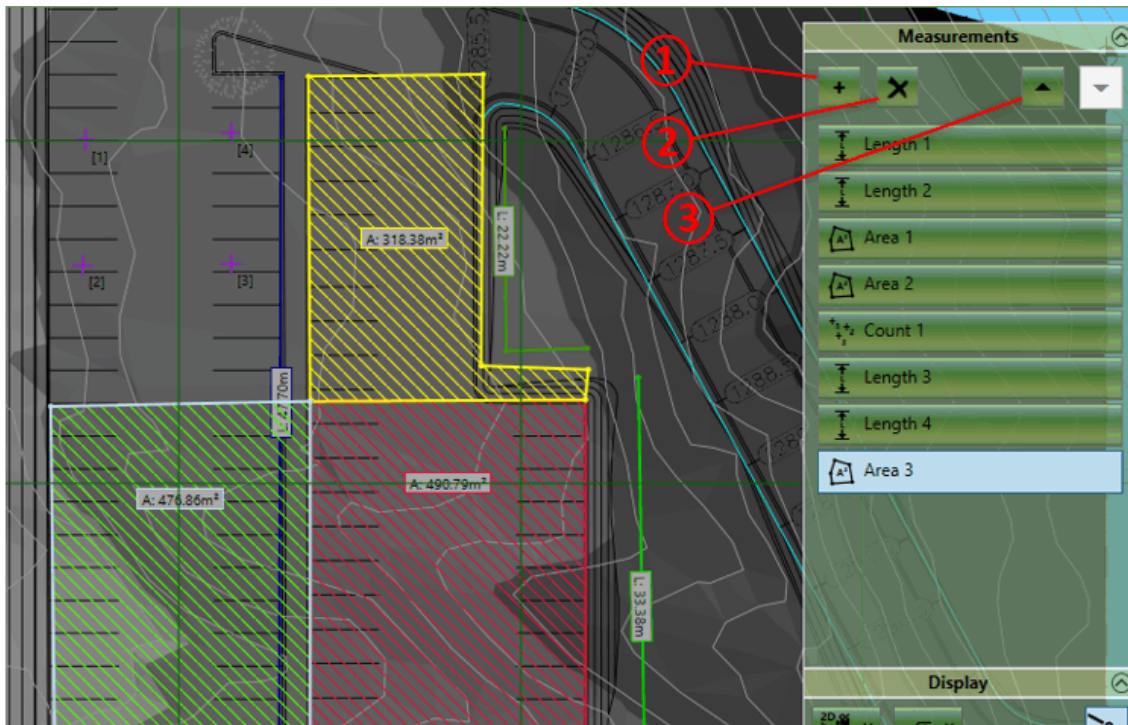
Adding Elements

New elements can be added to the measurements panel by clicking on the + symbol ①. You will be presented with the following list of elements that you can add :
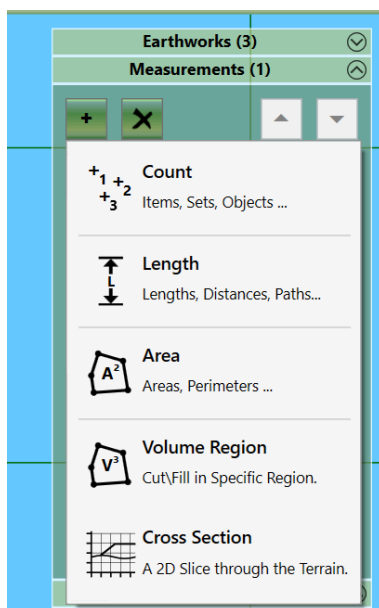
- **Count**

  The count element allows you to record the position and number of various groups of assets on the site. You can use a count element to record the position of manholes or count the number of trees. For more information see Count Element.

- **Length**

  The length element allows you to measure distances on the site as well as record assets that have a length property such as kerbs and fences. Length elements can be closed to measure perimeters. It is worth noting that all

earthworks elements report a boundary outline perimeter in the input data summary so there is no need to trace a line around any earthworks element. For more information see Length Element.

- **Area**

   The area element is used for measuring areas in the project. Areas of earthworks disturbance are recorded in the earthworks estimation summary so there is no need to measure these. Area elements only measure 2D areas as if they were measured from a paper plan. They don't measure the 3D surface area that can be found in the earthworks estimation report. For more information see the Area Element.

- **Volume Region**

   The volume region element is used for reporting cut\fill in different regions of a particular phase. It is worth noting that there is no requirement to have any volume regions in a phase. If none are defined the earthworks estimation report will still show a breakdown by element and results for all earthworks in the phase. For more information see the Volume Region Element.

- **Cross Section**

   The cross section element is used for visualising a cut through the terrain, displaying the existing and proposed terrain along the cross section. The cross section can be viewed in the software, and is also presented in some of the exports. For more information see the Cross Section Element.

When you have selected an element you will be able to start drawing its boundary or centreline points in the design area. **Left click** to place a new point, **right click** or press **Enter** to complete the creation of the element. If you want to cancel the operation entirely hit **Esc** key. When adding new elements the **back space** key can be used to undo the last placed point if a mistake has been made.

Renaming Elements

After an element is created it is a good idea to give it a relevant name so it can be identified in the report (e.g 'boundary fence' or 'flower bed'). To do this just double click on the name of the element and then overtype.

Editing Elements

Selection : Elements can be selected by **left clicking** on the title bar in the earthworks panel or by **left clicking** on a elements boundary or centre lines in the design area. Multiple elements can be selected by holding down **Ctrl** whilst making the selection. To unselect an element you can **right click** on it.

Edit Mode : If you double click on an element it will enter into 'edit mode', the properties of the element will be exposed and you will be able to edit the definition points of the element in the design view. To exit 'edit mode'; **double left click** in empty space in the design view.

Definition Points : When an element is in 'edit mode' the definition points of the boundary or centreline can be changed. In the design view **left click** on a point and drag it to the desired position. A point can be deleted by using the **Delete** key. New points can be inserted by selecting a line and hitting the **Z** key. Points can also by edited directly in the point list in the element properties. Clicking on the top right corner of the point list allows all the points to be copied using the menu command or **Ctrl+C**. Likewise a list of points can also be pasted into the point list from another program by clicking on the top right corner and using menu paste command or **Ctrl+V.**

Properties : For information on the individual element properties refer to the relevant sections for each element.

Notes on Point Snapping: When creating or editing the definition points of a measurement element it is possible to snap the points to other element definition points or to defined grid positions. To access the point snapping options click on the Edit menu and then the Snap Points. Here you can toggle snapping to boundary points and grid points as well as setting the interval and origin point of the grid used for snapping.

Amending the Order

You can change the order of elements in the list by selecting an element and using the up down buttons ③. Unlike the earthworks panel where the order of the earthworks can change the proposed elevations, the order of measurement elements has little consequence apart from changing which element shows on top if two intersect. You may want to change the order of elements so similar measurements are grouped together.

Copying & Pasting

It is often useful to copy and paste elements, this can be done using Edit menu commands or the keyboard shortcuts (**Ctrl+C, Ctrl+V**). You can copy and paste in the same phase to duplicate an element or copy and paste to move elements to different phases.
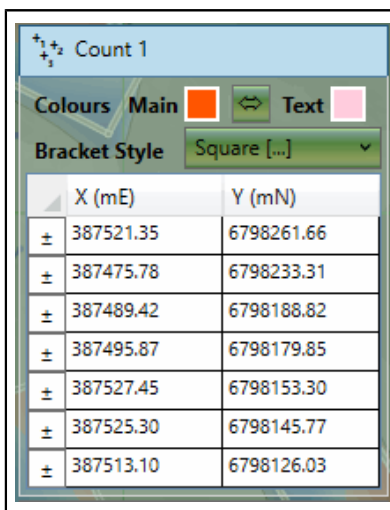
Deleting Elements

Elements can be deleting by first selecting them and then clicking on the X button at the top of the panel ②.

Measurement Elements

Count Element

The count element allows you to record the position and number of various groups of assets on the site. For example, you can use a count element to record the position of manholes or count the number of trees.

The properties that are exposed for the count element are summarised below.

<table>
<tr>
<td>

Count 1

Colours Main	⇔ Text
Bracket Style	Square [...] ▾

	X (mE)	Y (mN)
±	387521.35	6798261.66
±	387475.78	6798233.31
±	387489.42	6798188.82
±	387495.87	6798179.85
±	387527.45	6798153.30
±	387525.30	6798145.77
±	387513.10	6798126.03

</td>
<td>

• **Colours**

Here you can set the Main and Text colour of the count element. This can be useful for visually seperating different area measurements or making them easier to see against the colours of the topography.

• **Bracket Style**

The bracket style allows you to change the style of the brackets enclosing the item number. This can also be used to visually seperate different area measurements in your project. You can set the bracket style to 'none' if you want to show the number without brackets.

• **Definition Points**

These are the points which define the positions of the items of the count element.

</td>
</tr>
</table>

The measurement element 'Count' is described within the video Count, Length and Area Measurements . You'll see the placement of points that make up a count and also a brief explanation of why such measurement can be valuable.

Length Element

The length element allows you to measure distances on the site as well as record assets that have a length property such as kerbs and fences. Lengths elements can be closed to measure perimeters. It is worth noting that all earthworks elements report a boundary outline perimeter in the input data summary so there is no need to trace a line around any earthworks element.

The properties that are exposed for the length element are summarised below.

Length 1		
Colours Main ◼ ⇔ **Text** ◼		
☐ **Closed Line**		
X (mE)	**Y (mN)**	
± 387668.81	6798222.91	
± 387594.19	6798182.72	
± 387580.19	6798157.97	
± 387562.25	6798090.15	
± 387589.52	6798065.40	
± 387611.41	6798102.71	
± 387620.38	6798142.18	
± 387638.68	6798156.53	
± 387662.72	6798180.57	
± 387669.89	6798189.54	

- **Colours**

  Here you can set the Main and Text colour of the length. This can be useful for visually seperating different area measurements or making them easier to see against the colours of the topography.

- **IsClosed**

  You can choose for the length element to measure a closed line by ticking this box. You would typically use this options for perimeters in your project.

- **Definition Points**

  These are the points which define the points of the length element.

Measurement element 'Length' is described in the video Count, Length and Area Measurements. This tool allows you to measure between two positions.

Area Element

The area element is used for measuring areas in the project. Areas of earthworks disturbance are recorded in the earthworks estimation summary so there is no need to measure these. Area elements only measure 2D areas, as if they were measured from a paper plan. They don't measure the 3D surface area that can be found in the earthworks estimation report.

The properties that are exposed for the area element are summarised below.

Area 1		
Colours Main ◼ ⇔ **Text** ◼		
Fill Style Backward Diagonal ▾		
X (mE)	**Y (mN)**	
± 387469.70	6798301.88	
± 387468.66	6798207.76	
± 387526.06	6798206.21	
± 387537.96	6798259.48	
± 387511.07	6798281.71	
± 387515.20	6798308.09	

- **Colours**

  Here you can set the Main and Text colour of the area element. This can be useful for visually seperating different area measurements or making them easier to see against the colours of the topography.

- **Fill Style**

  The fill style allows you to fill in the area with different styles of hatching. This can also be used to visually seperate different area measurements in your project. You can set the fill style to none if you only want to see the boundary lines of the measurement.

- **Definition Points**

  These are the points which define the boundary outline of the area element.

'Area' is the last measurement tool in the video Count, Length and Area Measurements . You'll see how to draw the area boundary and use colour hatching to distinguish it from other measurements.

Volume Region Element

The volume region element is used for reporting cut\fill in different regions of a particular phase. It is worth noting that there is no requirement to have any volume regions in a phase. If there are none defined the earthworks estimation report will still show a breakdown by element and results for all earthworks in the phase.

Intersecting regions are not allowed. This is to avoid the potential confusion caused by cut\fill volumes being counted multiple times in the same breakdown. A region within a region will be handled by first calculating the outer region excluding the inner region and then calculating the inner region separately. Any areas not enclosed by a region will be listed under 'remainder'.

The properties that are exposed for the region element are summarised below.

Region 1	
X (mE)	Y (mN)
± 387656.38	6798196.90
± 387648.11	6798126.57
± 387657.42	6798071.24
± 387718.95	6798059.35
± 387736.54	6798133.81
± 387740.16	6798164.32
± 387733.43	6798203.11

- **Definition Points**

  These are the points which define the boundary outline of the region element.

In this video about the element Volume Region Measurements , you'll learn about drawing valid volume regions and how they are reported in the spreadsheet export.

Cross Section Element

The Cross Section element is used for visualising a slice cut through the terrain, and displaying both the existing and the proposed layers. The Cross Section can be viewed in the software, and also will be presented in exports.

The properties that are exposed for the Cross Section element are summarised below.

Section 1 **Graph** / **View** **Reverse Viewing Direction** ⇕ | X (mE)	Y (mN) | ±	64.97	49.64 | ±	91.38	58.89		• **View** You can click this button to view the cross section. • **Reverse Direction** The direction that the cross section is viewing will be indicated by the section arrows on the screen. You can reverse the direction by clicking this button. • **Definition Points** These are the points which define the boundary outline of the region element.

When you click on the View button, a screen will open like that one shown below. You can use the mouse to zoom in and out and pan around this section. As you move the mouse, the levels, and the cut/fill will be presented by the cursor. It is worth noting that the sections presented in this view will use the vertical exaggeration from the main window. If you find the section difficult to visualise because it is too flat, you can increase the vertical exaggeration before viewing the section.

Earthworks Cross Section

Section 1

Proposed Surface
Existing Surface
Vertical Exaggeration : 1X

Existing: 334.21m
Proposed: 333.60m
Cut: 0.61m
Distance: 8.10m
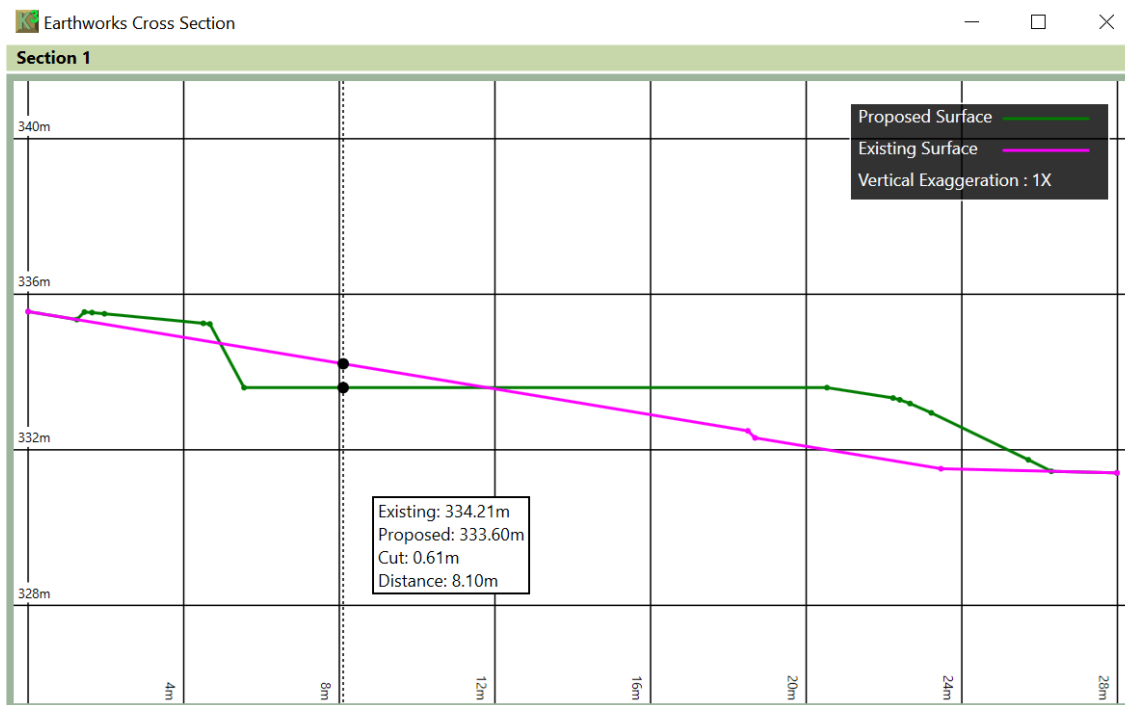
Measurements - Cross Sections shows you how to draw long sections and cross sections across a phase, before highlighting various viewing and export options.

Chapter

10

Presenting Results

Topics:

-

When it comes to presenting the results of a project to a client, colleague or other stake-holder, *Kubla Cubed* has a number of options available:

- **Spreadsheets:** An earthworks estimation spreadsheet can be produced that breaks down the earthworks in each phase. There are subsequent breakdowns by region, and by element. Another spreadsheet containing input data can also be produced, which is useful for validating inputs and viewing measurement information. For more information see Creating Spreadsheets.

- **Reports:** An earthworks estimation report can also be produced with the same breakdown as the spreadsheet. The report contains diagrams and formatting that makes it easier to understand so is often more appropriate to give to clients than the spreadsheet. A report containing input data can also be produced for validating inputs and viewing measurement information. For more information see Creating Reports.

- **Drawings:** Summary drawings can be presented of the project, showing a plan view of each phase, as well as the summary volumes and any transects that have been defined. These drawings can be exported either to a PDF file or to various CAD file formats. For more information see Creating Drawings.

- **CAD Data:** CAD files of all project data can be exported from the program. This is useful for integrating the earthwork eastimation data in with a larger CAD data set and for uploading to BIM systems. The CAD data can also be imported into machine control systems. This export is similar to the CAD Drawing export except that it doesn't contain page layout data. This can simplify the file format, if you are only interested in the data it contains. For more information see Exporting CAD Data.

- **LandXML Data:** A lot of the project data can be exported to this specialist land surveying file format. LandXML is a popular data transfer format used to import\export linework, survey points and surfaces. Like the CAD data, LandXML can also be used to import data into machine control systems. For more information see Exporting LandXml Data.

- **Images:** Images showing the design area can be exported to a several file formats. The images can display the shaded terrain and earthworks, and can optionally include grid lines, colour keys and contour lines. For more information see Creating Images.

- **Presenting in the Software:** Kubla Cubed has a presentation mode in case you to show the software in a presentation. This removes all the editing controls as well as the title bar, so that you can see in full screen all of the the relevant project content. To enter presentation mode click on Display and then Presentation Mode.

Within the program the options for presenting the above data are contained within the File menu. Here you will find the Create Spreadsheet, Create

Report and Create Drawing sub menus. For CAD Data and LandXML Data use the Export menu.

Creating Reports

To export a report click on the File menu item, then Create Report and finally Input Data or Earthworks Estimation, depending on the report you wish to create. The report can be saved in the MS Word (.docx) or Adobe Acrobat (.pdf) format.

Input Data Report

A report of the user input data, including all properties, boundary areas and perimeters. The report can be useful for validating input data and using boundary perimeter and area values in a bill of quantities (BOQ) or for doing further calculations on the data.

The report will contain the input data that has been entered by the user into the program. It contains no information regarding earthworks calculations (cut & fill); that information is contained in the earthworks estimation report. The count, area and length measurement elements will only appear in this report as they have no relevance to the earthworks estimate.

Notes on Boundary 2D Area and 2D Perimeter : The boundary areas and boundary perimeters in the input data report relate to the element boundary lines that have been input by the user. They will often differ considerably from the areas in the earthworks estimation report which are calculated from the earthworks area of disturbance.

Volume region elements are not allowed to overlap each other. Where one volume region is inside another, the area of the internal volume region will be removed from the external one. The area and perimeters presented for volume regions in the report are the areas after they have undergone this processing.

Earthworks Estimation Report

A report of the earthworks estimation, including levels, volumes and depths can be exported to a .xlsx file. The report can be useful for building into an earthworks bill of quantities (BOQ) report or for doing further calculations on the data.

This report will contain the earthworks estimation output calculated by the program. This includes cut\fill volumes, depths and areas. The earthworks estimate is completed for all earthworks in the phase. In addition it can contain the following breakdowns.

- **Breakdown by Element:** If there are two or more elements that don't intersect in a phase then a breakdown by element will be produced. Earthworks elements that intersect on the same phase are merged into a single proposed surface in the calculation engine and will report as a group in the element breakdown.
- **Breakdown by Region:** If volume region elements exist in a phase, a breakdown by region will be completed. A region within a region will be handled by first calculating the outer region excluding the inner region and then calculating the inner region separately.

Notes on Earthworks Estimation 2D and 3D Areas : 2D and 3D areas in the earthwork estimation report relate to the earthworks footprint (sometimes referred to as the area of disturbance). For the area and perimeter of the element boundaries refer to the input data report. The 2D areas reported are the same as if measured from a paper plan. The 3D areas take into account the surface area of the topography and therefore will always be the same or larger than the 2D areas.

Exports - Report & Spreadsheets video describes the main sections of a typical report.

Creating Spreadsheets

To export a spreadsheet click on the File menu item, then Create Spreadsheet and finally Input Data or Earthworks Estimation, depending on the spreadsheet you wish to create. The spreadsheet can be saved in the MS Excel (.xlsx) format.

Input Data Spreadsheet

A spreadsheet of the user input data, including all properties, boundary areas and perimeters. The spreadsheet can be useful for validating input data and using boundary perimeter and area values in a bill of quantities (BOQ) or for doing further calculations on the data.

The spreadsheet will contain the input data that has been entered by the user into the program. It contains no information regarding earthworks calculations (cut & fill); that information is contained in the earthworks estimation spreadsheet. The count, area and length measurement elements will only appear in this report as they have no relevance to the earthworks estimate.

Notes on Boundary 2D Area and 2D Perimeter : The boundary areas and boundary perimeters in the input data spreadsheet relate to the element boundary lines that have been input by the user. They will often differ considerably from the areas in the earthworks estimation report which are calculated from the earthworks area of disturbance.

Volume region elements are not allowed to overlap each other. Where one volume region is inside another, the area of the internal volume region will be removed from the external one. The area and perimeters presented for volume regions in the spreadsheet are the areas after they have undergone this processing.

Earthworks Estimation Spreadsheet

A spreadsheet of the earthworks estimation, including levels, volumes and depths can be exported to a .xlsx file. The spreadsheet can be useful for building into an earthworks bill of quantities (BOQ) report or for doing further calculations on the data.

This spreadsheet will contain the earthworks estimation output calculated by the program. This includes cut\fill volumes, depths and areas. The earthworks estimate is completed for all earthworks in the phase, in addition it can contain the following breakdowns.

- **Breakdown by Element:** If there are two or more elements that don't intersect in a phase then a breakdown by element will be produced. Earthworks elements that intersect on the same phase are merged into a single proposed surface in the calculation engine and will report as a group in the element breakdown.
- **Breakdown by Region:** If volume region elements exist in a phase, a breakdown by region will be completed. A region within a region will be handled by first calculating the outer region excluding the inner region and then calculating the inner region separately.

Notes on Earthworks Estimation 2D and 3D Areas : 2D and 3D areas in the earthwork estimation spreadsheet relate to the earthworks footprint (sometimes referred to as the area of disturbance). For the area and perimeter of the element boundaries refer to the input data spreadsheet. The 2D areas reported are the same as if measured from a paper plan. The 3D areas take into account the surface area of the topography and therefore will always be the same or larger than the 2D areas.

Cross Section Spreadsheet

A separate tab/sheet will appear for each phase. Each sheet shows sections top to bottom. There are five column headings: *Section Name*; *Segment Number* (meaningful for long sections); *Distance* (each value is relative to the start position); *Existing Level* and *Proposed Level*. Blank rows separate proposed elevations from existing, which are in row separated groups to make chart creation easier. When creating a graph in your favourite spreadsheet editor, select data and headings from the last three columns. Insert a chart and ensure it is a Scatter graph. We suggest 'XY Scatter' & 'Lines Only' in LibreOffice Calc; 'Scatter' & 'Scatter with Straight Lines' in MS Office Excel.

video describes the main sections of a typical spreadsheet.

Creating Drawings

The project data in Kubla Cubed can be presented as drawings which can be saved either to PDF or to various CAD file formats. These drawings will include plan views of each phase you export, as well as colour keys, earthworks quantity summary tables and transects, if you have defined any.

To create a drawing, click on File, Create Drawing and then PDF or CAD.
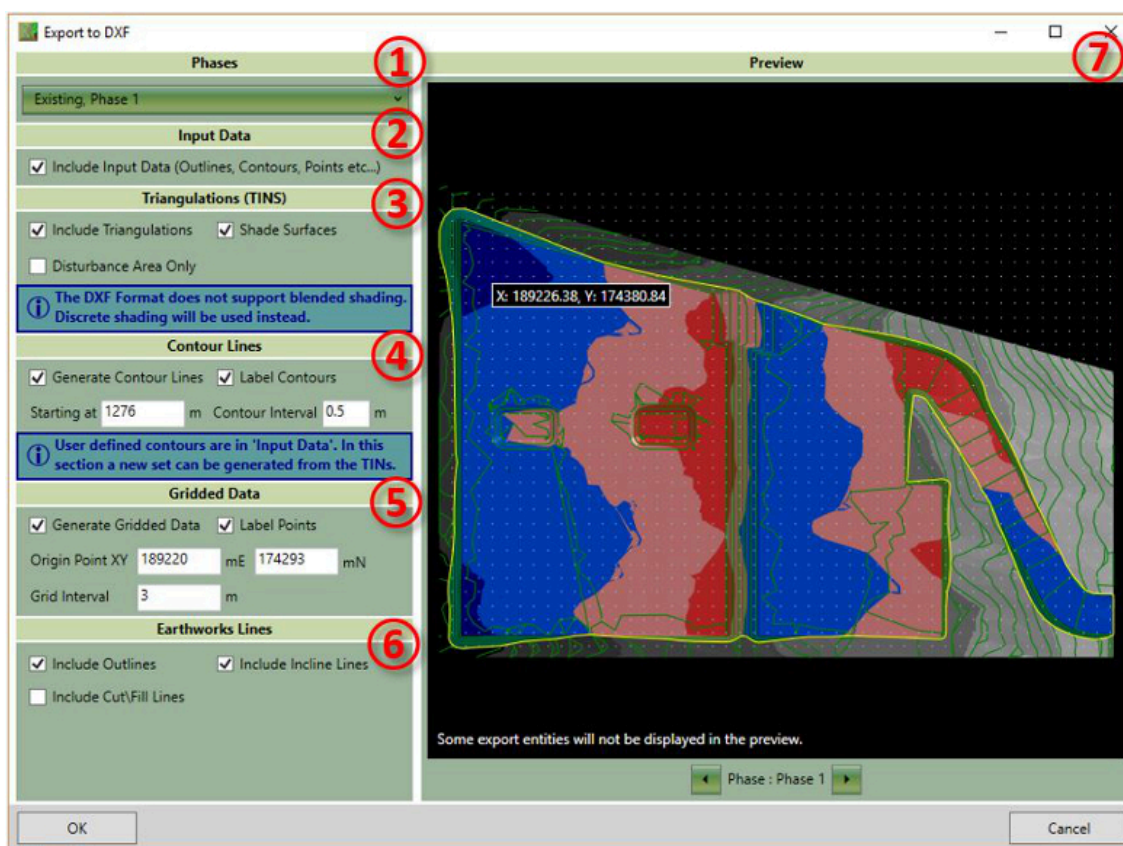
The available options on this form are described below:

- ① The phases drop-down allows you to select which phases are to be included in the drawings. By default, only the selected phase and the existing phase are included. In the file layers are used to separate the entities by phase.
- ②In this section you select whether the drawings should include the data that the user has input into the project (contours, points boundaries etc...).
- ③ In this section you can choose whether to include the TINS in the drawings. Often the TINS are not required if you are just interested in a contour line or gridded data visualisation.

  - Disturbance Area Only In some scenarios when exporting proposed surfaces, you will not want the undisturbed ground in the drawings.
- ④ In this section you can choose to generate surface contour lines. Be aware that contour lines that have been used to define 'Feature Surfaces' in Kubla Cubed will be included if 'Input Data' is checked and are not the contour

lines referred to in this section. The contour lines in this section are an entirely new set that can be generated from the entire proposed surface.

- • Label Contours You can choose to turn off the labelling of contour lines.
- • Starting At In this box you can set what level the contour lines start at, it is advised to start on a round number. The default will be set to the bottom of the surface rounded down.
- • Contour Interval In this box you can set the interval distance between each contour line. Very small contour intervals can cause large export times and large file sizes.
- • ⑤ As well as generating contour lines from the TINS, you can also include gridded data. It also can be used to create a cut\fill plan for site engineers, or for presenting results to people who are accustomed to using the grid method for calculations.
  - • Label Points You can choose to turn off the labelling of points as it saves space in the file. It is recommended you keep this on, as the points will have litle meaning otherwise.
  - • Origin Point In this box you can set the location of the origin point. The grid will extend out from here in all directions until it exceeds the extents of the surface. It is recommended that rounded numbers are used. By default, it is set to the bottom left rounded to a whole number.
  - • Grid Interval In this box you can set the distance between each grid point. Very small grid intervals can cause large drawing generation times and large file sizes.
- • ⑥ Earthworks linework created by Kubla Cubed can also be included in the drawings.
  - • Outlines The outlines of the earthworks can be included, this can be useful for knowing the location of designed features such as building pads, roads, ponds etc...
  - • Incline Lines Kubla Cubed generates 'incline lines' to mark the generated side slopes joining earthworks elements to the ground. You can choose to include these in the drawings.
  - • Cut\Fill Lines The lines can be exported in red and blue which show the earthworks cut\fill boundaries.
- • ⑦The preview can be used to give a good indication of what the drawing file will contain. It is especially useful for previewing the density of the generated gridded data and generated contour lines. Please note that this is a preview of the data only, and your drawings will not appear as they are presented here. When multiple phases are selected for inclusion you can cycle through which phase to preview using controls that will appear at the bottom of the preview panel. Multiple phases are not previewed all together to avoid confusion.

Once the drawing settings have been finalised click OK. You will be prompted for the location to save your drawings.

Export Image

Images showing the design area can be exported to a several file formats, including .bmp, .jpg and .png. These images can display the shaded terrain and platforms, and can optionally include grid lines, colour keys and contour lines.

To export an image, click on File, Create Drawing and then Image. The export window will appear, like the one shown below.
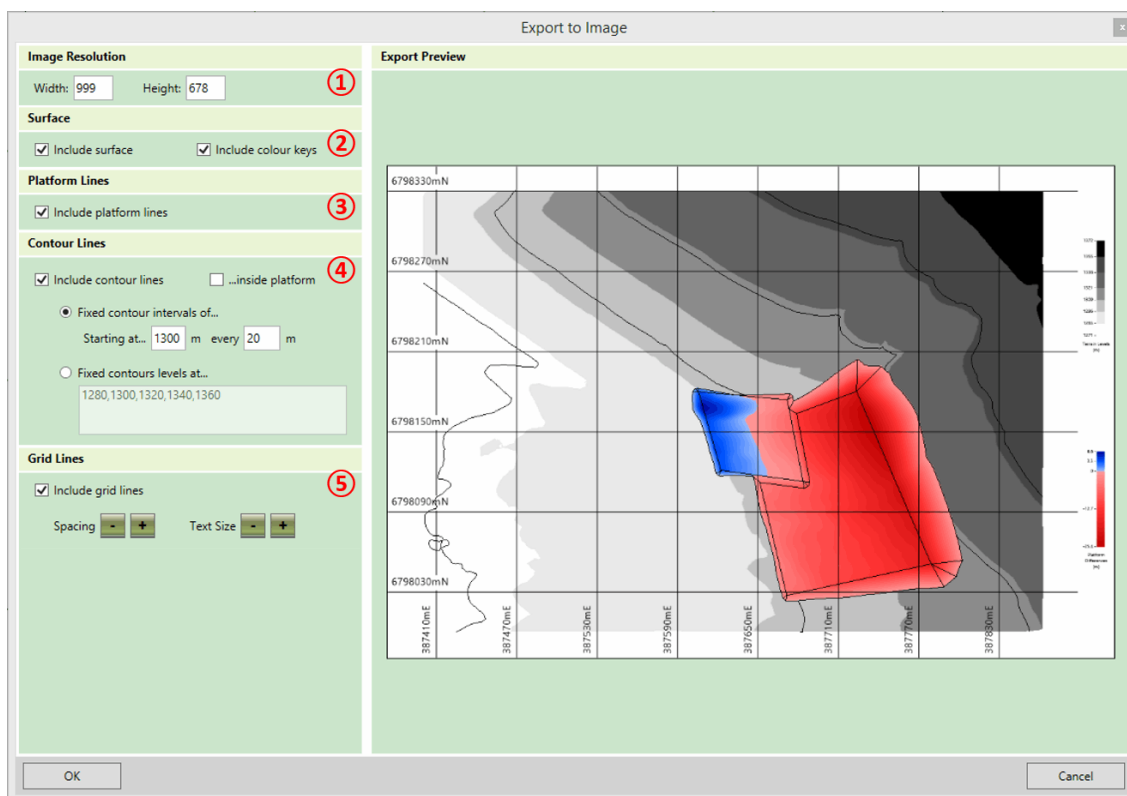
The export options on this form are described below:

- ① This section is where the resolution of the image is defined. If you need a higher quality image then the resolution can be increased, but it will take longer to generate the image and the file size will be larger. Note that the aspect ratio of the export image is fixed, so if you adjust either the width or the height the other dimension will be updated automatically.
- ② In this section you can indicate whether or not you want to include the shaded surfaces in your export, and if you do, you can also indicate whether or not you wish to include colour keys beside the image. If you choose to include surfaces then the shading in the export will be the same as the shading in the main window.
- ③ In this section you can indicate whether or not you want the platform slope lines to be included in the image export.
- ④ In this section contour line options are defined. In the first two check boxes you can indicate whether you want to include contour lines in the export image, and if you do, whether or not contour lines should be shown inside the platforms. Otherwise they will only be shown on the existing terrain. If contour lines are to be drawn you must also specify which level the lines should be drawn at, using one of the following methods:
    - Fixed Contour Intervals of... If this option is selected then contour lines will be shown with fixed intervals e.g. to draw contour lines every 20m. With this option you can also specify a level to start the contour lines from. Use this if you want to ensure that a contour line is drawn at a particular level, such as 0m. Note that contour lines will be drawn both above and below this starting line at the specified interval to cover all of the ground.
    - Fixed Contour Levels at... If this option is selected then the levels of each contour line can be specified by typing into the box, allowing for contour lines to be drawn at irregular intervals. Contour level values which are typed must be separated by a comma.
- ⑤ In this section you specify options for grid lines. In the first check box specify whether or not you want grid lines to be included. If grid lines are to be included, then the grid line spacing and the text size for grid lines can be increased or reduced by clicking on the + and - buttons.

Once the export settings have been finalised click OK. You will be prompted for the location to save the export file and the file format to save.

Notes on 3D View Images : The image export can only produce images in the design view. To export an image of the project in one of the 3D views it is best to use the windows snipping tool after putting the program into Prensentation

Mode. Within the program switch to one of the 3D views and navigate to the position you want. Then from the Display menu select Presentation Mode. Use the windows snipping tool to take a screen capture of the area that you want and then exit presentation mode by hitting the Esc key. For instruction on how to use the snipping tool refer to Windows Support : Use Snipping Tool to capture screenshots .

Numerous image export customisations are discussed in our video Exports - Images. Capture of 3D views using the Windows Snipping Tool is demonstrated later in the video.

Export to LandXML

The project data in Kubla Cubed can be exported to LandXML. LandXML is a widely supported format used for transferring engineering and surveying data between different programs. Many specialist software applications can import\export this format, visit www.landxml.org for an extensive list of software that can import\export LandXML. LandXML is the recommended method for transferring TINS between Kubla Cubed and other programs.

When developing workflows for use with machine control systems it is sometimes necessary to use LandXML and CAD exports in tandem. Typically, LandXML for the TINS and CAD for the linework.

To export project data to LandXML click on File, Export and then LandXML. The LandXML export window will appear as shown below.

The available options on this form are described below:

- ① The phases drop-down allows you to select which phases are exported to LandXML. By default, only the selected phase is exported. Unlike CAD, LandXML does not have a layer system so it is advantages to only export the data you need to avoid the confusion of having a long list of objects that aren't required.

- ②In this section you select whether the export should include the data that the user has input into the project (contours, points boundaries etc...). For many workflows this information is somewhat redundant and only the TINS are needed, however it can be useful in other design programs.
- ③ In this section you can choose whether to include the TINS in the export. TINs are the best way of transferring surfaces from Kubla Cubed to another program so you should usually keep this option checked.

  Disturbance Area Only In some scenarios when exporting proposed surfaces, you will not want the undisturbed ground in the model. If for instance you were exporting a surface for use in another cut\fill analysis you would only want the elevations in the disturbance area only.
- ④ In this section you can choose to generate surface contour lines. Be aware that contour lines that have been used to define 'Feature Surfaces' in Kubla Cubed will be included if 'Input Data' is checked and are not the contour lines referred to in this section. The contour lines in this section are an entirely new set that can be generated from the entire proposed surface.

  - Starting At In this box you can set what level the contour lines start at, it is advised to start on a round number. The default will be set to the bottom of the surface rounded down.
  - Contour Interval In this box you can set the interval distance between each contour line. Very small contour intervals can cause large export times and large file sizes.
- ⑤ As well as generating contour lines from the TINS you can also export gridded data. This can be useful for importing into other programs that do not support TIN import. It also can be used to create a cut\fill plan for site engineers.

  - Origin Point In this box you can set the location of the origin point. The grid will extend out from here in all directions until it exceeds the extents of the surface. It is recommended that rounded numbers are used. By default, it is set to the bottom left rounded to a whole number.
  - Grid Interval In this box you can set the distance between each grid point. Very small grid intervals can cause large export times and large file sizes.
- ⑥ Earthworks linework created by Kubla Cubed can also be included in the LandXML format.

  - Outlines The outlines of the earthworks can be exported, this can be useful for knowing the location of designed features such as building pads, roads, ponds etc...
  - Incline Lines Kubla Cubed generates 'incline lines' to mark the generated side slopes joining earthworks elements to the ground. You can choose to include these in the file.
  - Cut\Fill Lines The lines can be exported in red and blue which show the earthworks cut\fill boundaries.
- ⑦The preview can be used to give a good indication of what the exported file will contain. It is especially useful for previewing the density of the generated gridded data and generated contour lines. Please note that not all entities will show in the preview. When multiple phases are selected for export you can cycle through which phase to preview using controls that will appear at the bottom of the preview panel. Multiple phases are not previewed at together to avoid confusion.

Once the export settings have been finalised click OK. You will be prompted for the location to save the LandXML file.

Our Working with LandXML Files (.xml) video starts by looking at importing existing and proposed surfaces from LandXML using Triangle Surfaces. It then covers the options for exporting a Kubla Cubed project to a LandXML file.
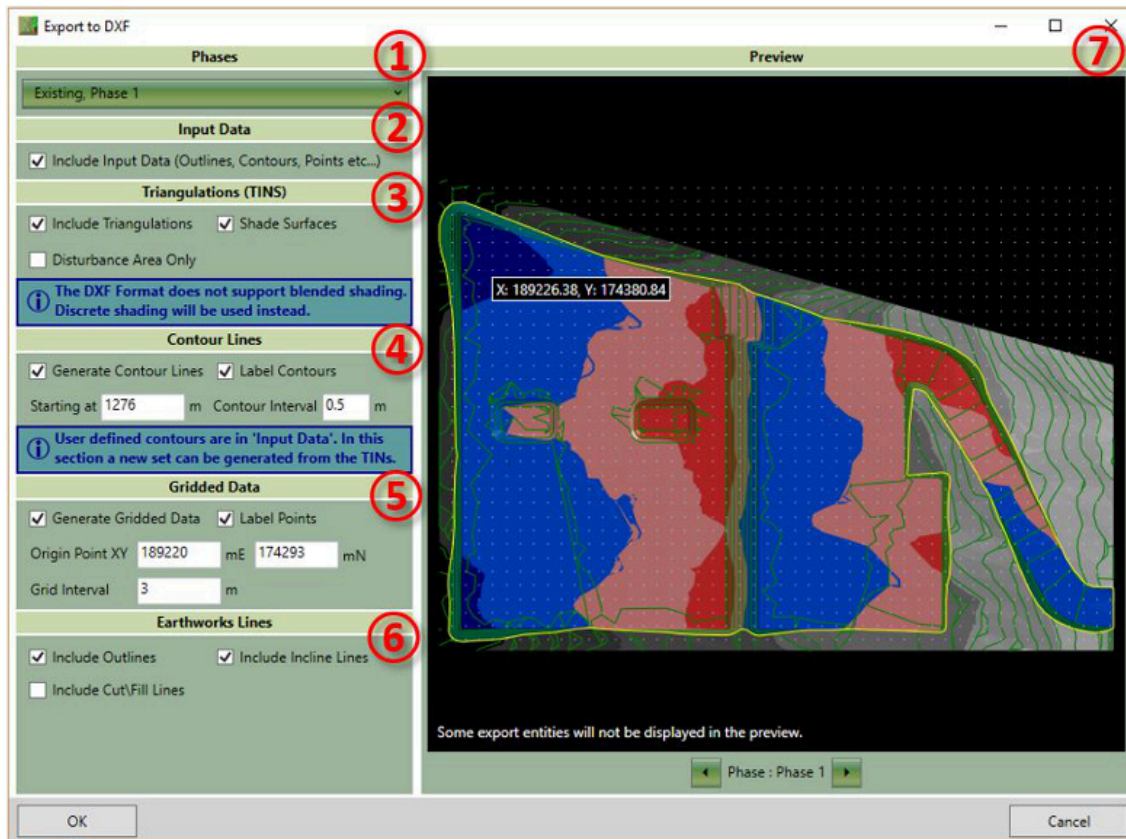
Export to CAD

The project data in Kubla Cubed can be exported to an CAD (.dwg, .dxf) file. These are a widely supported formats used for transferring engineering and surveying data between different CAD programs. Using the data exported from Kubla Cubed a CAD technician can produce PDF files of the Kubla Cubed data for distribution or combine with other

CAD data of the site to create complex drawings. For instance, the gridded data could be overlaid on the original site plan to produce a detailed visualisation of the cut\fill.

When developing workflows for use with machine control systems it is sometimes necessary to use LandXML and CAD exports in tandem. Typically, LandXML for the TINS and CAD for the linework.

To export project data to CAD, click on File, Export and then CAD Data. The CAD export window will appear as shown below.

The available options on this form are described below:

- ① The phases drop-down allows you to select which phases are exported to CAD. By default, only the selected phase and the existing phase is exported. In the file layers are used to separate the entities by phase.
- ②In this section you select whether the export should include the data that the user has input into the project (contours, points boundaries etc...).
- ③ In this section you can choose whether to include the TINS in the export. Often the TINS are not required if you are just interested in a contour line or gridded data visualisation.

  - Disturbance Area Only In some scenarios when exporting proposed surfaces, you will not want the undisturbed ground in the model. If for instance you were exporting a surface for use in another cut\fill analysis you would only want the elevations in the disturbance area only.

- ④ In this section you can choose to generate surface contour lines. Be aware that contour lines that have been used to define 'Feature Surfaces' in Kubla Cubed will be included if 'Input Data' is checked and are not the contour lines referred to in this section. The contour lines in this section are an entirely new set that can be generated from the entire proposed surface.

  - Label Contours You can choose to turn off the labelling of contour lines, however as CAD has a special entity for this exact scenario it is recommended it is left turned on.
  - Starting At In this box you can set what level the contour lines start at, it is advised to start on a round number. The default will be set to the bottom of the surface rounded down.

- Contour Interval In this box you can set the interval distance between each contour line. Very small contour intervals can cause large export times and large file sizes.
- ⑤ As well as generating contour lines from the TINS, you can also export gridded data. This can be useful for importing into other programs that do not support TIN import. It also can be used to create a cut\fill plan for site engineers.

  - Label Points You can choose to turn off the labelling of points as it saves space in the file. Be aware that points without labels will only be useful as an import into other programs, gridded points with no labels in a CAD drawing would have little meaning.
  - Origin Point In this box you can set the location of the origin point. The grid will extend out from here in all directions until it exceeds the extents of the surface. It is recommended that rounded numbers are used. By default, it is set to the bottom left rounded to a whole number.
  - Grid Interval In this box you can set the distance between each grid point. Very small grid intervals can cause large export times and large file sizes.
- ⑥ Earthworks linework created by Kubla Cubed can also be included in the CAD export.

  - Outlines The outlines of the earthworks can be exported, this can be useful for knowing the location of designed features such as building pads, roads, ponds etc...
  - Incline Lines Kubla Cubed generates 'incline lines' to mark the generated side slopes joining earthworks elements to the ground. You can choose to include these in the file.
  - Cut\Fill Lines The lines can be exported in red and blue which show the earthworks cut\fill boundaries.
- ⑦The preview can be used to give a good indication of what the exported file will contain. It is especially useful for previewing the density of the generated gridded data and generated contour lines. Please note that not all entities will show in the preview. When multiple phases are selected for export you can cycle through which phase to preview using controls that will appear at the bottom of the preview panel. Multiple phases are not previewed all together to avoid confusion.

Once the export settings have been finalised click OK. You will be prompted for the location to save the DXF file.

Our Exports - CAD Files video describes and demonstrates the options for customising CAD exports.

Chapter

11

Troubleshooting

Topics:

- **Essential Project Checks**
- **Error Messages in Kubla Cubed**

The troubleshooting section provides some quick tips and also more detailed explanation of how validation works in Kubla Cubed, which will help you find your own solutions to common problems.

This troubleshooting section also introduces the error/warning messages you may encounter. For example, suppose the intention is to model a site spanning 300m. You would be presented with a warning if you accidentally set the site size to 300mm!

Essential Project Checks

Project Checks

A computer model can only be as good as the data input to it; a frequently used industry phrase is 'GIGO' (Garbage In Garbage Out). Therefore, checking your input is essential to ensure that no mistakes have been made during the various steps. The checks should be made after the data is input (e.g check the site plan after it has been imported). However, we also recommended the following checks are done at the end of each project before producing reports...

1. Site Plan Scale Check

   Check that dimensions in site plan are correct. Press and hold the 'M' key on your keyboard, then drag your mouse from start to end over a known length. If the value matches that on the site plan, then you have scaled correctly. Be sure to pick a long length for comparison to remove the potential of small inaccuracies going un-noticed.

   Alternatively, you can use the 'Length' Measurement element. This can be found by double clicking on the 'Measurements' panel in the right-hand side of the program. For instructions, see our Count, Length and Area Measurements video. The added benefit of this method is that the element stays in place and can be referenced each time new site plan edits are made, helping ensure nothing becomes 'broken' without being noticed.

2. CAD data Import Units Check

   Check that the units in you CAD import, match the units used in your Kubla Cubed units setup. The importer has a units option and you can also change the Measure units from the main menu.

3. Elevation Spot Check

   Going back to check each point height would be a laborious effort. However, you can change the cursor options to show the XYZ values and then mouse over. To do this, from the menu, select 'Measure'. Within the sub menu 'Cursor', select the option *X: Y:* and then *Z(proposed):* and/or *Z(existing): .* Now, when you mouse over terrain, the selected dimension values will show beneath the cursor.

4. Elevation Cross Section Check

   Draw a cross section line across your site. View the graph within Kubla Cubed and check where the proposed line rises above and falls below the existing. Moving the mouse across the graph, you can also check individual sections are precisely as expected under the cursor.

5. Vertical Exaggeration Check

   To help check for incorrect Z values and to a lesser effect XY values, exaggerate the terrain height... Change to one of the 3D cameras to show the Vertical Exaggeration Tool. Move the tool's slider up/down to highlight obvious mistakes such as height spikes.

6. Input Validation Check

   Once all you data has been input, from the main menu select 'Create Spreadsheet' and then select 'Input Data'. Check that the Spreadsheet contents match your original input data.

Error Messages in Kubla Cubed

All software will give error messages from time to time and Kubla Cubed is no different. In this post we discuss the 'Calculation Error' message which can sometimes occur when working on complex projects. We also discuss the Kubla Cubed's calculation steps and the error reporting features. This section contains discussion of quite advanced topics and is therefore targeted at experienced users.
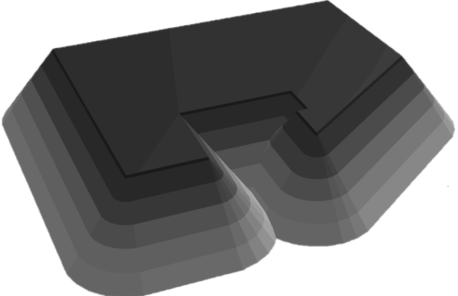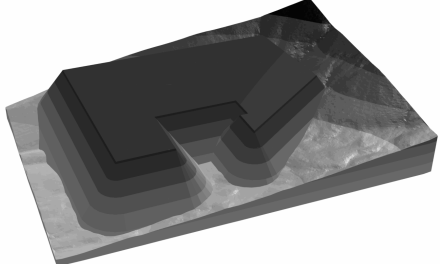
Overview

Calculation error messages are displayed in Kubla Cubed where the calculations fail, or where a validation step fails. Validation steps are run at numerous points during the calculation to ensure the integrity of the final result. No calculation engine is going to be entirely free of errors, and especially not one whose calculations are based

on Triangular Prisms, like Kubla Cubed. This method is the most accurate, but is also far, far more technically challenging than the grid and cross-section methods that are used by some other earthworks software. Kubla Cubed allows users to create as many phases of work as they wish, with each phase containing an unlimited number of earthworks elements. This provides a great deal of flexibility to our users. However, it also allows for very complex projects to be defined, increasing the likelyhood of calculation errors when compared to more restrictive software.

Calculation Steps

In order to understand the sources of calculation errors, it helps to understand the steps involved in the calculation. We will briefly summarise the process below. These steps are repeated for each phase in the project.

For each earthworks element in a phase, there is a three step process:
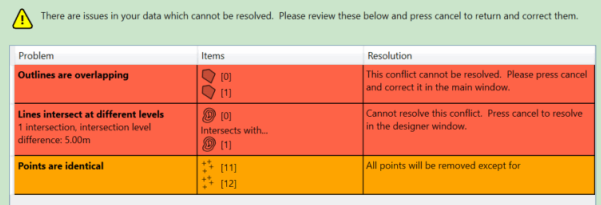
Step one Generating the surface mesh. For a platform, this is trivial and unlikely to cause an error. However, it is potentially quite complicated for a feature surface with many ground features. It can also be challenging for a strip or overlay, where the ground below is complex.	
Step two Generating batter slopes. These are the side slopes that will be used to connect the surface mesh to the terrain. The complexity of this process depends largely on the complexity of the outline of the element. However, if the batters are set to vertical this step is quite straightforward for the software to complete.	
Step three Merging the element with the terrain. This is usually a fairly challenging step for the software, particularly if the existing and/or proposed meshes are complex.	

Once all of the earthworks elements have been processed in this way, there will be 2 meshes; the mesh at the start of the phase, and the mesh after all the elements have been merged into it. The final step is to project the initial mesh edges onto the final mesh. This will create a mesh which contains all the edges of both the initial and the final meshes. This 'Calculation Mesh' is used to generate volumes and to present cut and fill maps. This final step of the process is extremely complex and is one of the most common sources of error.

If an error occurs when merging an earthworks element into the terrain, the software will identify the element that caused the error. However, if an error occurs when generating the calculation mesh, it is not possible to identify a specific element that has caused the problem. For this reason, these errors can be particularly difficult for our customers to resolve with the current error messages.

General Approach

At Kubla, we use the following approaches to minimise the frequency and impact of calculation errors:

• Thorough validation of the data that is input by the user. This minimises the likelyhood of situations that will cause errors. • Continual improvement to make the calculations as robust as possible. Our developers are constantly working through calculation errors reported by users; fixes are included in regular software updates. • Presenting error details to the user about errors when they occur, to enable them to resolve the issues themselves. • Directly supporting customers who run into calculation errors.	
We believe that our validation, calculations and support are amongst the best available in the industry, although we continue to improve these areas. However, it has become clear that our users are often finding that when error messages occur they are difficult to make sense of and do not always provide enough information for them to find a solution on their own. For this reason, the latest release of the software includes work to improve this aspect of the software. This work is ongoing and will continue in subsequent updates.	The validator in Kubla Cubed aims to prevent errors in the terrain definition. It will block blatant errors, such as contour lines crossing each other with different levels. It will also warn the user about likely errors, such as one elevation which is very different from all of the others.

Improvements to Error Reporting

In earlier versions of the software, only one error message could be displayed to the user. This provided limited ability for our developers to communicate the source of the error to the user of the software. One major upgrade to error reporting is to present the full error path to the user, which allows for much more detail about the error to be communicated to the user.

However, the most significant improvement to error reporting is the ability to display the region in which the error has occurred on the screen. This allows our users to inspect the problem area, and see if they have made any mistake, or if they could simplify the way they have defined the ground levels in this area. Sometimes even just moving some features in this area by a negligable amount may cause errors to go away.

However, it's important to understand, that due to the complexity of the calculations it's not always obvious where they have initially gone wrong. The error regions displayed will sometimes represent a 'best guess' of the location of the source of the error. The project should be checked in the vicinity of the identified error region, as well as within the region itself. It should also be noted that it is not possible to identify an error region for every type of error, and it will not always be displayed. However, the most common errors will now have error regions, and coverage will be expanded to more error types in the future.
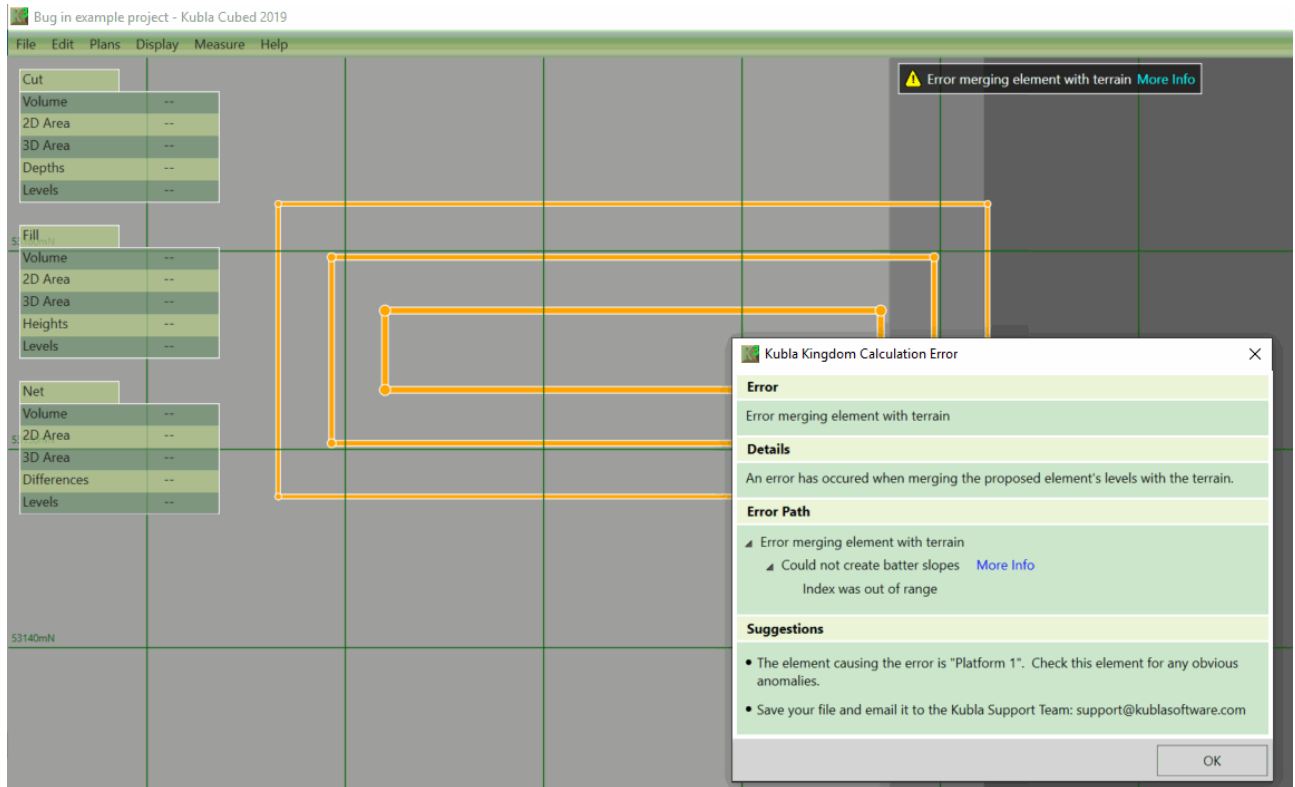
The ability to view the error region, as well as the full error path are two significant upgrades to error reporting in Kubla Cubed

Source: *Error Messages in Kubla Cubed* was originally in the Kubla blog