



Reality Modeling: Utilising Drone and Aerial Photos

November 2017

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Introduction

Quick poll

- ContextCapture users ?
- Other Bentley reality modeling product users ?
- Total beginners ?
- Persons in charge of data capture ?
- Persons consuming reality modeling data ?



What is Reality Modeling ?



What is reality modeling ?

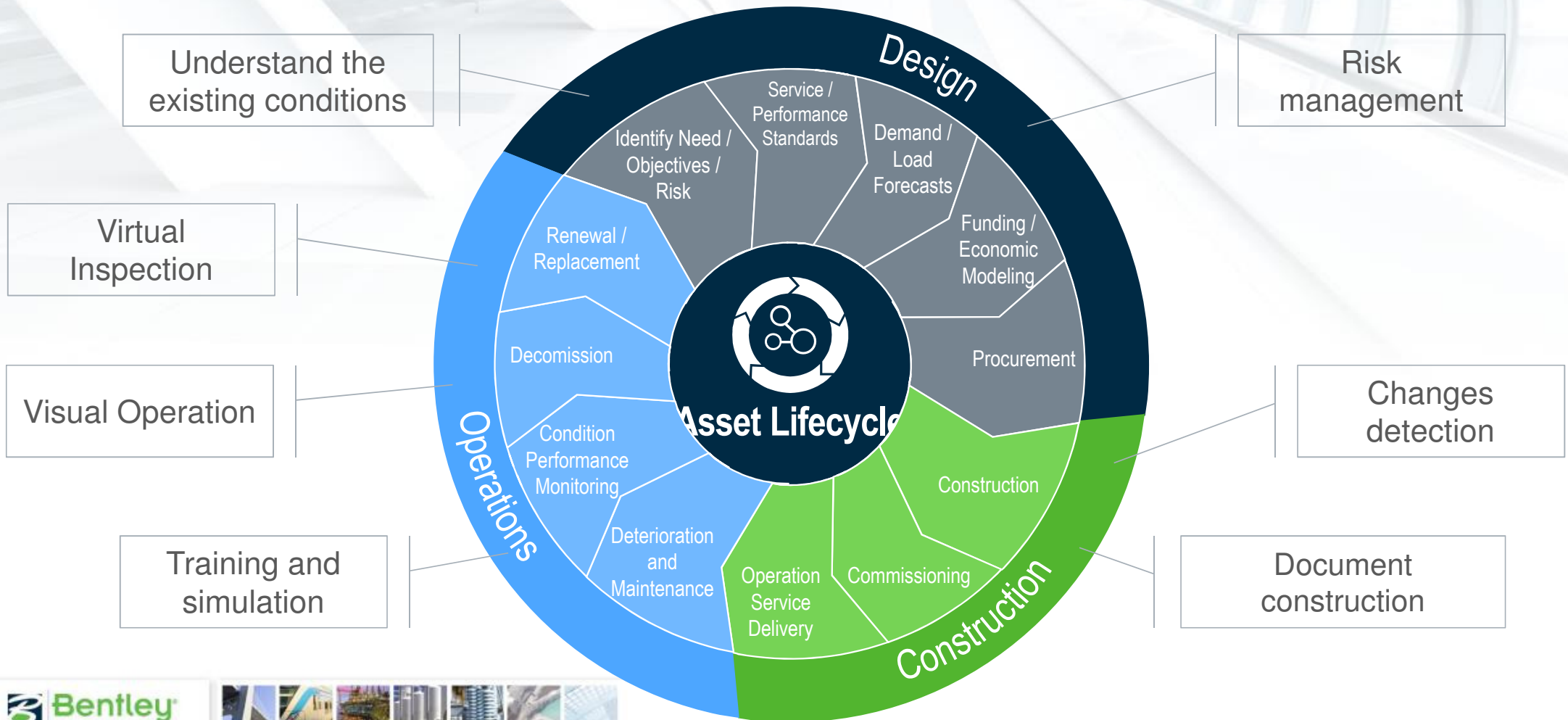
Capturing existing conditions in **3D using one or a combination devices.**
(UAVs, Handheld Camera, Laser Scanner)

to support different applications such as

**Mapping, Design, Construction, Inspection and
Asset Management**



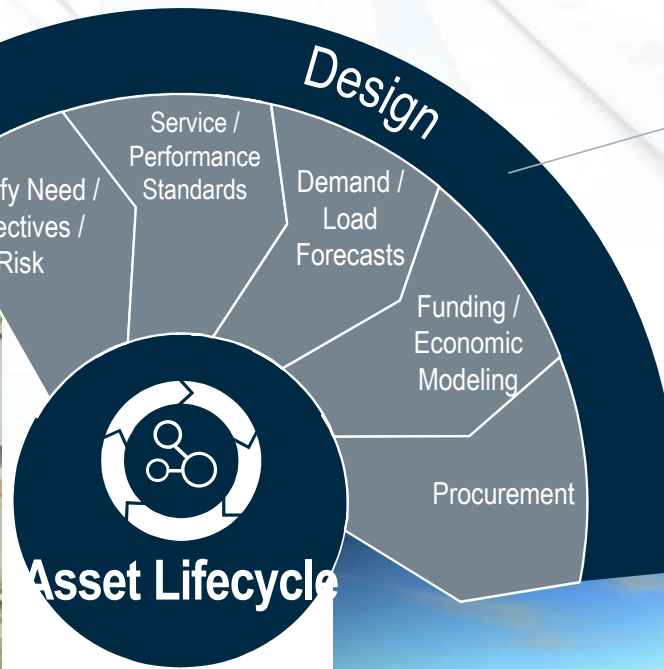
Why Model Reality?



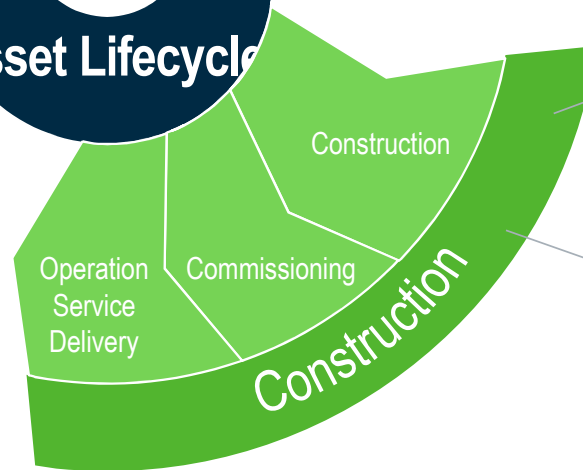
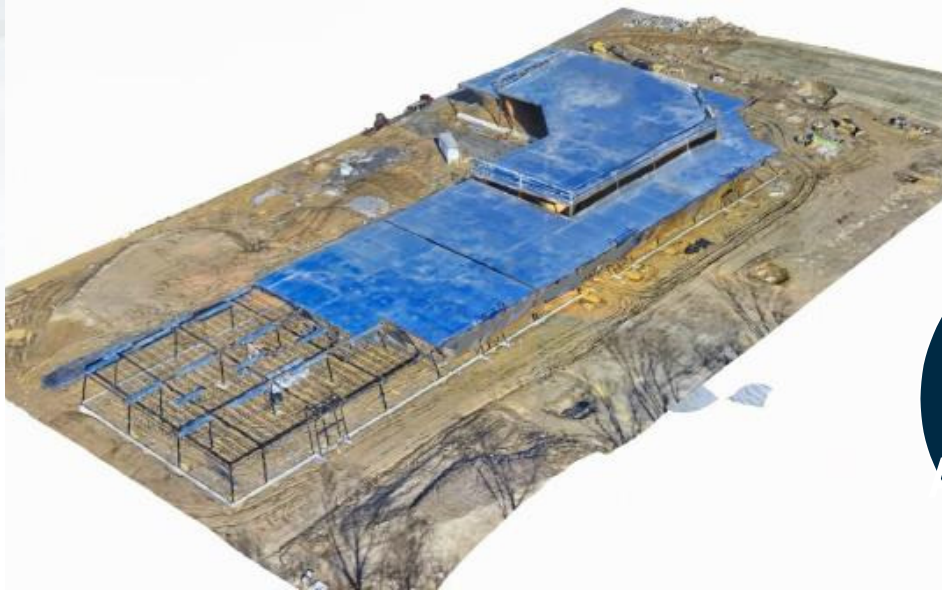
Why Model Reality?

Understand the existing conditions

Risk management



Why Model Reality?



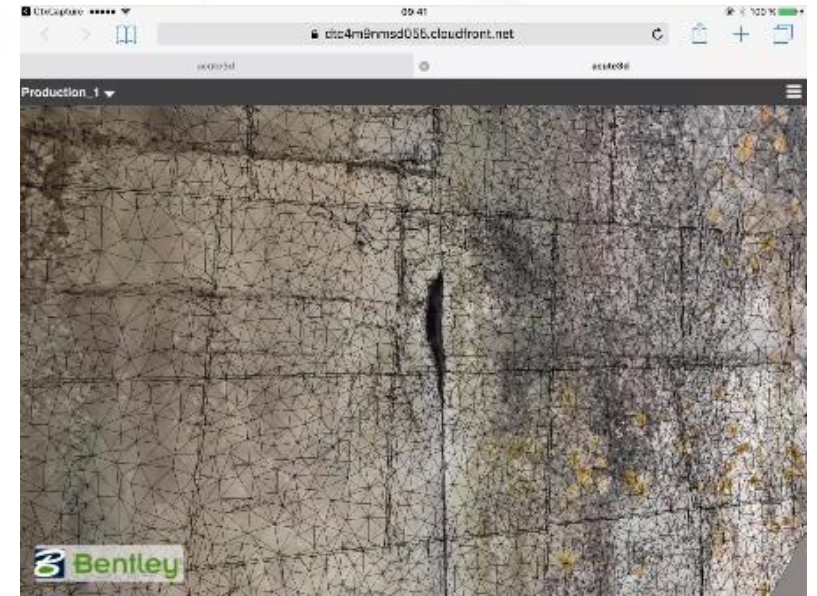
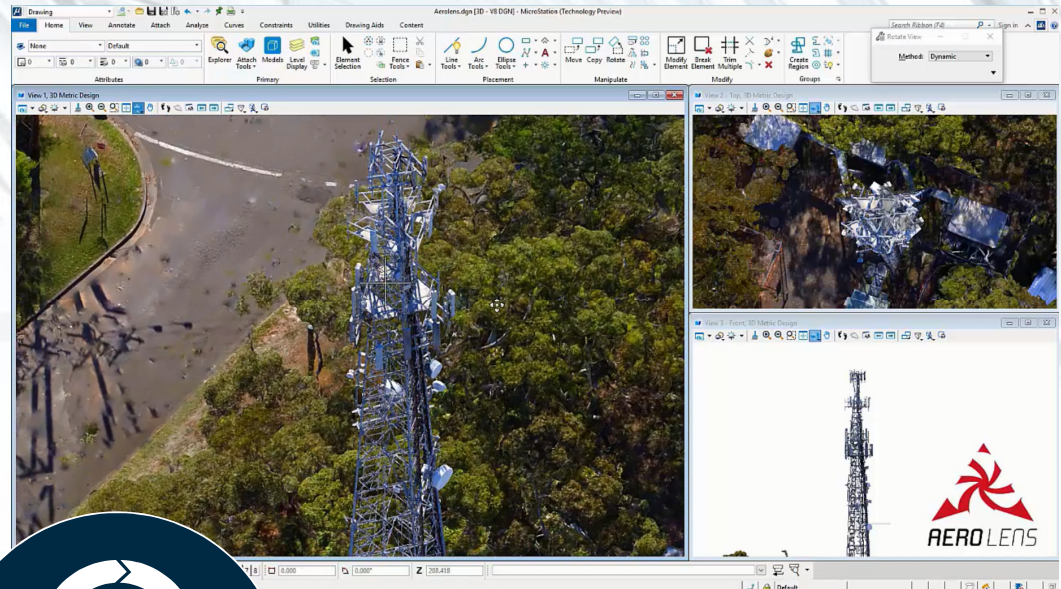
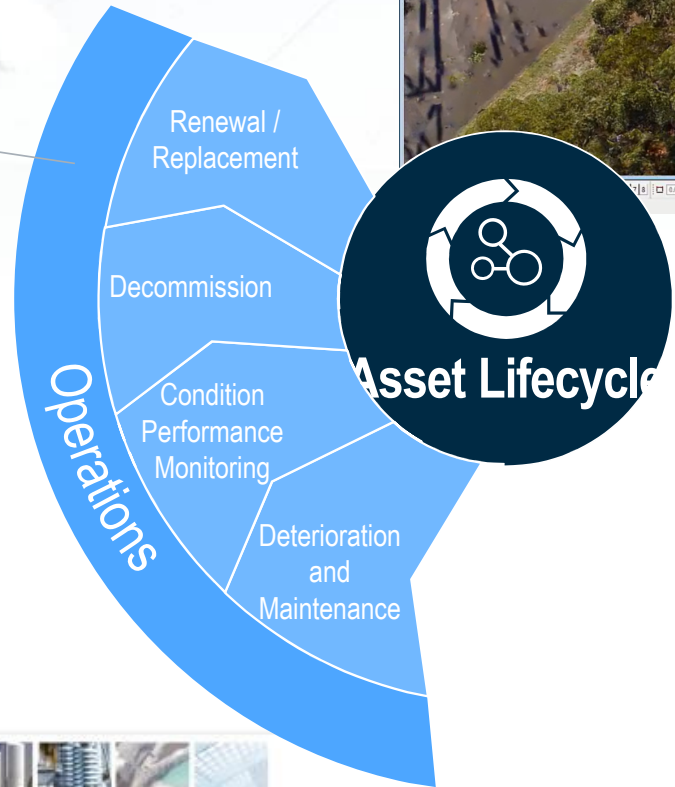
Changes detection

Document construction



Why Model Reality?

Virtual Inspection



Why Model Reality?



Unlimited Scalability



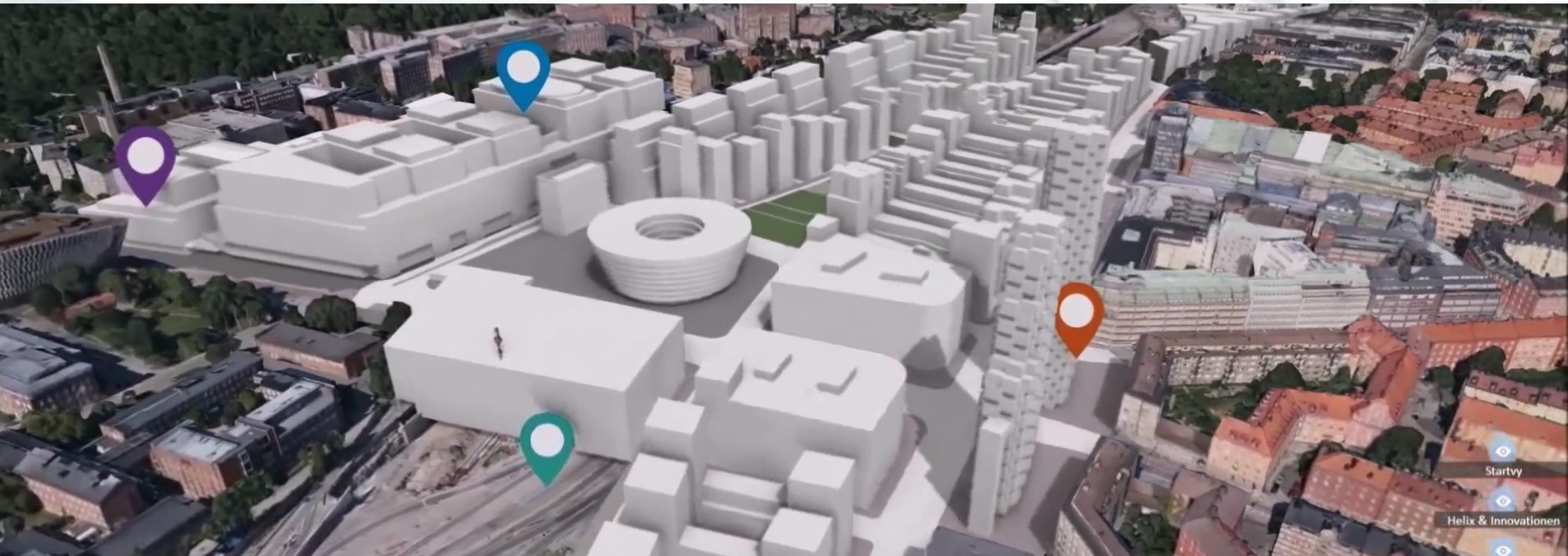
Example Aerial Models



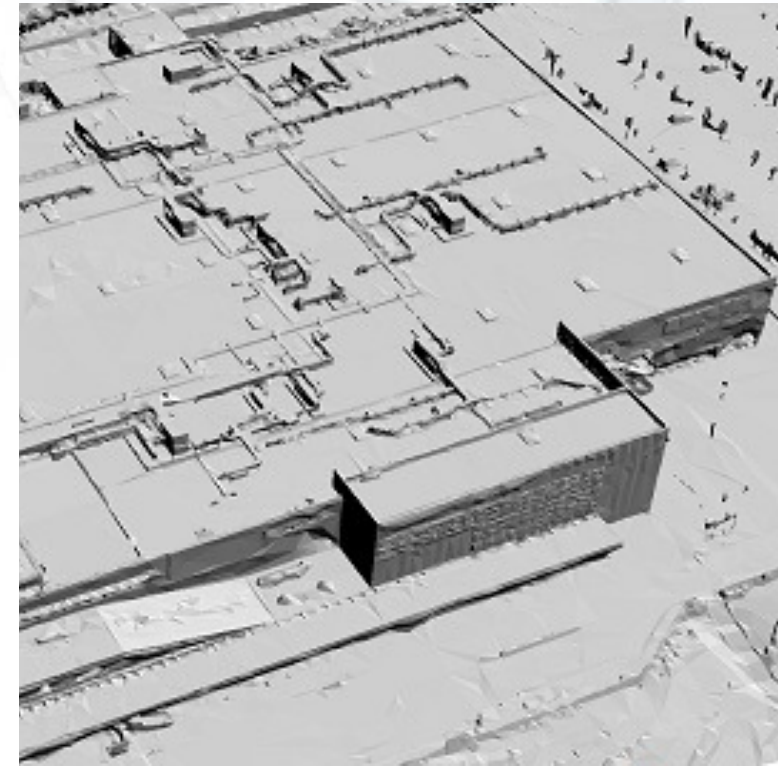
Infrastructure | Petrochemical Plant



Urban Planning | Aligning Conceptual Design With Reality



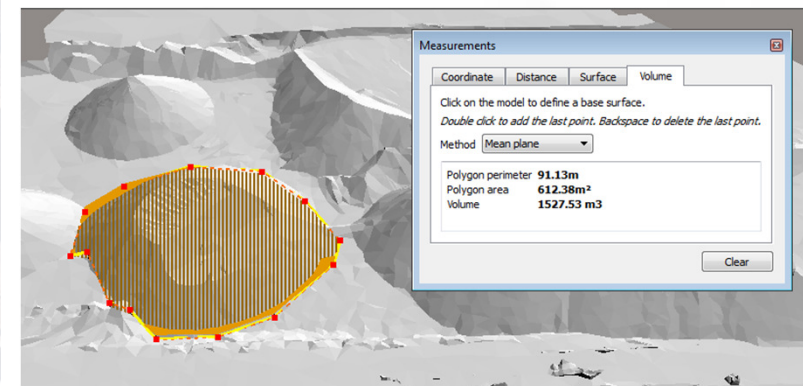
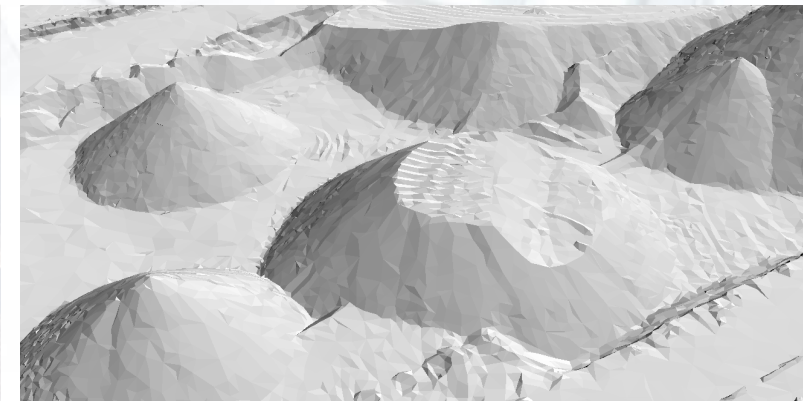
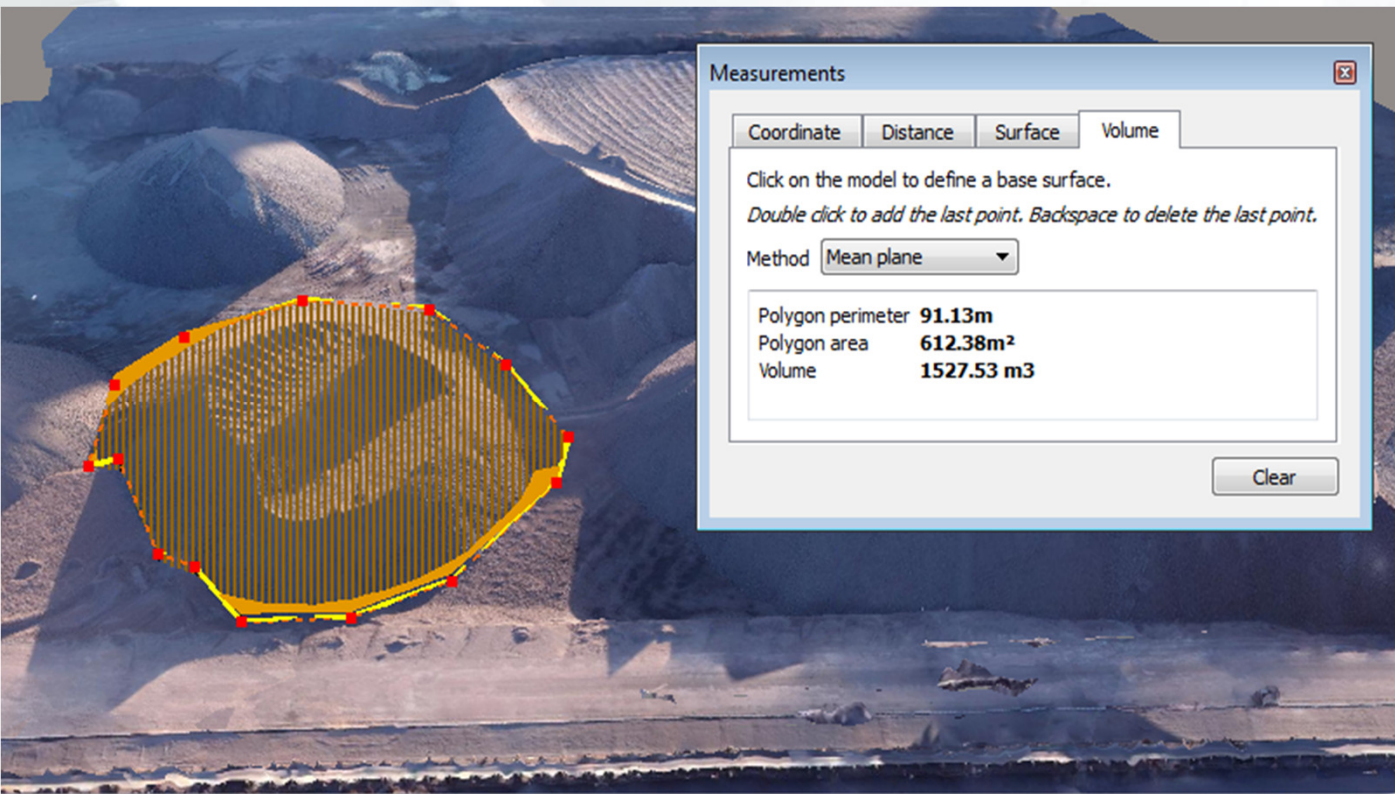
Surveying | Building Conditions and Roof Structures



Transportation | As-Built Structures Modeling



Surveying | Stockpile Volume Measurement



Communication | Illustration of Disaster Impacts



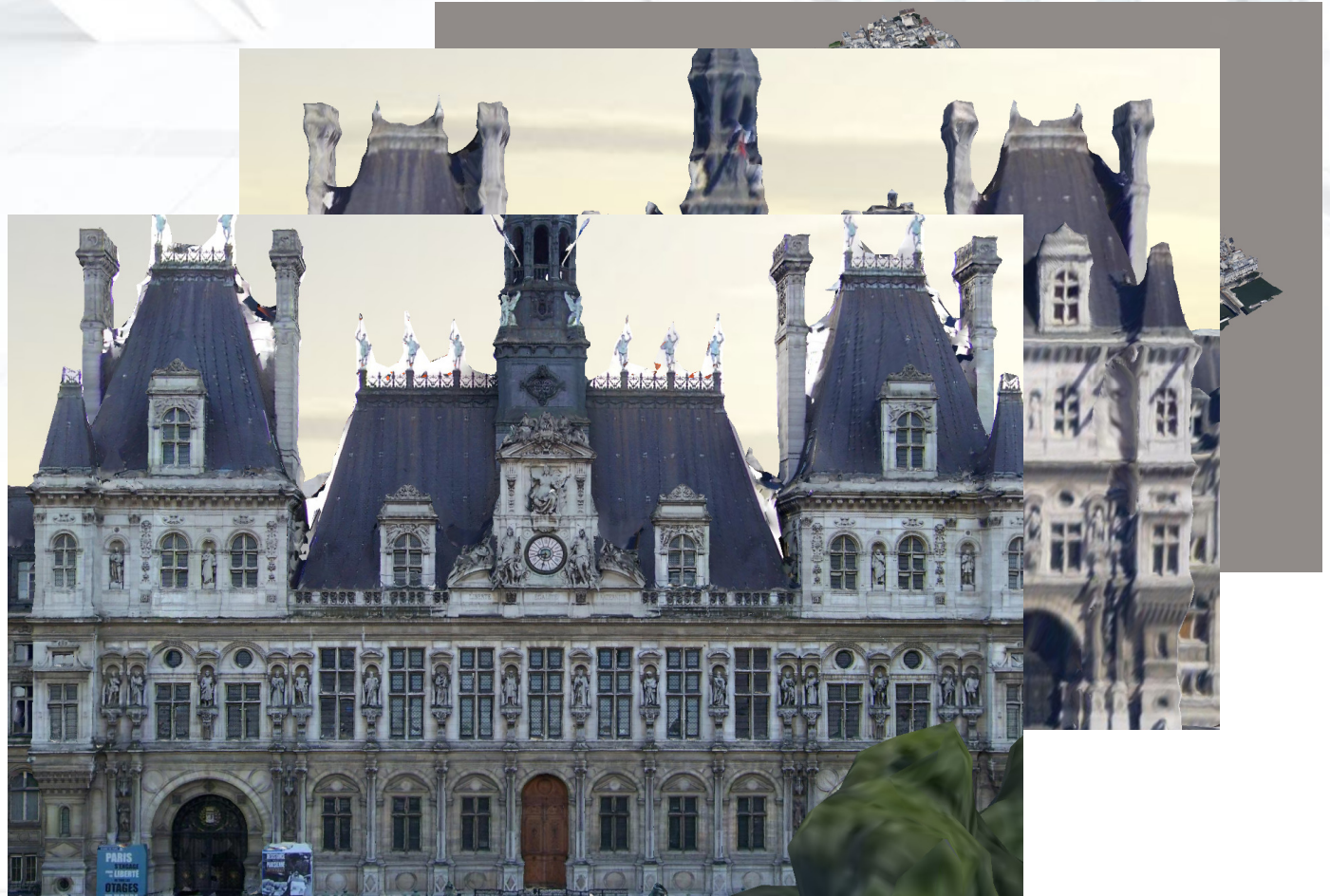
Mixing aerial and ground photography





The interest of the fusion

- Mixing dataset from different point of view
- Covering the model from all angles
- Mixing dataset at different resolution



Two workflows

- Workflow 1 : mixing dataset that are too different to be matched automatically.
- Workflow 2 : mixing dataset that are difficult to mix fully automatically.



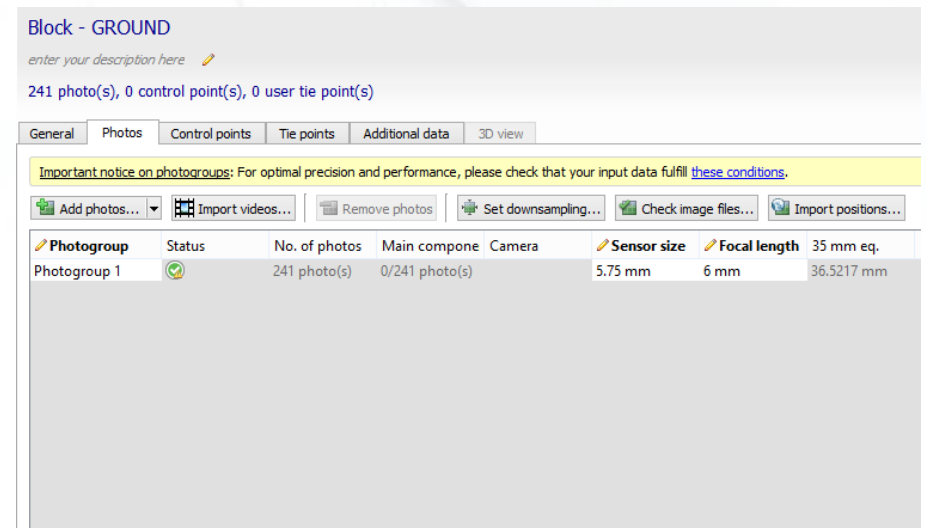
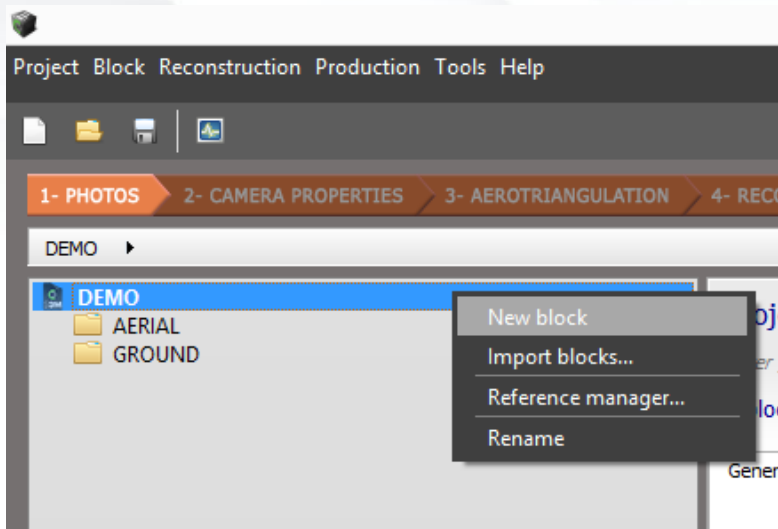
Two workflows

- **Workflow 1** : mixing dataset that are too different to be matched automatically
 - Create two independent blocks (or more) : Block_1 / Block_2
 - Process AT separately on each of this block.
 - Create user tie-points in Block_1 (at least 3). It should be visible in the photos of Block_2 as well.
 - Export the tie-point list in a txt file.
 - Import the tie-points as control points in Block_2
 - Perform the control points measurement in Block_2
 - Resubmit Block_2 AT and choose “use control points for rigid registration”
 - Merge both blocks
 - Create a reconstruction (adaptive tiling)
 - Submit production



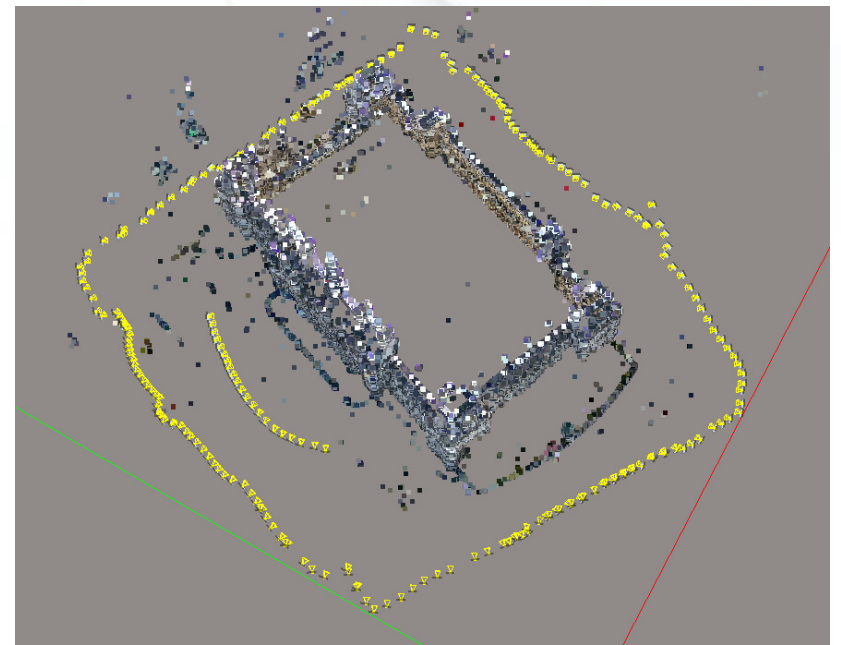
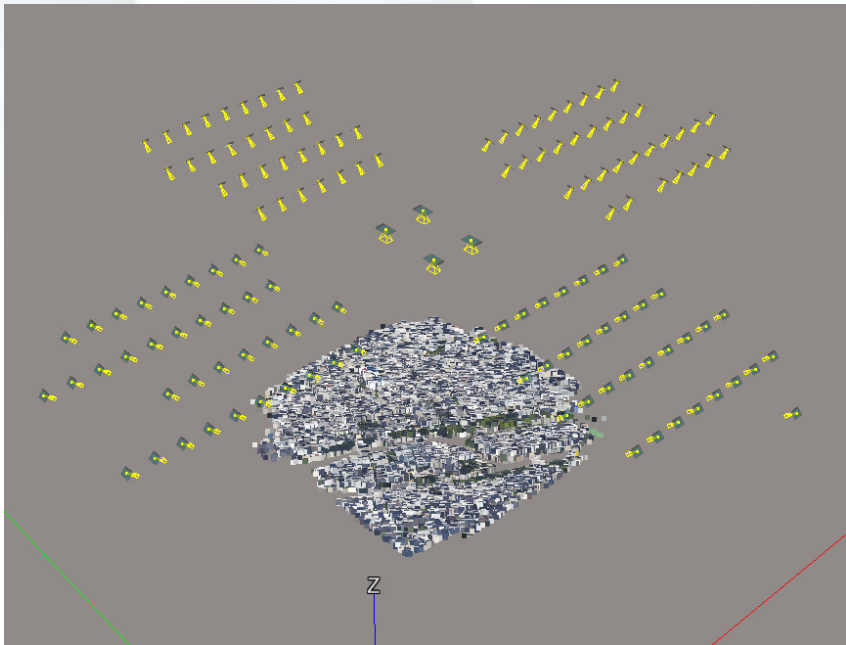
Workflow 1

- Create two independent blocks (or more) : Block_1 / Block_2



Workflow 1

- Process AT separately on each of this block.



Workflow 1

- Create user tie-points in Block_1 (at least 3). It should be visible in the photos of Block_2 as well.

User tie points editor

File Actions

User tie points

Spatial Reference System (SRS): WGS 84

Name	Longitude	Latitude	Ellipsoidal height	RMS of reproj. error [px]	RMS of dist. to rays [m]
User tie point #1	2.3517074	48.8559999	74.883	0.48	0.030
User tie point #2	2.3523182	48.8571079	74.915	0.70	0.050
User tie point #3	2.3526541	48.8557250	81.572	0.09	0.007
User tie point #4	2.3533559	48.8568607	76.938	0.48	0.031

Photos

Display photos: [That might view point] Display points: All Display hints: Yes

02_064000_31 02_064000_31 02_064000_31 02_064000_31 03_067000_41 03_067000_41 03_067000_41 03_067000_41 067_2193 067_2194 02_072000_56 02_072000_56

Measurements

Image	x	y	error
...TLEY_PROJECTS	6568.26	3265.06	0.
...TLEY_PROJECTS	2120.41	5492.31	0.
...TLEY_PROJECTS	1394.41	3519.35	0.
...TLEY_PROJECTS	1306.17	2262.51	0.

Statistics

All user tie points:

- number of points: 4
- RMS of reproj. error: 0.49 px
- RMS of dist. to rays: 0.034 m

Current photo:

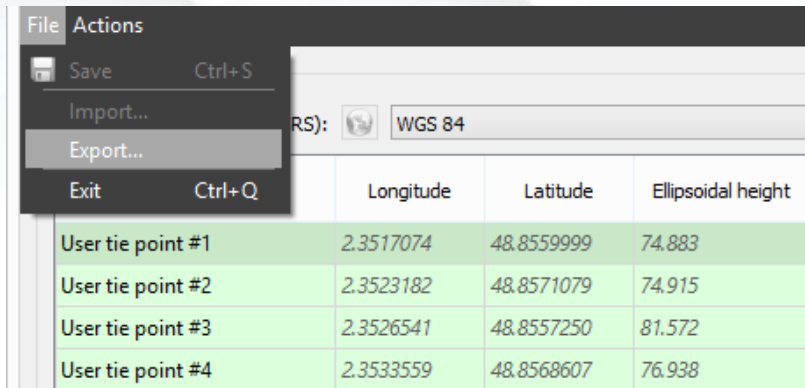
- number of usable measurements: 1
- RMS of reproj. error: 0.65 px
- RMS of dist. to rays: 0.039 m

Zoom: wheel ; ctrl ; +/- ; 0 | Move viewing area: click and drag | Add/Modify measurement: shift click | Quality=cached (Load original: 0)



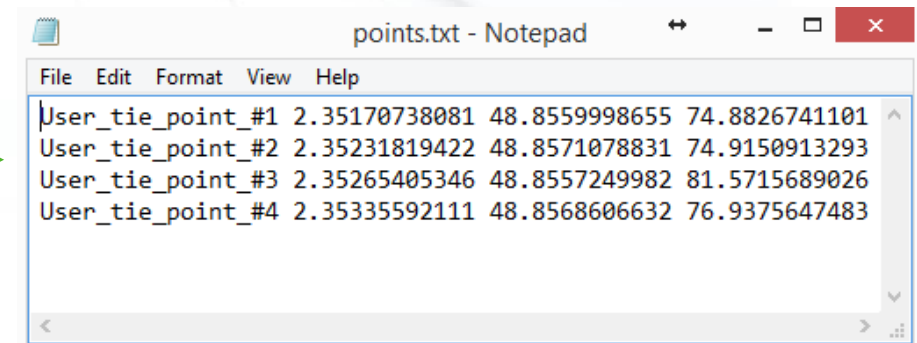
Workflow 1

- Export the tie-point list in a txt file.



The screenshot shows a software interface with a table of tie points. A 'File' menu is open, highlighting the 'Export...' option. The table has columns for 'Longitude', 'Latitude', and 'Ellipsoidal height'. The data rows are highlighted in light green.

	Longitude	Latitude	Ellipsoidal height
User tie point #1	2.3517074	48.8559999	74.883
User tie point #2	2.3523182	48.8571079	74.915
User tie point #3	2.3526541	48.8557250	81.572
User tie point #4	2.3533559	48.8568607	76.938



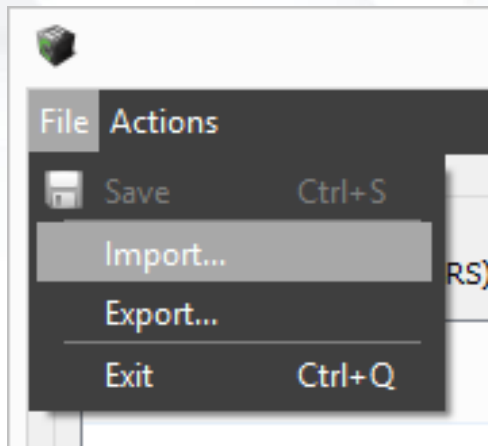
The screenshot shows a Notepad window titled 'points.txt - Notepad'. The text inside the window is the same data as the table in the previous screenshot, formatted as a text file.

```
File Edit Format View Help
User_tie_point_#1 2.35170738081 48.8559998655 74.8826741101
User_tie_point_#2 2.35231819422 48.8571078831 74.9150913293
User_tie_point_#3 2.35265405346 48.8557249982 81.5715689026
User_tie_point_#4 2.35335592111 48.8568606632 76.9375647483
```



Workflow 1

- Import the tie-points as control points in Block_2



Control points

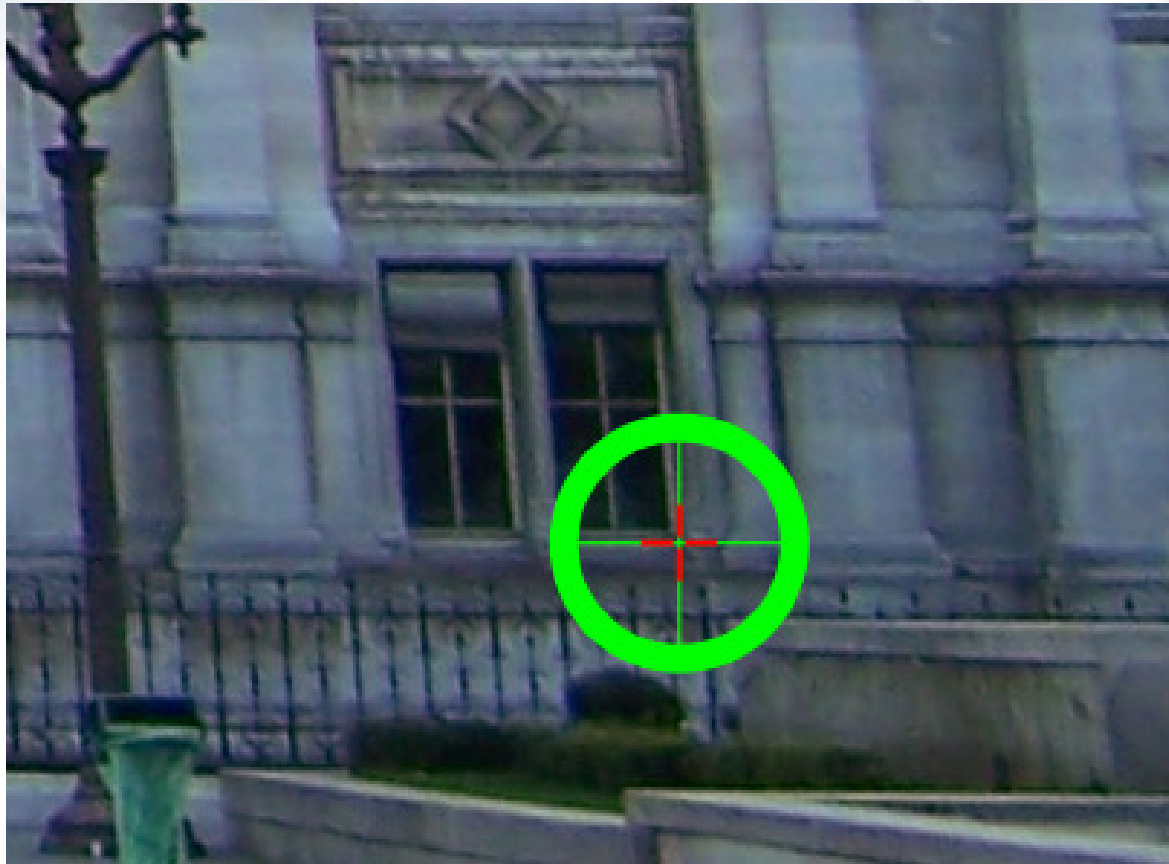
Spatial Reference System (SRS): WGS 84

Name	Category	Check point	Given Longitude	Given Latitude	Given Ellipsoidal height
Control point #1	Full	<input type="checkbox"/>	2.3517074	48.8559999	74.883
Control point #2	Full	<input type="checkbox"/>	2.3523182	48.8571079	74.915
Control point #3	Full	<input type="checkbox"/>	2.3526541	48.8557250	81.572
Control point #4	Full	<input type="checkbox"/>	2.3533559	48.8568607	76.938



Workflow 1

- Perform the control points measurement in Block_2



Workflow 1

- Resubmit Block_2 AT and choose “use control points for rigid registration”

Output block name

Components

Positioning/georeferencing

Settings

Positioning/georeferencing

Choose how the aerotriangulation should place and orient the block.

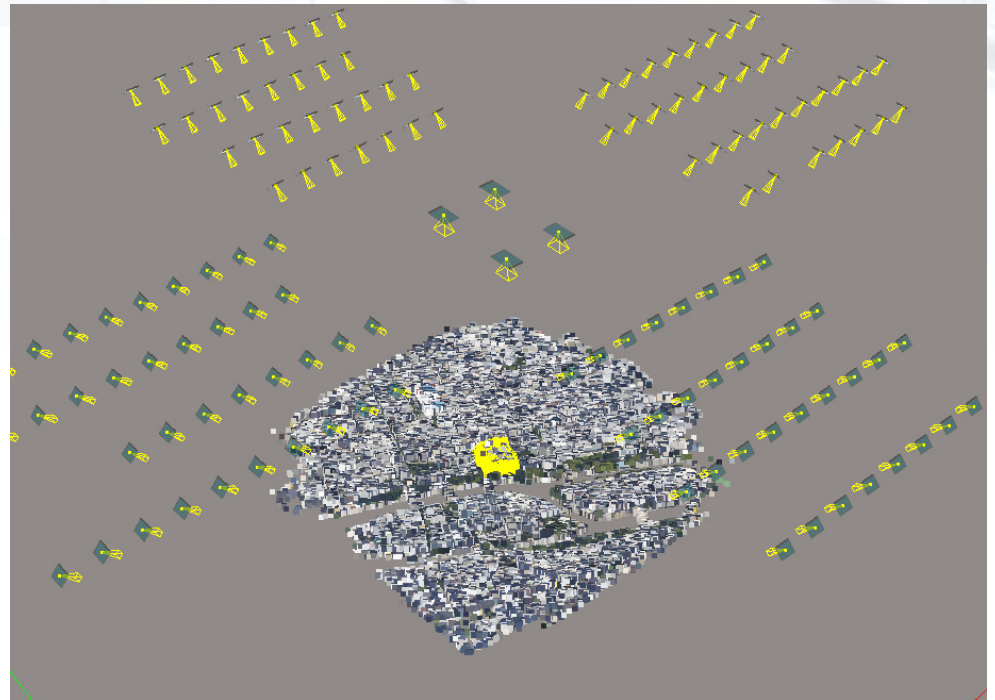
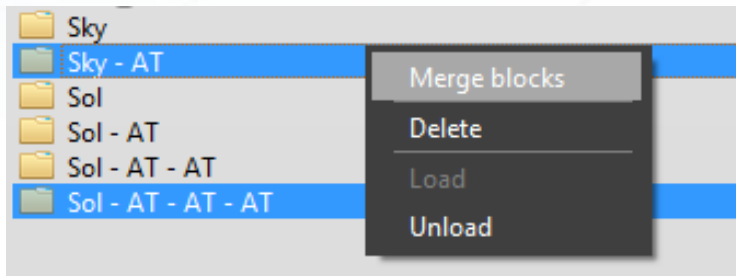
Positioning mode

- Arbitrary**
Block position and orientation are arbitrary.
- Automatic vertical**
The block vertical direction is oriented according to input photo orientation. Block scale and heading remain arbitrary.
- Use positioning constraints on user tie points**
The block is rigidly placed/oriented/scaled thanks to predefined constraints.
- Use photo positioning data for adjustment (3611/3611 photos have positioning data)**
The block is adjusted according to photo positions (advised with **accurate** positions).
- Use photo positioning data for rigid registration (3611/3611 photos have positioning data)**
The block is rigidly registered to photo positions (advised with **inaccurate** positions).
- Use control points for adjustment**
The block is accurately adjusted to control points (advised with **accurate** control points).
- Use control points for rigid registration**
The block is rigidly registered to control points without handling long-range geometric distortion (advised with **inaccurate** control points).



Workflow 1

- Merge both blocks



Workflow 1

- Create a reconstruction (adaptive tiling)

Tiling

Mode **Adaptive tiling** Adaptively subdivide reconstruction into boxes to meet target RAM usage.

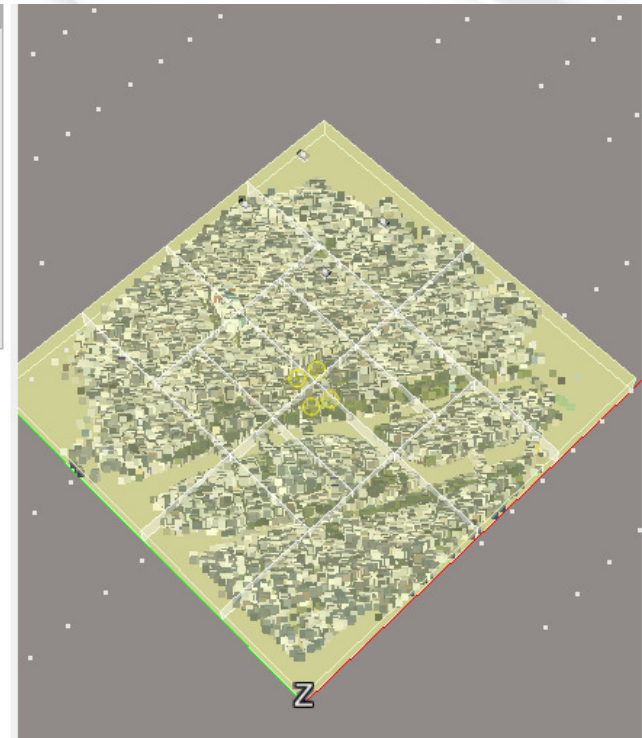
Options

Target RAM usage GB

Discard empty tiles

Overview

The tiling contains **16 tile(s)**
Expected maximum RAM usage for a job: **15 GB**



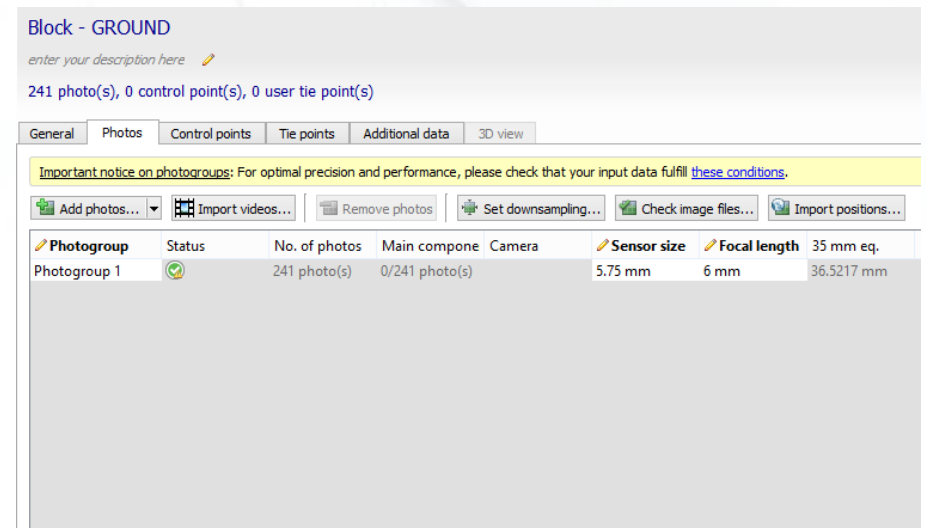
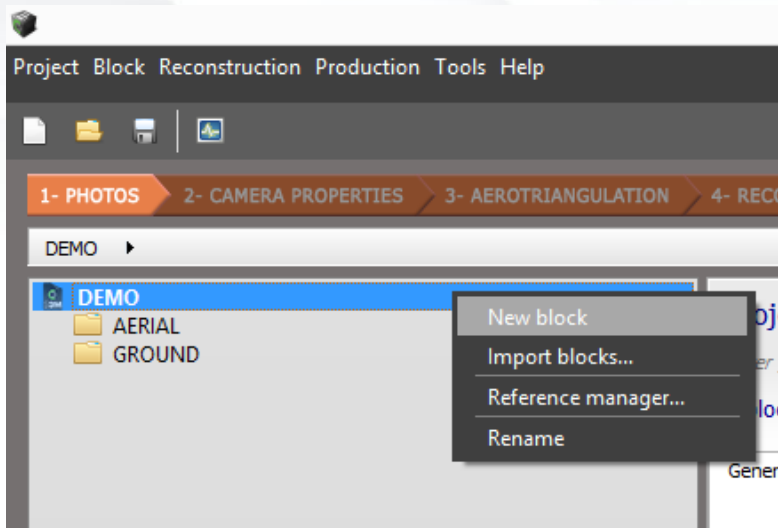
Two workflows

- **Workflow 2** : mixing dataset that are difficult to mix fully automatically
 - Create two independent blocks (or more) : Block_1 / Block_2
 - Process AT separately on each of this block.
 - Geo-reference both blocks separately (GPS tags, control points, control points extracted from one block using tie-points).
 - Merge both blocks
 - Set the block type to “structured aerial dataset”
 - Submit a new AT of the merged block
 - Create a reconstruction (adaptive tiling)
 - Submit production



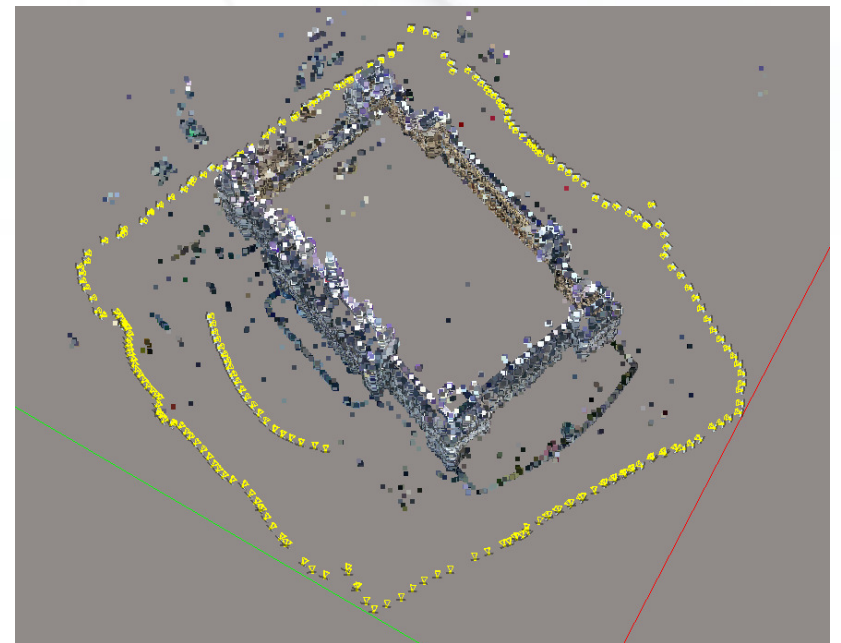
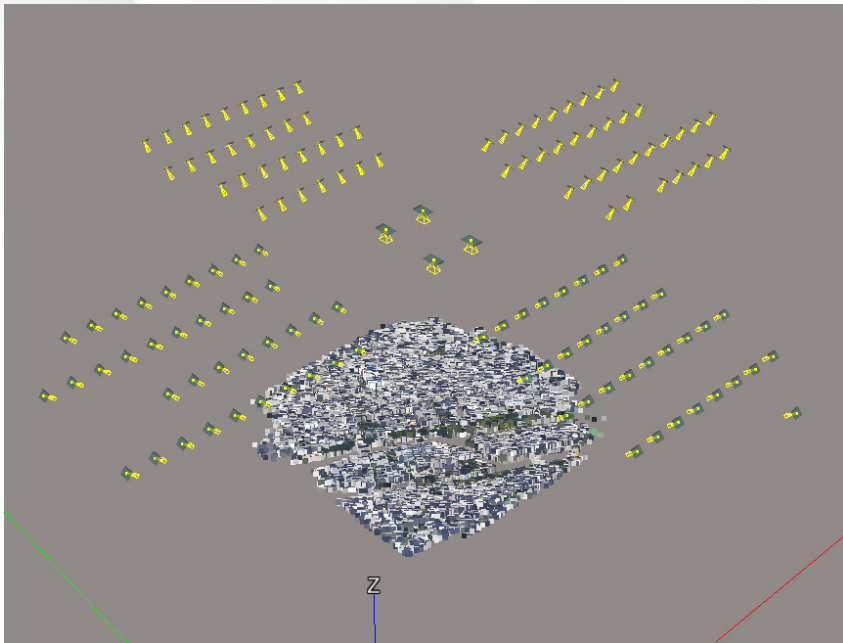
Workflow 2

- Create two independent blocks (or more) : Block_1 / Block_2



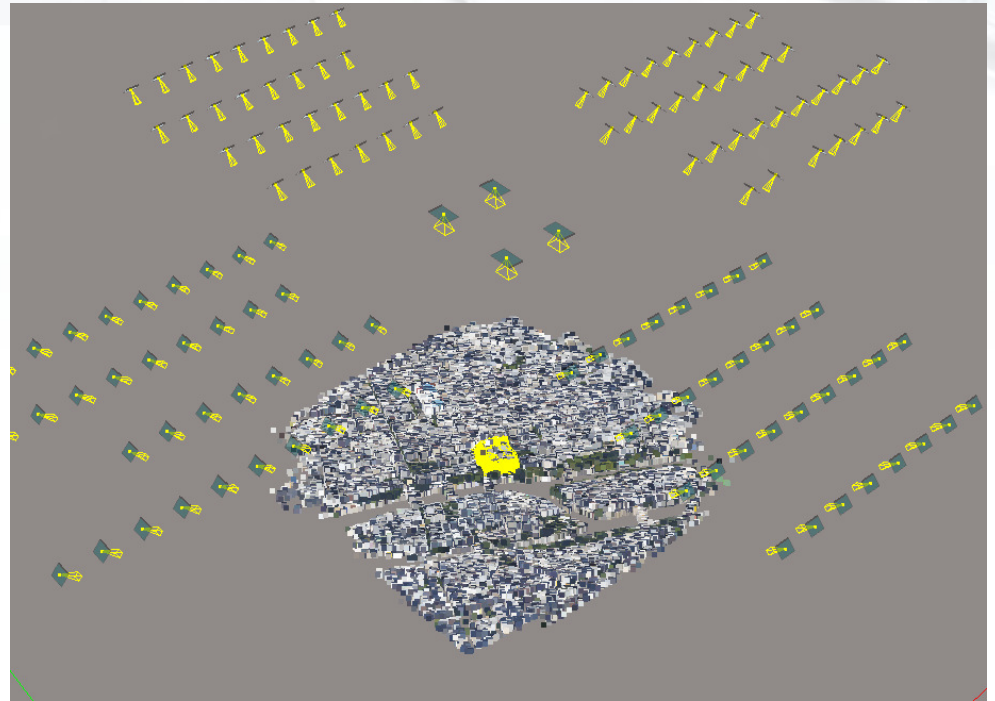
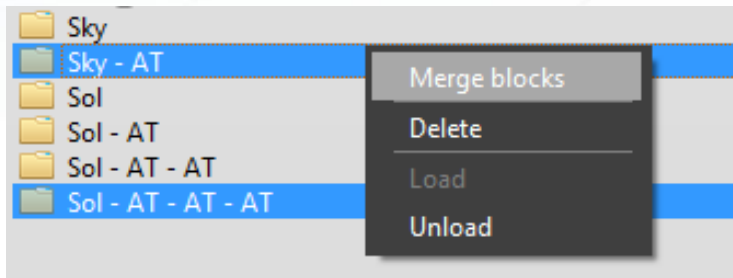
Workflow 2

- Geo-reference both blocks separately (GPS tags, control points, control points extracted from one block using tie-points).



Workflow 2

- Merge both blocks



Workflow 2

- Set the block type to “structured aerial dataset”

General Photos Point clouds Surveys **Additional data** 3D view

You can specify here additional knowledge on the acquisition in order to help the aerotriangulation.

Block type: Structured aerial dataset with vertical and oblique views.

Minimum viewing distance: meters Leave this field empty if unknown.

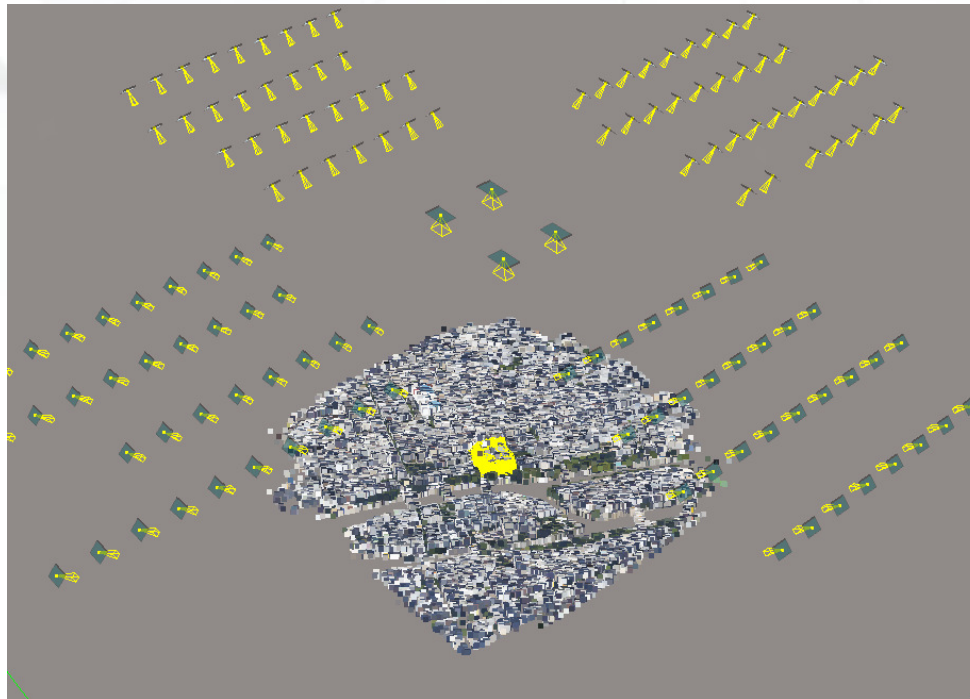
Maximum viewing distance: meters Leave this field empty if unknown.

When a block type is set to structured aerial data and all the photos have position and rotation information, a **tilt ratio** is applied to help the keypoint matching of oblique and Nadir photos. Oblique photos will be shrunk so that the horizontal surfaces will be similar to the nadir photos.



Workflow 2

- Submit a new AT on the merged block



Workflow 2

- Create a reconstruction (adaptive tiling)

Tiling

Mode **Adaptive tiling** Adaptively subdivide reconstruction into boxes to meet target RAM usage.

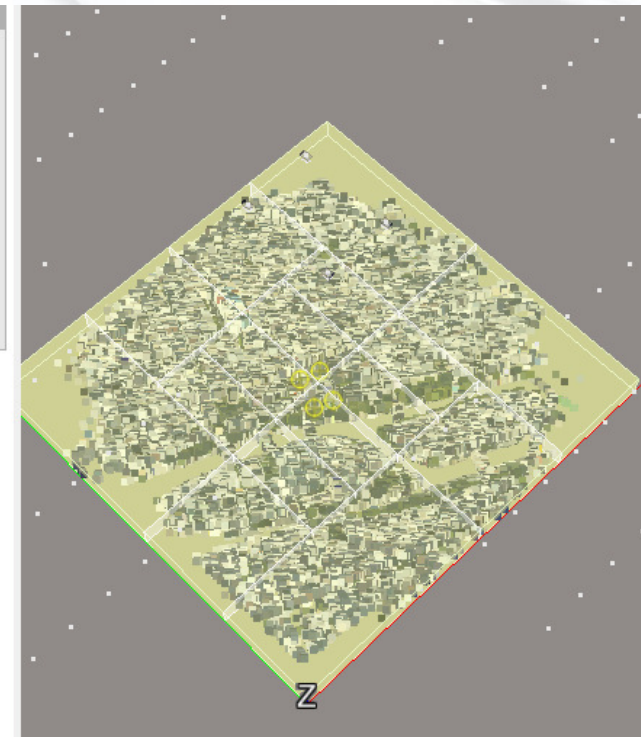
Options

Target RAM usage GB

Discard empty tiles

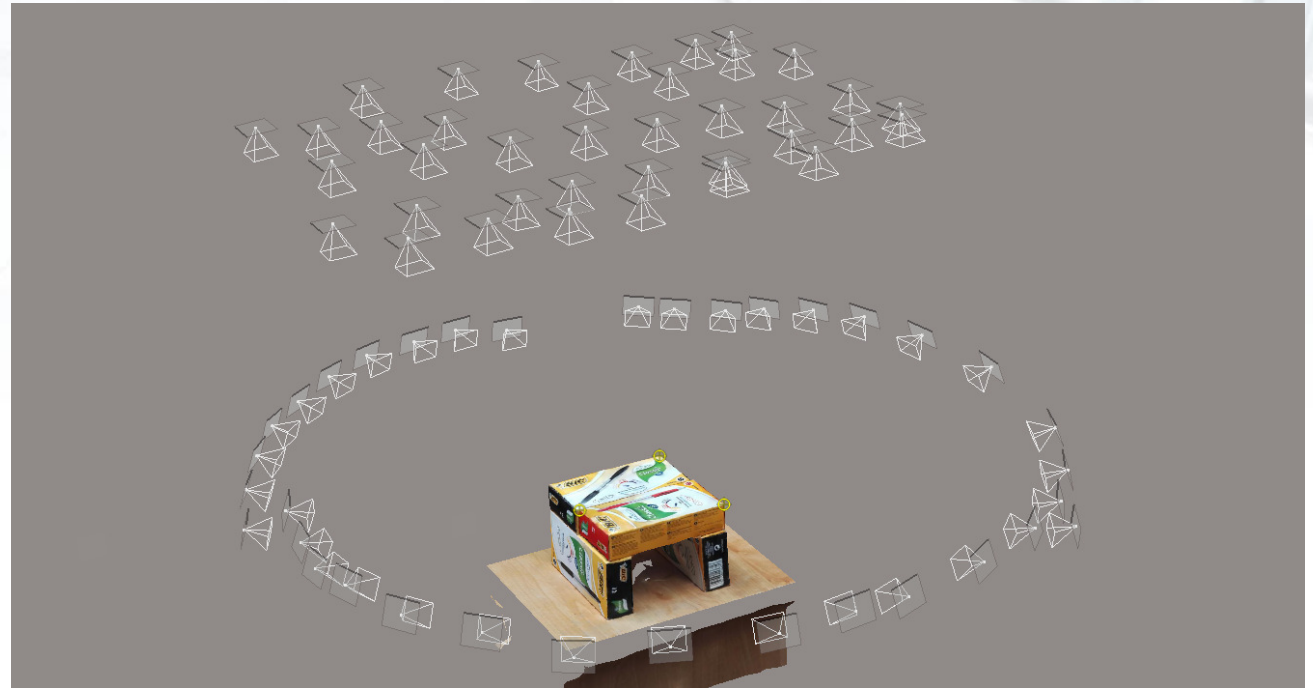
Overview

The tiling contains **16 tile(s)**
Expected maximum RAM usage for a job: **15 GB**



Workflow 2

- Submit production



Demo



Any questions?



