VFW

Technical Guidelines

On the excavation site (for diggers)

0. Removal of the previous unit.
1. New Stratigraphic Unit (US = “Unità Stratigrafica”) identification.
2. Open a new US sheet and assign a new US identification number (ID) from the **Master Unit List**. Take the first free number.
3. Carefully clean and prepare the layer for documentation. Consult with the field director.
4. **Photographic documentation:** Place the blackboard, the North arrow and the scale on the ground within or in proximity of your unit. Take your photos according to the **Guidelines for the Digital Recording System §3**. Fill both the **Photo List** and the US sheet with the reference numbers of your photos.
5. **Total station survey:** Draw in plan a polygonal shape by means of the total station following the US contours. Enter the proper name for each point (e.g. “US40.1”; “US40.2”; “US40.3”; etc.).
6. Take the minimum, the maximum and additional elevation values by means of the total station. Enter the proper name for each elevation point (e.g. “US40.Qmin”; “US40.Qmax”; “US.Q1”; “US.Q2”; “US.Q3”; etc.). Fill the US sheet with minimum and maximum elevation values together with length and width values.
7. If significant X finds are visible, nail a label to the ground in proximity of the objects and measure the point with the total station. Name properly your X finds (e.g. “US40.X1”).
8. Prepare the bag for your finds, if any, and fill correctly the label according to the **Guidelines §4**.
9. **Photogrammetric survey:** Remove all the objects from the ground (blackboard, arrow and scale) and call the surveyor for the photogrammetric survey. If needed, the surveyor will place additional ground control points (GCPs), nailing small checkerboard targets to the ground (see figure below). Remember to include any new GCP target when making measurements by means of the total station. Enter the code “M” followed by the number visible on the target (e.g. “M69”; “M70”; “M71”; etc.). GCPs numbers must be unique for the entire excavation year. Already placed targets should not be reused!

10. Finish removing your unit and complete the US sheet according to the **Guidelines §2**.
11. Resume from point 1.

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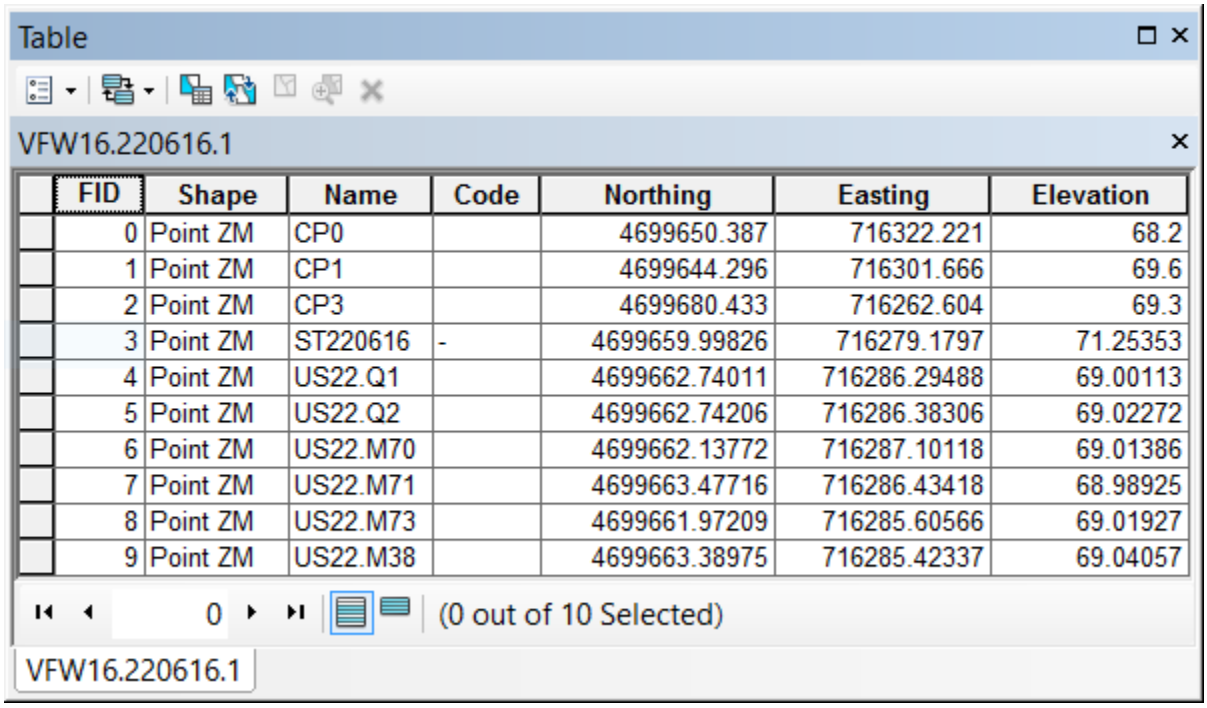
Post-excavation (for diggers)

1. **GIS editing:** Open the local ArcGIS Project that you find on the tablet desktop. Make sure that it is the one named with the current year and the tablet name (e.g. VFW18_GISMontelius).
2. Import your points from the total station.
3. Right click on the newly added layer (which should have the name "VFW[yy].[ddmmyy].[n]") in Table of Contents and select the **Attribute Table**:



FID	Shape	Name	Code	Northing	Easting	Elevation
0	Point ZM	CP0		4699650.387	716322.221	68.2
1	Point ZM	CP1		4699644.296	716301.666	69.6
2	Point ZM	CP3		4699680.433	716262.604	69.3
3	Point ZM	ST220616	-	4699659.99826	716279.1797	71.25353
4	Point ZM	US22.Q1		4699662.74011	716286.29488	69.00113
5	Point ZM	US22.Q2		4699662.74206	716286.38306	69.02272
6	Point ZM	US22.M70		4699662.13772	716287.10118	69.01386
7	Point ZM	US22.M71		4699663.47716	716286.43418	68.98925
8	Point ZM	US22.M73		4699661.97209	716285.60566	69.01927
9	Point ZM	US22.M38		4699663.38975	716285.42337	69.04057

4. Edit your **Single Context Plan** in the proper shape file layer: Related points are named:
   - **UnitFootprint** (Shapefile Feature Class: **Polygon ZM**) US[id].[n]
   - **Unit_ Details**_Lines (Shapefile Feature Class: **Polyline**)
   - **Unit_Elevation** (Shapefile Feature Class: **Point**) US[id].Q[n]
   - **X-finds** (Shapefile Feature Class: **Point**) US[id].X[n]
5. Each shape file layer has preset attribute fields that need to be filled in by the excavator as they are digitized:

Unit Footprint:

- **UnitNo** [id]
- **Excavated** Yes/No/Partial
- **Notes** [Unit interpretation]
- **Phase** [ ]
- **Source** [Photo source file name]

Unit_Details_Lines:

- **UnitNo** [id]
- **Type** Ext/LOE/TR/SL/IS

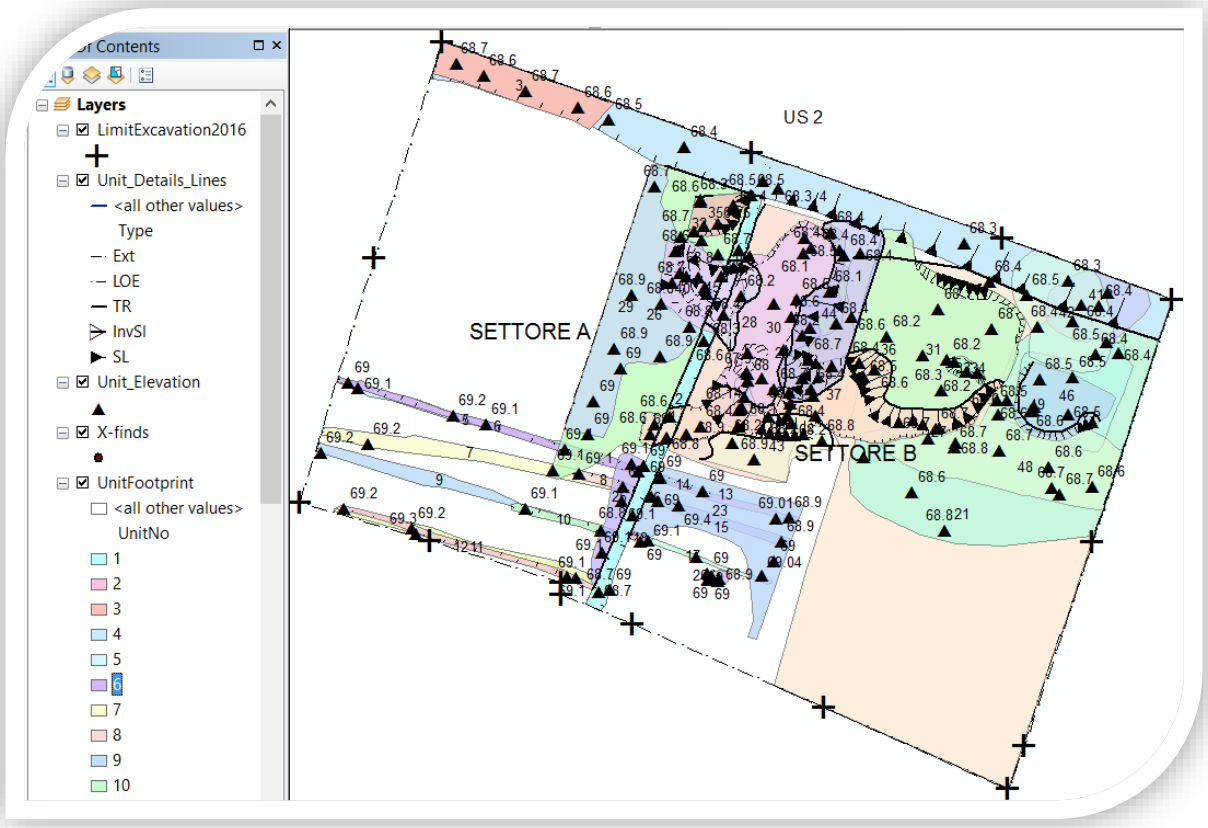
Unit_Elevation:

- **UnitNo** [id]
- **Elevation** [Meters ASL, (Precision .00)]

X-finds:

- **UnitNo** [id]
- **Type** Bead/Blade/Worked bone/etc.

6. Each shape file has a different line style or hachures according to the drawing conventions:
   - Ext Extent of Unit
   - LOE Limit of Excavation
   - TR Truncation
   - SL Slope
   - IS Inverted Slope



7. Import the US Orthophoto and DEM layers as provided by the surveyors. Adjust and refine your UnitFootprint shape file on the base of the Orthophoto. Adjust and refine your slope hachures on the base of the DEM.
8. Alternatively to point 7, export your UnitFootprint shape file in ESRI .shp format.
9. Run PhotoScan and open your US photogrammetric 3D tiled-model as provided by the surveyors.
10. Import your UnitFootprint shape file (Main toolbar: Tools/Import/Import shapes …)

11. Make sure that the view is set on **Orthographic** and **Top** view (Main toolbar: View/Orthographic (or press "5" on the keyboard); View/Predefined Views/Top (or press "7" on the keyboard). You should see the shape file matching the 3D model.
12. Adjust and refine the shape file on the base of the photogrammetric tiled model. Make sure to move every single vertex of your polygon in order to project it onto the model surface. Right click on a segment and select **Insert** / **Delete Vertex** in order to add or remove vertices. You can rotate or pan the model while drawing using the mouse right and central buttons.

13. When done, export the following files from PhotoScan into the VFW2017 geodatabase (Main toolbar: File/Export Orthomosaic/Export JPG/TIFF/PNG…; Export DEM/Export TIFF/BILL/XYZ…; Tools/Export/Export Shapes…):

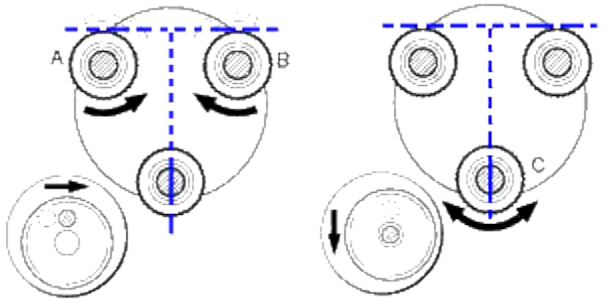
The US **orthomosaic**	**"**US.[id]_Ortho".tif
The US **DEM**	**"**US.[id]_DEM".tif
The US refined **shape file**	**"**US.[id]".shp

    Make sure that the names of these files match the unique US number (id). Do not save the files with the original multiple-USS name as provided by the surveyors (e.g. "US.-36" and not "USS.-34.-36.37.38")! Always export in TIFF format and in WGS84 UTM 32N coordinates.

14. Save the entire US chunk into the VFW2017 geodatabase.
15. Complete your US sheet with the drawing references and submit.

Total station: Setup (for topographers)

1. Firmly place the tripod in a proper location alongside the excavation boundaries and gently push the bottom of the legs of the tripod into the ground to give extra stability.
2. Mount the station on the tripod and level the instrument by adjusting the legs length and by operating leveling screws:



3. Turn on the station and the radio controller (check batteries and antennas).
4. Select **Jobs/New Job**:
    - Job name: "VFW[yy]_[ddmmyy].[n]" (e.g. "VFW17_210617.1")
    - Precision: Scale 1.0000000000
    - Units: Meters
    - Linked files: Add/Vulci3000/**CP1-3**
5. **Accept**.
6. Select **Measure/VX& S Series/Resection:**
7. Precision levelling (keep it within .03).
8. Station point:
    - Instrument Point Name: "ST[ddmmyy].[n]" (e.g. "ST210617.1")
    - Code: "_"
    - Instrument height: 0
9. **Accept**.
10. Select the first point from **List** (stored in CP1-3 file):
    - Point name: **CP0**
    - Target height: 2m (or whatever the prism pole is)
    - Method: Angles and distance.
11. Place the prism pole on the control point 0 and select **Measure**.
12. Select the second point from List:
    - Point name: **CP1**
13. Place the prism pole on the control point 1 and select **Measure**.
14. Check the accuracy of Horizontal, Vertical, and Standard Deviation (ΔHA-ΔVA-ΔSD). Accept the result only if the error is below 0.005 m.
15. Select **+ Point** and select the third point from the List:
    - Point name: **CP3**
16. Place the prism pole on the control point 3 and select **Measure**.
17. If out of tolerance, Reselect CP3, select **Use/Back/+Point** and measure the point again.
18. **Check results** (σ Easting and σ Northing must be ≤ .005) and **store** (You should hear "Resection setup complete").

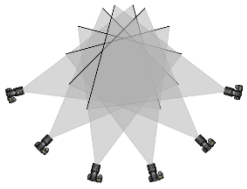
Total station: Topographic Survey (for diggers)

1. Select **Measure/Measure topo**.
2. Enter the appropriate name:
    - Point name: “US[id].[n]” (e.g. US68.1) for polygon vertices.
    - Point name: “US[id].Q[n]” (e.g. US68.Q1) for elevations.
    - Point name: “US[id].X[n]” (e.g.US68.X1) for X finds.
    - Point name: “M[target n]” (e.g. M291) for GCP targets.
3. **Measure**.
4. **Store** and continue collecting points …
5. Select **Measure/End Conv. Survey** when the entire job is finished (usually at the end of the day).
6. Select **Jobs/Import-export:**
    - File format: ESRI Shape file
    - Coordinates: Grid
7. **Export**.

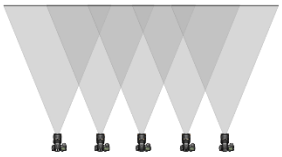
Photogrammetric survey, Photo shooting (for 3D surveyors)

1. Spending some time planning your shot might be very useful.
2. More photos is better than not enough, you will not have a second chance to take additional photos after the US is removed.
3. Set your cameras parameters in a way that proves optimal for photogrammetric acquisition.
4. Employ a camera with 5Mpx resolution at least. To produce professional quality ortho photomaps, it is better to opt for 12Mpx resolution photography.
5. Fixed lens are preferred. If zoom lens are used, focal length should be set either on maximal or minimal value.
6. Using RAW data losslessly converted to the TIFF files is preferred, since JPG compression induces unwanted noise to the images.
7. Minimal possible ISO value should be used. High ISO values will induce additional noise.
8. Shutter speed should be fast enough to prevent blur caused by possible movements.
9. Before shooting, perform the **white** (or gray) **balancing** using a checker card (picture below). In alternative, use a perfectly white sheet and make sure that it is clean and nor wrinkled. Digital cameras have a custom white balance (WB) feature in the white balance menu. Place the card (or the sheet) directly under the sunlight so that no shadows are cast on it. The card has to be large enough so that you can fill the frame when taking your custom WB reading in camera. Read the camera manual on how to set custom white balance in camera. WB readings must be taken before a shooting sequence and every time when light conditions change. If small cumulus clouds are casting shadows, try to linger a bit to let them pass away before resuming shooting.

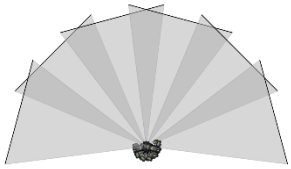
10. Make sure to identify or place on ground markers that will be used to set reference coordinate system and scale. The small number should be clearly visible at least in two images. Take a couple of photos from close enough to ensure their visibility.
11. Plan a shooting path in a way to cover the entire surface of your subjects. Keep a record of it (a sketch, for instance) if necessary.
12. When shooting provide the necessary **overlap** (~60%) and **parallax**. Capture most important scene content from multiple viewpoints (3 or more). Use a ladder if necessary.



Convergent
(Good for free standing objects)



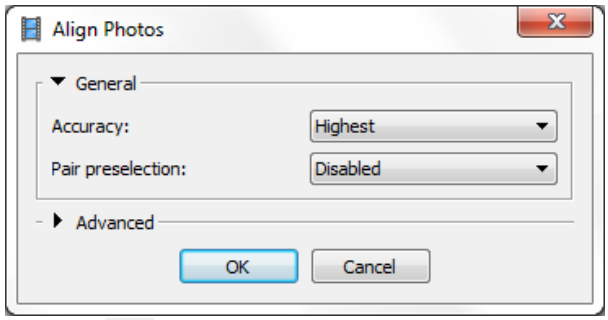
Parallel
(Good for flat surfaces)



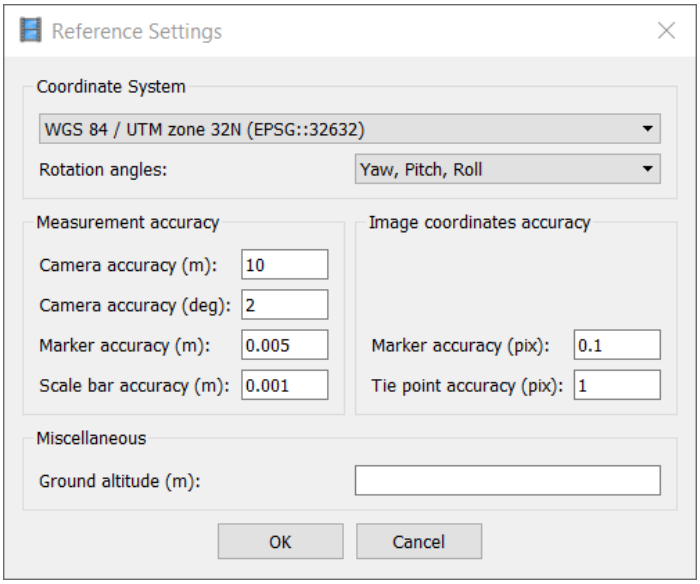
Divergent
(Bad, no parallax)

Photogrammetric survey, Processing (for 3D surveyors)

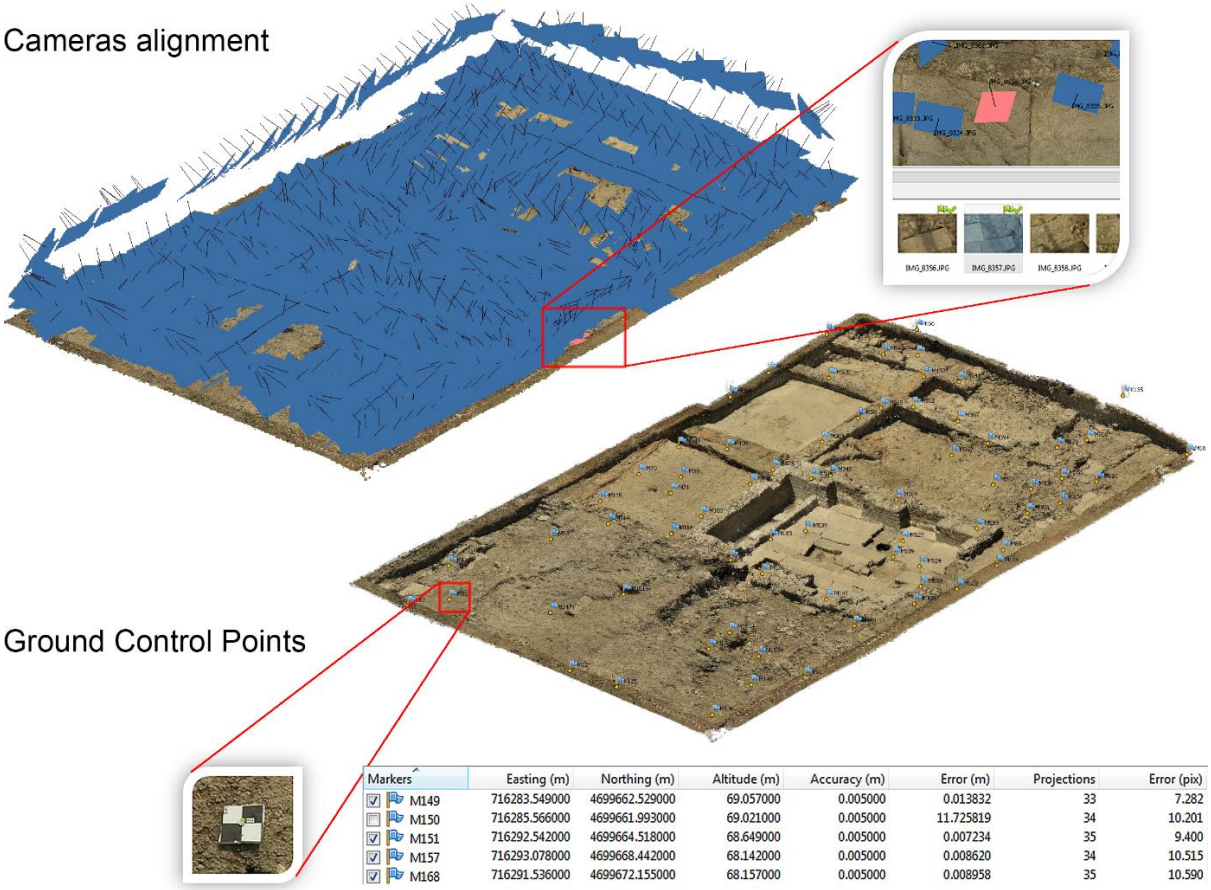
1. Upload the photos in PhotoScan and save the project using the name of all the USS included (e.g. "USS.-34.-36.37.38"). Do not crop or edit the images in a digital image processing software!
2. Align photos:



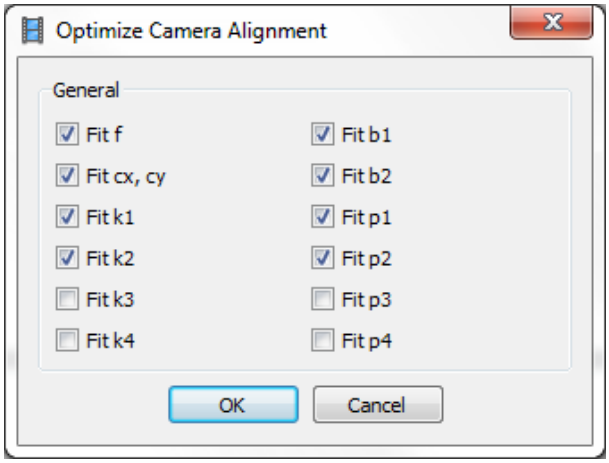
3. Select **Reference** tab / **Settings** and set **WGS 84 / UTM zone 32N** in Coordinate System:



4. Find the GCP targets in each photo and place a marker at the center of the checkerboard. Make sure that the name of the marker matches the number of the target preceded by an “M”:

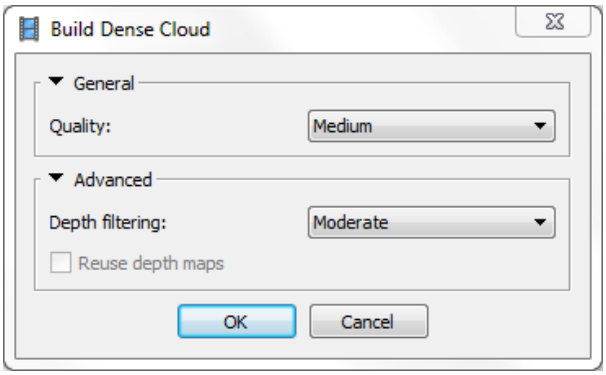


5. Enter the GCPs coordinates for each marker as taken by the total station. Alternatively, you can import a CSV file with the X (Easting) Y (Northing) Z (Altitude) values as long as the GCPs names match the markers ones.
6. Optimize cameras alignment :

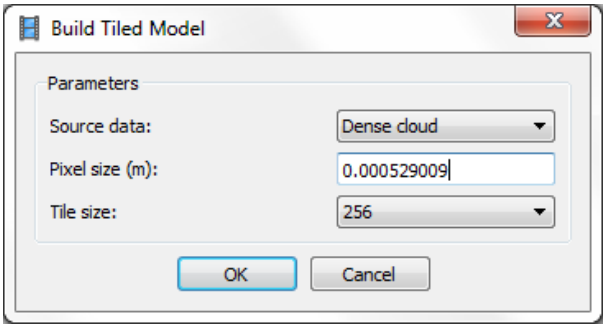


7. Adjust the region (bounding box) to fit the US area.

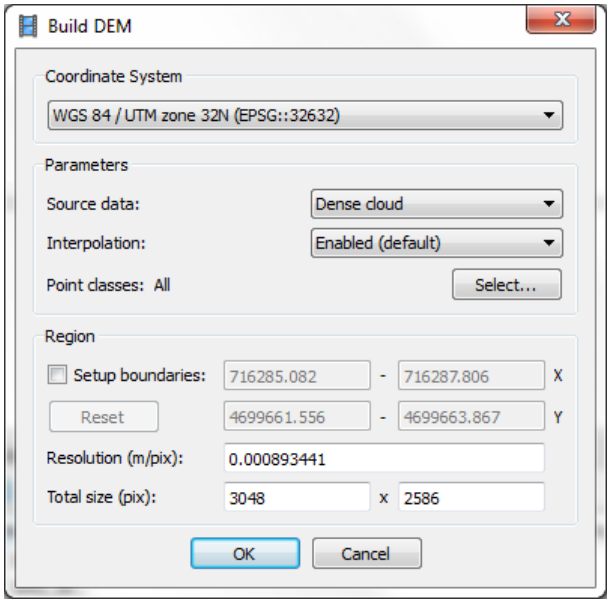
8. Build the **dense cloud**:



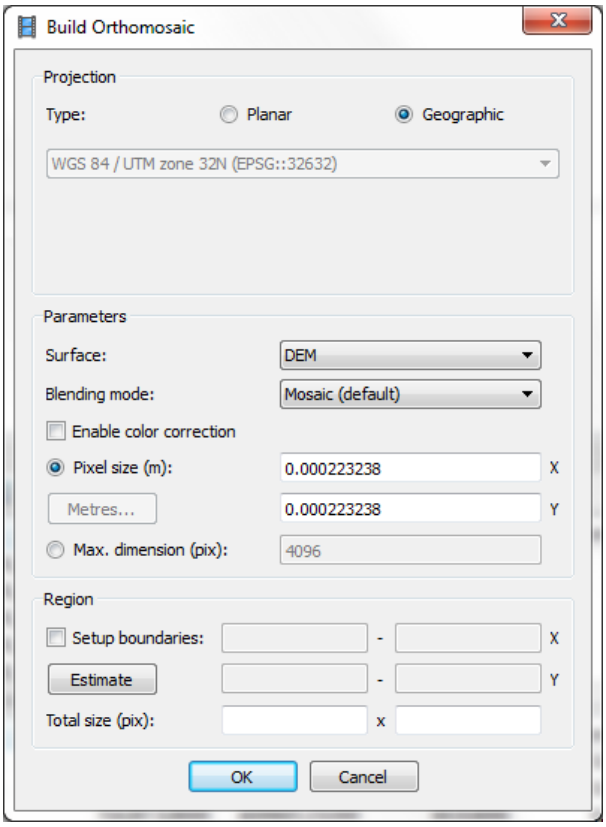
9. Build the **tiled model**:



10. Build the digital elevation model (**DEM**):



11. Build the **orthomosaic**:



12. Save the chunk.

From PhotoScan to Unity (for 3D visualization)

1. Export the models in OBJ format in geographic coordinates:

   WGS84 / UTM zone 32N (EPSG: 32632)

2. When exporting, apply the following shift:

   716280 4699660 65

3. Select PNG format for the texture.
4. Export the vector shapes in DXF format.