Emerging technology unveils castle's past

The full range of Leica Geosystems' instruments - GS20, TPS, GPS, HDS as well as ERDAS software - are currently being used by a group of archaeology students to uncover the past of Tutbury Castle. The castle, located in the heart of England, dates back to 1070 when it was built for one of William the Conqueror's Barons. The excavations of the tower ramparts and medieval walls are being carried out by a group of 20 students from The University of Birmingham, under the guidance of Archaeologist / Research Fellow at the university's Institute of Archaeology and Antiquity, Glynn Barratt.

(Above): A view of the south range of buildings showing the Motte in the top right-hand corner

Survey of castle interior

The group have used GPS System 500 to create a control framework for all subsequent recording work at the castle and TCR 300 and 1100 total stations to perform detailed earthwork and building surveys. A GPS base station was erected high upon the Motte of the castle with this position subsequently corrected to Ordnance Survey grid using RINEX data for post processing. From these control points and other ground control points (GCPs), an ERDAS ortho-rectifcation of the castle will ultimately be created. High-definition laser scanning using both HDS 2500 and 3000 instruments is also being employed to record the fabric of the castle providing a fully 3D point cloud model of the ruins. In order to record the wider landscape, aerial photogrammetry techniques are being employed, supported by Leica's GS20 professional data mapper that is being used to provide control points for aerial photo rectification and for the rapid recording of earthworks and surface find sites.

In addition, a geophysical survey of the inner ward of the castle has been undertaken. The inner ward is one of three defensive enclosures, or baileys, making the castle one of the most substantial medieval strongholds in the area. Resistivity and Ground Penetrating Radar (GPR) geophysical techniques have been applied, so far only to the inner of the three enclosures. Resitivity involves passing current through the earth and measuring the changes in resistance that relate to buried archaeological structures in the first metre beneath the surface. GPR sends a powerful radar beam into the earth, recording features, in this case up to a depth of 3 metres and in 3-D. The data collected using these two complimentary techniques is collected in the same spatial framework using grids positioned by either GPS or Total Station. Once the data is processed it allows the archaeologists to visualise and map what lies beneath the surface. Initial results, according to Glynn Barratt, indicate that the inner ward of the castle once contained a complex of buildings, which are revealed in the geophysics as a series of responses suggesting the presence of rubble platforms and surviving walling. "This indicates that the interior of the castle once may have contained a complexity of buildings which are now buried beneath the current ground surface. A letter from Mary Queen of Scots written during her imprisonment at the castle, describes the inner ward as a shamble of closely spaced buildings with narrow streets and foul smelling drains. The initial findings from the geophysics tend to support this description," he said.

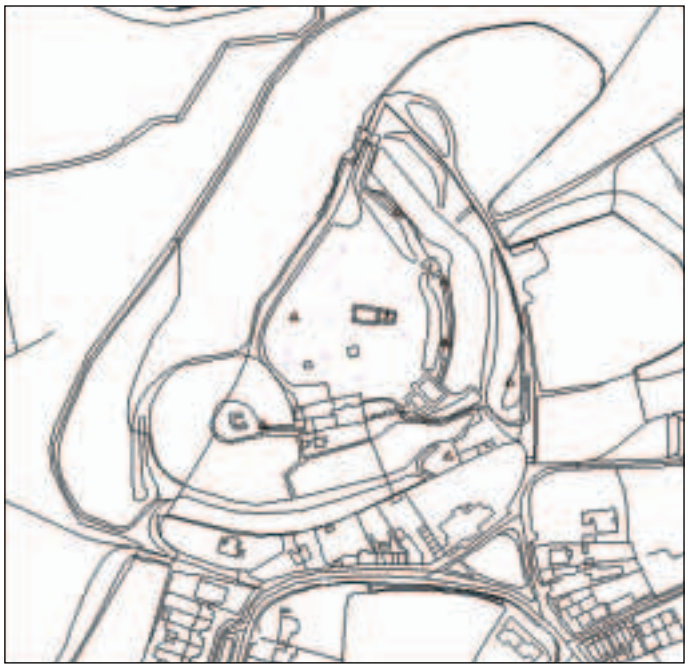
Archaeological evidence of castle occupations

In the centre of the grounds lie ruins of a late 12th Century Chapel. The existing gate-

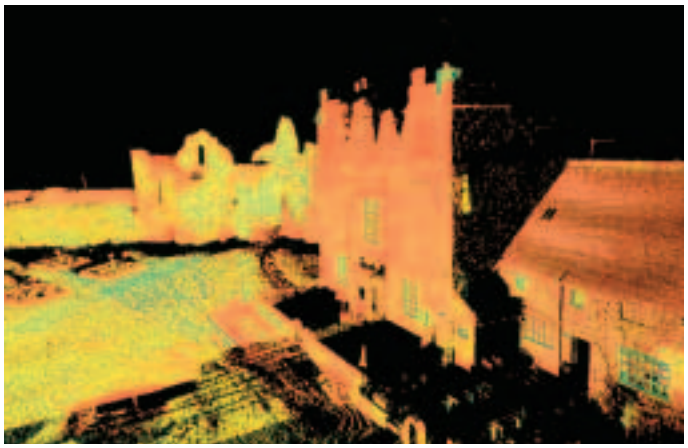
(Below): Archaeologist Glynn Barratt with the excavation site of the tower ramparts in the background

(Above): Clearly evident from aerial photographs, one can see the undulations of a medieval field system and water meadows (castle grounds can be seen in the bottom right-hand corner)

(Below): Leica's GS20 provides control points for aerial photo rectification and for the rapid recording of earthworks and surface find sites



(Below): High-definition laser scanning using both HDS 2500 and 3000 instruments records the fabric of the castle and provides a fully 3D point cloud model of the ruins



house of the castle is dated from the early 14th century and the south tower ramparts were built from 1442-50. In the excavations, post-medieval walls are present and several layers of deep clay, pebble, charcoal, and flint reveal earlier occupations. The presence of worked flints indicate that the site was also used in the prehistoric period and it is possible that an iron-age settlement may have originally occupied the site followed by an early Anglo-Saxon borough. Because of its prominent position, the site offered many generations not only a strategic location for settlement but also for defence. On top of the Motte, stands an 18th century folly, however it is suspected that an original Norman shell keep, perhaps originally built in wood and later in stone, originally stood at this position. Tradition says that a 'ubliert', a subterranean chamber often used to incarcerate prisoners, lies inside the Motte. A legend has it that this is full of bodies from a massacre that occurred at the castle. Glynn however was keen to explain that to-date there is no archaeological evidence to support this theory, though future seasons work may explore the archaeology of the Motte.

"Leica's instruments provide a vital link to the investigations to piece together the parts of this 21st century Sherlock Holmes mystery."
Lesley Smith
Castle Curator

This first year's investigations are seen as a pilot for a large ongoing project and it is intended that further seasons of investigations will further explore the archaeological potential of the site. The Castle Curator, Lesley Smith and the owners, The Duchy of Lancaster, are enthusiastic for the study to continue and the researchers to have full access to the castle and its records.

Emerging technologies used to recreate the past

Glynn Barratt said that Leica's instruments are enabling a much more complete and easier survey of the entire site. "We are using new emerging technologies to tell story of this castle and ultimately recreate it," he said. "Eventually, we will be able to virtually reconstruct walls and building and hope to provide an interactive display on-site. This type of recording and display has great potential for the entire cultural history in the UK, and if proven here, could become a range of integrated techniques which will be used in the investigation of major historic sites nationwide."

"Leica's instruments make these tasks so much easier," Glynn Barratt said. "In the past we had to use a tape measure, optical square or perhaps a microptic alidade and plane table. The integration of this suite of current survey tools creates enormous scope and potential for the non-destructive investigation and recording of archaeological sites."

The GS20 in particular gives users the capability to walk around a landscape and map features on the fly, particularly important being the capability to actually see the recorded information graphically as the survey takes place. "We can also record much more associated detail, such as the diversity and maturity of tree species or concentrations of specific flora and fauna. This enables gathering of not only archaeological information, but environmental data as well, towards a more complete understanding of the

management requirements of a site such as Tutbury Castle," he said.

Mapping surrounding features with GS20

Glynn Barratt is also looking off-site for evident of earlier periods of occupation. Standing on top of the Motte, and even more clearly evident from aerial photographs, one can see the undulations of a medieval field system and water meadows between the castle and the river Dove to the north of the castle - the powerplant of the whole economy at that time. Other off-site earthworks which have been recorded using the GS20 may represent part of an iron age settlement, later incorporated into the boundary which marked the extent of a former park or town boundary associated with the creation of the castle.

Each of these features is being recorded using the GS20, with points being entered into the computer for comparison with the Ordnance Survey map using ESRI Arc GIS software. Mark Kinsey, a post graduate student at Birmingham, is using this technique to investigate the relationship of the town of Tutbury to the castle. This will also involve the local community and school who will assist with this part of the work. The ease of use of the GS20 allows this technology to be easily assimilated by those participating in the work.

Ancient plant species uncovered

Additional investigations by botanists have also revealed in the 35 acres of steep slopes surrounding the castle, an ancient thicket of blackthorns and elderberries as well as rare winter-flowering barley. "This is wonderful as it opens up further opportunities for projects such as bread-making using original medieval barley in a charcoal oven," said castle curator Lesley Smith. "Much to my delight, I have also been informed that an ancient rose has also been discovered - one that that was thought to be previously extinct. Perhaps we may be able to use these things from the past to create ancient perfume from the roses that we can smell and ancient bread from the barley that we can taste."

Supporting academic programs

"Leica has always been prepared to support programs and give time to the academic sector. We have always been happy with the quality of the instruments, but fundamentally, it is the relationship that we have with the Leica sales and support people that we value."

"There is significant potential for these investigations to develop into an outreach program, encouraging the schools and community of Tutbury to become more involved in their history," Glynn Barratt said. "Since this is a Motte and Triple-Bailey castle, there are also the other two baileys that could be studied in later years. Overall this project has the potential to make a major contribution to an understanding of the economy and structure of society of this part of England through a major part of the medieval period."

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Recreating History at Tutbury Castle – a vision

The vision of castle curator Lesley Smith is to recreate history and make it live again. "We want to bring history to life here - make the walls rise, generate the smell of wood smoke, and bake fresh bread."

Indeed already, in the five years since the former PR consultant became curator of the castle, visitor numbers have increased from 8,000 a year to a massive 110,000. This has been achieved by her enormous drive, energy and enthusiasm, and the desire to give visitors a taste of the real thing. On regular occasions, Lesley will don the costume of Mary Queen of Scots or Elizabeth I, giving visitors a complete historical review of the castle from the point of view of her chosen character. She is also convinced that people need to be able to touch and feel history, and so has collected artefacts and furniture from these times that visitors can actually touch. Adding various television appearances to that, it is clear why she has been so successful in her quest.

Lesley hopes that the survey work undertaken may eventually lead to a computer-generated 3D recreation of the castle. "At the press of a button, we could make the walls rise."

"Leica's instruments provide a vital link to the investigations to piece together the parts of this 21st century Sherlock Holmes mystery," Lesley Smith said. "The castle has an extremely full history - we want to know more about why Kings and Queens chose to live here." She goes on to list former inhabitants of the castle spanning from the Kingdom of Offa, to Maid Marion, John of Gaunt, and Mary Queen of Scots. "The ancestors of most of the royal people in Europe were at some time living or visiting this castle," she adds.

"There must have also been significant lives lost on this site - with two great sieges and much evidence of weaponry," Lesley said. "If the remains of people are found, we want to mark the ground and show our respect."

(Above): Elizabeth I (Castle Curator Lesley Smith) examines the GS20 that is used to map points in the castle grounds and surrounds