Historic England

Geospatial Survey

A Trial of Different Geospatial Techniques to Improve the Legibility of the Engraving on the Stone from Fishpool Valley

Elizabeth Stephens

Discovery, Innovation and science in the Historic Environment

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FISHPOOL VALLEY, CROFT CASTLE, HEREFORDSHIRE

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SUMMARY
Historic England was asked if they would be able to use any techniques to help decipher the inscription on the stone. The exercise was seen as a learning opportunity for the teams Geospatial Survey Technician Apprentice to use a range of different techniques to record the stone while also trying to identify more of the inscription. As part of the learning process a number of techniques were used.

CONTRIBUTORS
The different techniques used on the stone where undertaken by different members of the team. Elizabeth Stephens was present for all techniques with assistance and guidance provided by Gary Young for the Faro and P40 scans, Jon Bedford for the PrimeScan data capture and processing as well as the processing to Sketchfab as well as advice on the photogrammetry and Adrian Hedges for the Prince hand held scanner.

ACKNOWLEDGEMENTS
Thanks to the Imogen Sambrook from the National Trust for lending the stone and allowing it to stay within the team while the different survey techniques were carried out. Thanks to Paul Bryan for organising the project and returning the stone to Croft Castle.

ARCHIVE LOCATION
Enter location of the Report and Archive here

DATE OF RESEARCH
December 2018 – July 2019

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BACKGROUND

An engraved stone from Fishpool Valley Herefordshire was uncovered during excavations in 2018. These excavations were looking to clarify areas of the landscape and the engraved stone was found in a previously unknown location of a small terrace and possible arbour. The inscribed stone was found set into the leading edge of a paved area at the top of a flight of steps. The initial report states 'It measures 68cm (E – W) by 58cm (N – S), the thickness has yet to be determined. The lower and left hand edges are well cut and meet at a right angle whereas the upper and right hand sides are more irregular and meet at a roughly chamfered corner' the report also attempts to decipher the inscription 'The inscription is fairly evenly spaced across the face of the slab but the lettering is poorly done and quite worn in places. At some point the letters have been highlighted with the application of a bright blue pigment. Pending further work to be done to re-examine the slab under special lighting conditions or by scanning the reading is both partial and provisional:

( ) D . ( ) D
(J) K . I K
I K . E K . W K
B C GUARDIAN 1838
( ) to build each other ( )
( )'

METHODS OF SURVEY

The aim of the project is to use a wide range of techniques including Photogrammetry, FARO and P40 scans, AICON PrimeScan and red and blue light handheld scanner. These methods will be assessed to see which work best in recording the surface and helping to reveal more of the engraved lettering.

PHOTOGRAPHY USING RAKING LIGHT

A number of photos of the stone were taken early on under raking light to see if this simplest of methods could enable any more of the engraved surface to be visible. This method works very well in producing an image of the stone showing much of the detail.

Light shone obliquely over the surface, casting shadows in the lettering.

FARO AND P40 LASER SCANNING

Both of these scanners are designed to scan much larger areas and the detail achieved from these scanners was a lot less than the other methods used. Neither of these methods gave any more information on the stone then could be seen by the naked eye and was in fact worse. These two scanners were used as a trial to find out what detail they could pick up and not with much expectation for the result.

PHOTOGRAMMETRY

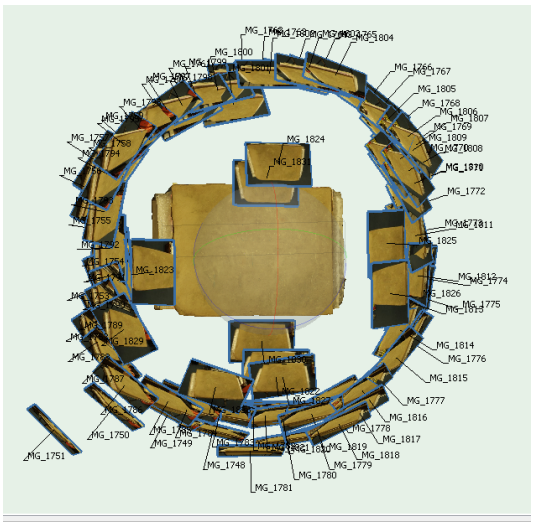
Photogrammetry was used on the top surface of the stone. The method consists of taking a series of overlapping images from as top down a position as possible. The images are then analysed using Agisoft Metashape where they are aligned, a 3D point cloud is generated, a mesh is built and then a texture is built. The result is a 3D textured model as can be seen below.

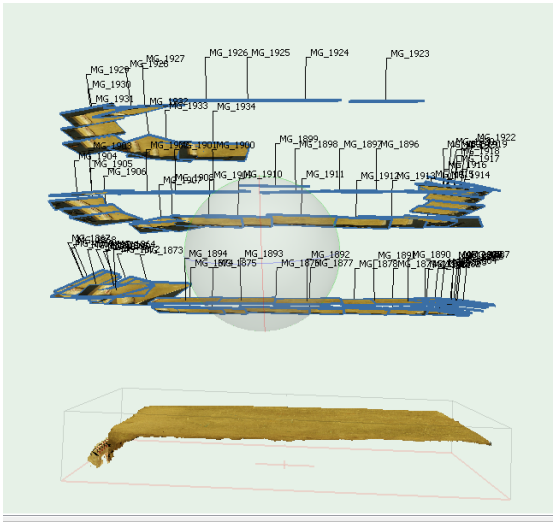
With the coloured textures on, the engraved surface is not easier to read, instead the colour confuses the model and makes it harder to distinguish the lettering.
To use the model to more clearly see the surface the file is opened in Geomagic Wrap. This software alows the surface shape to be seen without the added coloured texture, it also has the function to move a virtual light over the surface of the model. When placed in a raking position the engraved surface becomes a lot more visible and sections that could not be seen with the naked eye become a lot more apparent.

Below are two screen shots showing the model with the virtual light in different posittions.

The use of photogrammetry for this project is a very useful tool; the data capture can be quickly and easily performed using a camera. When using this technique two sets of images were taken. The first set was taken at a more oblique angle which resulted in only parts of the image being in focus and the background being slightly out of focus. When this set of images was processed through Metashape the resulting model was not as crisp as would be expected. After going back to the

images and finding the issue with the focus a second set of images was taken using an extending arm for the camera, which enabled a more vertical angle of the camera above the stone. When the second set of images was processed the resulting model was much crisper and to a standard that was acceptable.
The images below show screen shots of the camera positions for the two sets of photos. The first set, on the left, showing the oblique angle that they were taken at and the second set, on the right, showing the photos taken closer to vertical above the surface.





This method was used for the front of the stone only.

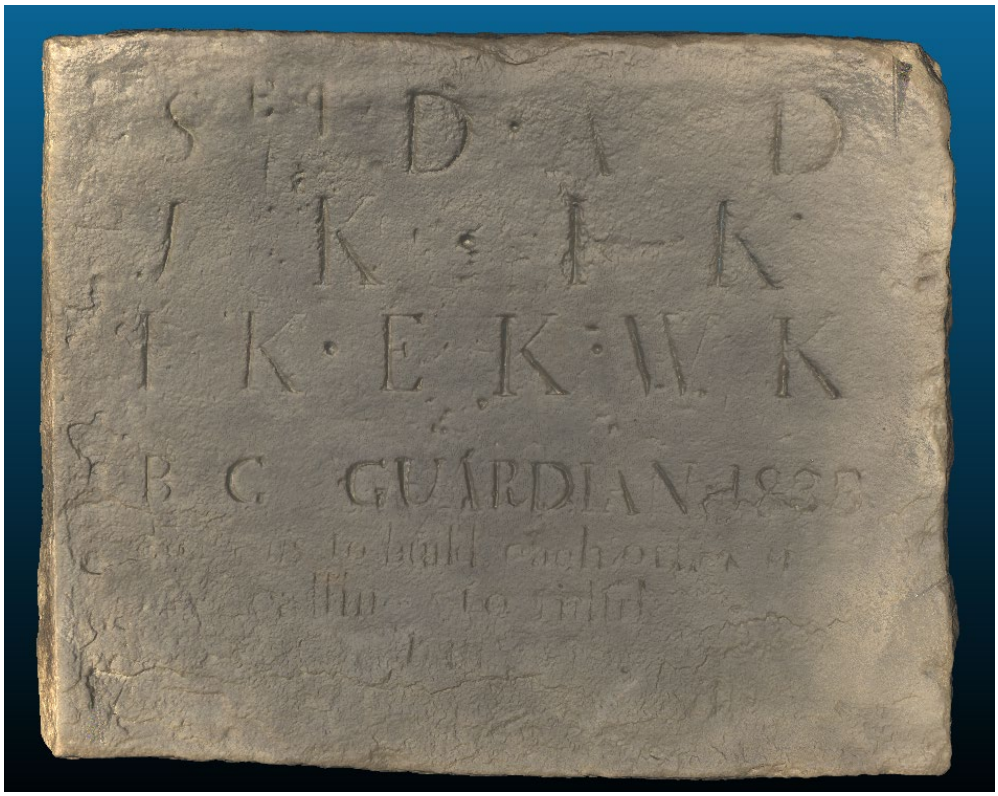
PRIMESCAN

The AICON PrimeScan is a scanner designed for precise measurement of industrial components and works by projecting a series of patterns over the surface. Over 50 scans of the stone were taken including the bottom of the stone in order to build up a complete 3D model. The OptoCat software used to align the images managed to automatically align almost all of the scans with only a few requiring manual tying in.
When the scanning was complete the model was made watertight and any small holes were automatically filled by the OptoCat software. The model was then exported as a full STL file. The full STL can be used to generate a 3D print.
Viewing the model in Geomagic Wrap the virtual light can be used to pick up the surface detail. Compared to the model produced by photogrammetry the outputs are very similar.

Below are two screen shots of the data from the prime scanner in Geomagic Wrap


S E I D · I D
I K · I K
I K · E K · W K
B C GUARDIAN 1837

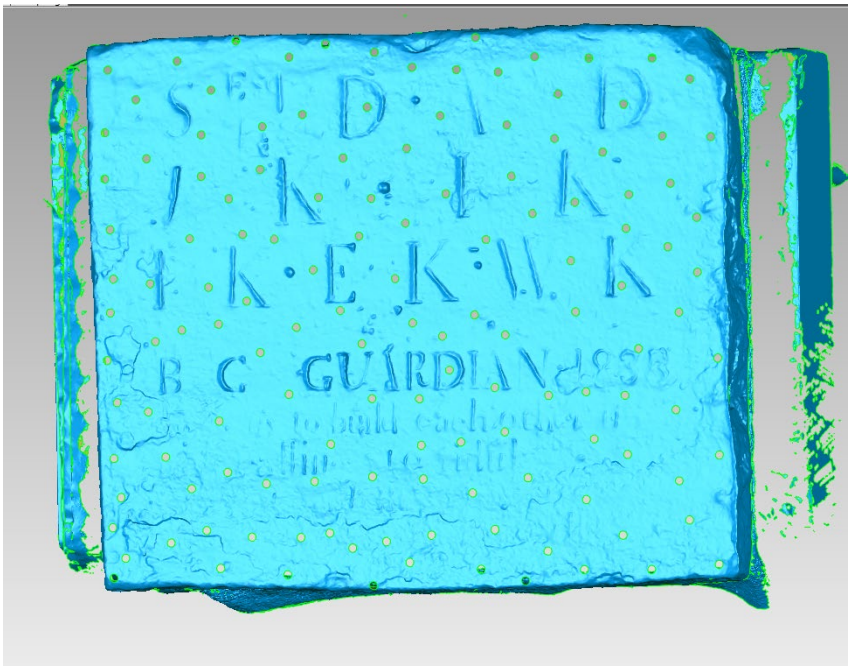

S E I D · I D
I K · I K
I K · E K · W K
B C GUARDIAN 1837



The screenshot above shows the model in CloudCompare with the texture applied. The colour on this model is much better then the colour produced on the photogrammetry model.

PRINCE HAND HELD SCANNER

A demonstration of a PRINCE handheld scanner which has dual scanning modes of 7 red cross lasers and 5 blue parallel lasers was carried out on the stone. The two modes, red and blue, have different accuracies, the red mode is for faster capture of larger areas and the blue mode is for capturing finer detail.
This scanner requires reflective marker dots to be placed on the surface of the object as it uses the pattern of these dots to work out a relative position and build up the model of the surface.
Using the 7 red cross lasers scanning mode was a reasonably quick process and is carried out by moving the scanner slowly across the surface. The 5 blue laser mode is easily switched to and date is captured in the same way but the scanner has to be moved at a much slower speed. The blue laser mode had issues matching the scanning together and required more reflective dots to be added. The scan data was saved and then opened in Geomagic. Screen shots from the two scans can be seen below.



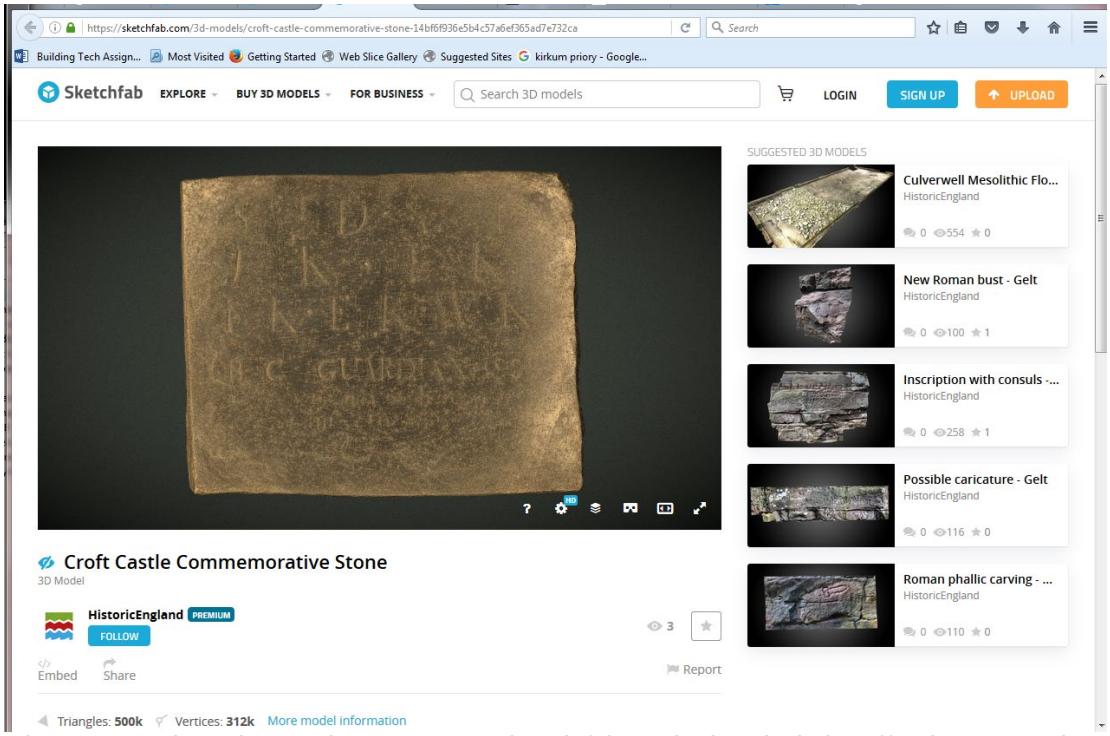
Red mode

Blue mode

The two scans do pick up the lettering with the blue light mode being slightly clearer. The downside with this scanner is the missing circles over the surface where the reflective dots were placed. For smooth industrial componants these would be easy to fill without worrying about missing data, but with the undulating surface of the stone, filling in the holes would be adding date that would not be acurate to the actual surface.

SKETCHFAB

A model from the date gathered by the PrimeScan was uploaded to the website Sketchfab as a private model. This was done as a training exercise to go through the different steps to get the model online. The file had to be reduced in size to be able to load quickly online, this requires reducing the number of vertices that make up the model, thus reducing the detail. When viewing the model online the large lettering at the top of the stone shows up clearly however the lettering on the lower section no longer shows up as crisply as on the original model. The process of using a texture generated from the OptoCat software appears to have made the colours of the stone darker in places.



This screenshot shows the stone on Sketchfab with the clightly off colours produced by the OptoCat software.

CONCLUSION

This report has looked at a number of different techniques to try and improve the legibility of the Croft stone. Photogrammetry and the AICON PrimeScan produced the best results, with photogrammetry having the added benefit of requiring easily accessible equipment. The other method that worked very well was the photography under raking light however this cannot be used for 3D printing or for further remote investigation. The FARO and P40 scans were not useful in gaining any additional surface information but can show dimensions. The PRINCE hand held scanner did produce a model but there were gaps in the model produced by this method. These analyses have allowed additional lettering to become visible.

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