# VISUALISING HERITAGE

## digital innovations bring new insights to Birmingham's earliest railway infrastructure

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**The work that Visualising Heritage have been doing at Birmingham for HS2 has been to record and capture the archaeology in a way that helps to show the public what has been carried out behind the hoardings, using innovative and engaging methods.**

We have used a varied set of advanced digital capture methods to document the exposed archaeology (including Stephenson's roundhouse), and its setting within the past, present and future cityscape.

As a group we have developed our expertise in imaging, process, analysis and presentation of complex 3D data over the past ten years since our landmark digital bioarchaeology project, *Digitised diseases*. Since then our attention has been drawn to the need to be able to capture and record at varying levels of scale, from small objects using micro CT and structured light scanning to large landscapes using drones and LIDAR data in a way that helps to bring realism and context to the data and ultimately the objects and landscapes we wish to understand and to communicate. By selecting the right methods of capture, we can give a different perspective to the data and see things that may not be visible at the time, or allow people to explore sites that they are not able to in person, for whatever reason (disability, safety, access, distance).

Our multi-scalar approach means that we are able to draw together information from varied sources and link them together with the data we capture on site. This allows us to produce a set of outputs that can be used in a variety of ways, from the traditional static reconstructions to more immersive animations, interactive 3D models and 'XR' mixed-reality experiences (VR and AR).

For the exposed archaeology at Curzon Street, and previously at Park Street, we have been using structure-from-motion (SfM) photogrammetry, combined with laser scanning to accurately record the exposed archaeology. This will later allow a viewer to explore the site as though they were standing there. Alongside the recording of the archaeology we have used 360-degree video to record some of the archaeological work while it was underway, with the use of cameras mounted in or on plant machinery, specific tools and sometimes the archaeologists themselves.

In my role as Senior Scientist, I have been responsible for much of the development and evolution of our methods of capture, processing and display of data. For me, technology and archaeology have always gone hand in hand, right from my earliest experiences. While still at school, I worked with the County Archaeologist for Wiltshire, using CAD and GIS for the first time and learning how to rectify aerial photographs. Having grown up not far from Avebury, I wanted to learn and find out more. For me geophysics was a direct specialism that enabled this – a key reason why I chose Bradford for my studies.

My journey as an archaeologist has allowed me to work on some brilliant projects with some fantastic people and visit some amazing sites and places; from each of these I have learned new skills. My way of working is very hands-on, often approaching a problem from a different perspective to others, something that I partly put down to my dyslexia. Archaeology is such an interdisciplinary subject and as archaeologists we can draw upon wide-ranging and transferable skills. Although I consider myself a field archaeologist and an archaeological geophysicist, I regularly call upon my skills as a surveyor, computer programmer, web designer, electronics engineer, 3D artist, photographer, illustrator, CAD and GIS technician, drone pilot and recently as videographer and field recordist.

As archaeologists we have always been good at adapting technologies and new methods of recording or reusing data, from the earliest uses for aerial photography, to using oil and gas exploration data to look at

*Orthographic image from a work in progress 3D model of Stephenson's roundhouse. Credit: Visualising Heritage, University of Bradford; © HS2 Ltd*

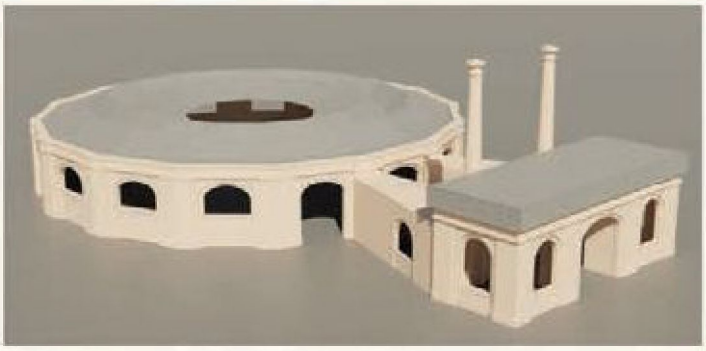
past landscapes in the North Sea. At Bradford we have been working at ways to capture more and record more quickly by adopting new technologies and equipment. Fifteen years ago, when I was working in commercial archaeology doing rectified photography, this would involve placing markers and recording at least four points for every image, then manually stitching them together in CAD, or when doing 360 photography, manually moving the camera around its nodal point and capturing lots of images. Although we sometimes still do this, we can now capture similar or far greater levels of information at a touch of a button, with the use of 3D laser scanners with integrated cameras and off-the-shelf 360 cameras. With ever-increasing levels for data capture we are always looking at new and better ways to process, combine and display information in easier, more informative and more immersive ways.

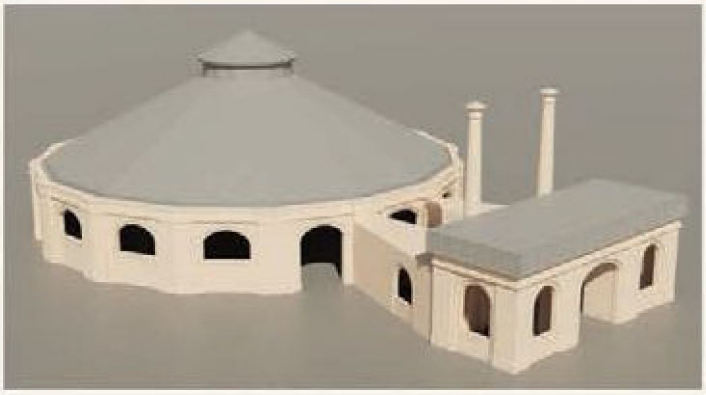
At Curzon Street we are using similar techniques to those we have used in working on reconstructions of damaged or destroyed monuments in Palmyra, Syria and temples in Kathmandu, as we plan on using historic and crowd-sourced plans and images to help produce 3D reconstructions. We were the first university in the UK to purchase a GeoSLAM Zeb Horizon handheld scanner, which we are using to capture the wider cityscape in Birmingham in order to link and provide context to the railway heritage that is being uncovered. We are working to combine this already-fast mobile capture system with RTK GPS and 360 video, to allow us to capture and quickly produce our own base maps and VR environments.

For me, although I work on lots of varied projects using many different techniques, my work is fundamentally all about data that shapes the world around us, both past and present. These layers, or commonalities, help us to relate a point in time, a location, etc, as we convert, fuse, and combine this data. Sometimes we may be trying to do things that have not been done before, or not viewed in the same way before – a key reason I taught myself computer programming, as I needed a way to do things that were not commonly done or possible before. The research and methods we use are being fed back into our teaching at Bradford to allow our graduates to be aware of and use these new methods of capture and recording.

Having worked in industrial commercial archaeology for a number of years before returning to Bradford, the opportunity to work on Stephenson's roundhouse is fantastic as it's such an iconic structure, from such a key time in the history and development of the railway infrastructure, that it can be seen as a 'henge' of its day.

*360-degree video camera setup to record excavation. Credit: Visualising Heritage, University of Bradford; © HS2 Ltd*





*Initial reconstructions based on Stephenson's plans and the later redesigned roof. Credit: Visualising Heritage, University of Bradford; © HS2 Ltd*

**Tom Sparrow**

Tom is a Senior Scientist based in the School of Archaeological & Forensic Sciences at the University of Bradford. He works at part of the Visualising Heritage team and has been at university for over ten years. Initially on an IFA bursary, Tom has since worked on a broad range of projects from surveying latrines in Tanzania for a Bill & Melinda Gates Foundation project to using UAVs to capture the fossil-bearing landscapes of Turkana Basin, Kenya with Louise Leakey, to mapping the temples and squares of Kathmandu damaged during the 2015 earthquake.

Tom worked at various units including ARCUS and Oxford Archaeology for several years prior to returning to the University of Bradford, having studied there as an undergraduate and postgraduate, getting a BSc in Archaeological Science (2001) and a MSc in Archaeological Prospection (2004).