A virtual documentation of excavation through 3D modeling: is it worth the effort?

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Introduction

Does virtual documentation using 3D modeling better compensate for the irreversible and destructive nature of archaeological excavation? Here I present the use of Agisoft Photoscan Pro to build 3D photogrammetry models as a form of illustration of archaeological finds from the Bronze Age cemetery site of Békés 103 in Hungary. Unlike laser-based 3D modelling, this image-based method is inexpensive and its user-friendly platform does not require extensive training. Although the processing is automatic, the photogrammetry modeling requires considerable effort in photography, georeferencing and a devoted workstation for processing. The goal of this poster is to demonstrate that despite these energy costs, the information generated using this method adds benefits to understanding of this site that were otherwise not possible using traditional models of documentation and illustration.

Methods

Stage 1

Fig 1: Measuring points

Fig 2: Taking concentric images

Stage 1: Flagging multiple points and measuring them using a total station, followed by capturing a series of concentric images.

Stage 2: Using the three-dimensional information from images, Agisoft Photoscan Pro builds the 3D model in 4 automatic steps.

Stage 2

Fig 3: Aligning images and matching points

Fig 4: Building Dense cloud

Fig 7: Composite Model

Fig 6: Textured model and points

Fig 5: Building Geometry

Application

Here I use three examples to evaluate the effectiveness of photogrammetry modeling at the Békés 103 cemetery. The first shows how this tool adds the ability to interact with the realistic details of a site context from the lab. The other two examples indicate its ability to illustrate complex archaeological data and its efficiency in preserving and representing 'context' in a highly interactive way. This undoubtedly has helped us in dealing with unintentional human error in recording 'context' and in depersonalizing archaeological information.

❖ Providing interactive realistic details

3D models (fig 8) using this tool are highly interactive and can be used for measurements and even for 3D printing. Using these models, a realistic distribution map can be created that has textural information (fig 9). A 2D drawing lacks such information (fig 10) and images lack the georeferenced environment needed for measurements.

Fig 8: A snapshot of a 3D model of a burial urn and the arrows indicating its ability of 360° manipulation
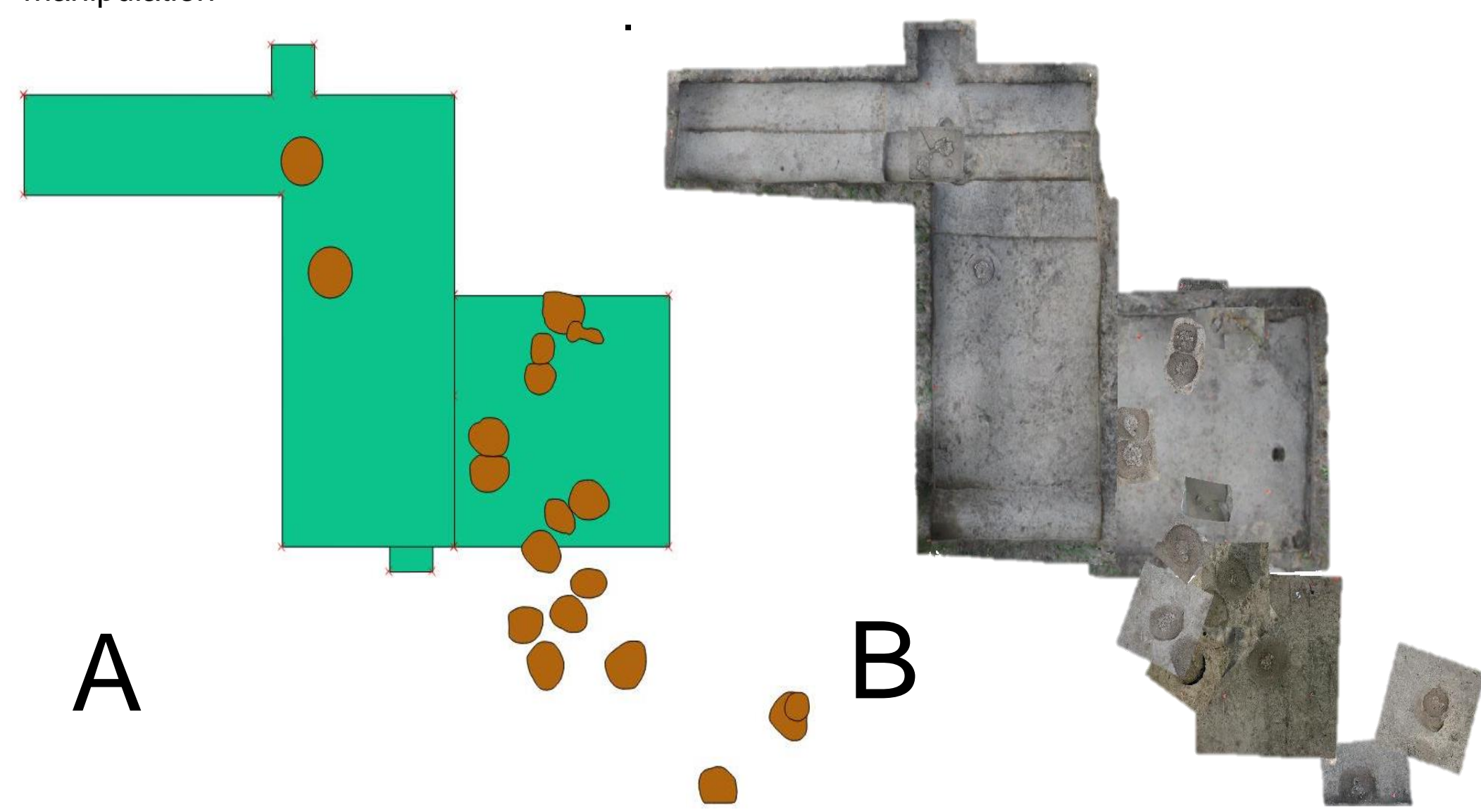
A

B

Fig 9: A distribution map of blocks and human burials: (A) a map created using QGIS; (B) same map created using the models of photogrammetry and QGIS.

❖ Transcending field drawings

Below is an example of how 3D models transcend the limits of field drawings in documenting spatial relationships. Using these traditional drawings (fig 10) it was not possible to prepare a composite profile of these two burials that were found a month apart, in the same location, but at different depths. Different coordinates and profiles were used to draw them (fig 10 and 11), as the illustrator was not aware of their interrelation.
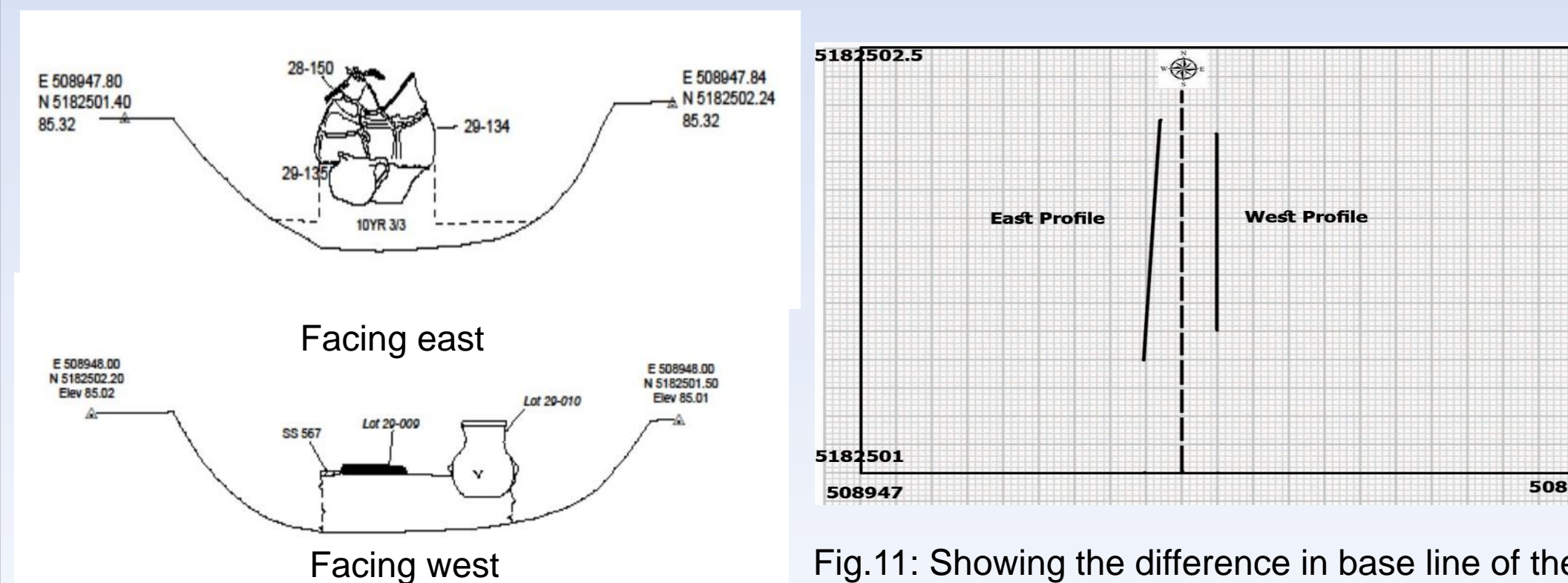
Facing east

Facing west

Fig. 10: (A) the profile drawing of HB-15; (B) the profile drawing of HB-43.

Fig.11: Showing the difference in base line of the profiles of both burials.

This problem is then solved using 3D models of the burials which provide us with sufficient information to make a drawing of the composite profile (fig 14). The composite profile helps us to visualize how they were situated in the burial pit without disturbing each other (fig 12, 13).
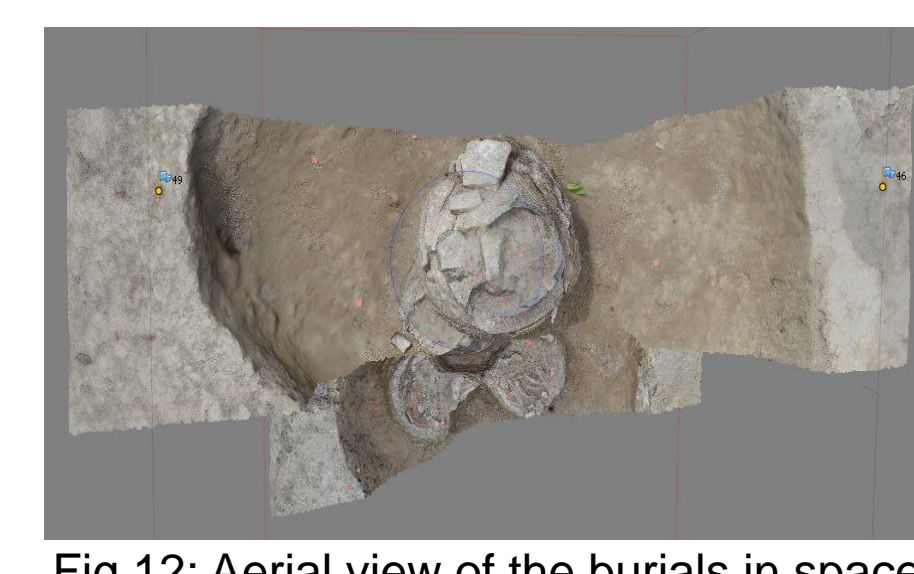
Fig 12: Aerial view of the burials in space
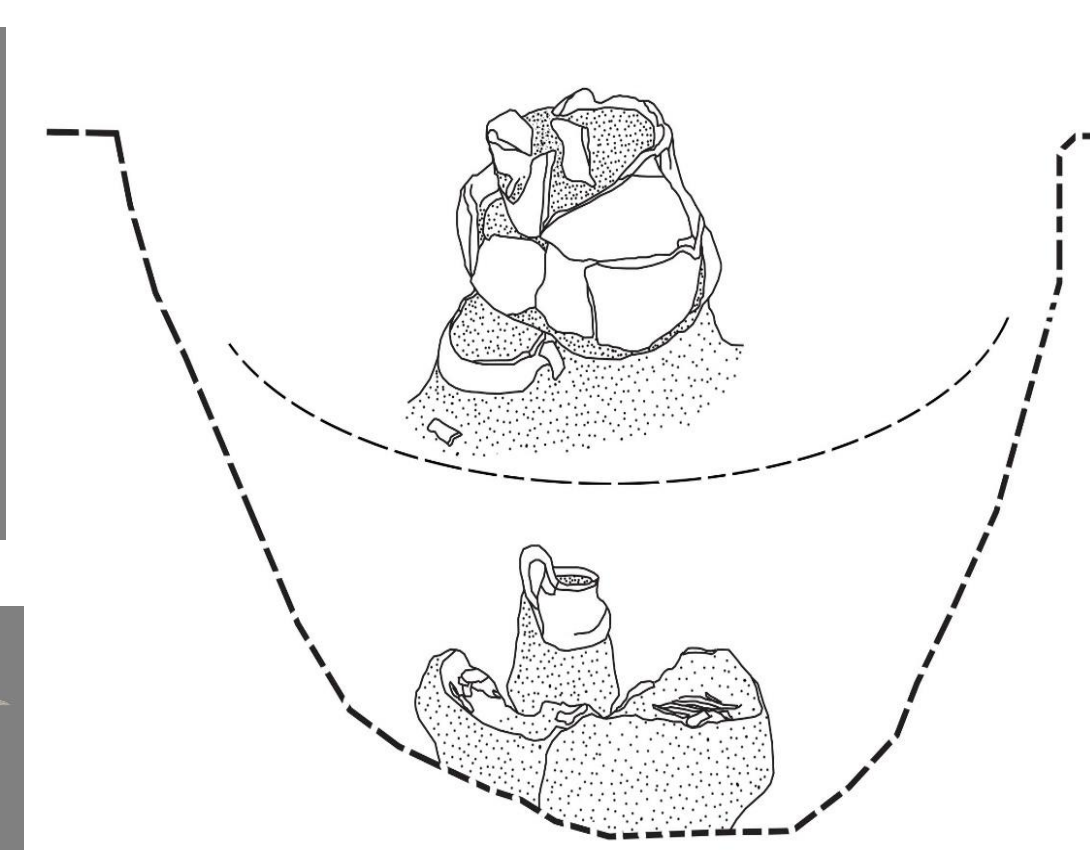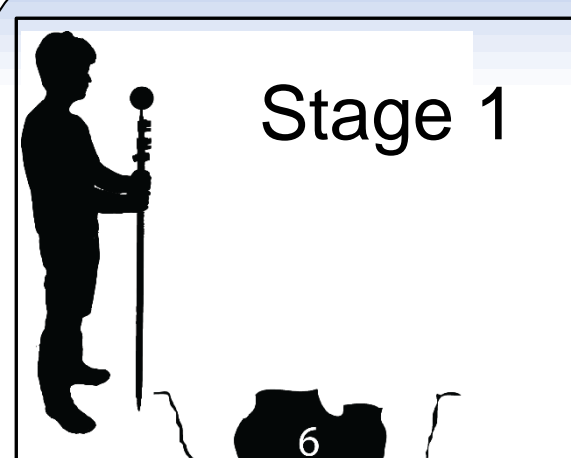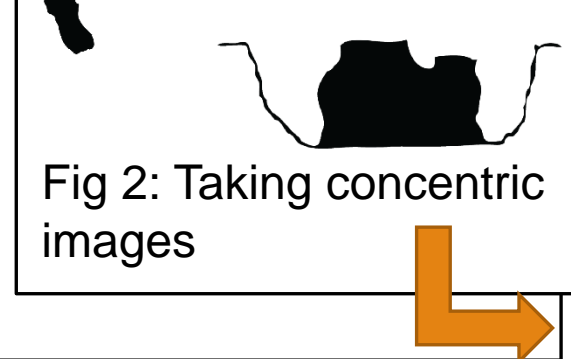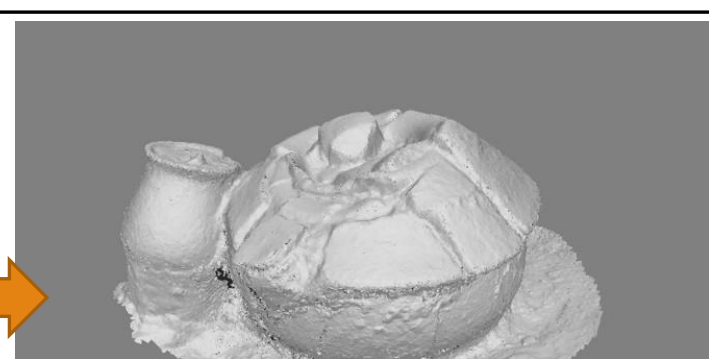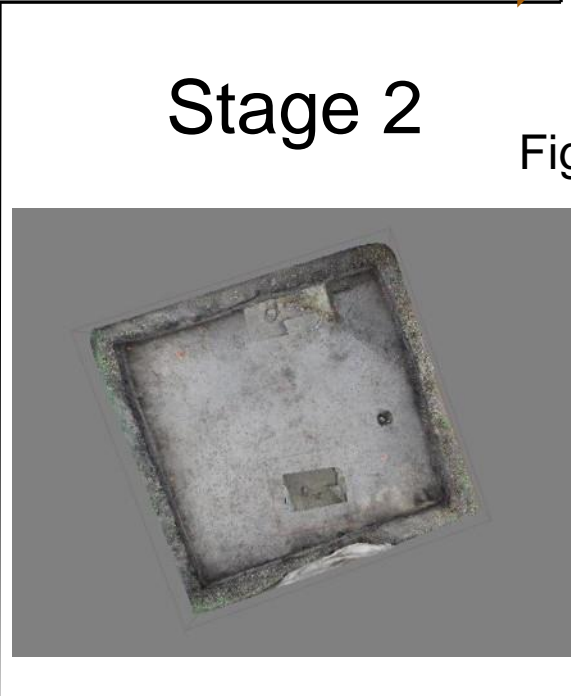
Figure 13: Profile view of the burials in space

Fig 14: Drawing of a composite profile map of the burials using models in adobe illustrator

❖ Layer by layer documentation

This tool was also used to document layer by layer excavation. Here it illustrates how modern vineyard trenches (parallel, oblique features) disturbed the burials underneath. Using a traditional method, this illustration would have required multiple drawings, images and measurements from field notes.

Fig 15: Block 43, a layer by layer documentation of the excavation (the elevations of each layer has been modified by adding one extra meter to improve visualization).

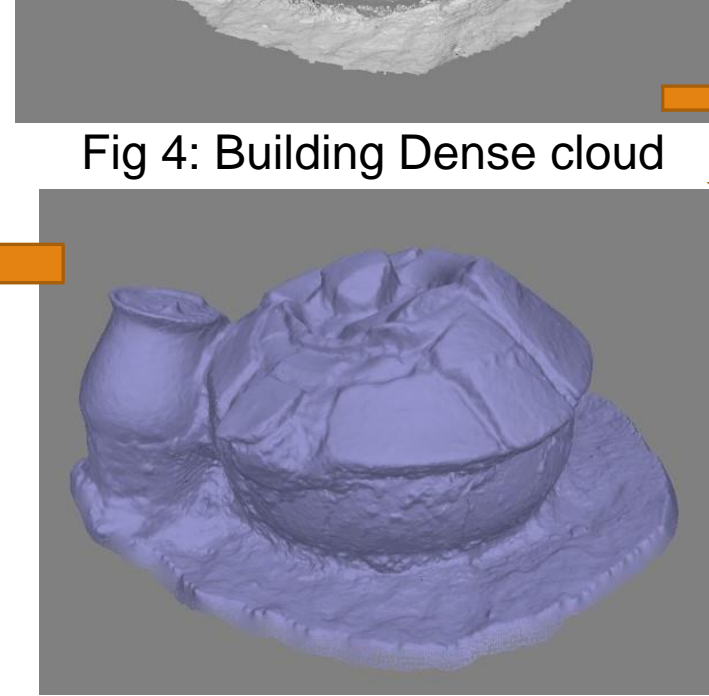## Limitations and conclusion

As this is an imaged based modeling approach, the quality of image affects the quality of the models. The software is unable to make models of objects that do not have clear edges, such as transparent and glossy objects (see Olson. et al 2013 for details). However, in an excavation situation, to document large features and objects, this tool provided sufficient accuracy.

Here I explained how this form of illustration adds lab based interactive details, documents context efficiently, overcomes limitations in field drawings. and illustrates large, complex archaeological features in an interactive way. I believe this three-dimensional highly interactive illustration will not only help professionals but can also greatly enrich public understanding of archaeological data.

References
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