Bentley Institute

Practice Workbook

This workbook is designed for use in Live instructor-led training and for OnDemand self study.
OnDemand videos for this course are available on the *Bentley Learn Server*.

QuickStart Using ContextCapture

Desktop edition V4.3.0.507

About this Practice Workbook...

- This PDF file includes bookmarks providing an overview of the document. Click on the bookmark to quickly jump to any section in the file. You may have to turn on the bookmark function in your PDF viewer.
- This course has two data sets. The first contains the raw images for processing.
  A second dataset with the larger projects already processed is also available and can be downloaded separately.

Have a Question? Need Help?

If you have questions while taking this course, click the button below to submit them to the ContextCapture forum on Bentley Communities where peers and Bentley subject matter experts are available to help.

Bentley Communities

TRNC02567-1/0001

Introduction

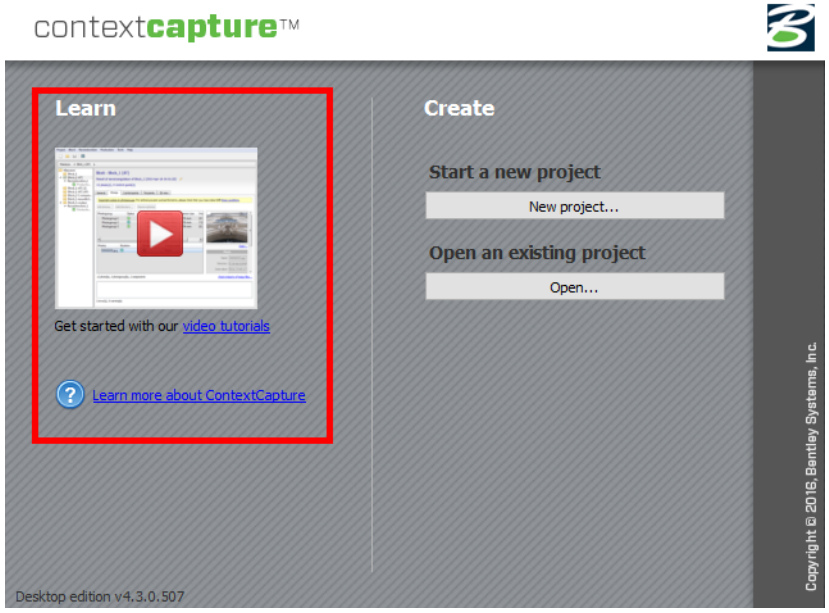
First let's discuss core concepts and the goal of QuickStarts.

ContextCapture is a software package that takes several standard 2D images and through a complex mathematical process creates a 3D model of the data. This data can then be represented as a mesh or point-cloud and can then be used in several Bentley products either as reference data or converted into a terrain model. This lends itself to many uses from concept planning through construction. The data may also be generated in formats that allow use in several third-party programs as well.

QuickStart courses are designed to introduce you quickly to the processes involved but not every nuance of the software. For more training you can review the videos and material linked from the start screen. Also check for new offerings on the Bentley Learn Server.

Included with the dataset is the file; **007_Smart3DCapture_Quick_Acquisition_Guide.pdf.** Inside you will find some suggestion to improve your success collecting photos but there is no substitute for just getting out there and practicing.

Hopefully this QuickStart will inspire you to get out there and try a couple examples yourself.



Exercise 1: Investigate the User Interface

Description

In this exercise you will become acquainted with the user interface.

Skills Taught

- Introduction to the user interface.
- Navigate the file system.

Exercise 1: Investigate the User Interface

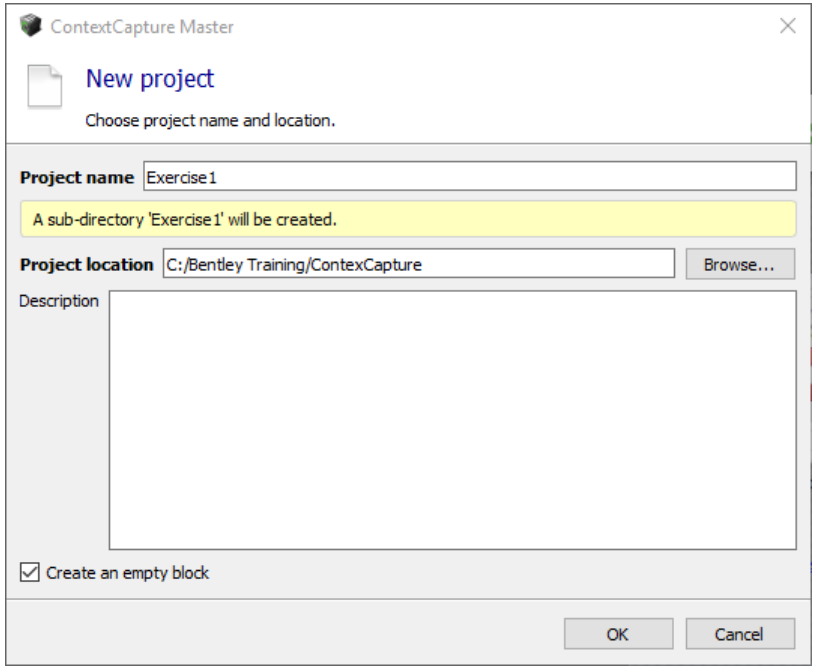
1. To start the software *double-click* on the **Icon.**

2. Under *Start a new project*, click **New project**...

3. For the *Project name*, type **Exercise1**.

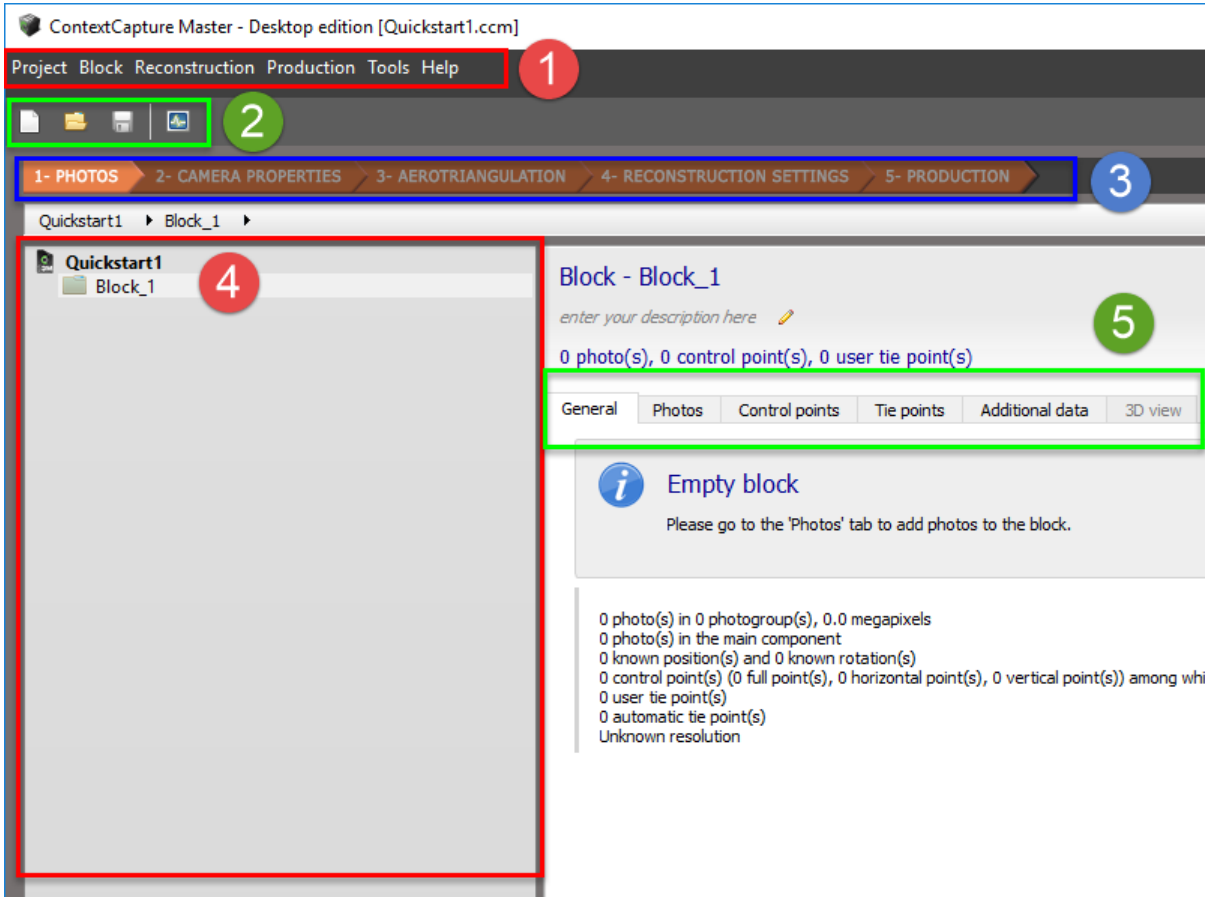
4. Select the *Project Location* **C:/Bentley Training/ContextCapture**
   (Or the directory where the course files were installed.)

5. Click **OK** to create the project and associated directory.



Investigate the interface

1. **Menu block** - Here you will find all the tools and options available in ContextCapture.
2. **Icon Menu** - Icons for New Project, Open Project, Save project and the Job Queue monitor.
3. **Work flow Assistant** - Shows a Progress bar of sorts and the work flow we will follow from start to finish.
4. **Project Tree** - Displays the process steps as the project matures. Allowing you to keep track of multiple aerotriagulation and reconstruction sessions.
5. **Block Tabs** -The main functional tabs used in processing the data set(s).
   - *General* shows the general settings for the current block of data.
   - *Photos* is the interface to load/import photos for processing.
   - Use the *Control points* tab to tie the photos to known coordinates.



   - *Tie points* allow you to add user defined points to scale the 3D model or to fix the orientation to an axis or plane.
   - *Additional Data* allows you to add additional positional data for the photographs (typically from high-end equipment.)
   - Finally the *3D view* tab allows you to review and verify the aerotriangulation results before submitting the block for reconstruction.

Exercise 2: Process Photos and Create 3D Model

Description

In this exercise you will learn the process to take images provided; process them through ContextCapture and examine the resulting 3D data.

Skills Taught

- How to build a dataset by selecting images for processing.
- Submitting jobs for processing.
- Starting the ContextCapture Engine to process submitted processes.
- How to examine a 3D model in Acute 3D viewer.

Import Photos

In this exercise you will select and import photos for processing.

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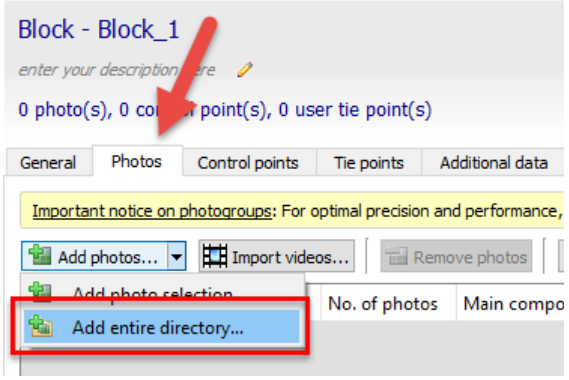
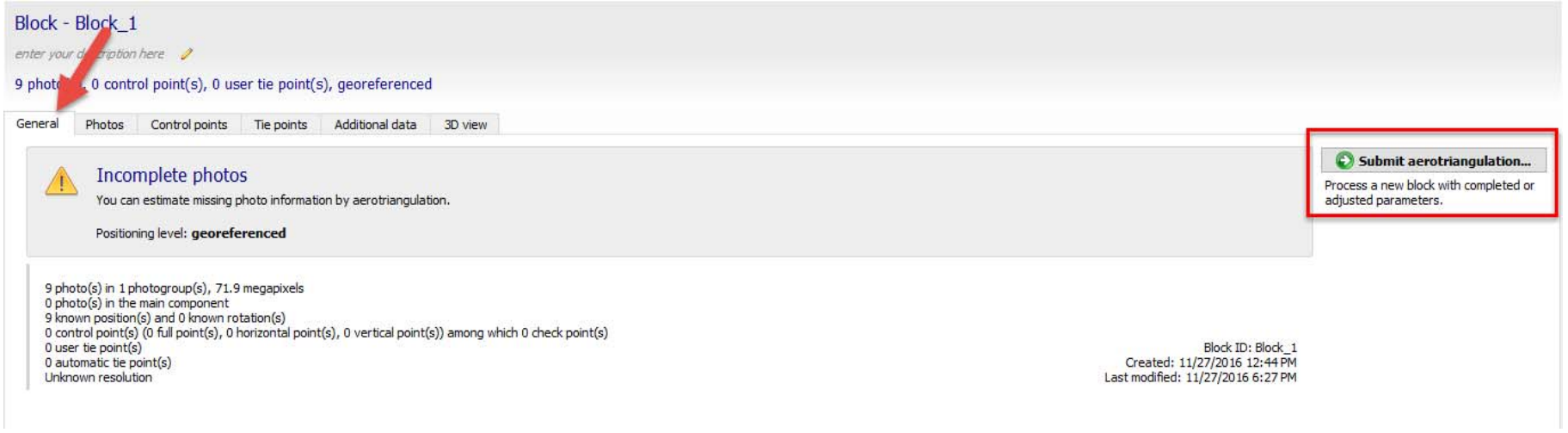
1. Select the **Photos** tab.



2. Under *Add photos* select **Add entire directory**.

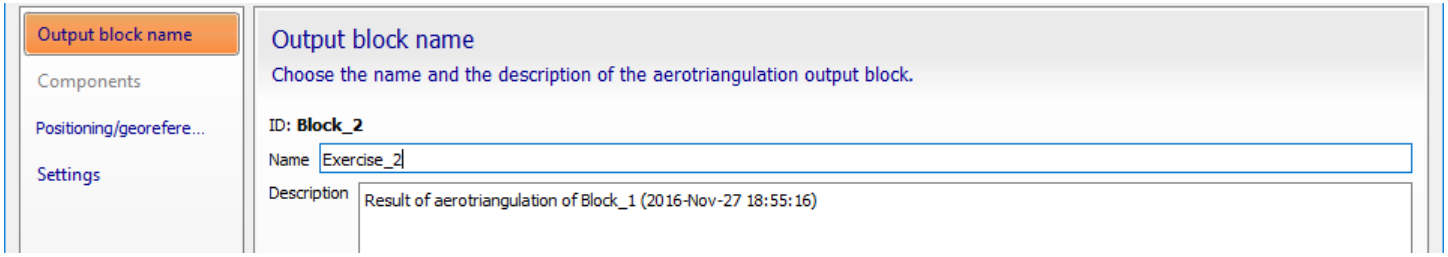
3. Navigate to; **C:\Bentley Training\ContextCapture\QuickStart_Data**
   (Or wherever you installed the dataset.) and select that folder to load photos.

4. Select the **General** tab.



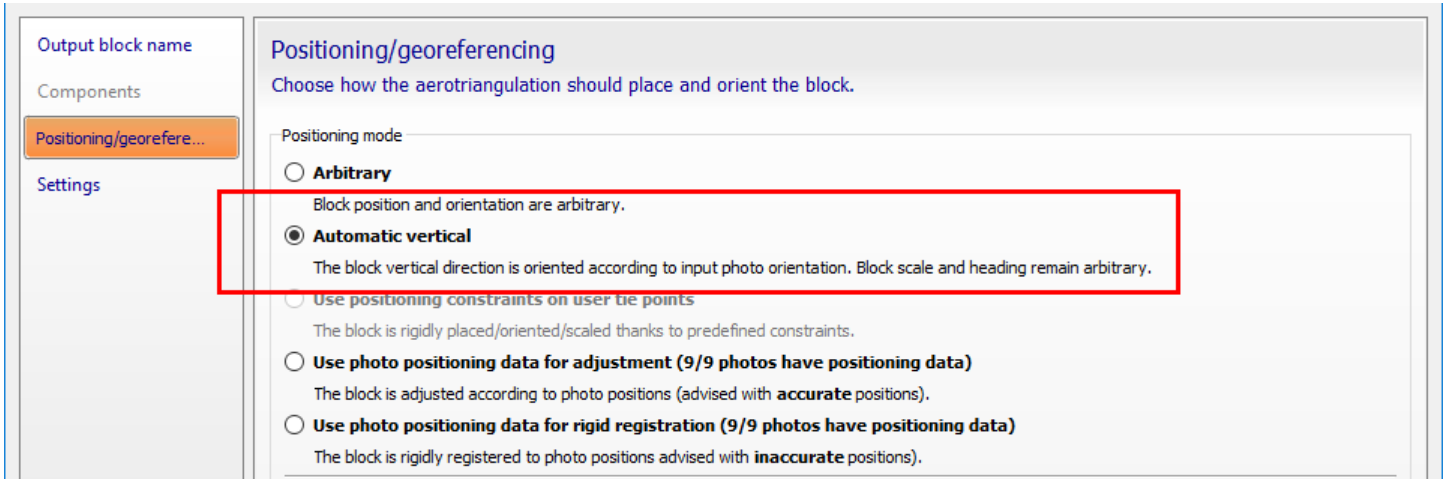
5. Select the **Submit aerotriangulation** button.

6. Type in a *Name* for the output block and click the **Next** button.

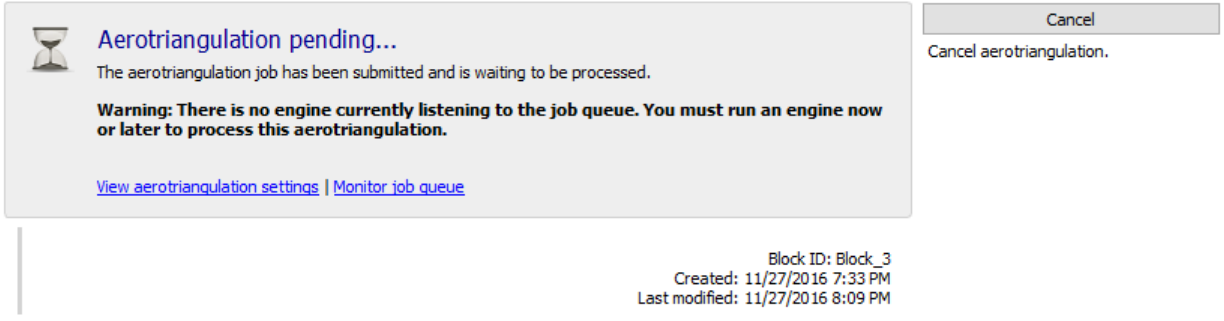


7. Select **Automatic vertical** as the positional mode. Then click the **Next** button.

   The images were taken with an smart-phone and have positional data ContextCapture can use to orientate the images.



8. Leave the default options for the *Settings* tab and select **Submit**. You are automatically brought back to the *General* tab and see the notice below.

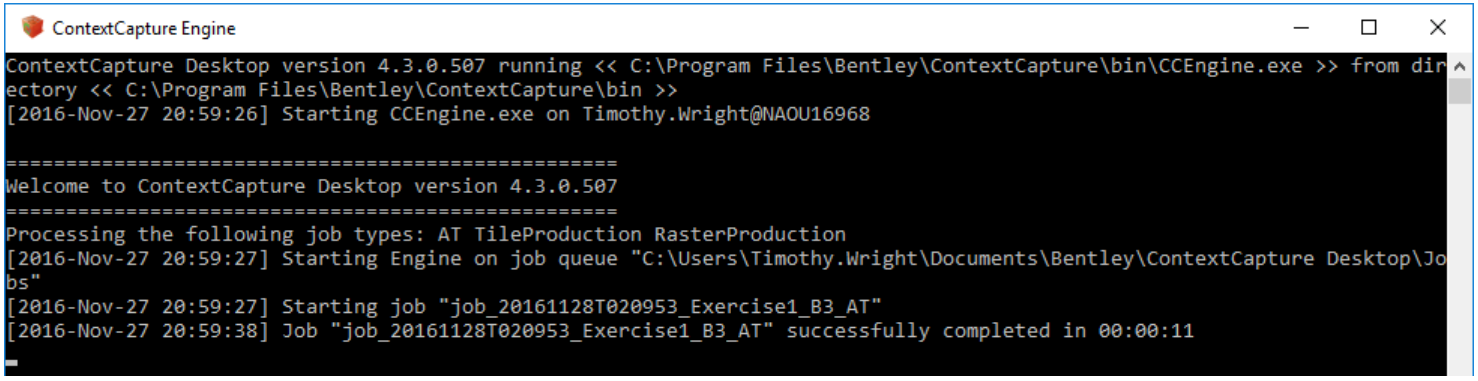


Process Aerotriangulation

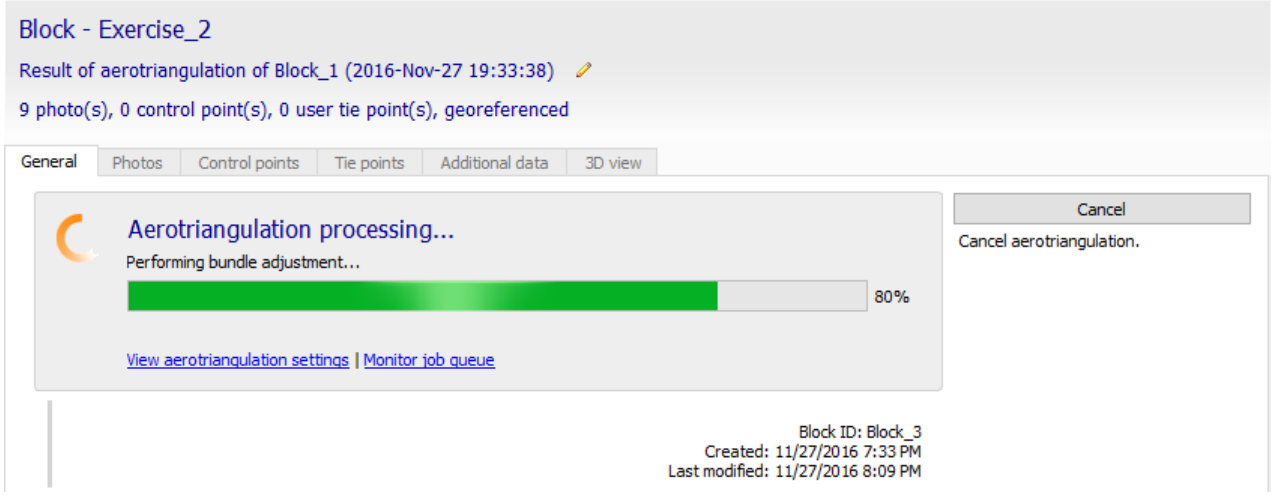
1. To process the aerotriangulation job you need to start the ContextCapture Engine.
   Double click on the **Engine icon** to start the process.

   The ContextCapture Engine is a separate program that once running will automatically search for jobs to process. For larger jobs multiple engines can run and process jobs in parallel across a network.

2. Notice within the ContextCapture Engine window the job in the queue has started processing.



3. The progress bar now shows the processing status.



4. Once the job finishes select the **3D view tab** to review the results of the aerotriangulation.

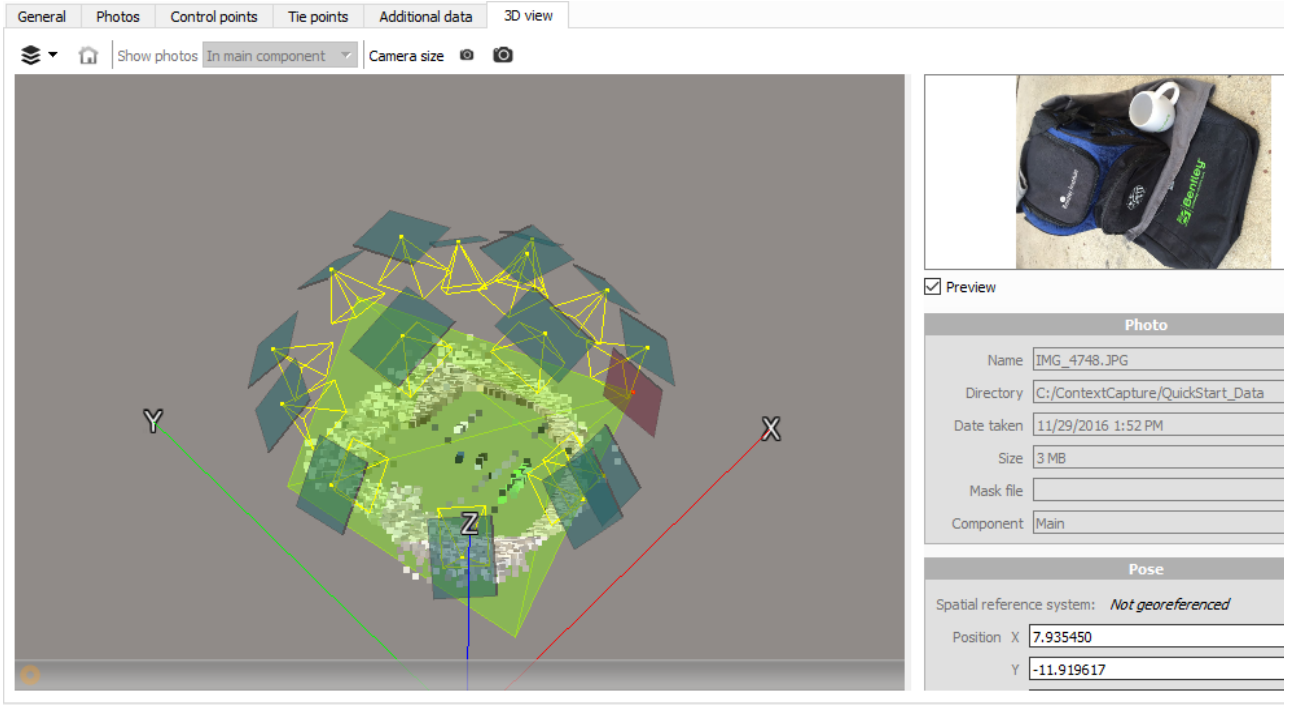
   This will allow you to review and verify the orientation of the photos before submitting the job for the reconstruction process (which can be time consuming.)

5. Navigate the **3D view** by;

   - Holding the left mouse button down to *rotate*.
   - Holding the shift key and Left mouse button to *pan*.
   - *Zoom in and out* via the mouse wheel.
   - Selecting one of the images (green squares) will display that image in the preview pane.

6. First verify that the orientation of the images is correct in regard to the axis.

   - If the axis is skewed, try selecting a method other than Automatic vertical as the positional mode. Then resubmit the aerotriangulation job.
   - You can also enter control points or user defined tie-points to orientate the images to a plane and scale.
   - Once a block has been processed, subsequent jobs submitted will process quicker.



7. Once you are satisfied with the results of the aerotriangulation you can submit the job for reconstruction (the process where the photos are processed into the 3D mesh and/or point-cloud.)

Submit a Job for Reconstruction

The reconstruction process uses the aerotriangulation information to process the images and create a 3D dataset. That data is then presented in a user selected format such as a 3D mesh, point-cloud or orthomosaic raster images.

The data set for this exercise has been selected to process in a relative short time (expect a processing time of about 10 minutes.)

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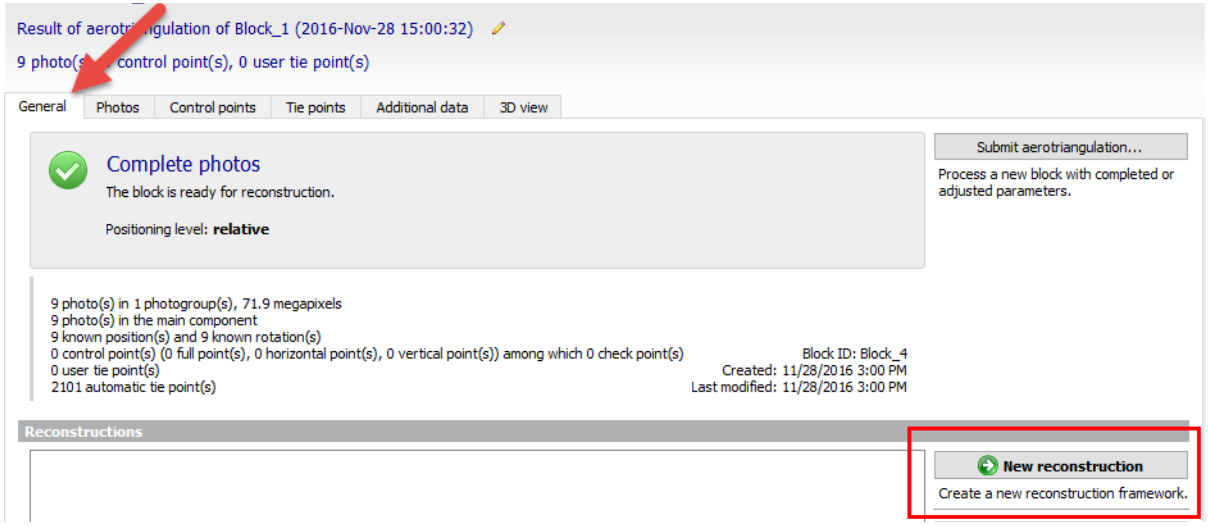
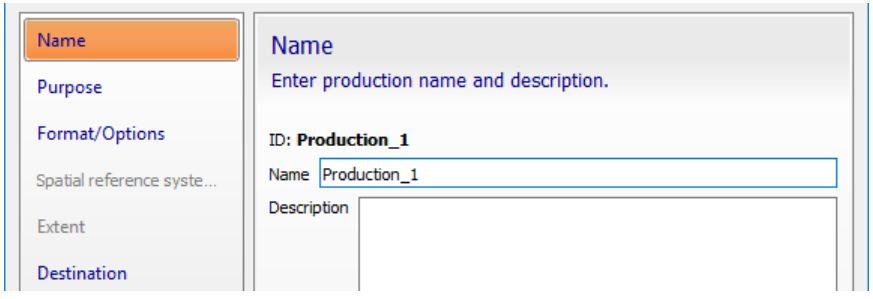
1. From the *General* tab select **New reconstruction**.

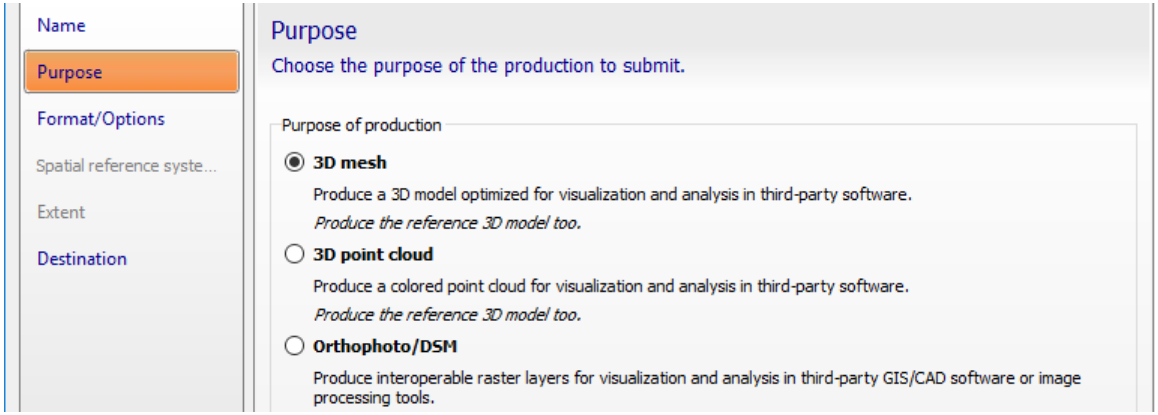


2. Type a *Name* and *Description* (if desired) for the Production then click **Next**.



3. Select **3D mesh** as the *Purpose*, this defines the format options of the output files.

   - For our example we will select the 3D mesh because this is the base output model and very useful.
   - Notice that there are several different output options available to make the 3D model more accessible to different platforms.

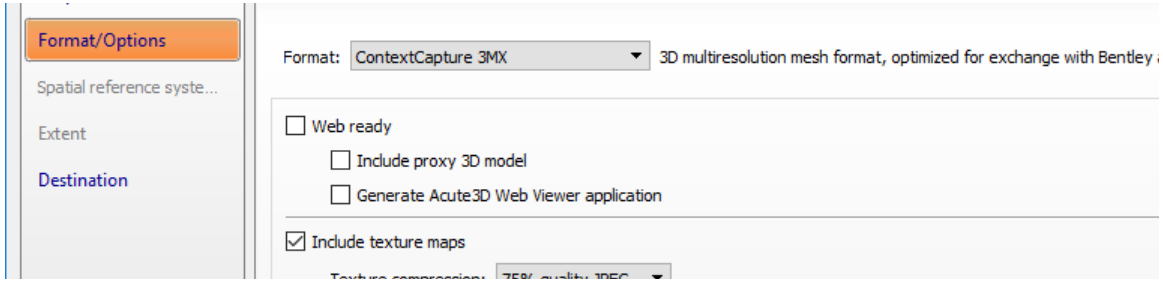


4. Click **Next** to move to the next step.

5. For *Format/Options* select **ContextCapture 3MX**.

   Under **Format**, several different output format options are available. Google Earth KMZ for example.

6. Click **Next** to move to the final step.

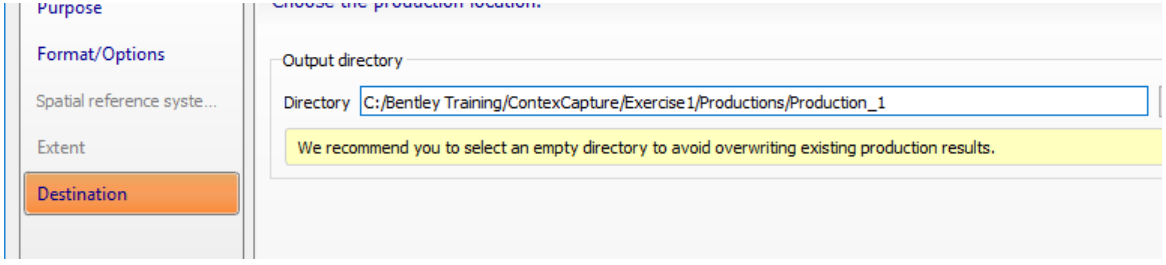


7. Finally select the *Destination* (the Directory where the 3D mesh will be created.)

   By default this will be under the block (project) directory.

8. Click **Submit** to send the Job to the queue.

   If the ContextCapture engine isn't already running, start it to process the job.



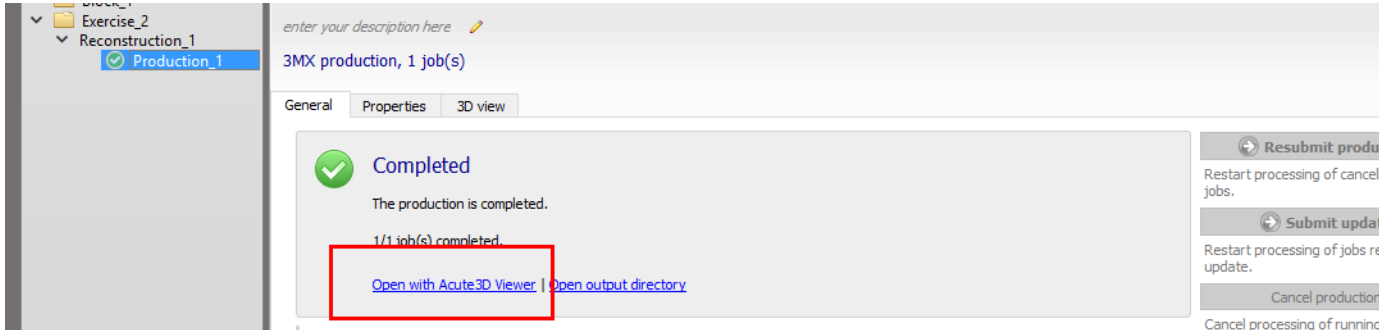
The job should finish processing in about 10 minutes. While you are waiting, this is an excellent time to review the PDF **007_Smart3DCapture_Quick_Acquisition_Guide** included with the course dataset. It explains ways to improve your success while collecting images for projects.

Review the 3D Model

Now we get a chance to take a look at the generated 3D data.

1. Click the link **Open with Acute 3D Viewer** on the completed tab to open the completed job.

   The viewer is a free program and allows you to share your data with other interested parties.



2. The Acute3D Viewer opens and the 3D model is presented.

   - In this example we limited the number of photos to manage the size of the download. Therefore you might notice small omissions (holes) in the finished model. Do not be concerned as this might be expected with limited coverage.
   - We also used common items to encourage you to try taking a run at collecting a dataset yourself.

Examine the User Interface

The controls to navigate are the same as in ContextCapture.

1. **Menu** - Contains tools and settings as well as more advanced options. for now, let's stick to the icon driven menu. Although do note the **Help** option to view the manual.
2. **Icon menu** - includes common tools for easy access and mirrors tools in the menu above (menu category.)


Open file (File)


Return to home position (Camera)


Orbit mode (Camera)


Hand mode (Camera)


Toggle texture map (Display)

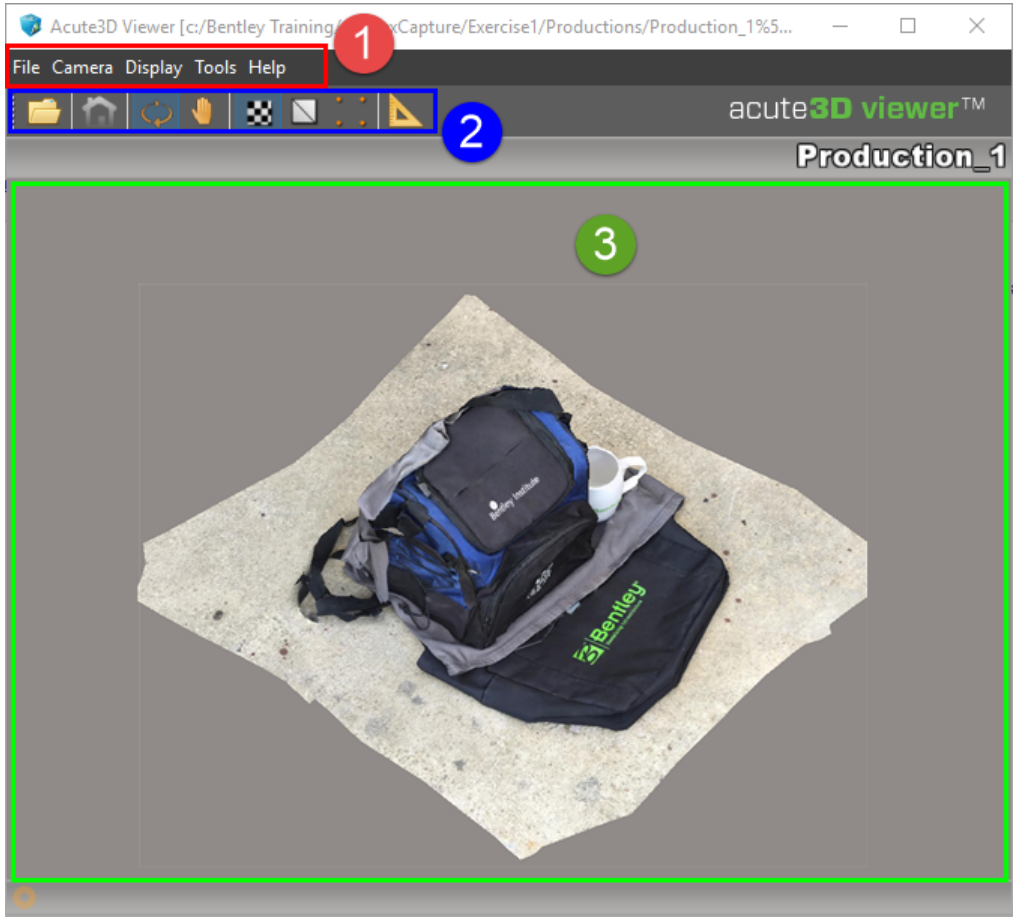

Toggle wireframe (Display)


Toggle point cloud (Display)

Note that the point cloud supersedes both the textures and wireframe display toggles.


Measurement (Tools)

3. **3D view** - this is where the 3D model is displayed.



Take a few moments to *examine* the **3D model**.

Exercise 3: Add Control Points to Geolocate a project

Description

In this example we will add known control points (see photo) to a data set, which will Geolocate a project. This is very useful as the data can now be referenced into products for concept work and design in real-world units and location.

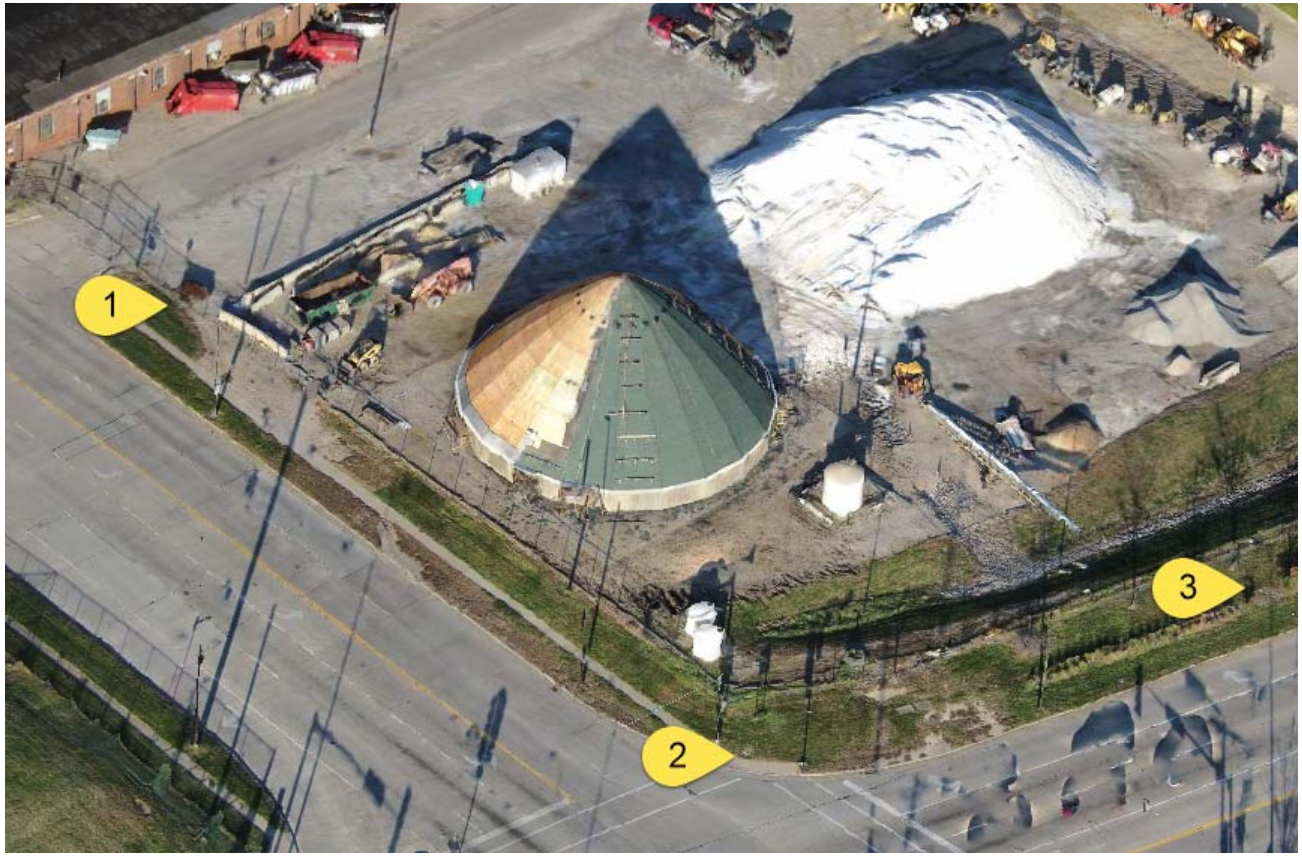
The images were collected with an older DJI Phantom 2. Therefore the resolution of the images is a little lacking. They also have a curved appearance due to the fish-eye lens.

Fortunately the software will correct for the distortion and lower resolution images means a smaller dataset to download.

Black and white target panels were constructed and GPS coordinates were taken via a hand-held GPS device (Dual XGPS150A.)

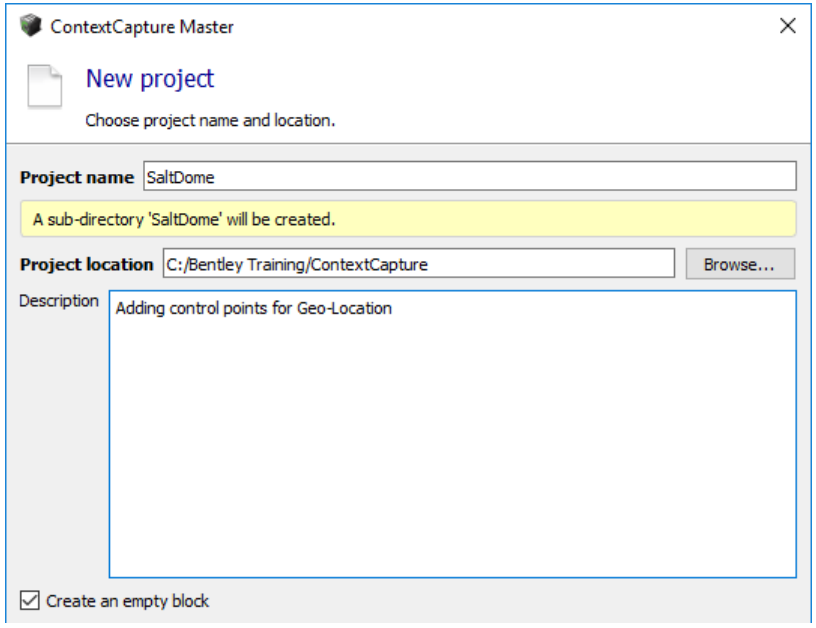
While this will NOT provide survey level accuracy it is more than adequate for our purpose here.

This illustrates that even with somewhat antiquated hardware, we are able to achieve impressive results with the power of the software.

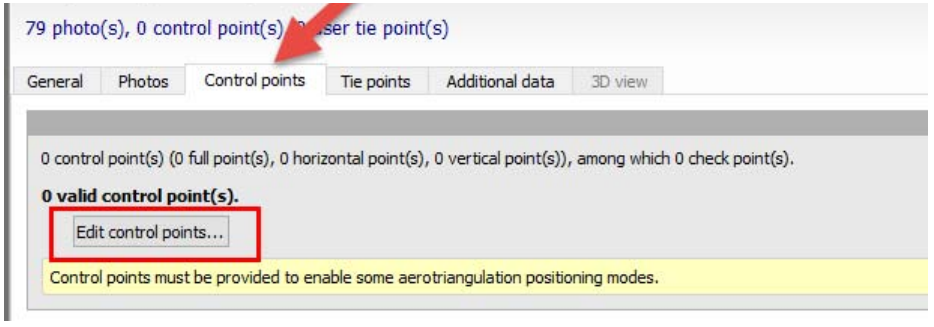


Import Photos and Open Editor

1. Select **New project** from the main menu or icon.
2. Type in **SaltDome** as the *Project name*.
3. Click **OK** to create the project.
4. Select the **Photos** tab.
5. Select **Add entire directory** from the *Add photos* menu.
6. Navigate to;
   C:\Bentley Training\ContextCapture\SaltDome_Data\Images
7. Click **Select folder** to import all of the images in that folder.

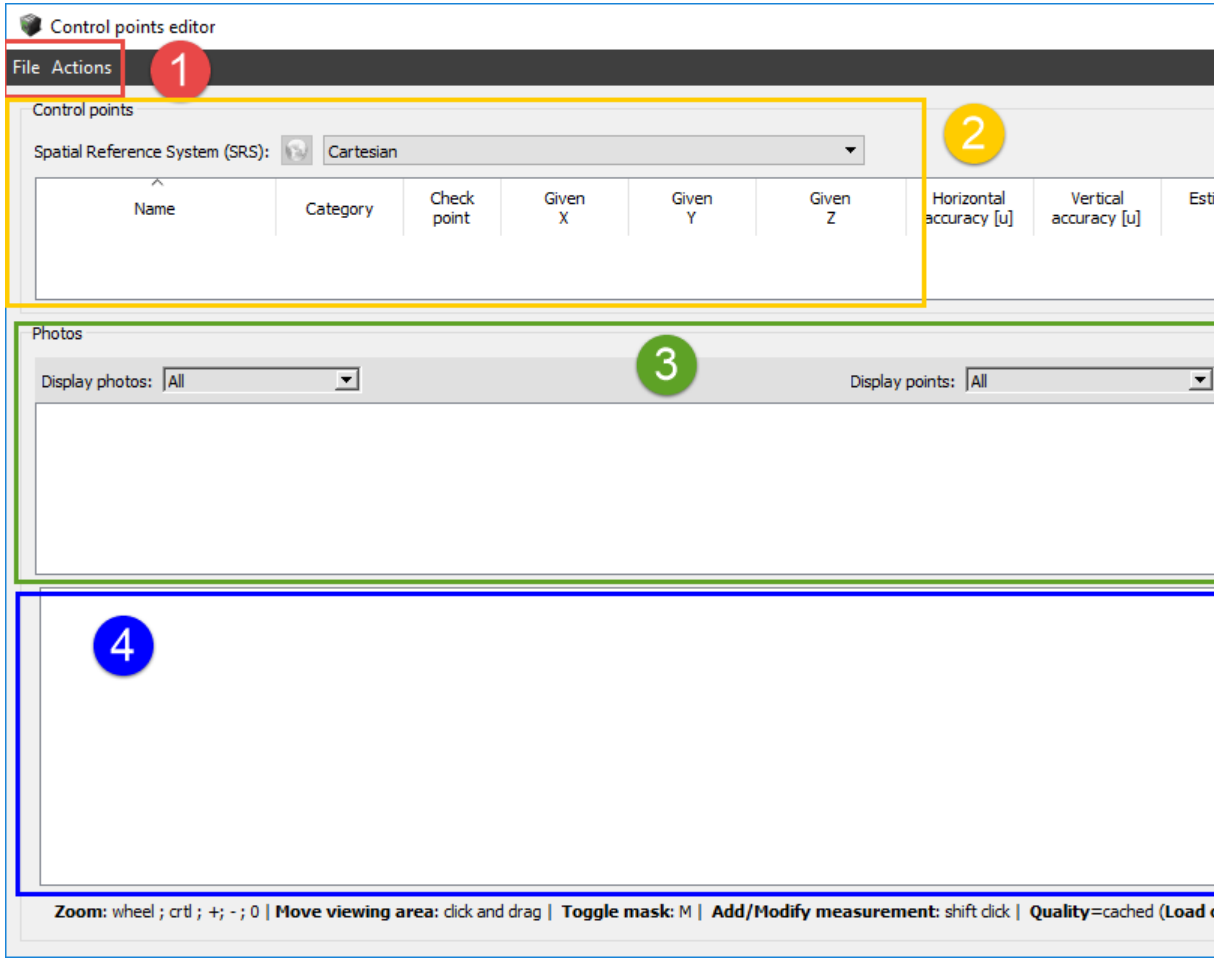


8. Select the **Control points** tab.
9. Click **Edit control points** and the Control points editor dialog appears.
10. Maximize this dialog to make the assignment process easier.



Control Points Editor Interface

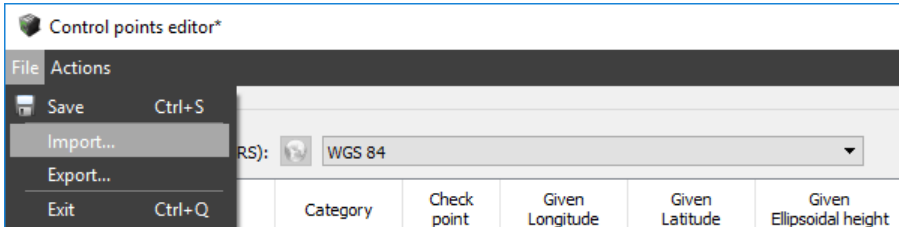
1. **Menu** - Options to save the configuration and import coordinates.
2. **Control Points interface** - Here you find and set Geo-spatial information for the control points. To the right are tools to manually add or delete points from the list.
3. **The Photos frame** - This area allows you to see the list of images in the project. Select an image here to see it displayed in the frame below and set the control point graphically.
4. **Graphic location window** - Here you will see the selected image allowing you to pan and zoom to locate the target in the image associated with the control point.



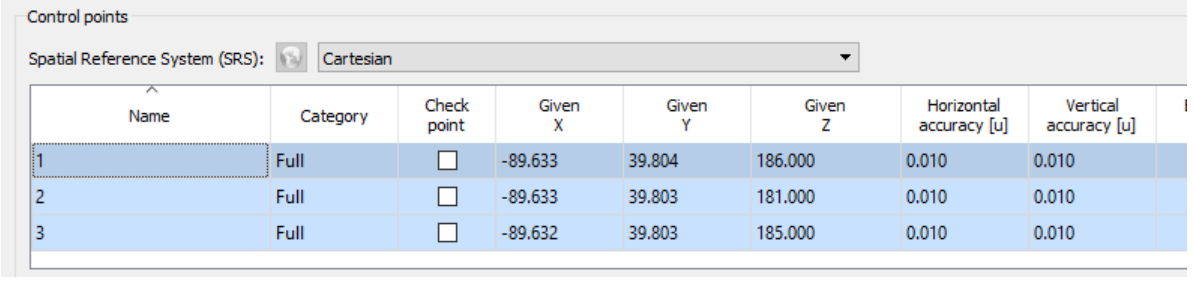
Importing Control Point Data

Control Points can be defined manually or in a simple text file that can be imported to load the information. For our example a text file (SaltDomeControl.txt) has been prepared for you and can be found under the SaltDome_Data folder.

1. Under *File* select the **Import** command.
2. Navigate to the **Data Directory**.



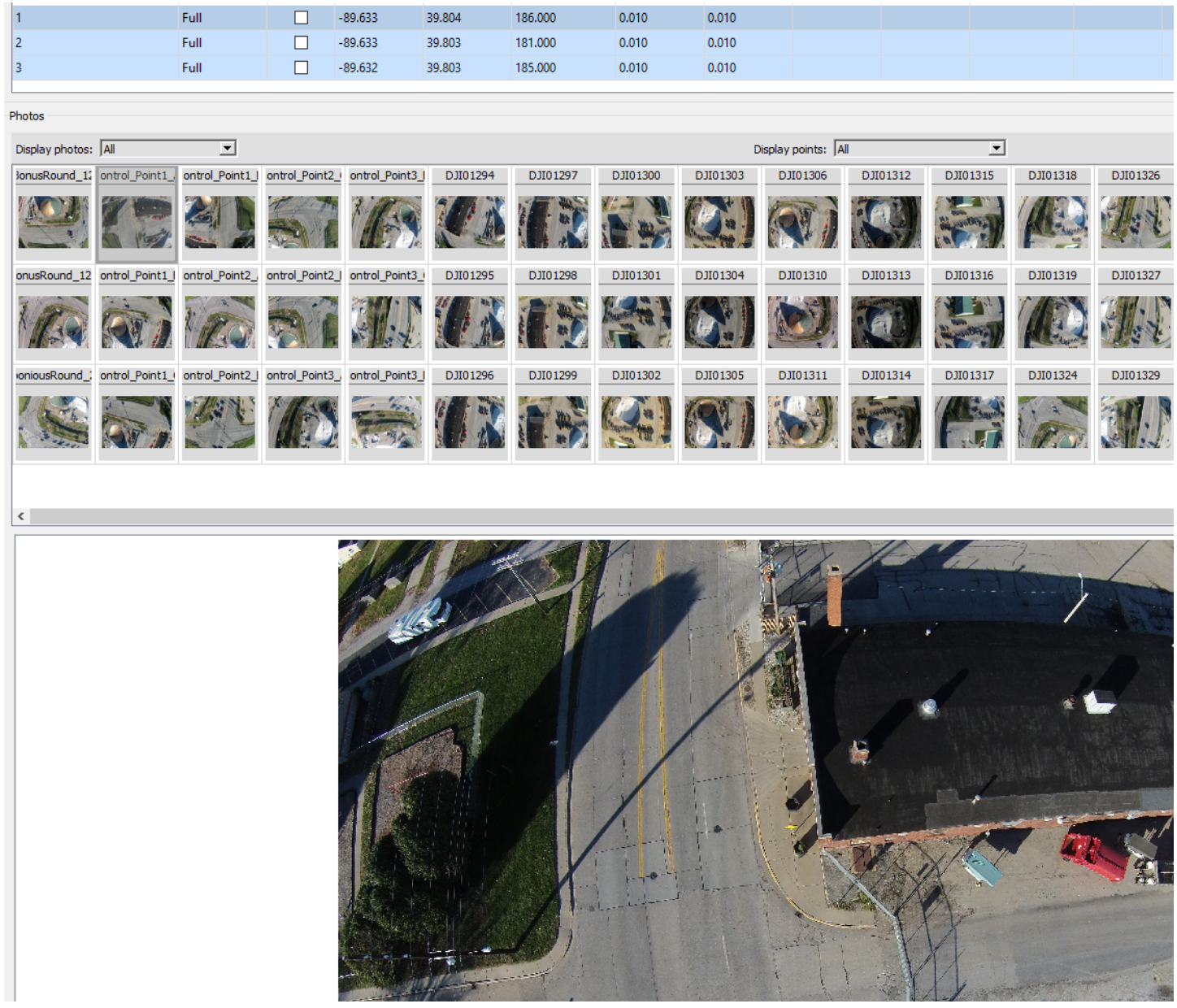
3. Select the text file **SaltDomeControl.txt** to import the points and populate the list.
4. Set the *Spatial Reference System (SRS)* to **WGS 84**
5. Select first control point on list (Point **1**) by clicking in the name field.



Name	Category	Check point	Given X	Given Y	Given Z	Horizontal accuracy [u]	Vertical accuracy [u]
1	Full	☐	-89.633	39.804	186.000	0.010	0.010
2	Full	☐	-89.633	39.803	181.000	0.010	0.010
3	Full	☐	-89.632	39.803	185.000	0.010	0.010

6. Click on photo **Control_Point1_A.jpg**.
   Photos have been renamed in this dataset (with the control point and index) to make selecting the appropriate image easier.

The selected image will display in the lower graphic location window.



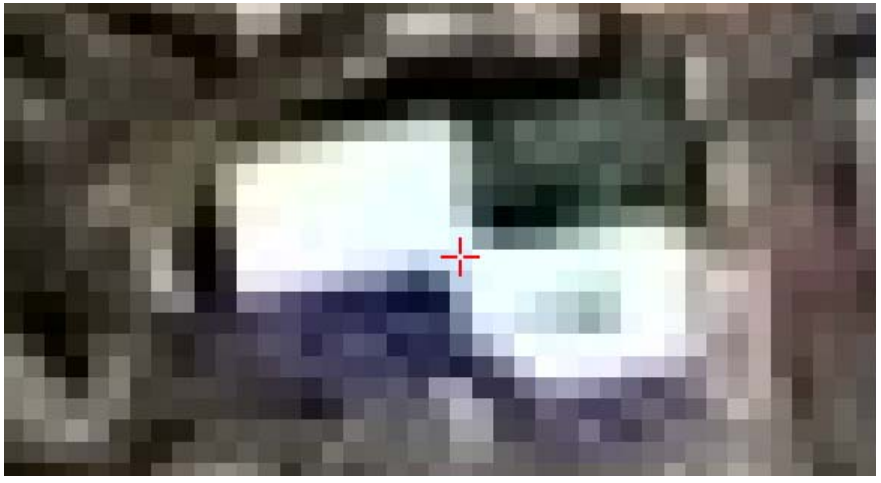
Placing the First Control Point

1. Navigate to the location of **target #1**.

- Holding the left button and dragging the mouse will pan the view.
- Use the mouse wheel to zoom in and out.

2. Place the control point in the center of the target by *holding the shift key and clicking the left mouse-button*.

- The location of the control point is displayed as a red cross.
- If misplaced, simply shift-left click again and the position will be updated.
- If you zoom in enough you can see the limitation of the equipment used to collect this data. The higher the quality (resolution) of the imagery, the higher the accuracy of the finished 3D model.



3. Select the second photo named **Control_Point1_B**.
   The image displayed in the graphic pane is replaced with the new image.

4. Navigate to the *target #1* location and *Shift-Left Click* to place the reference point again at the center of the target.

5. Do the same for photos; **Control_Point1_C** and **Control_Point1_D**.

   To utilize control points there must be at least three different points. Each point must then be defined in at least three images.

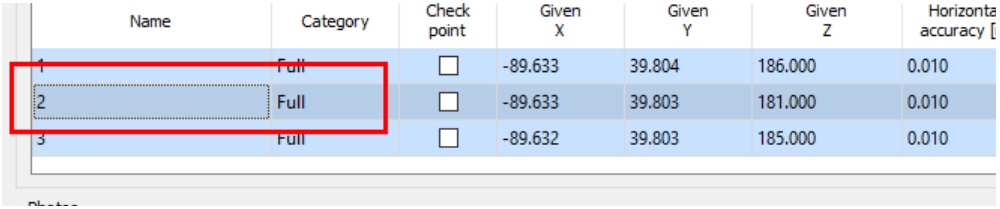
   To improve the error correction we will locate each point in four images. The naming convention for the images **Control_Point1-3_A-D** was chosen to facilitate the process.

   There are also three images where two or more control points could be located (named **BonusRound_XX**) if time permits you may define the listed control points (XX) in these images as well.

Assigning Control Points 2 and 3

1. Select the second control point **(2)** from the list.

   Caution, do not skip this step.
   It is easy to forget to select the next control point from the list and assign subsequent images to the prior control point.



Name	Category	Check point	Given X	Given Y	Given Z	Horizonta accuracy [
1	Full	☐	-89.633	39.804	186.000	0.010
2	Full	☐	-89.633	39.803	181.000	0.010
3	Full	☐	-89.632	39.803	185.000	0.010

2. Select image **Control_Point2_A** and place the reference point at the center of *target #2* in the image.

3. Continue to define control points in images **Control_Point2_B.jpg** through **Control_Point2_D.jpg**.
4. Select the third control point **(3)** and locate in images **ControlPoint3_A** through **ControlPoint3_D**.
5. Under the *File* menu, select **SAVE** to save the control point definitions.
6. Close the *Control points editor* dialog.

   At this point you are ready to submit the job for processing...

   HOWEVER; Due to the size and number of photos in this data set it could take several hours to process this dataset. You can skip this processing during the training and continue with a dataset we have already processed.

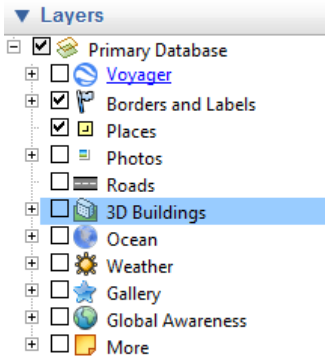
7. Navigate to **C:\Bentley Training\SaltDome\Productions\Production_1\Scene** you should find the file **Production_1.3mx**

   Double click that file to open it in the Acute3D viewer.

8. Review the 3D mesh in the Acute3D viewer.

9. Also in that folder is the Google Earth KML file named **SaltDome.kml**.
   If Google Earth is installed on your computer, you can double-click and open it to see the data set projected in Google Earth as well.

10. Toggle off the **3D buildings** *layer* in Google Earth to avoid confusion between the two surfaces.



Exercise 4: Use Measure Tools

Description

Once the 3D model is created, it can be used in many situations. Often the ability to take measurements (both linear and volumetric) from the data is highly desirable.

Skills Taught

- How to take real world Length and Volume measurements from within the Acute3D viewer.

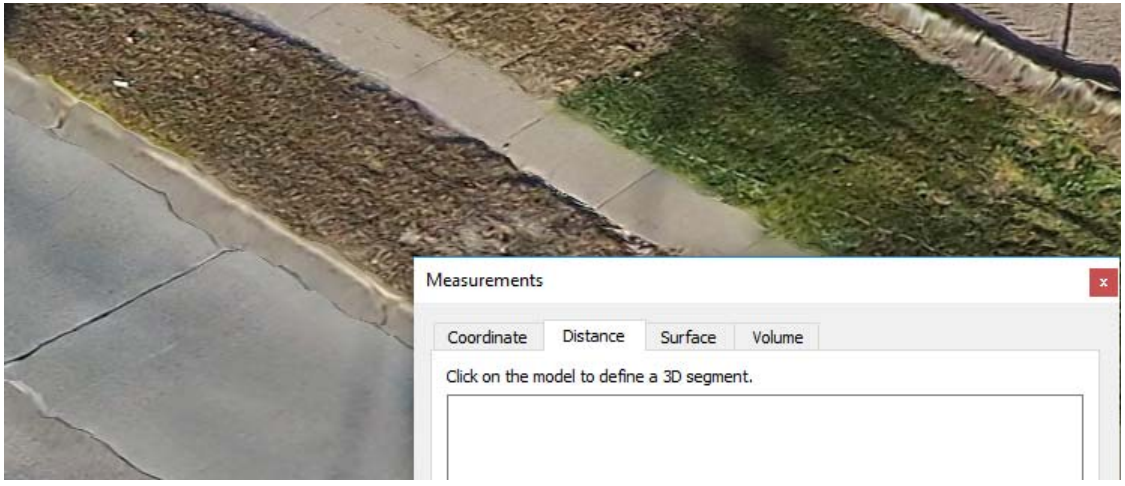
Use Measure Tools

1. Within the Acute3D viewer, select the **Measurements** icon.

   The Measurements dialog appears; notice the different tabs.

2. Select the **Distance** tab.

   Navigate to a point in the 3D model that allows you to measure the distance for the sidewalk and road.



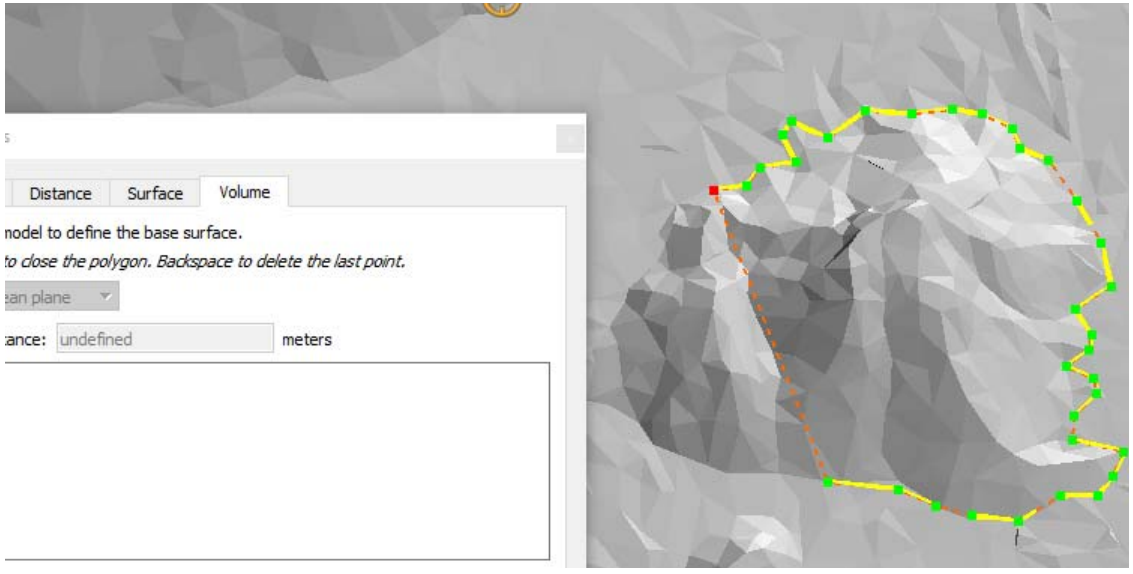
3. To take a measurement, *left-click* with the mouse where you want the measurement to start and *left-click* again to end the line and display the measurement.

4. Take a couple of measurements to get familiar with the tool.

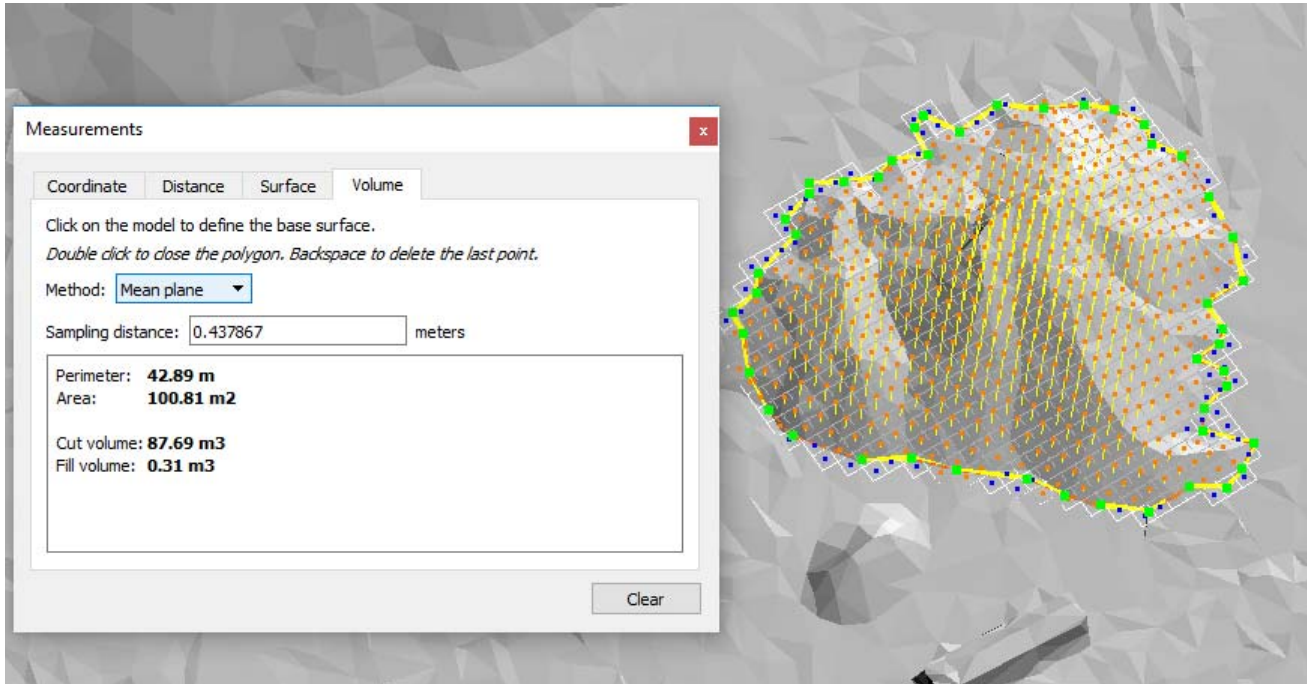
5. Select the **Volume** tab.
6. Navigate to one of the piles.

   To get a volumetric measurement, a boundary polygon is placed in the X,Y plane of the 3D model

7. Turn off **Textures** to make placing the boundary polygon easier.
8. Just like the linear tools a *left-click* will start placement of the boundary polygon.
9. Continue to place data points until the perimeter of the area to be measured is defined.



10. Once you are finished defining the boundary a *right-click* will terminate the placement process and display the measured volume.



Hopefully this QuickStart has given you enough insight and courage to try your own projects.

For more training, help and questions please visit the Bentley Learn Server and get involved with Bentley Communities.