

FOCUS

2017

INFORMING THE CONSERVATION OF THE BUILT ENVIRONMENT

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HISTORIC
ENVIRONMENT
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Partnership

Focusing on delivery

CONSERVATION

Ensuring a stable, sustainable future for Stirling Castle and Ring of Brodgar

TECHNICAL RESEARCH

How detailing can make buildings more resilient to climate change

TRADITIONAL SKILLS

Craft Fellowships produce Orkney's next-generation boat builder and miller

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Engine Shed:
Ready for opening



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Conservation:
Dumbarton Castle's paintings

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Front and back cover: Traditional
woodworking at GalGael, Glasgow

Welcome



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Welcome to *Focus* 2017. This magazine began as a technical publications catalogue over a decade ago, and has evolved year on year to become a place where we at Historic Environment Scotland (HES) share our research and technical conservation work with others, and increasingly to highlight the work of our partners in the sector.

Of course, 2017 is also a special one for all of us working in the heritage sector, as it marks Scotland's Year of History, Heritage and Archaeology. This is a great opportunity to shine a spotlight on all the different ways that heritage engages with people and we have a packed programme of activities taking place during the year.

This publication is an opportunity to showcase some of the work we do, to introduce our teams across the country, to put some faces to names and stimulate further collaboration – that's why mugshots (even the scary ones!) and email contacts appear beside every article. Many people do follow up with our staff directly, and we continue to build and evolve our network. This magazine is shared across the world and is a reminder of our role as part of an international heritage community and of the vibrancy of our sector in Scotland.

This year's issue focuses on partnership working – an increasingly important aspect of our work. We take a look at some of our more recent partnership projects, from conserving the largest Viking hoard discovery in Scotland to tackling the aftermath of the devastating fire at Glasgow School of Art. We also see how community collaborations have been the drivers behind conservation work on our estate. We hear from our climate change colleagues about how they are feeding into adaptation planning for climate projections, an issue that transcends sectors and borders.

We look back at some of the work we have been doing in 2016 and reveal some of our plans for the future, from carrying out essential works to maintain and improve visitor access at some of our largest sites – including Stirling and Edinburgh castles and the Ring of Brodgar – to planning the Engine Shed opening.

We also take a look at some of the technical skills that go into our conservation work: we hear from our Senior Technician and our Digital Intern on the intricacies of their professions, while our painting conservators take us through the complexities of restoring historic paintings. We hear from the future generation of conservation professionals, introducing our new HES-funded Craft Fellows in Orkney and finding out what some of our former Conservation Summer School students are doing now.

We hope you enjoy this year's *Focus* and we look forward to welcoming you to the Engine Shed this year.

New Chief Executive for HES



Alex Paterson took up his new role as Chief Executive Officer (CEO) of Historic Environment Scotland (HES) in September. Alex, who was previously CEO at Highlands and Islands Enterprise, will be taking forward the continued roll-out of the organisation's Corporate Plan and the development of a new Business Plan to support the delivery of our role as Scotland's lead public heritage body.

A key focus for 2017 will be to work with partners to highlight the wider contribution of Scotland's historic environment

during the Year of History, Heritage and Archaeology.

Alex said: "The historic environment in Scotland attracts 14.6 million visitors a year and contributes in excess of £2.3 billion to the economy. This themed year provides us with a great stage to bring all the different elements that make up Scotland's rich, diverse historic environment to audiences like never before. It's an exciting prospect for the months ahead."



Rock stars

The very first Historic Environment Scotland (HES) stone carving competition saw our stonemasons and apprentice masons battling it out to design and carve a grotesque to be featured at the Engine Shed.

The three winning entries were Works Manager Lindsay Vaughan's 'Grotesque of two halves', which showed both

modern and medieval influences; third-year apprentice Megan Crawford's 'Lewis Chessman'; and Edinburgh Castle Stonemason Jack Ogilvie's 'Rock person being squashed into a mell'.

Showcasing unique designs and incredible skill, the carvings will form part of the Engine Shed's interpretation, with visitors having the opportunity to laser scan the winning carving.

The results of HES's inaugural stone carving competition showed off their makers' skill and attention to detail



Collaboration in heritage science

Historic Environment Scotland (HES) continued to support collaboration in heritage science by hosting the annual business meetings of the National Heritage Science Forum (NHSF) and the Scottish Cultural Heritage Consortium (SCHC) last year.

The meetings, held on the same day, were followed by a research summit that brought together the organisations and other interested parties to discuss current research and the future for heritage science.

The summit gave HES PhD students an opportunity to showcase their work. Professor Ian Simpson from the University of Stirling gave a talk about interdisciplinary research, and the NHSF's Nancy Bell talked about the 'Filling the Gaps' project to establish gaps in knowledge and techniques.

The summit provided a stage for discussing the future priorities for heritage science research. Topics covered included the adaptation of traditional buildings to the consequences of climate change, a need for new ways of enthusing others about heritage and a shift in how research is translated into practice.

Lights out for Earth Hour

Historic Environment Scotland (HES) received an award from WWF Scotland in recognition of its dedication to tackling climate change and reducing carbon emissions.

The Public Body Champion Award acknowledges HES's continued support of WWF Earth Hour. In 2016, HES switched off the lights at 13 sites,

including Edinburgh Castle, Linlithgow Palace, Glasgow Cathedral and Castle Campbell. This commitment is part of a wider agenda to drive behavioural changes within HES to ensure it is a leading body in the transition to a low-carbon economy in Scotland.

Celebrate WWF Earth Hour on Saturday 25 March 2017 at 8.30pm by turning off the lights with us. www.wwf.org.uk/earthhour



Castle Campbell staff Lisa Daniels and Finlay Lumsden with the WWF award and panda mascot

HES progresses its plans for the future

In October 2015, Historic Environment Scotland (HES) assumed responsibility of managing the properties in the care of Scottish ministers under a formal Scheme of Delegation.

"Following this, our focus in 2016 has been the development of our Asset Management Plan, a key tool to help us fulfill our obligations under the Scheme of Delegation," said Head of Estates Joann Russell. "The activities included in the plan will help us deliver our operations more efficiently, with greater accountability and transparency.

"HES has developed a new digital condition survey capture, monitoring and reporting tool, a unique system to reflect the particular needs of properties in care (PIC). This has involved an update of digital survey information using the Monument Condition Indicator data. The Rae Project is also progressing, capturing digital scan data for sites and investigating how best building information modelling can be used within PICAMS, our PIC asset management system."

Joann added: "We've developed a new climate change risk assessment methodology (see page 40) and published conservation standards for PIC. Our Resource Needs Assessment set out future conservation investment and resource requirements, which will be invaluable as we move forward. We have also developed a resource prioritisation matrix to articulate the conservation needs and opportunities within the wider HES Investment Plan."

For more information, see *A progress report on the conservation and management of the properties in care of Scottish Ministers* at www.bit.ly/HESreport or email joann.russell@hes.scot



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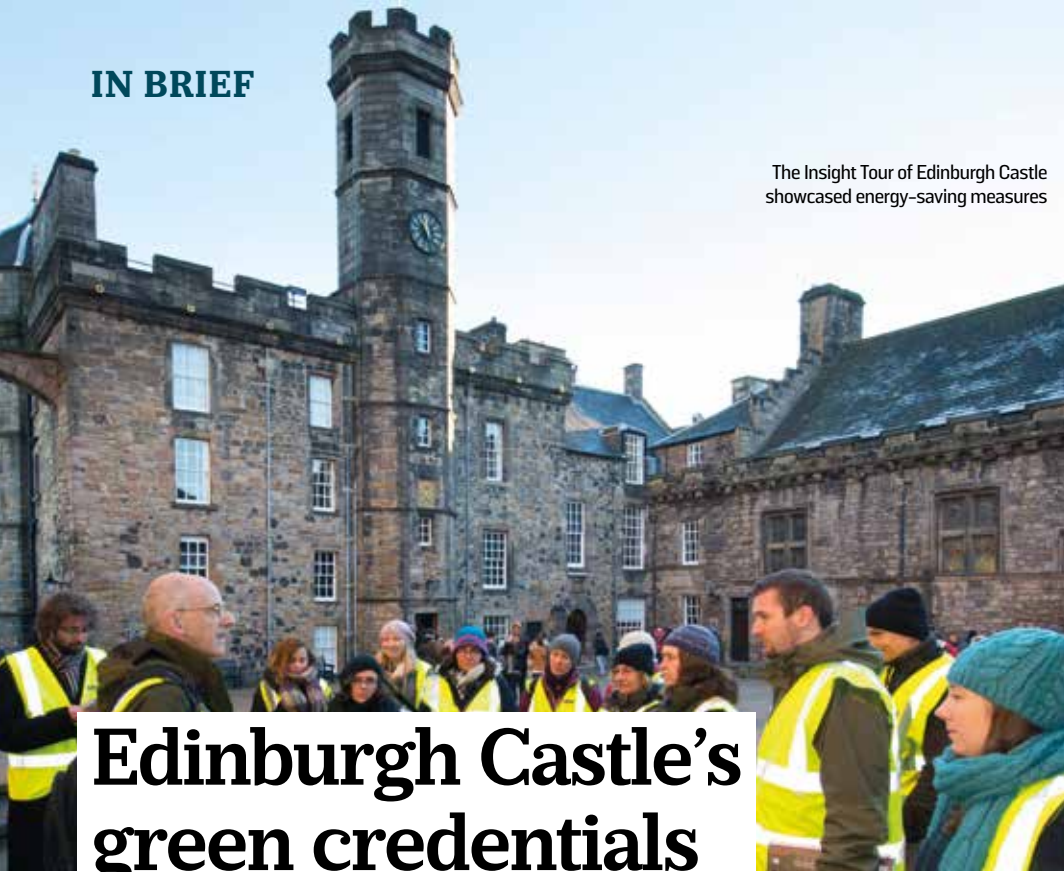
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- **Discounted entry** to English Heritage, Cadw and Manx National Heritage sites

By joining, you will be making an important contribution to the preservation of Scotland's built heritage for future generations.

The Insight Tour of Edinburgh Castle showcased energy-saving measures



Edinburgh Castle's green credentials

Edinburgh Castle's energy usage has been drastically reduced over the last few years despite the demands of rising visitor numbers. From the baseline figures of 2008–2009, energy consumption has fallen by 29% and carbon emissions by 31%.

This was achieved through measures such as replacing old boilers, switching to more energy-efficient light bulbs, putting sheep's

wool insulation into loft spaces and encouraging changes in behaviour.

Members of the public went behind the scenes to see the changes during an Insight Tour in November 2016. District Architect Bruce Chandler and members of the Climate Change Team showed people around the energy-saving techniques applied at the castle. **See page 22 for more about HES action on carbon emissions**

Spotlight on stone

Stone specialists from around the world gathered in Paisley when the University of the West of Scotland hosted the 13th International Congress on the Deterioration and Conservation of Stone in 2015. Historic Environment Scotland (HES) joined the international audience to discuss new research and share case studies from around the world.

HES scientist Dr Clare Torney presented research on restoration mortars, while stone conservator Christa Gerdwilker and conservation scientist Dr Maureen Young led a field trip to Skelmorlie Aisle.

To round off the conference, HES Head of Sustainability, Science and Research Dr Ewan Hyslop presented a paper on the impact of science on conservation practice, with a focus on sandstone consolidation in the Scottish built heritage.

A seat fit for a queen

To mark her 90th birthday last year, Her Majesty the Queen was presented with a stone bench by First Minister Nicola Sturgeon carved by our very own HES stonemasons.

Elgin-based stonemason Mark McCarther, Training Manager Graham Campbell and apprentice stonemason Charlotte Bough carved the bench from a single piece of Clashach sandstone hailing from one of the few remaining Scottish quarries.

The timber for the seat came from the garden at the Palace of Holyroodhouse and it was built at St Anne's Maltings Workshops in Edinburgh.



First Minister Nicola Sturgeon, her husband Peter Murrell, Her Majesty the Queen and Duke of Edinburgh admire the sandstone bench

Accolades for our apprentices



Ross Kennedy at the SkillBuild contest

The high quality of the stonemasonry apprenticeship training HES provides at its training centres in Stirling and Elgin was showcased at the 2016 Construction Industry Training Board (CITB) Awards.

Three apprentices who trained at the Elgin centre – Gregor Alcorn, Scott Pierce and Ross Kennedy – won prizes at the awards. They, along with 75 other entrants from 10 different trades, competed in the CITB's SkillBuild Final, held at Birmingham's NEC Arena. Gregor, based in Shetland, won the gold for stonemasonry and Orkney-based Ross took home the bronze.

The award for the Best Scottish and GB Apprentice also went to an Orkney stonemason apprentice from the Elgin training centre. Sophie Turner, who is in the fourth and final year of her apprenticeship, works for Orkney Council at St Magnus cathedral in Kirkwall. Elgin was crowned Best Masonry College in the UK and was awarded the Peter Ellis Shield for the second year in a row.

Carving out American links

Historic Environment Scotland's (HES) Building Crafts

Development Manager Ian Walker and Training Manager Charles Jones represented Scottish traditional crafts at the International Preservation Trades Workshop 2016,

held in Virginia by the US's Preservation Trades Network (PTN).

PTN aims to bring together traditional trades practitioners who work in the conservation of the built environment to share their skills and knowledge. Its 2016 workshop also celebrated the network's 20th anniversary, and to

mark this, Charles carved a bench from Scottish sandstone as a lasting memory of the event.

HES has developed strong links with PTN over the last 20 years and is hoping to host the 22nd event at the Engine Shed in Stirling – set to be the first time PTN visits Scotland. www.ptn.org



Training Manager Charles Jones with his specially carved bench

New short guide to thermography

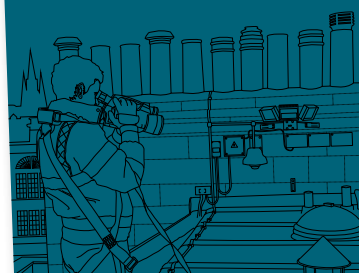
One of the newest additions to the Historic Environment Scotland (HES) Short Guide series is *Thermal Imaging in the Historic Environment*.

Thermal imaging is a non-destructive investigation technique that can be used on traditional buildings to identify problems such as damp and heat loss. The guide gives an overview of where thermography can be usefully applied, along with a basic introduction on how to analyse and interpret the data.

Our Short Guide series provides technical guidance and advice for practitioners, professionals and property owners on how to maintain and conserve traditional buildings. The guides are available to download from our website. www.engineshed.org

10

Short Guide
THERMAL IMAGING
IN THE HISTORIC ENVIRONMENT





On authenticity and ruin lust

Dr David Mitchell offers some personal thoughts on authenticity, urban explorers and the concept of 'sweaty' patina



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Experiencing the authentic means seeking out places with integrity that lack any kind of designed presentation. They prompt a sense of discovery and the excitement of exploration. For me, these places are often on the fringe of formally constituted heritage – largely vernacular or industrial. The latter (especially small-scale ‘human’ industrial) appeals to me because it reflects my life experience and personal history.

Objects fulfil this desire more easily. The term ‘barn fresh’ wonderfully describes objects – often industrial and very often automotive – that wear their patina honestly. On the TV programme ‘American Pickers’, Mike Wolfe describes this

authenticity as ‘a bit sweaty’. For those with knowledge, these – not the over-restored examples – have the most value. Wear and tear is good: it provides an unadulterated connection.

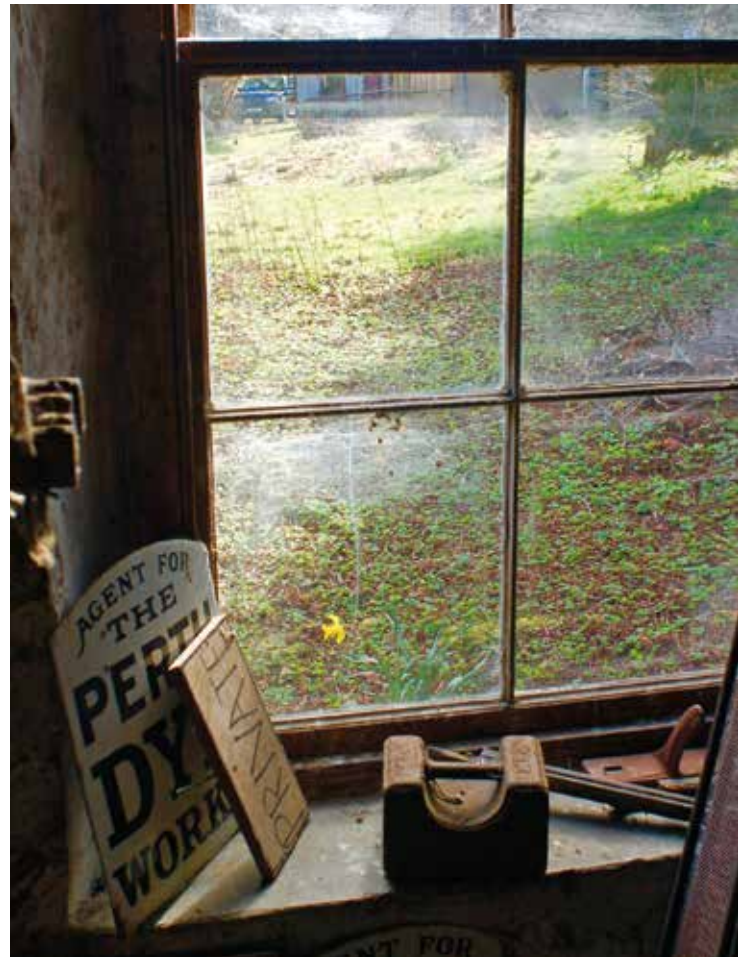
I had the pleasure of visiting Knockando Woolmill in Speyside prior to its restoration. The working life of Hugh the weaver hung in the air in the typical shambles of the vernacular industrial enterprise: the order books, oil cans and even the dirt on the windows. We all knew that the building would have to give up some of its sense of place to survive. It did, and although the project team took great care, some of that essence was inevitably lost.

In the Hebrides, I stopped by the ruin of an old croft and my knowledgeable colleague Chris

McGregor pointed out detailing I would have missed. We grabbed our cameras and peeked inside. The roof had mostly gone and it was precarious in places, but it had not been tampered with. As the building dissolved back into the landscape, it revealed its secrets by literally turning inside out. Walls crumbled, rafters and layers of cobbled-together wallpaper were exposed, a Singer sewing machine sat in the corner, rusty but defiant.

Another winter and this place may have been lost forever. It was both sad and exciting. We found something remarkable – we photographed it and, in some tiny way, we saved it from an undignified death. Our photographs will end up in the archive, online or in books – the good ones will capture a sense of

Above: Exploring derelict, cavernous spaces beneath Central Station in Glasgow



place and in their processing we will attempt to invoke that sense in presentation.

I am fascinated by urban explorers, who seek out the past and connect with dereliction. Their code of honour requires them to enter without force and take nothing but photographs as trophies. Their photos capture the essence of place, but also prove they have been there. Like the sketch of the historic explorer in far-flung lands, the 'urbex' devotee records their discovery in pixels. Ruin lust is not a new concept – the sketcher has been replaced by the digital photographer.

'Conserve as found' has become more common over the past decade or so. The work at Newhailes House outside Edinburgh pushed the concept hard and is well worth a visit. These places have an entirely different feel – the sense of time travel is acute. There is no fiction here, no sanitisation. You feel like a voyeur in some high-quality virtual reality experience.

Visitors seem to react very positively. We know that tourists are generally seeking more authentic experiences and are now better informed than ever. We sell our authenticity to them as our country's core offer, yet sometimes we are still peddling *Brigadoon* – thankfully much less than before.

Adopting such a philosophy with places that have not been subject to intervention is entirely desirable. What about those places that have many, even hundreds of years' worth of change and intervention – not all of it good? Many properties in state care have been manicured to present a romanticised version of a ruin

There is no fiction here, no sanitisation. You feel like a voyeur in some high-quality virtual reality experience

in the landscape so often seen in Victorian litho plates – tumbling ruins with tangled vegetation. This, of course, is also part of their story.

So what does this mean for the properties in our care? Our traditions of presentation have been formed over several hundred years, the result of the amateur antiquarian, the over-exuberant architect or archaeologist, and the Ministry man who tried to combine the romantic ruin with the Victorian approach to parkland – manicured to within an inch of its life.

The crunch of gravel, the cast-metal signs of the Royal Label Factory and the heavy, bronze handrails are now an intrinsic part of the story, but they can present a confusing picture. A Pictish carved stone, presented simply, remains a powerful symbol. It continues a physical connection to a place that prompts us to consider that timeline. The challenge we all face is in considering where we go from here.

Above left: Finzean Bucket Mill in Aberdeenshire

Above: The 'shambles of vernacular industrial enterprise' at Knockando Woolmill prior to its restoration

All systems go for opening

The Engine Shed Team introduces Scotland's new dedicated building conservation centre based in Stirling, which opens its doors this year



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Following years of development, Historic Environment Scotland (HES) is thrilled to be opening the Engine Shed in 2017. It has been fantastic to see the project develop through the funding application phases and now the delivery stage.

Throughout the project, I have been working on the development and delivery of the centre's Activity Plan alongside our other public-facing activities and events. We have researched, reviewed, piloted, promoted and evaluated every aspect of the Activity Plan

over the last couple of years – it's been quite a learning curve. I believe the result is a programme that really does offer something for everyone.

Part of my role is continued consultation with stakeholders, from those working in the heritage sector and other fields to local community and school

We want to enable people to understand and value their built environment from a young age

groups. The overwhelmingly positive response demonstrates the level of support the new centre has and how much people are looking forward to it opening.

Here, Engine Shed team members give an overview of what they have been working on, including milestones such as launching our new website and welcoming 1,500 visitors at last year's Doors Open Day weekend.

We look forward to continuing to build on this work. I very much look forward to welcoming you to the Engine Shed and hearing your thoughts on what you find there.



The Engine Shed undergoing a full transformation into a building conservation hub



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Public programme

The Engine Shed will be a welcoming space – modern in design with striking traditional features, and a friendly team eager to discuss conservation and traditional skills with anyone who enters. The space has been designed to host a variety of events and activities, and it is through our public programme that we will reach out to a diverse audience.

So far for 2017, we have programmed national conferences, specialist seminars, local heritage talks and family workshops. The aim of our programme is to engage everyone with the built heritage, from professionals to students and families, and ultimately inspire a strong culture of care and appreciation of traditional buildings in Scotland.

Over each year, the theme of our events will change, corresponding with the subjects covered in our advanced diploma in traditional building conservation and our dynamic programme of temporary exhibitions. The first temporary exhibition, developed in collaboration with the Glasgow School of Art, will focus on the aftermath of the devastating fire at its iconic Mackintosh Building in May 2014 (also see page 52). Exhibitions will be changed every few months, each time showcasing a new and exciting area of conservation research.



Top right and below:
Welcoming visitors
of all ages at Doors
Open Day 2016



JORDAN IRVINE
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Education programme

The Technical Outreach and Education Team has been working hard to bring conservation into the curriculum. As part of HES's mission to support people in understanding and protecting their built environment, we are developing a range of school-based resources and lesson plans to enrich and enthuse pupils. We want to enable and empower people to understand and value their built environment from a young age.

Over the past nine months, over 200 pupils have learned about the porosity and permeability of traditional materials through the use of microscopes, stone samples and thin sections. The activities we've developed encourage pupils to ask questions about their surroundings and take notice of the wide range of materials they encounter every day.

At the Engine Shed, pupils will learn about conservation in all areas of the curriculum, including the science of stone, the importance of maths in the creation of buildings and a range of hands-on crafts skills. In addition to curriculum-based learning, the centre will offer Saturday activities for the public, which will be informal in nature, and focus on conservation and traditional skills in an engaging and creative way.



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Engine Shed online

The new website, www.engineshed.org, went live in October 2016, replacing our old conservation Knowledge Base website. The new website has a clean, modern look that works well on mobiles and tablets, and offers a wealth of useful content in these sections:

- **Technical publications:** From detailed technical papers to advice for conservation beginners.
- **Building advice:** Aimed at giving homeowners the confidence to employ contractors.
- **What's on:** Our upcoming events.
- **Learning:** Information about our new advanced professional diploma in technical building conservation.
- **Blog:** Concentrating on discussing building conservation issues that our researchers and scientists are working on.

We want the website, like the Engine Shed itself, to be a focus for the heritage sector and a forum for discussion of best practice. We also hope it inspires more people to care for the built heritage.

Take a look at it, tell us what you think and sign up for our newsletter to be kept up to date with all our events and activities.

Visit www.engineshed.org

New qualification to build conservation skills

Gordon Urquhart introduces a unique new postgraduate course based at the Engine Shed



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Historic Environment Scotland's (HES) exciting new advanced professional diploma in technical building conservation is designed to meet the growing demand for conservation skills and prepare candidates for a range of specialist careers in the heritage sector. New graduates, emerging professionals and experienced practitioners can all benefit from this opportunity to broaden their expertise.

The programme aims to give its students a wide spectrum of knowledge and skills in practical building conservation techniques, backed up by a thorough understanding of Scottish architectural and construction traditions. We will also cover current issues and leading technical developments to ensure that learning is grounded in today's conservation principles and best practice.

Our diploma programme will give unrivalled access to national and international experts in the field, from skilled practitioners to academics and scientists. You'll take classes and participate in hands-on demonstrations of traditional skills, laboratory practicals with HES scientists, digital documentation fieldwork and visits to local quarries, workshops and artisan studios. Based at the Engine Shed, the first modules will run from August 2017 to May 2018.

The diploma is made up of four units, and each unit comprises a number of modules that can also be studied individually. The units are:
1. Conservation in Context: A thorough grounding in the basic principles and traditions that underpin architectural conservation, in seven modules.
2. Masonry, Limes and Cements: Exploring the key elements of



Top right: Templeton carpet factory in Glasgow, probably one of the finest examples of brickwork in Scotland

Centre: Doulton Fountain in Glasgow Green, believed to be the largest terracotta fountain in the world

Below: Terracotta chimney pots at Moray Place, Glasgow, conserved by Glasgow City Heritage Trust



traditional Scottish building construction, from stone and clay to historic limes and concretes, in six modules.

3. Structures and Finishes: A closer look at the wide range of materials used to construct and finish traditional buildings in Scotland, in six modules.

4. Final Project: Apply the knowledge and skills acquired in Units 1 to 3 to a practical challenge similar to those faced by professional conservationists.

MORE INFORMATION

Full course details are at www.engineshed.org/learning/diploma and to register interest, email gordon.urquhart@hes.scot

Brick by brick

Here's a look at the Fired Earth Conservation module for an idea of what to expect:

Origins of the material and Scottish traditions

- History and distribution of brick and clay use in Scotland
- Historic brick manufacturing
- Traditional brickwork
- Terracotta, faience and cast stone
- Tiles
- Decay mechanisms

Repair and conservation

- Techniques
- Specifying repairs
- Health and safety issues

Potential site visits

- Doulton Fountain, Bain Street pipe factory and Templeton carpet factory – all in Glasgow
- Raeburn Brickworks, Blantyre
- Cox's Stack, Dundee
- St Bride's Roman Catholic Church, East Kilbride
- City Heritage Trust sites
- Conservation Area Regeneration Scheme sites
- Townscape Heritage Initiative sites
- HES estate projects

Rock solid in Edinburgh

New construction using traditional skills and materials now reduces the danger of rock fall from the slopes of Castle Rock, explains Bruce Chandler



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Castle Rock, surmounted by Edinburgh Castle, is a magnificent edifice, but one that brings some challenges to those in Historic Environment Scotland (HES) responsible for its condition and safety.

The fabric of the castle, which has been added to over the centuries, has helped to stabilise and protect large parts of Castle Rock. However, the exposed slopes continue to be degraded by weather and vegetation growth, and occasionally loose fragments succumb to the forces of gravity.

Regular inspections and rock scaling by our trained staff reduce the risk to people below, but it's not possible to eliminate that risk entirely, so some areas have required a more proactive approach. One such area is along Johnston Terrace, on the south side of the castle.

Here, after analysis by our appointed geotechnical

engineers, a rock trap and new boundary wall were completed in May 2016. Constructed in partnership with the City of Edinburgh Council and funded by the Scottish Government, this development is designed to reduce the ongoing risk from rock fall to pedestrians and road users.

The new stone boundary wall, topped by iron railings, runs parallel to the old boundary, but on what was the centreline of the road, thus giving space for a gravel-filled rock trap designed to catch any falling debris.

The surface of the rock trap is a crushed basalt fill from a Fife quarry and the new Swinton Sandstone masonry for the wall was supplied,

dressed and hand-tooled directly from the quarry in the Borders. The iron railings were forged in Yorkshire and installed by the same blacksmiths using traditional methods.

Making use of indigenous materials and traditional skills was important to us – it fits in with surrounding built environment and invests in the future of local industries and the survival of rare skills. Two substantial Swinton Sandstone piers terminate the new wall, and HES apprentice stonemasons Jack Ogilvie and Alan Cormie undertook the task of carving the dates and symbols on the half-round pier caps.

The project has been an innovative answer to improving health and safety in a way that is sympathetic to this internationally significant site. It is also a great example of using traditional skills and materials in new construction.

Making use of indigenous materials and traditional skills was important to us

Below: Director of MS Stone Mark Schulz, former HES Works Manager Stewart Mackenzie, District Architect Bruce Chandler, MS Stone apprentice Charles Lynch, HES Architectural Technician David Nicol and District Works Manager Stewart Downie





Making Stirling Castle stable and sustainable

Work to stabilise stonework and make the castle resilient for the future relies on collaboration, as Tom Gaze explains



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Above, from left to right: Stonemasons Gary Sneddon, Steven Lumsden, Chris Ross and apprentice stonemason Andrew Harvey, with Works Manager George Simpson at centre

Perched on a volcanic rock in central Scotland, spectacular Stirling Castle comprises a number of buildings and structures ranging from the 12th century up until the modern day. These diverse structures bring with them a number of challenges in their care and maintenance.

The discovery of masonry saturation in the late-medieval forework of the castle led to a programme of essential works undertaken in 2016 to stabilise the masonry and improve drainage. This also triggered an investigation into the resilience of the fabric to the projected effects of climate change.

The castle's regular routine inspections had identified masonry saturation and displacement. This was caused partially by the absence of 'through stones' in the later military stonework of the upper courses, which are necessary to tie the ashlar frontage to the inner core of the parapet wall.

In combination with this, a latent defect in the rainwater goods was causing saturation build-up in the walls, which was exacerbating the natural effects of water entering and moving through the stonework. The resulting freeze-thaw cycles had flushed out the mortar and loosened

individual stones, eventually weakening areas of masonry.

The works specified to tackle these issues included repointing all open joints in lime mortar and introducing slate pinnings between the joints widened from past movement. This method was employed as it had been previously used on the monument to successfully tighten joints and return rigidity to the ashlar coursing.

In addition, to secure the outer ashlar face to the inner core, non-ferrous stainless steel tie-rods, known as helical bars, were installed mechanically through joints in the ashlar facing stone and secured into the rubble core. This method was chosen as it would not be visible on completion and – in line with best conservation practice – would fit into mortar joints and not damage the ashlar masonry itself.

The discovery of the ineffective rainwater drainage



Insight
Tour
led by
Tom Gaze

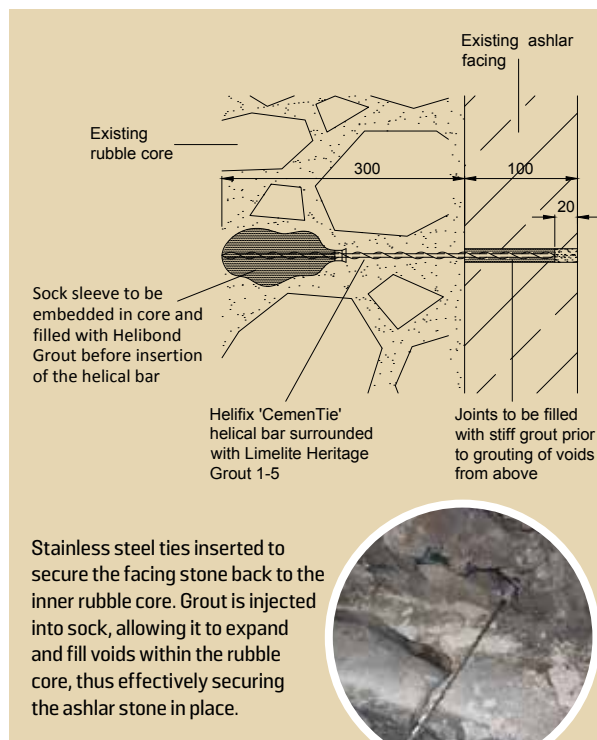
Improving the castle's resilience was viewed as crucial

goods coincided with investigation by the Climate Change and Technical Research teams into the risks and effects of climate change on traditional structures (see page 24). Improving the castle's resilience was viewed as crucial and will form phase two of these works.

Sharing information about what we're doing has also been a priority for us. Insight Events, which are run by myself and the castle's Works Manager, George Simpson, opened up the scaffold to visitors and gave us the opportunity to explain the works to new audiences.

In addition, there have been formal visits from groups including the Fit for the Future sustainability network. Such outreach, educational and skill-sharing activities help us to promote the value of work to our monuments.

The collaboration of technical staff with our in-house team of stonemasons and conservationists – supported by our District and Works Managers, architects, technicians and engineers – means that the organisation is well equipped to meet the challenges presented by unforeseen works. This helps us improve the way we work and the quality of service we provide, and minimises the impact on visitors.



Stainless steel ties inserted to secure the facing stone back to the inner rubble core. Grout is injected into sock, allowing it to expand and fill voids within the rubble core, thus effectively securing the ashlar stone in place.

Grand entrance



Built between 1501 and 1506 for King James IV, the forework was the original late-medieval main entrance, and stood as both an impressive frontage and as the first line of defence across the southern front of the castle. Today, little is left of the two semi-circular towers either side of the two remaining gate towers. The forework in its present form is largely a result of 18th- and 19th-century remodelling.



Sharing expertise for a sustainable future

Fit for the Future (FftF) is a growing network of over 80 UK organisations – including landowners, charities, public sector organisations and community energy groups – that share information and expertise on lowering their environmental impact. The network hosts a series of regular events and site visits for members to see practical, sustainable interventions in different settings.

FftF's visit to Stirling in May 2016 was a chance for Historic Environment Scotland (HES) to talk about its flagship sustainability projects in this area. The day started with a visit to our new conservation centre, the Engine Shed – a great example of re-using historic buildings and choosing sustainable materials.

We also showcased energy efficiency improvements at the offices in Argyll's Lodgings and demonstrated how thermal imaging cameras can be used as non-destructive survey tools for identifying where energy-saving improvements can be made.

The last stop was Stirling Castle to see how climate change is already affecting monuments and how adaptations such as drainage improvements can make them more resilient. Following the success of the Stirling event, HES is keen to host similar visits as part of the FftF network.

Repairing a path well trodden

Lucy Vaughan explains how monitoring and path improvements at Orkney's much-visited Neolithic stones ensure an up-close visitor experience while combating erosion



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The Ring of Brodgar sits as part of the Heart of Neolithic Orkney World Heritage Site and is cared for by Historic Environment Scotland (HES) Orkney Monument Conservation Unit, based in Kirkwall. The site's natural, uncluttered appearance requires a substantial amount of work behind the scenes – managing the destructive presence of rabbits, specialist conservation works to the stones and encouraging biodiversity – all while protecting both the standing and below-ground archaeology, and providing access to more than 80,000 visitors a year.

Visitors really enjoy being able to explore the ring and stones, and the

aim has always been to provide as much access as is feasible, but also keep the site looking as natural as possible. Visitor numbers continue to grow year on year, and this can have damaging effects on the site through erosion to the land and paths, and potential disturbance of the archaeology.

We have been closely monitoring erosion due to



The test footpath proved successful and so the pilot is being extended

footfall since 2002. This was originally carried out photographically, comparing the results every two years. This recorded erosion as well as the regular repairs required to maintain turf footpaths.

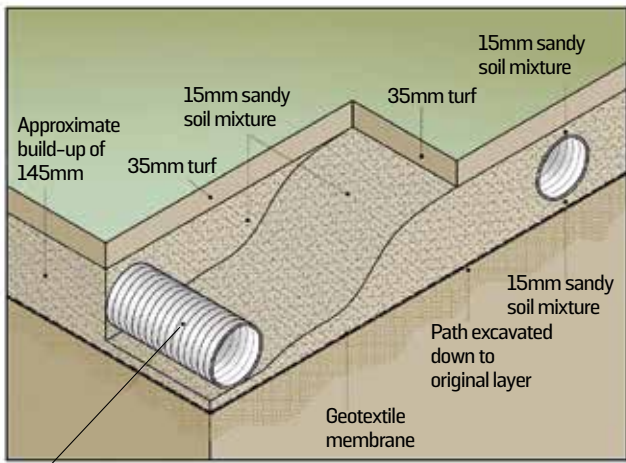
Now we also have access to scanned data and aerial photographs from our unmanned aerial vehicle (UAV), helping to better inform the work we carry out to protect the site. With changing weather patterns, including increased winter rainfall and more unseasonal summer rainfall, it is becoming increasingly important to proactively manage access to the site.

Using this information, we have been able to develop a rigorous maintenance regime to keep the footpaths in good condition. A visit to Stonehenge had highlighted a number of adjustments we could make to path maintenance, including

Centre: Amphibian inhabitant, a common frog

Below: Severely eroded path due to increased footfall and rainfall





Above: WavinCoil single-wall perforated PVC-U pipe, 80mm diameter, laid across width of path at 500mm crs, drains into external ditch



physically moving the paths a small distance to 'rest' worn areas, and cultivating and sourcing appropriate local turf in Orkney for repairs.

Despite proactive management, it was still apparent that the increased footfall, combined with climate change, was resulting in severe erosion. To tackle this, District Architect Stephen Watt and District Architectural Technician Craig Hamilton developed a pilot

study to slightly elevate the footpath to the inner ring, and install a drainage layer of sand and gravel below the turf.

This was trialled in 2015, a year that saw unusual levels of heavy rain combined with high visitor numbers. Even in these conditions, the test footpath proved successful, and so an extension of the pilot study was included in the site management strategy. Work to extend the elevated path is now

underway and will be completed by the summer of 2017, with the entrance causeway to be done by spring 2018.

We have also been working to improve the biodiversity of the site by changing our grass-cutting regimes and de-nitrifying the soil to encourage the growth of wild flowers. All these initiatives contribute to the continued protection and care of this inspirational site to ensure it is accessible for future generations.

Above: Installing a drainage layer to the path

Inset: Path section showing the drainage system

Below: The repaired path



Community support

HES hosted a community meeting in nearby Stenness village in October 2015 to discuss its conservation work at the World Heritage Site – including the new footpath at Ring of Brodgar – with residents. The meeting generated good discussion and showed that there is strong support from the local community.

This feedback matched our findings and gave us the backing to carry out the first phase of path improvements. When work started on site, it was soon being discussed on social media. The local community was quick to address any concerns raised, thanks to an understanding of our approach and the aim of the work.

Condition survey for royal portraits

New technology has played a crucial part in surveying the condition of Dumbarton Castle's centuries-old royal paintings, says **Ailsa Murray**



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The Governor's House at Dumbarton Castle is home to a stunning collection of ancient royal paintings dating from the 16th to the 19th century. They are mostly royal portraits, including depictions of Elizabeth I, Mary Queen of Scots and James VI.

As part of a significant refurbishment to the castle, the paintings have undergone an in-depth condition survey using a variety of new technologies to help inform us of their necessary conservation needs, and to re-assess some of the previous conservation treatments used on them.

Investigation techniques used include ultraviolet light examination, microscopy analysis, multispectral imaging system (Musis) examination and

visual inspection. Collaboration with the HES Conservation Science Team also allowed for non-destructive portable X-ray fluorescence (pXRF) analysis of pigments.

The investigations revealed that the collection is in a good condition, with the constituent layers being structurally sound and only small evidence of active flaking paint. Only minor stabilisation was required, which involved using light-heated spatulas to sensitively apply an adhesive to reattach loose paint flakes.

In addition, light aesthetic treatments were necessary to improve their condition. We removed discoloured, degraded varnish to reveal the colours and tones of each painting more clearly, nearer to how the artist had intended them.

In some cases, the non-original passages of overpainting can be misleading and are often obliterating 'original' paint. However, sometimes they can be too difficult to remove and so are just left untouched. Every case is different.

Examinations also showed that a variety of supports, or backings, have been used for the paintings – oil on canvas, panel and copper – giving an insight into the history of these paintings and the surroundings.

This vital task of recording the collection not only provides a detailed assessment of the paintings' current condition, but also helps develop a greater knowledge and understanding of each work of art, and ensures a comprehensive documentation for future reference.

Above: XRF analysis in action

Right: Paintings conservators Damiana Magris and Ailsa Murray with a painting from the Dumbarton Castle collection, 'View of the Clyde and Dumbarton Rock'



Hi-tech survey tools

Multispectral imaging system (Musis)

A specialist, non-destructive camera sensitive to ultraviolet to near infrared wavelengths. The UV light is used to observe varnishes, coatings and retouchings on the surface of a painting, as well as artists' alterations and some pigments. It can also

provide information about the condition of the painting and previous treatments. During removal of discoloured varnishes, it can help observe the cleaning process and the extent of varnish remaining.

Infrared

A non-destructive, penetrative technique for

observing what lies beneath the surface of the painting, for example underdrawings, signatures and inscriptions.

Many paints that appear opaque can become transparent in longer-wave infrared light, and carbon-based materials beneath the paint layers, such as pencil, become visible.

False colour infrared

FCIR combines a visible light and infrared spectral image to visually distinguish between substances of similar hues but different chemical compositions. FCIR can sometimes be used, in combination with instrumental analysis techniques, to help identify pigments in a painting.

X-ray fluorescence (XRF)

XRF is used to analyse the inorganic components of paint and can provide a breakdown of the chemical elements present in certain pigments. It is often complemented by other techniques, such as cross-section microscope analysis, to achieve a clearer understanding of the constituent materials.



A technician through time

Rob Nuttall looks back over a three-decade career and the technological innovation in his profession



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Top: Representatives from the HES Architectural Technician Team from left to right: Brian Pringle, Neil MacFarlane, Rob Nuttall, John Crae, Lyal Purves and Stuart Deasley

Below: One of Rob's first hand drawings for Historic Scotland was of Edinburgh Castle's old ticket office



My career as a technician has been incredibly blessed. I've been involved with some iconic projects and have seen huge technological innovations transform the profession throughout the years.

Working closely with architects and other professionals, the work of an architectural technician is often the glue that holds an architectural project together. From surveying sites and preparing working drawings and specifications, to ensuring compliance with technical standards and managing risk, it is our work that takes a project from concept into reality.

The production of drawings has always formed a large part of the technician's role. When I first started out, I did so on a wooden drawing board using a T-square with pens of different tip sizes. Nowadays, we use computer aided design (CAD) applications to produce drawings digitally.

Similarly, surveying was very much a manual process using measuring tapes and an automatic level. Then came the electronic Total Station, which fires a single laser pulse to measure distances and both vertical and horizontal angles.

More recently, the advent of laser scan technology has

revolutionised surveying, especially of heritage sites, allowing the amorphous details and surfaces to be recorded automatically and with high precision at 100,000+ points per second in 3D.

This technology is now becoming more affordable and accessible with the advancement of 3D digital photogrammetry, a process that creates 3D spatial data (point clouds and models) by overlapping digital images taken with just a mobile phone.

3D modelling is another increasingly important tool. Building information modelling (BIM) is a 3D model-based process involving the generation and management of all the physical elements and functional characteristics of a building project to aid in the management of a building's life cycle.

Now, as a Senior Technician, I am drawing on my experiences to help implement and drive forward new technologies.

Scanning World Heritage sites in India and Australia as part of the Scottish Ten project has to be a highlight of my career to date.

I am drawing on my experiences to help drive forward new technologies

Now we are rolling out the use of 3D documentation to our own estate through the Rae Project, which will directly support our ongoing conservation works and site management activities.

Digitising our processes is another move we are making. We're working in partnership with the British Geological Survey to develop a new onsite GIS-based digital recording tool that turns paper-based monument condition monitoring into live digital capture using tablets. We certainly live in interesting times.

Yet regardless of all these technological advances, the same basic principles of surveying, drawing production and conservation practice underlie everything, and this is what I am passing on to our trainee technicians. I'm proud of the fact that HES still runs Architectural Technician apprenticeships offering a recognised qualification and practical experience in the heritage sector.

When I was offered the job in 1994, it was billed as Architectural Technician for Edinburgh Castle. I thought: "How could you beat joining the team responsible for Scotland's most iconic building?" That feeling hasn't changed 22 years on – helping care for the nation's heritage remains a privilege and a passion.

Pioneering automation in digital surveys

An innovative research partnership with Heriot-Watt University has paved the way for automating the analysis of historic building fabric in the future, reports James Hepher



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Below: Height-pole
photogrammetry data
being taken at the castle



The results of ongoing research into digital survey methods – led by Heriot-Watt University (HWU), funded by Historic Environment Scotland (HES) and guided by our Digital Documentation, Science and Climate Change teams – were published in late 2015.

The research, by Dr Frédéric Bosché, Dr Alan Forster and Dr Enrique Valero from the CyberBuild Lab at HWU's Royal Academy of Engineering Centre of Excellence for Sustainable Building Design, compared 3D laser scanning and photogrammetry, and their respective suitability for accurate survey of masonry walls. It was carried out at Craigmillar Castle, where datasets were taken of the east-facing walls and compared with each other.

A second component of the research involved using data from laser scanning to test bespoke computer algorithms that might rapidly and automatically extract information from the 3D data, such as areas of stone versus areas of mortar within the make-up of a wall face. The ultimate objective was to look at how, using these algorithms, analysis of digital surveys could make masonry surveys more efficient, objective and easy to quantify.

The HES Digital Documentation Team provided 3D laser

scanning and height-pole mounted photogrammetric data. Comparison datasets were provided by the University of Cambridge in the form of stereo photogrammetry and Cyberhawk (unmanned aerial vehicle [UAV]-mounted aerial photogrammetry). Each dataset was processed and sent to HWU, which compared their accuracy and applied bespoke algorithms to automatically characterise the stone and mortar wall composition.

The HWU team concluded that laser scanning data provided by HES was the most accurate for producing 'point-cloud' data of the wall; height-pole mounted photogrammetry was second; UAV coverage, while versatile, was third; and stereo photogrammetry fourth, but with future potential.

The project has resulted in the successful programming of an algorithm that may be ground-breaking for future analysis of historic building fabric, pioneering a step towards automatic classification of stonework from 3D data. Classification in this case means deciding what in the wall is stone and what is mortar, and perhaps in the future what is sandstone, limestone, brick and so forth.

To support the success of this research, HES and HWU are collaborating for phase two, scheduled for 2017. Improved algorithms based on earlier findings will hopefully enable

automatic determination of successive build phases in heritage buildings and help identify mechanisms of stone wall degradation in a way that is more efficient than existing survey methods.

MORE INFORMATION

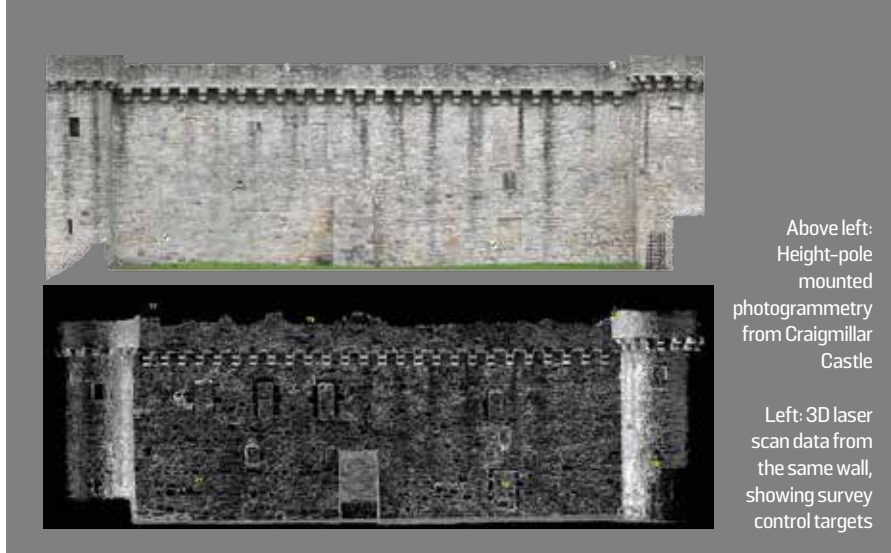
HWU's CyberBuild Lab is at www.bit.ly/CyberBuild and the report is at www.bit.ly/3D-Report



Results of the HWU algorithm, which classifies the 3D data into either stone or mortar joints (courtesy of HWU)

About the algorithms

Algorithms work by comparing the individual and collective attributes of the 3D data and using these values to calculate the unknown answers – in this case, what form the stone in the wall takes if it is depicted as a vector graphic and, as such, what that graphic would represent – stone or mortar.



Above left: Height-pole mounted photogrammetry from Craigmillar Castle

Left: 3D laser scan data from the same wall, showing survey control targets



A digital intern's year

Sofia Antonopoulou reflects on her year of training in digital technologies for heritage and conservation



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Working as an intern with Historic Environment Scotland's

(HES) Digital Documentation Team has been a fantastic experience, especially as I have always had an interest in the application of digital technologies for conservation. I originally trained as an architect before studying architectural conservation.

During my Masters, I focused on the application of building information modelling (BIM) and digital documentation techniques in conservation practice.

My placement was funded by the Heritage Lottery Fund's Skills for the Future programme, and focused on the use of digital technologies to record historic sites and buildings across Scotland. I had the opportunity to work with a variety of digital documentation techniques, including laser scanning, structure from motion (SfM) photogrammetry and 3D printing. This enabled me to become familiar with a range of equipment such as 3D laser scanners and DSLR cameras, as well as computer software to process the data.

Most of my work fell within the remit of the Rae Project, a programme to digitally



DIGITAL DOCUMENTATION

document the HES estate in 3D, covering over 300 properties and a large number of objects from our collections. Digital data from the Rae Project can be used in many ways to help with conservation and heritage management, but also interpretation and learning.

Fieldwork for the project has taken me to locations all over Scotland, from Edinburgh Castle to the Neolithic village of Skara Brae in Orkney. The Rae Project covers many different aspects of Scotland's heritage, from a delicate bone comb found at Caerlaverock Castle to the imposing stone tower of Glasgow Cathedral.

My placement with the Digital Documentation Team gave me the opportunity to meet and work with experts from many different fields, both within HES and external partners. I have had a chance to

work on an exciting 4D coastal monitoring programme at Skara Brae and see how laser-scanning data can be used to assess coastal erosion and, potentially, the impacts of climate change. This was done in partnership with Scottish Natural Heritage (SNH) for the Dynamic Coasts project.

Digital skills are increasingly important in the heritage sector, but also in architecture and construction. Technologies such as virtual reality, augmented reality and BIM are being more widely adopted and, in that respect, my placement with HES has helped me develop valuable skills that can be applied across several disciplines.

MORE INFORMATION

See www.engineshed.org/about-us/teams/digital-documentation-team for more about the Digital Documentation Team

Top: Scan of Skara Brae for the coastal monitoring project © The Centre for Digital Documentation and Visualisation LLP

Above right: Laser scanning the Cochno Stone in Glasgow in partnership with Facticum Foundation and the University of Glasgow © Keats Webb



Ambitious plans to shrink carbon footprint

Adam Florence explains how the organisation is upping the ante on climate change with a forward-thinking carbon emissions reduction plan, to be launched this year



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I took up my new position as Carbon Manager at Historic Environment Scotland (HES) in September 2016, building on my previous role as Project Officer – Energy Efficiency and Carbon Reduction at a local authority. When the opportunity arose at HES, I jumped at the chance to take on a new challenge and make better use of my postgraduate qualification in geography and my experiences as a conservation volunteer for the National Trust for Scotland.

HES has been through a time of great change, and has already achieved an impressive 17% emissions reduction across the organisation compared with the baseline year 2008-2009. The launch of an innovative new Carbon Management Plan (CMP)

later this year offers a positive opportunity to implement a more radical and forward-thinking emissions-reduction programme to meet wider emissions targets set by the Climate Change (Scotland) Act and to strengthen our position as a sustainability leader in our sector.

I have received positive responses from colleagues on new strategies to roll out climate change activities, including integrating behaviour change initiatives and developing more effective ways of gathering information and data from across our operations. Going forward, these will allow for better engagement with all parts of the organisation and a more strategic overview of climate change projects. We'll be recording progress on this annually in our

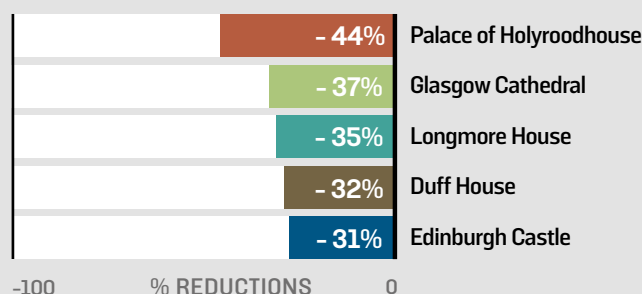
Sustainability Report and the new Public Sector Climate Change Report.

My immediate next step is to identify a series of themes and potential activities that will collectively provide a comprehensive CMP to help us reduce our carbon footprint efficiently. We hope to achieve this by resetting our baseline to 2014-2015 and aligning our emission reduction targets with the Scottish Government's.

Instead of just measuring our current year against our baseline year, we would aim to have a year-on-year reduction of around 2.3%, with actual performance being measured against the cumulative carbon budget (the amount of carbon we have allowed HES to emit each year). As performance is measured cumulatively, this means that any 'under-' or 'overspend' in the interim years may be carried forward, and ensures all years are considered in measuring our performance.

I will use this to develop a methodology that may improve HES's current processes and create additional opportunities for partnership working so we can continue to provide leadership to the sector in climate change mitigation.

Top five carbon emissions reductions since 2008-2009



Top left: Energy efficiency measures at Edinburgh Castle include installing sheep's wool loft insulation

Top right: Behind the scenes in Edinburgh Castle's boiler room, featuring new boilers, during the Going Green Insight Tour in November 2016

Restoring a century-old hydro scheme

Gary Carvel tells the story behind a new addition to our Refurbishment Case Study series – the resurrection of a micro-hydro scheme built nearly 110 years ago at Blair Castle



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The reinstatement of one of Scotland's earliest surviving micro-hydroelectric plants at Atholl Estates in Perthshire means that Blair Castle is now self-sufficient in electricity. The project is the subject of a newly published *Refurbishment Case Study*.

Hydro power has been used to produce energy for centuries, and Scotland's topography and rainfall made it particularly well positioned to adopt this technology. In the late 19th century, before electricity was available through the National Grid, hydro systems were adapted and developed to produce electricity for domestic lighting and power.

In 1908, Atholl Estates was among the first estates in the UK to install a micro-hydro system. Due to the local topography, dredging work to create a channel and ponding system took the estate team just two months. The estate generated its own electricity until the advent of the National Grid in the 1950s proved more economically efficient.

However, the rising cost of electricity, together with the opportunity to create a new revenue stream with the Government's Feed-in Tariff scheme, made micro-hydro viable once again.

Atholl Estates had already trialled biomass, but poor

efficiency and issues around maintenance and fuel supply made it unfeasible.

Unusually, the 200-yard-long penstock (a pipe that delivers water to hydro turbines) and upstream infrastructure of the micro-hydro system had survived, enabling Atholl Estates, in partnership with the Blair Charitable Trust, Historic Environment Scotland (HES) and Gilkes, manufacturer of the original turbine, to restore the system and upgrade it to use a modern turbine.

The penstock had been retained as a water supply for the emergency fire sprinkler system, so the piping was in good condition and could handle the required water pressure. Only minimal dredging was needed for the ditch and pond system, and a silt trap, spillways and new pond cill completed the works.

The 1908 turbine house was used as a showcase for the project – its existing profile metal roof covering was retained and the internal walls of the new lobby were clad with vertical 'tongue and groove' Scots pine, a common 19th-century finishing detail in the Highlands.

LED lighting was installed throughout the castle, significantly reducing its energy use and allowing the building to become self-sufficient in electricity. This project, which spanned the

centuries by reigniting historic links, revitalised one of the earliest examples of micro-generation to the significant benefit of the current working estate.



Refurbishment Case Study series

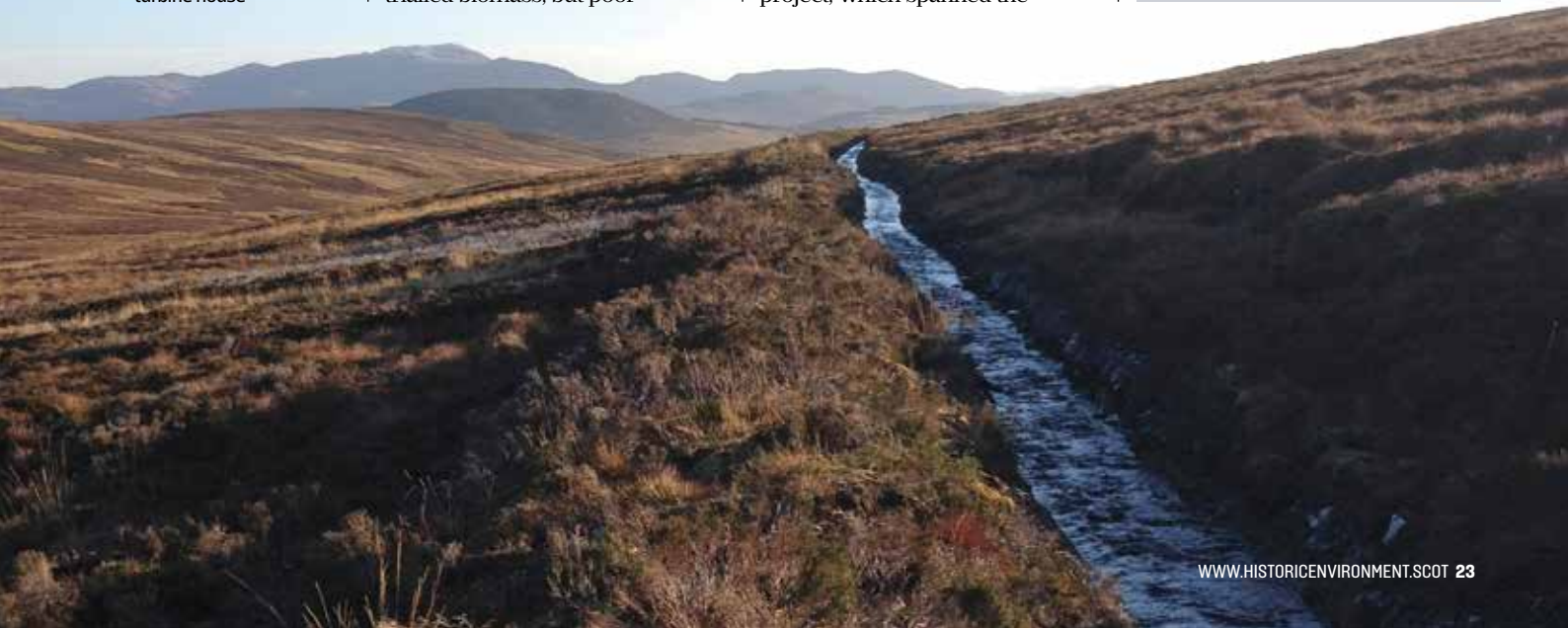
www.historicenvironment.scot/refurbishment-case-studies

The HES Technical Research Team undertakes projects to test and trial methods for the refurbishment of traditional buildings. Findings are published in our *Refurbishment Case Study* series, detailing practical applications around the conservation, repair and upgrade of traditional structures, while seeking best practice throughout.

These informative case studies cover measures such as repairs to masonry and upgrades to windows, walls and roof spaces in a range of traditional building types, including tenements, cottages and public buildings.

Below: Hill ditch supplying the micro-hydro scheme with water

Right: Interior of the turbine house



Adapting to a changing climate

Enhancing original features or adding detailing can help make traditional buildings more resilient to climate change, explains Roger Curtis



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Scotland has always experienced harsh weather, and most traditional buildings were designed and built robustly enough to resist these extremes over their lifetime. For instance, water-shedding details such as string courses and oversailing eaves are common features of traditional buildings, and for hundreds of years they have sufficiently prevented water ingress to building fabric and consequent deterioration.

However, Scotland's changing weather patterns over the last few decades – and projected shifts towards more

intense rainfall, increased storm events and high winds – are placing additional pressures on all our traditional buildings. Ensuring the built environment is resilient to these changes is vital to safeguard the future of our building stock – in the last few years, this has been the focus of the Technical Research Team's investigation and recently published guidance.

The first and crucial step towards improving the resilience of buildings is through regular maintenance. If correctly maintained, most components of a traditional building will last for over 100 years – and, in many cases,

significantly longer – before replacement is required. Good maintenance can ensure that a building's external envelope remains wind- and water-tight, and functions as it was intended to. It is also cost-effective and often prevents serious problems later that may eventually require costly and extensive works.

Nonetheless, with recent changes in climate, such as increased rainfall, existing features are, in some cases, no longer able to cope and function as they once did. There is increasing evidence that some building types are becoming wetter – structures that

Effects of climate change on buildings

Wetter winters, more intense rainfall

- Increased run-off from farmland
- Ditches and culverts overwhelmed
- Water run-off from hard landscaping
- Below-ground drainage overwhelmed
- Inundation of flood plains
- Flash flooding from changed land management
- Softening of ground, trees uprooted

Rising sea levels, wind and tide

- Loss and destabilisation of foreshore
- Destabilisation of foundations
- Damage from salt spray
- High tides and storm surges



Hotter, drier summers

- Increased thermal stresses on fabric
- Cracking of hard materials
- Ground shrinkage and heave
- Internal overheating
- More moths and internal pests



More high winds and winter storms

- More wind-driven rain
- Damage to pointing and masonry
- Loss of slates and roofing materials
- Higher rate of stone decay
- Collapse of fragile masonry
- Increased splashback from hard materials



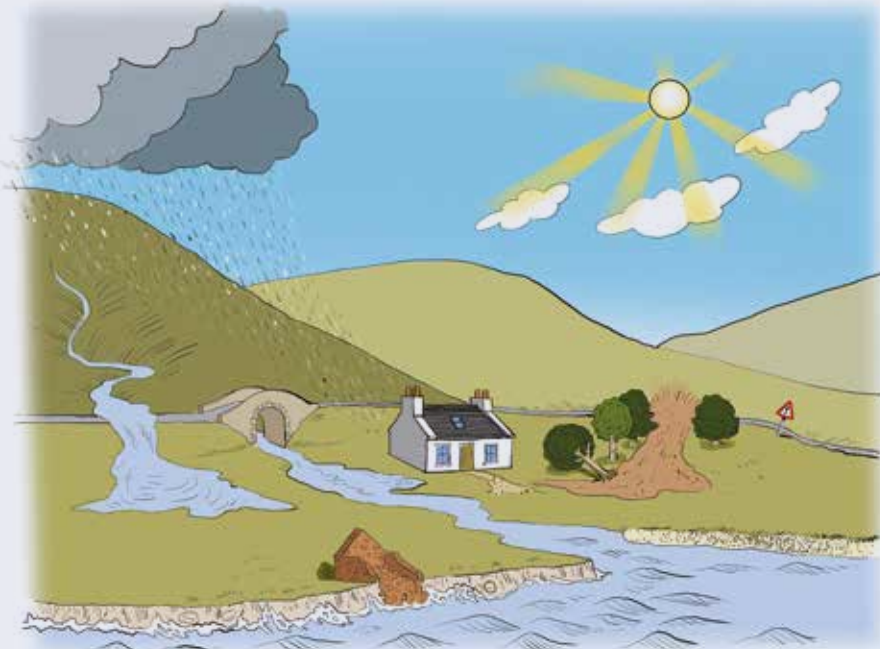
More water on and around the building

- Rising groundwater levels
- Dampness in walls and basements
- Increased wetting and drying cycles
- Increased saturation of building fabric
- Blockage of rones and downpipes
- Saturation of walls and masonry
- Internal timber decay



Warmer winters

- Higher internal humidity
- Increased wood beetle attack
- More moss and algal growth on masonry





Far left: Resilience of this gable end has been improved by adding additional lead work to skew copes and a hood mould over the window to shed water more effectively from the walls

Left: This previously wet gable is now dry after being repaired and improved with traditional materials

Below: This small addition below a window cill has kept the masonry below dry



Top: Poor detailing of rainwater goods has led to overflow and saturation of masonry

Above: Failing masonry and damp on a gable end in Scotland

performed well in the past are now showing signs of stress, with dampness and associated timber decay more common. In such cases, the reinstatement or enhancement of original protective features, or the adoption of additional detailing, may need to be considered to increase water-shedding capabilities.

There are many methods for adapting traditional buildings, and the most appropriate solution will depend on the specific nature and needs of the structure in question. Furthermore, it is important to ensure that any additions or changes are in keeping with the historic character of the building, and that materials are compatible with the original fabric of the building.

Our recent technical buildings research has involved trialling various

With modest alteration, the ability of a structure to shed water can be improved

methods to test their effectiveness. This has included a number of site projects designed to demonstrate that, with modest alteration, the ability of a structure to shed water can be improved. Much of this has involved the addition or improvement of traditional features or detailing that prevents water running into the fabric of a building.

In a project in Shetland, the use of a hot mixed lime render, along with enhanced chimney-head water-shedding detailing, made a previously wet and damp

building into a dry and warm home. Small things can make a difference, too. At Hobkirk Church in the Scottish Borders, a modest lead drip was added below a window to reduce wetting of the masonry below.

The Scottish Government's Climate Change Adaptation Plan has mandated adaptation research as part of a national response across all areas of society. Historic Environment Scotland's recent Short Guide was designed as a tool to meet this need throughout Scotland. However, its principles can be applied worldwide. This is being recognised internationally, with our work sitting at the forefront of a number of initiatives around the globe to tackle the issue.

MORE INFORMATION

The new Short Guide is at www.ingeshed.org/publications

INDUSTRIAL HERITAGE



Watt's ruined cottage at Kinneil

Inset right: Portrait of James Watt. Courtesy the McLean Museum

Watt's the story

A host of plans are underway to celebrate the work of renowned Scot James Watt in 2019, Miles Oglethorpe reveals



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Historic Environment Scotland (HES) is leading preparations for two important anniversaries relating to inventor and engineer James Watt: the 200th anniversary of his death in 1819 and the 250th anniversary of his separate condensing steam engine being patented.

Watt first conceived the idea of the separate condenser in 1766

when walking across Glasgow Green. His idea transformed the efficiency of the steam engine, revolutionising industry and transport, and bringing about huge economic and social change around the world.

To commemorate his invention, the Friends of Kinneil and HES organised a parliamentary reception at Holyrood in January 2016, hosted by Falkirk MSP Angus MacDonald. The event brought together a wide variety of stakeholders with a common interest in Watt, ranging from mechanical engineers to heritage professionals and teachers.

The ambition is to stage a range of commemorative events in the years and months leading up to major anniversaries in 2019. A working group has been established under the chairmanship of HES to take this forward.

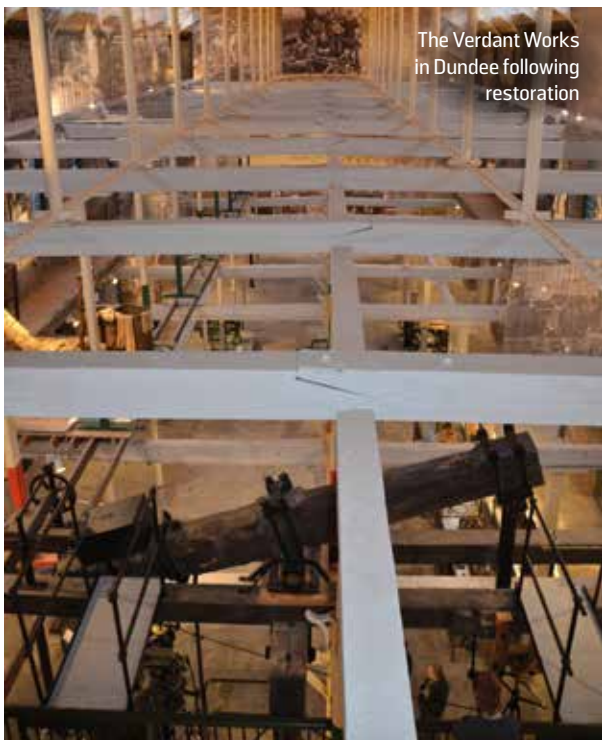
The group brings together key partners, including Glasgow and Heriot-Watt universities; the Royal Society of Edinburgh; Inverclyde, Falkirk and Glasgow councils; Glasgow Life; Falkirk Community Trust; Friends of Kinneil; the Library of Birmingham; the Science Museum; and the UK's key engineering institutions.

Recently, we have seen the completion of some inspiring Watt-related projects, such as the conservation and installation of a Boulton & Watt engine by Dundee Heritage Trust in Verdant Works. This 19th-century jute mill has recently been re-opened after a spectacular refurbishment project, with HES and the Heritage Lottery Fund among its key sponsors.

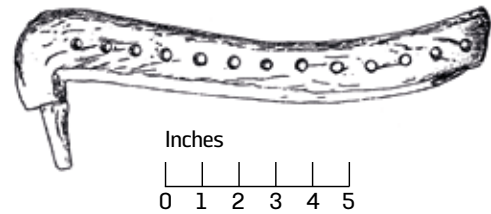
Verdant stands as a fantastic example of an industrial mill conversion, managing to retain most of its historic fabric while being successfully adapted to accommodate a new function with an iconic Watt engine at its heart.

In addition, HES recently digitally recorded Watt's ruined cottage at Kinneil, so there is the potential for a virtual 3D project combining the physical remains of the building with Watt-related artefacts and archives from collections across the UK.

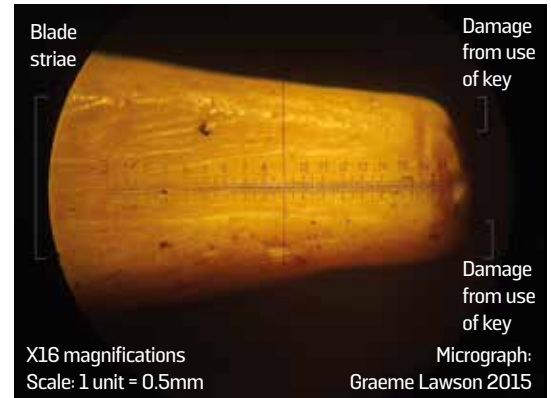
With so many Watt projects and events planned, and 2018 already earmarked in Scotland as being The Year of Young People, perhaps 2019 could be designated as The Year of Watt-ever!



The Verdant Works in Dundee following restoration



From Lawson 1980, after Knowles 1896



Science sheds light on castle harp

Recent scientific analysis of an unusual bone tuning peg found at Edinburgh Castle has given clues to its date and use, explains Rachael Dickson



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A rare bone tuning peg from a stringed instrument has been re-examined using modern scientific technologies to try to discover more about this unusual object. The peg was unearthed during excavations in 1988–1991 at the castle, alongside other materials and artefacts that provide an insight into the economy and daily life at the site from the late Bronze Age through to modern times, and reflect the changing function and status of the castle.

Tuning pegs have been found at sites in Ireland, Wales and England, where they date from the 12th to the 16th century, but this type has not previously been reported in Scotland.

Wooden tuning pegs rarely survive, but they can yield a huge amount of information about the forms of the instruments for which they were made and the geographical distribution of string musical traditions.

The tuning peg is small and cylindrical, with a squared head and flattened tip perforated

transversely by a drill hole. Although it is simply made, its dimensions indicate that the lost instrument had been built to standard units of measurement (inches and fractions of an inch), and was probably the product of a craft workshop and therefore a valuable item of equipment.

Dr Graeme Lawson of the University of Cambridge led the detailed examination of the peg. He looked in particular at its specific use and date. From its curved outline, he surmised a date of around 1100–1300, based on comparative images in manuscripts. Identification and investigation was further enhanced by X-ray fluorescence (XRF) analysis undertaken by the HES Conservation Science Team.

They used XRF to identify the composition of staining noted where the (now absent) string is thought to have sat adjacent to the string hole. Copper and zinc concentrations were observed over the surface of the peg, with the relative concentration of copper being highest at the end where the string would have been fixed.

Close to the string hole are oblique stains, suggestive of a

winding of metal wire, and XRF in this area indicates long-term exposure to strings of copper-alloy or some nearby copper-alloy fitment. However, an unexpectedly strong iron signal from within the soil residues still packing the string hole alludes to the use of steel wire. While there is a possibility the residue is from incidental iron frost soil deposits trapped in the perforation, the concentrations of manganese (often found with iron) do not correspond.

The re-examination and analysis of this small but significant find almost 30 years after its initial publication demonstrates the merit of revisiting old discoveries. The application of detailed scientific XRF analysis has added much to our understanding.

In addition, re-evaluation of the morphological details compared with other known northern European harp components has shed light on its date and wider significance. These methods have enabled the tuning peg to be identified as that from a small harp, probably of early medieval date.

Clockwise from top left: The bone tuning peg is 44.2mm long; sockets for tuning pegs in the wooden neck of an early medieval harp found at Carncoagh, Co. Antrim; optical micrograph of the squared head shows tool marks on the surface, the angles blurred from the use of a tuning key

New hands for traditional crafts

Historic Environment Scotland's (HES) Craft Fellowships are helping to keep traditional skills alive. Here, Craft Fellows Jeff Mackie and Sam Britten talk about being part of continuing Orkney's unique heritage



JEFF MACKIE
Boatbuilder

I've been a joiner since I left school. As a born-and-bred Orcadian, I've been surrounded by boats all my life, although my real interest was sparked when I worked on boats in the south of France for two years. So when I saw this Fellowship advertised, it sounded like an opportunity to combine my two backgrounds and try something interesting.

Boats are a vital part of life here in Orkney – the islands have some unique traditional boat designs, such as the Orkney yole. Once widely used for transport and fishing, there was just one working yole left a few years ago. Now, thanks to new builds and restorations led by the Orkney Historic Boat Society (OHBS), the yole is making a comeback as a leisure sailing boat.

Most of Orkney's skilled traditional boatbuilders are getting on in age, so my Craft Fellowship, hosted by the OHBS

My Craft Fellowship is aimed at training up a craftsman to carry on the business and keep the tradition alive

with well-known Stromness boatbuilder Ian Richardson, is aimed at training up someone to carry on the business and keep the tradition alive.

Over the summer of 2016, I had my first taste of working with Ian in his workshop for a month. I helped restore a boat, putting in some new planks and seats, and replacing a handmade wooden cleat, while OHBS volunteers did the painting – it was hugely satisfying.

Then, in September, I began a 47-week boatbuilding course at the International Boatbuilding Training College in Lowestoft, Norfolk. So far, so good.

Our first 12-week block took us back to basics, working with hand tools only and honing those traditional skills that you just don't have as a modern joiner armed with power tools. Other topics include plumbing, electrics, paint and varnish finishing, knots and rope splicing.

Once I've completed the course at Lowestoft, I am looking forward to getting back to Orkney to work with Ian for the second year of my Fellowship. Having lived in the Mediterranean, Orkney is where I want my future to be.



MORE INFORMATION

HES is looking to set up and recruit four further Craft Fellowships this year: in blacksmithing, quarrying, bronze and statuary. Interested organisations and individuals can contact Steve Townsend at stephen.townsend@hes.scot

Below: Jeff Mackie with mentor Ian Richardson





SAM BRITTEN
Miller

In my previous life, I was a chef for 16 years, with fine dining experience in London and Australia. I'm originally from Nottingham and moved to Orkney with my wife a few years ago.

I've always had a keen interest in artisan food producers and traditional ingredients. So when I spotted the advert for this two-year Fellowship at Barony Mills, an 1870s watermill run by the Birsay Heritage Trust, I loved the sound of it. The mill's unique product is traditional bere meal made from bere, an ancient, hardy landrace of barley that copes with the cooler climate.

I'd never set foot in a watermill, but after a year here, I have built up the core skills under the guidance of Ray Phillips, a third-generation miller who knows this mill like the back of his hand. I've had to get to grips with mechanics and

I feel we're riding a wave of interest in artisan food and drink

maintenance, such as dressing the stones, and now I'm trusted to run the mill on my own.

In September 2016, we took in 30 tons of bere, which we'll mill by April at a typical rate of around a ton a week. It's a one-man operation and this quaint old mill has its own pace. The process starts with gently drying the bere on the fire-warmed kiln floor. Putting it through the first stone removes the husk, then it is ground in two further stones. All this involves me running up and down stairs to check that all the belts are moving properly – it's physical work.

These days, I'm geeky about grain. I've experimented with malting both the bere and

conventional barley, and I'm experimenting with brewing my own beer, too. We now have artisan whisky distilleries and breweries taking our malted grain – I feel we're riding a wave of interest in artisan food and drink.

Part of my job has been showing visitors around and promoting our bere meal to new customers such as restaurants. With my background as a chef, I have the advantage of speaking their language. Both the visitors and customers love the story and provenance.

It might be historic, but Barony is also a viable commercial mill – I believe the potential is huge here and I'd like to be part of its future. In the meantime, I'm looking forward to attending a milling seminar in London in March and visiting other historic mills around the UK to learn from them.

Above and left: Barony Mills, Orkney's fully operational 1870s watermill

Inset above right: Sam Britten at work in the mill

Summer School's a stepping stone

Five students look back on their experience at our Conservation Summer School

Historic Environment Scotland's (HES) Conservation Summer School offers an introduction to building conservation, traditional materials and skills through a week of talks, workshops, field trips and hands-on activities. Our objective is to inspire students to pursue a career with traditional buildings. Every year, a number of bursary places go to students on relevant degree courses, including architecture, surveying and engineering. Here, five former Summer School students explain how their attendance inspired their interests and provided a stepping stone in their careers.



Katiera Donnelly

Attended: 2016

Now: BEng Civil & Environmental Engineering, University of Strathclyde

As a civil and environmental engineering student, I was keen to explore the application of conservation techniques in my field, as it is not readily discussed in my academic studies. At Summer School, I learned about conservation and restoration techniques of which I would otherwise have been unaware. Dr Maureen Young's Summer School lecture on non-invasive conservation techniques sparked my interest in thermal imaging.

In fact, I'm doing my fourth-year dissertation on how this technology – along with others such as X-ray diffraction and microwave moisture meters – can be used to detect deterioration in the facades of historic and traditional buildings. I'm excited to have the opportunity to do fieldwork with Dr Young and her colleague, Dr Alick Leslie, to develop my dissertation.

Summer School has made me consider a career in conservation after graduating – something that I hadn't thought of before – and has given me an understanding of how conservation and restoration can intertwine with civil and environmental engineering in different interesting applications.



Conor Lynch

Attended: 2013

Now: Graduate building surveyor, Brown + Wallace

HES Summer School was a great help in improving my understanding of traditional building construction, materials, defects and solutions, including sandstone and lead. These were subject matters that interested me. Now, my daily work as a building surveyor in Glasgow often involves condition surveys of traditional buildings, so I'm putting into practice the knowledge I gained at Summer School.

Summer School also provided me with documents and guides that were useful in my university studies and are just as invaluable now as I work towards becoming a chartered surveyor. In all, Summer School showed me other career paths that are open to building surveyors, and I feel it has set me apart – certainly prospective employers have remarked on it when looking at my CV.

Summer School showed me other career paths and it set me apart – certainly prospective employers have remarked on it





Elsbeth Tayler

Attended: 2014

Now: Part II architect, Highland Council

Conservation is rarely covered in any great detail in architecture schools, so Summer School introduced me to a range of conservation ideas, principles and practices that I wouldn't have encountered otherwise. The hands-on experience of skills such as stonemasonry, slating and lead work was hugely interesting, and helped me appreciate the craftsmanship that goes into restoring stonework or creating a carved timber staircase.

Many of the buildings I work on now are historic and listed. Summer School gave me the ability to approach these projects confidently, from understanding the architectural history of a building to sourcing the correct materials for repairs and improving the energy efficiency of historic buildings. Summer School certainly provided me with extra knowledge that many architecture graduates do not have. Conservation is where my passion lies and I hope to become an accredited Conservation Architect in the future.



Stacey Rowntree, left, and a fellow Summer School student try their hands at drystone dyking during the traditional skills workshop



Matt Fleming

Attended: 2013

Now: Part II architectural assistant, MacDuff Architects

As an architecture student at the time, Summer School helped focus my interests. The hands-on elements of the course improved my understanding of various techniques involved in dealing with older buildings. My Honours dissertation was on the topic of improving the energy efficiency of traditional buildings through sympathetic means.

Now I'm with a firm specialising in conservation, so I have the opportunity to work with older buildings, whether listed or historic, which is allowing me to further develop my skills and knowledge in the field. My experience at Summer School – together with work experience gained at English Heritage and the Scottish Lime Centre Trust – has contributed to my aspiration to gain professional accreditation as a Conservation Architect in the near future.



Stacey Rowntree

Attended: 2011

Now: Building surveyor, Scottish Lime Centre Trust

As a building surveyor, I inspect buildings for defects and recommend repairs. For traditional or historic buildings, this means using the right materials and repair strategies. The whole concept of using the right materials – and understanding buildings by the materials used – was covered extensively at Summer School and reinforced during a conservation module at university. I now put that knowledge into practice every day.

Summer School also highlighted the skills that are required to use these materials, and the implications for the repair schemes chosen. It really opened my eyes to the range of careers in conservation, and how various trades and professionals work together.

I'm fortunate to be working as a surveyor in conservation at my age. Summer School helped to take me to where I am now – it gave me confidence to pursue a career in conservation and gave me an edge when looking for jobs.

MORE INFORMATION

See www.engineshed.org/learning/building-conservation-summer-school or email technicaleducation@hes.scot for more information about HES Summer School 2017

FOCUS ON PARTNERSHIPS



At GalGael's workshop in Glasgow, traditional woodworking and boatbuilding skills can change lives

Introduction

This year our FOCUS ON section casts the spotlight on partnership working. Collaboration is a key strand in the ethos of Historic Environment Scotland, and much of our work is realised and implemented through the invaluable links and networks we have throughout the sector.

Our partners include communities, experts, other organisations, private companies, schools and interested individuals. It makes sense for us to partner up where we can to share expertise and resources, ensuring our work is as effective as possible.

In this issue, we highlight some of our most recent partnership stories. We take a look at how the discovery of the largest Viking hoard in Scotland brought a whole host of people together to work to protect and record the buried treasure. Our Technical Research and Science teams join up to talk about turf capping trials with the National Trust for Scotland, and the recent national thatch survey delivered together with the

Society for the Protection of Ancient Buildings (SPAB).

We also tell some of our recent climate change stories. We have been focusing on determining the risks facing our historic properties, along with international energy saving projects such as EFFESUS, highlighting the inroads being made to reduce energy usage in historic cities in Europe. Our recent community partnerships also take centre stage, showing how important it is to involve local people in the work that affects the heritage in their area.

These are just a few examples of the many invaluable partnerships we've been building, and we aim to continue to expand on this trend. The opening of the Engine Shed will provide a hub for fostering and facilitating partnership working nationally and internationally, strengthening the resilience of Scotland's historic built environment for future generations.

Dr Ewan Hyslop, Head of Technical Research and Science
ewan.hyslop@hes.scot

Carving out a future together

For over a decade, Govan-based GalGael has built a reputation for making a real difference to many who struggle with life and are left marginalised and isolated. Through woodworking skills, culminating in traditional boatbuilding, the community group helps people find purpose and inspiration. In its own words: "To the unskilled, we offer a chisel so that they might carve out a future."

Over the past year, Historic Environment Scotland (HES) has strengthened its relationship with GalGael, helping with mentoring across a range of activities, from honing skills to product development. The latter means that GalGael will be able to supply hand-crafted wood products

Through woodworking, GalGael helps people find purpose and inspiration

that will be featured in the Engine Shed.

Visiting GalGael is an inspiration. They are so focused on helping people that they sometimes need a hand to see the range of opportunities available out there. It's a pleasure to support traditional skills being used to truly change people's lives.

Colin Tennant, HES Head of Technical Education and Training
colin.tennant@hes.scot

Adapting northern Europe's historic places to climate change

The impact of climate change on Europe's far northern regions is potentially very severe, and many of its historic places already experience increased deterioration and damage. Local communities and authorities often lack the resources to adequately plan and implement adaptation measures to protect these sites.

To help, Historic Environment Scotland (HES) has applied for funding from the European Union's Interreg Programme for the Northern Periphery and Arctic (Interreg NPA) for a three-year project called Adapt Northern Heritage.

The project's aims are threefold: to develop a software platform to assess risks and vulnerabilities of

historic places to the impacts of climate change, and plan conservation-minded adaptation measures; to demonstrate this form of adaptive conservation planning in 10 case studies (two in Scotland); and to

create a community network of concerned organisations.

The project proposal was developed in 2016 as part of an Interreg NPA preparatory project with the same name, in which HES worked jointly with Norway's Directorate for

Cultural Heritage (Riksantikvaren), the Norwegian Institute for Cultural Heritage Research (NIKU) and the Swedish National Heritage Board (Riksantikvarieämbetet). www.interreg-npa.eu



Coastal erosion was threatening Fredheim, a listed hunting station on the Norwegian archipelago of Svalbard in the Arctic Ocean, so it was moved further inland in 2015

© Riksantikvaren/photographer Susan Barr

Energy project milestone

The Capturing the Energy (CtE) initiative celebrated its 10th anniversary in 2016. The project aims to help preserve historic records of offshore oil and gas companies active in the North Sea, many of which have changed hands in recent years.

With decommissioning driving a period of rapid change, CtE is working with the industry and the Department for Business, Energy and Industrial Strategy (BEIS) to ensure that the most important records are not lost.

CtE was founded in 2006 by core partners including Total, Oil & Gas UK, RCAHMS (now HES) and the University of Aberdeen (where the project is based). Currently, it is discussing documentation with Shell, whose iconic Brent oil and gas field is being decommissioned. www.capturing-the-energy.org.uk

Restoring Kinneil orchard

The historic orchard in the grounds of Kinneil House in Bo'ness will be fruitful again, thanks to the planting efforts of primary six pupils from Kinneil and Deanburn schools.

The restoration involving local schoolchildren was a collaboration between Forth Valley Orchards Initiative, the Central Scotland Green Network, the Friends of Kinneil and Falkirk Community Trust.

Together, the organisations had determined which modern and heritage fruit tree varieties should be planted to ensure that the restored orchard was authentic.

The schoolchildren were taught how to position trees and prepare the ground for planting.

It is hoped that the project has helped engage younger generations with their historic and natural environment.



Pupils planting trees at Kinneil Orchard



Shared ambition for Forth bridges

The Forth Bridges Forum continues to grow from strength to strength after the Forth Bridge was inscribed in 2015 as Scotland's sixth and newest World Heritage Site.

The Forum's partners include Historic Environment Scotland, Network Rail, Transport Scotland, Visit Scotland, Amey, and Fife and City of Edinburgh councils. It oversees the maintenance of all three bridges and plans to promote them as a new tourist destination in the future.

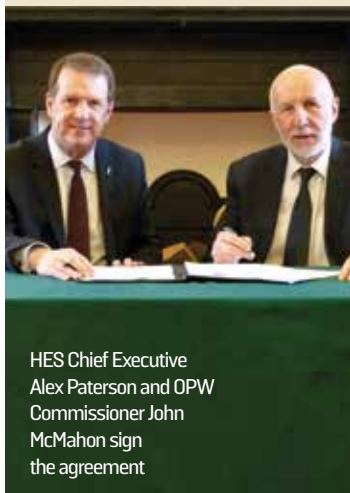
Key to this has been the recent 3D documentation of the bridges by the Centre for Digital Documentation and Visualisation, with funding from Transport Scotland. www.forth-bridges.co.uk

Irish partnership to protect skills

When it opens this year, the Engine Shed will continue to support the long-standing relationship between Historic Environment Scotland (HES) and the Office of Public Works (OPW) in Ireland. Scotland and Ireland share similar building traditions, and both HES and the OPW are dedicated to conserving the built heritage and promoting traditional building skills.

The two public bodies have a Cooperation Agreement for Technical Conservation, and the Engine Shed will help strengthen this cooperation with knowledge exchange and training programmes.

The agreement will also enable the OPW to become a formal part of the Building Conservation Network and assist in the provision of technical specialists to assist research, training and education in Scotland.



HES Chief Executive Alex Paterson and OPW Commissioner John McMahon sign the agreement

Towering success for Forth initiative

Clackmannan Tower's visitors can now enjoy the view from the top with greater ease, thanks to the installation of a handrail and internal lighting.

Access improvement at the tower is among 50 projects driven by the Inner Forth Landscapes Initiative (IFLI), which is funded by the Heritage Lottery Fund and supported by

partners including Historic Environment Scotland, local authorities, Scottish Natural Heritage, the RSPB and Central Scotland Green Network. Other key projects include conservation of the Kennetpans Distillery and Charlestown Limekilns. The IFLI comes to an end in 2018. www.innerforthlandscape.co.uk



Construction professionals visit Clackmannan Tower on an Insight Tour

Construction skills agreement

Cadw, Historic England and Historic Environment Scotland are signing a new agreement with the Construction Industry Training Board (CITB) to secure the future of traditional building stock.

The agreement aims to ensure that the UK construction industry is equipped with the knowledge and skills to conserve, repair and maintain traditional stock. Under the agreement, areas of common concern at a UK-wide level will be addressed and best practice will be shared.

A star partnership in education

In November last year, the partnership between Historic Environment Scotland (HES) and Forth Valley College (FVC) was highly commended in the Partnership of the Year category of the Scottish Qualifications Authority's Star Awards 2016.

Both HES and FVC provide opportunities to gain skills and qualifications in traditional building, along with work experience and bursary placements.

The partnership, which was formed in 2012, has seen the development of a bespoke traditional skills training centre at FVC's Stirling Campus. Currently providing training nationwide, HES and FVC hope to offer training programmes from the Engine Shed to international audiences.

Together, HES and FVC have also established the Forth Valley Traditional Skills Forum and have engaged with key national and international stakeholders.



Ian Morrison, Head of Construction at Forth Valley College, left, with HES Training Manager Charles Jones

Chinese collaboration celebrated

This year will see the celebration of a new partnership between Historic Environment Scotland, the University of Stirling and The Palace Museum of The Forbidden City, Beijing, with the joint hosting of an international heritage conference in September.

The partnership agreement, signed in October 2016, established a joint research centre for the three partners to collaborate on heritage research themes such as conservation science and asset management of complex heritage sites. The partnership will foster the exchange of knowledge and

staff, providing training opportunities to both sides.

September's conference will address global challenges in heritage management, from climate change to engagement. It will involve a body of international experts, and will include sessions at the Engine Shed and Stirling Castle.



Striking Viking gold in Galloway

Richard Welander reports on the most significant Viking hoard to be found in Scotland in more than a century



RICHARD WELANDER
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Above: The Viking hoard includes a Carolingian pot packed with precious objects

Facing page clockwise from top: CT scanning the pot before opening it; the exterior encrusted with textile remnants; one of the silver brooches found inside

The Galloway Hoard was a remarkable discovery that forged new partnerships and built on existing ones. Made in September 2014 by a group of metal detectorists led by Derek McLennan, the discovery revealed an incredibly well-preserved and complete hoard of more than 100 objects dating from the ninth and 10th centuries AD.

The finds include silver ingots, brooches and armbands, gold and silver objects, and a Carolingian silver pot packed with treasures. This find is now deemed to be the most significant Viking treasure hoard ever found in Scotland, and its discovery sparked a series of events that saw conservation works take centre stage.

Viking hoards are valuable not only for containing precious metals, but also for the wealth of information they can give us about the social contexts of the time they were buried. Derek's prompt early reporting of what had been found meant that a small team of professional archaeologists had a rare, if not unique, opportunity to excavate and record both the

context and the content of the hoard. Being able to excavate finds *in situ* was hugely significant – without this, an enormous amount of uniquely important archaeological evidence would have been lost forever.

From the moment the hoard was discovered, the estimated high value of the find meant the site and its contents had to be protected immediately. Historic Environment Scotland (HES) Senior Designations Officer Andrew Fulton was among the first on site, and worked with the local farmer (who put his bull in the field!) and the police to secure the site overnight from 'nighthawkers' (illicit metal detectorists) plundering it. On recovery, the finds were taken for initial safekeeping to Dumfries Museum, where they could be properly examined for the first time.

Under contract to HES, fieldwork was commissioned by Edinburgh-based archaeological services company AOC Archaeology Group. Working alongside HES and Andrew Nicholson, the archaeologist for

Dumfries and Galloway Council, work begun on a rapid geophysical survey of the field in which the hoard was found, followed by a small-scale excavation of the immediate area around the find spot in order to gain greater understanding of the context of the hoard and the character of the surrounding remains.

It was clear from the outset – particularly with the discovery of extensive surviving rare textile remains – that work would be required straightaway so that immediate conservation needs could be urgently assessed. This meant a substantial commitment of resources well ahead of any allocation decision, sparking lively discussion about how funds and resources would be raised.

AOC Archaeology Group was also commissioned to take on the documentation, recording and conservation of the hoard. The intention behind this work was to produce a comprehensive inventory of every single object in the hoard, supported with images, video, X-rays, detailed



dimensions, weights and – where possible – chemical composition.

AOC conservators Gretel Evans and Natalie Mitchell worked alongside HES scientist Dr Maureen Young to assess the hoard's contents using portable X-ray fluorescence (pXRF) equipment to analyse all the metallic and inorganic components – crucial data to support the expert valuations.

One of the more unusual partnerships was with Dr John Reid of Borders General Hospital in Melrose. John, chairman of the Trimontium Trust and an archaeologist in his spare time, generously arranged after-hours access to the hospital's CT imaging facilities so that Gretel could examine the contents of the Carolingian pot before attempting to open and empty it. The images were truly astonishing, even if the objects' geometry was somewhat distorted.

The extent of worldwide media interest in the hoard was remarkable, and communications teams at both HES and the Crown Office were kept busy trying to coordinate press releases, arrange interviews, and respond to calls for more information and greater access. *National Geographic* sent a writer and photographer to do

an article on the find, and the story was also covered on BBC Four's 'Digging for Britain' series.

At the time of writing in late 2016, the decision on where the hoard will be permanently housed was still to be made. The Scottish Archaeological Finds Allocation Panel (SAFAP), an advisory Treasure Trove group drawn from across the heritage sector, was yet to meet to discuss its recommendations and to advise on the level of ex gratia payment. The Treasure Trove Unit continues to work on the difficult task of placing current market values on all of the items within the hoard.

We are nearing 'the end of the beginning', as they say. The hoard will soon be allocated; the recipient museum will have to start the challenging job of raising funds to procure it, and embark on a full programme of conservation, research studies and public exhibitions. A whole world of new partnerships beckons.

MORE INFORMATION

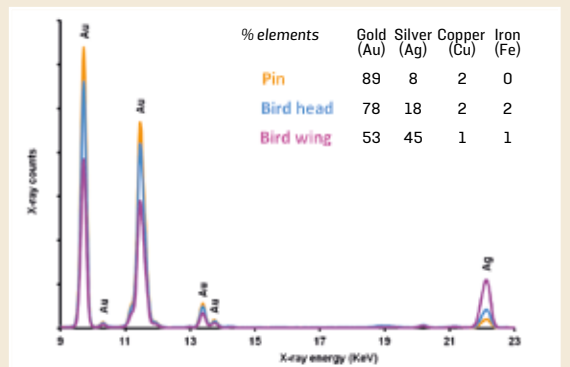
See www.treasuretrovescotland.co.uk for what to report and how if you find an object. More about metal detecting and archaeology is at www.historicenvironment.scot/metal-detecting



Local authority archaeologist Andrew Nicholson investigates the archaeological context of the hoard

Scotland's Archaeology Strategy

Securing this exciting discovery was only made possible by the prompt reporting of the hoard from the finders and the collaborative efforts of at least seven agencies and organisations, and dozens of people besides. With this in mind, Scotland's Archaeology Strategy, launched in 2015, promotes collaboration to increase the impact and reach of archaeology across and beyond Scotland. The discovery of the Galloway Hoard, while testing the ability of the sector to respond to emergency discoveries, demonstrated the scale of goodwill and collaboration, and the potential for ongoing and future research and greater engagement with the findings. Dr Rebecca Jones, Head of Archaeology and World Heritage, rebecca.jones@hes.scot



X-rays reveal metal composition

Portable X-ray fluorescence (pXRF) was used to analyse the composition of selected pieces from the hoard. This technique uses X-rays to identify chemical elements and enables us to quantify the composition of metals. pXRF analysis of the bird pin revealed that it is made of a gold-silver mix. The parts differ in composition, showing that it was not made from the same batch of metal. The pin was the highest-purity gold (almost 90%), the head included about 20% silver and the wings 45% silver. Each element must have been made separately then joined together into the finished bird brooch.

Dr Maureen Young, Senior Conservation Scientist, maureen.young@hes.scot



Turf trial is a team effort

Four conservation bodies collaborated in soft capping trials at Balmerino Abbey in Fife, write Jessica Hunnisett-Snow and William Napier



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A joined-up approach has helped tackle water ingress at National Trust for Scotland's (NTS) Balmerino Abbey, a ruined 13th-century Cistercian monastery in a beautiful but exposed site on the Tay Estuary. Recent soft capping trials, funded by the Historic Environment Scotland (HES) Technical Research Team, hoped to develop a technical solution to improve the resilience of ruinous monuments to climate change.

When we first visited the site in early 2016, it was clear there were many conservation challenges typical of this type of ruinous monument. The exposed wall heads of the structure were prone to water ingress through the ageing and cracked cement-bonded capping applied in the last

century. Other cement repairs to the pointing were causing the moisture to become trapped within the wall cores, leading to swift deterioration of the fabric.

To address this, soft capping trials were proposed using a locally sourced clay and sand mortar mix to form a cambered core, shaped to encourage rainwater run-off. This was topped with a turf cap. The turf was taken from the walled garden at nearby Hill of Tarvit Mansion to ensure that the local ecological characteristics were maintained.

The masonry beneath was treated in three different sections to assess the role of the mortar pointing in enabling the wall to dry out. One area was left with its cement pointing in place; a second was raked out and left exposed, and the third area was repointed in a gauged, hot-mixed lime mortar. The

effects of the trials are being monitored by HES's Conservation Science Team (see right).

The work was coordinated by NTS and carried out by Alison Davie, a lime and earth building specialist, with the help of 20 volunteers arranged through the Society for the Protection of Ancient Buildings (SPAB) Scotland. This collaboration between HES, NTS, SPAB Scotland and the Building Limes Forum brought together four conservation organisations to deliver a week-long event, attracting a diverse group of volunteers and over 70 visitors to an open day.

The project not only enabled us to address the technical issues affecting masonry monuments as a result of increased rainfall, but also to promote our shared philosophy of repair and conservation.

Completed soft capping
at Balmerino Abbey



Monitoring wall moisture at Balmerino

The work to Balmerino Abbey provided the Conservation Science Team with an opportunity to measure moisture in the walls of a building both before and after soft capping, writes Conservation Science Manager Dr Alick Leslie



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The water content in a wall is measured with a microwave meter that sends a pulse of microwaves through the stone and mortar at a range of depths. At Balmerino, we measured the water content to a depth of 30cm and 80cm to record what was happening at the core of the thick masonry walls.

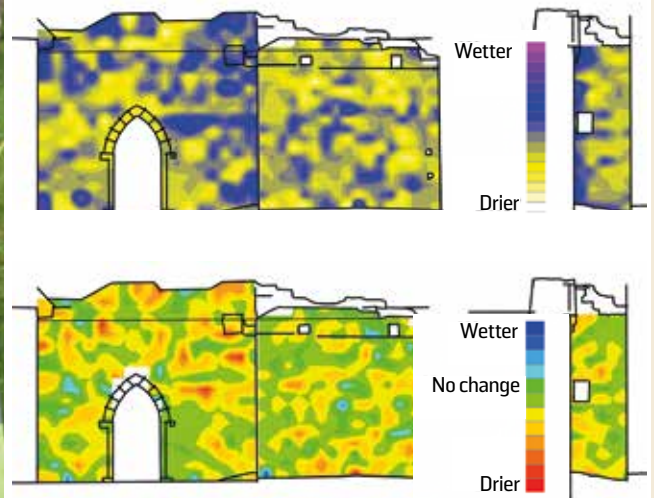
The first measurements were made in February 2016, several months before the work. At this time, moisture mapping showed an uneven distribution of water through the wall, suggesting that wetter areas are due to water

entering near the top and pooling in the wall at certain levels.

Repeat measurements were taken after the work. Almost all the wettest areas at the top of the wall appeared drier in September. This might be a positive result, but is likely to be influenced by seasonal factors, so further measurements will be needed to test if the capping work is effectively protecting the wall heads. We plan to analyse the walls using the same equipment every six months for the next few years to see how the soft capping is managing moisture in the walls over time and in summer and winter.

Below left: Taking moisture measurements with a microwave meter

Below right: Moisture mapping shows water at 80cm depth in Balmerino's east wall in February (top) and September 2016 (bottom)



What is soft capping?

This technique uses living plants and soil as a thermal and moisture-buffering outer layer to protect exposed wall heads from water saturation. It is low maintenance, non-destructive, reversible, sustainable and aesthetically pleasing.

For more information on soft capping and its best practice, see the research report *Soft Capping in Scotland* at www.engineshed.org/publications



SPAB working party preparing the wall heads for soft capping



Climate change: collaboration is our first defence

David Harkin on how Historic Environment Scotland (HES) is working alongside other public bodies to assess climate change risk



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A project to assess the risks posed by climate change across the HES estate is currently underway to inform our works schedule and ensure that our historic sites are protected for future generations.

Our Climate Change Risk Assessment (CCRA) forms part of the national Climate Change Adaptation Programme and utilises datasets from other organisations, including the Scottish Environment Protection Agency (SEPA) and the British Geological Survey (BGS). Using the data, we are developing a methodology to evaluate which sites are most at risk from hazards such as flooding, coastal erosion and ground instability.

The project is a GIS-based desk study utilising special data from our partners on the likelihood of groundwater flooding, pluvial and fluvial flooding, coastal flooding, coastal erosion and landslides.

These spatial information sets are overlaid with our property

boundary data to determine which sites are located in areas where the likelihood of hazards is the highest. This data is then combined with a number of site-specific factors such as the type of property, its staff presence and visitor access in order to assign a risk rating.

The project is vast, with over 300 properties spread across the country. The types of sites range from roofed and unroofed buildings through to standing stones, field monuments and carved stones, all of which will respond to climate change in different ways and test us with a diverse array of unique and varied challenges.

Changes in our climate are pushing us into uncharted territories, with many sites facing challenges they were never designed to deal with

In addition, the very nature of the properties we care for means many are located in positions that have always been vulnerable to hazards such as flooding and coastal erosion. This is a legacy of the needs of the people who constructed and used these monuments.

In many cases, our properties actually show a degree of resilience to the environmental hazards that many more modern constructions do not show. However, changes in our climate are pushing us into uncharted territories, with many sites facing challenges they were never designed to deal with. This is the crux of why our research is so important.

The race to understand the impacts climate change will have is not just a challenge relevant to us. The effects are already being felt across the sector and beyond, and what we can learn along the way is as important for others as it is to us.

As such, our current approach to assessing the risk across our

Safeguarding the future of Blackness Castle

Left: Blackness Castle on the Firth of Forth

Below: The new coastal wall at the castle



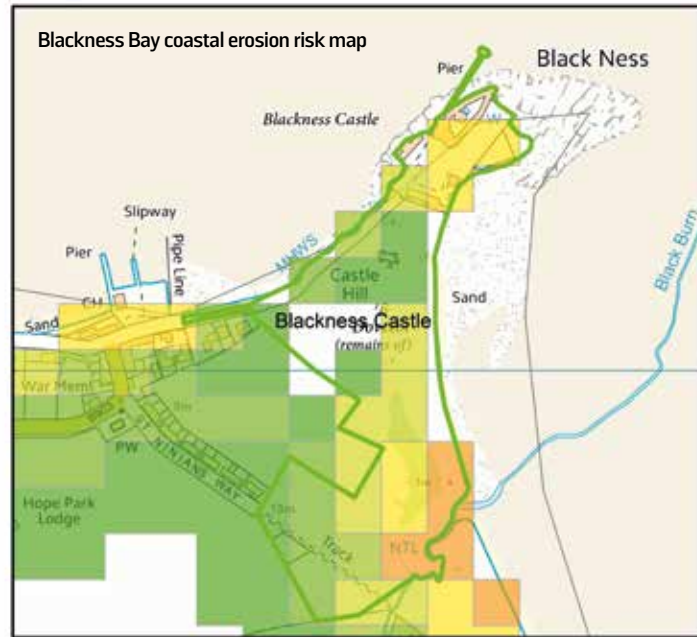
own estate is one facilitated – and influenced strongly – by working in partnership with other organisations. This joined-up approach enables us to benefit from the knowledge and expertise of others, while equally contributing our own experiences.

We are conducting this project alongside a host of other public bodies as part of an Adaptation Learning Exchange (ALE) programme facilitated by Adaptation Scotland. ALE supports regular meetings and information exchange with organisations such as the NHS and Scottish Water (amongst others), allowing us to ‘sense-check’ our approach at various stages throughout the project. Our individual approaches vary, reflecting the different operations and priorities of each organisation, yet our needs are essentially the same.

The work to date has provided a basic methodology and baseline assessment of risk at our properties from various natural hazards. We now need to test the robustness of the process and expand the analysis to include future climate change projections. The results will feed into the estate management practice, as well as having relevance for the wider historic environment.

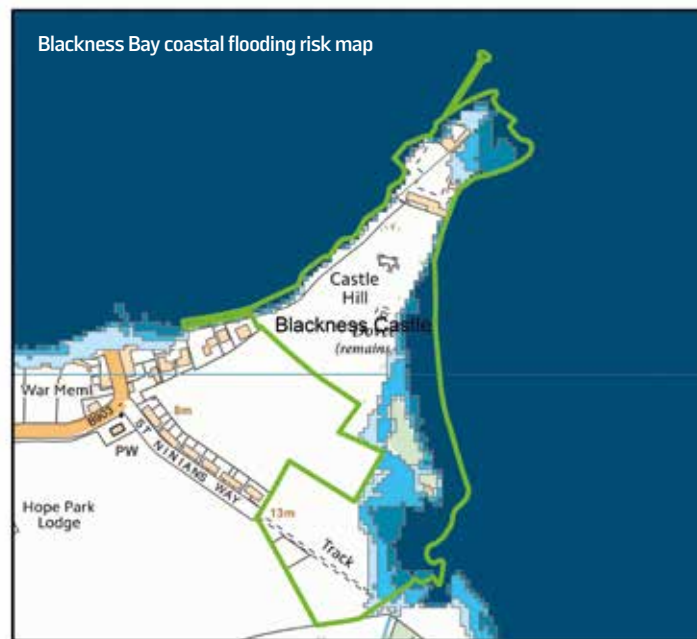
Situated on the shores of the Firth of Forth, Blackness Castle – like many of our properties in care – is vulnerable to natural hazards, including coastal flooding and coastal erosion. These hazards had already been observed and works had started to construct a retaining wall as a buffer against this flooding risk.

The CCRA validated these observations, showing the south-east corner of the site to be particularly susceptible to these hazards. This information is key to help inform the works schedule at Blackness and provide evidence for continued investment in flood defences.



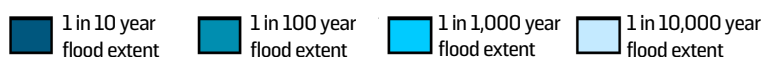
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Coastal heritage on the edge

As sea levels rise due to climate change, how much of a risk does coastal erosion pose to Scotland's cultural heritage? Assessing this is a collaborative effort, explains Dr Alistair Rennie



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Scotland's Climate Change Act has been praised for its bold carbon-emission reduction targets. It also places a duty on the public sector to appraise the risks of climate change and develop adaptation strategies to manage the changing impacts.

Rising sea levels are likely to increase flooding on our coast at a faster rate than terrestrial flooding. Erosion is also expected to increasingly affect society, infrastructure and our coastal heritage.

With a problem so large and a coastline so complex, a problem shared might well be a problem halved. So Historic Environment Scotland (HES) is participating in the National Coastal Change Assessment, a Scottish Government project commissioned by Centre of Expertise for Water (CREW) to appraise how our coast has changed and may change in the future.

Working with the University of Glasgow and Scottish Natural Heritage, historical, recent and modern maps have been checked – including updates from modern surveys – to develop the evidence base for the whole of Scotland. Approximately 4,000km of soft or

potentially erodible shoreline has been identified from all 21,000km of Scotland's coast.

Within these areas, the 1890s, 1970s and modern mapping were then analysed at 10-metre intervals with 1.2 million data points to identify stability, accretion and erosion. Past rates of change have been projected forward, and overlaid with maps of our cultural and natural heritage, alongside other infrastructure and assets.

Analysis is ongoing, but the mapping results to date are available on the project website. Whilst coastal erosion is a concern for a number of properties in care and scheduled monuments, many of our protected sites have always been located on very dynamic shores.

Much of the mapping highlights locations where we already know of erosion problems. The results also show assets protected by natural defences.

The maps are already helping us to understand coastal change at properties on the HES estate. They will also support national and local strategic planning, and aid identification of vulnerable areas of coastline that may require additional attention. Further collaboration is planned, with improvements to the evidence base to support the development of mitigation and adaptation plans for our assets at greatest risk.

MORE INFORMATION

The project website is at www.dynamiccoast.com

Above: Anti-glider poles at Culbin Forest in Moray, once located within sandflats, are now being exposed as the beach retreats © A. Rennie/SNH

Right: Since the 1960s, the pier at Dunrobin Castle in Sutherland has been eroded away and now the adjacent gardens are at risk © Moray Firth Partnership and Scotavia





A borrower and lender be

Hugh Morrison reflects on how visitors' experiences are enriched by the lending out and borrowing of a diverse range of objects



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With over 35,000 objects associated with Historic

Environment Scotland (HES) properties, we are continually looking for opportunities to make this rich resource more accessible. Lending objects to museums and galleries for temporary exhibitions helps us to reach and engage new audiences, while borrowing objects can enrich our properties and add value to their interpretation and events programmes.

In 2015, we worked with The Museum of the Royal Scots Regiment on an exhibition to commemorate the bicentenary of the Battle of Waterloo. The two regimental colours associated with the battle were too big to display at the museum, so they were brought out of storage and exhibited at Edinburgh Castle, giving visitors a rare opportunity to see the banners in their full glory.

Duff House in Banff is an important venue for our varied temporary exhibitions programme. In the last year, visitors have been able to see a recently rediscovered masterpiece by Rembrandt from the National Galleries of Scotland, as well as 'The Pergola' by John Lavery, on private loan to the public for the first time since the 1940s.

Contemporary artists including Bryan Angus, Keiko Mukaide, Atsuo Hukuda and an exhibition of work by students at Robert Gordon University in Aberdeen have also featured in the house.

In addition, a recent partnership with Aberdeenshire County Council and National Museums Scotland brought the 'Treasures of Historic Banffshire' exhibition to Duff House. It celebrates the centenary of the discovery of the Deskford Carnyx and gives visitors a special opportunity to view this iconic Celtic trumpet and other archaeological finds in the area where they were found.

HES has also been active in lending out objects to museums, galleries and other institutions. In March 2016, a section of submarine telecommunication cable that once connected Scotland and Norway was lent to the Royal Botanic Garden Edinburgh for an exhibition about useful products from the tropical tree family Sapotaceae, which includes gutta-percha, a latex from tree sap used as an electrical insulator for cables in the 19th century.

In the summer of 2016, two James IV coins, a portrait print and monogrammed tile – found at Glenluce Abbey, Dumbarton Castle and Linlithgow Palace respectively – were lent to Berwick Museum and Coldstream Museum for a touring exhibition on the Battle of Flodden in 1513.

In the next two years, HES is planning to lend to the Museum of the Isles in Skye, Nanjing Museum in China and the V&A

Museum of Design in Dundee. National and international loan partnerships are a key way to extend the value of our collections for the benefit of a wide range of audiences.

MORE INFORMATION
The database of HES collections is at www.historicenvironment.scot/collections

Caring for the colours

Providing public access to the colours of the 3rd Battalion of the Royal Scots Regiment while they were on loan presented us with a number of challenges.

These large, fragile textiles were slowly and painstakingly unrolled and cleaned. Our in-house Conservation Team custom-built two enormous display cases with acrylic hoods to protect the colours from dust and provide controlled environmental conditions.



Top: Installation of the Waterloo colours in Edinburgh Castle's Great Hall by the Conservation Team

Above: The section of submarine cable lent to the Royal Botanic Garden Edinburgh

Right: Rachael Dickson cleaning the colours





Hand in hand with communities

A partnership with the local community is breathing new life into Lochmaben Castle's remains and carving out a plan for its future, says Jane Rahil. At Linlithgow, Historic Environment Scotland (HES) is working with the community and interested organisations to improve the iconic loch, explains Martin Gray



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A community conservation story

Lochmaben Castle in Dumfries and Galloway has a turbulent past. Built by an English occupying force in the 1300s, it was an important site in the wars with the English until it was finally abandoned in the 1700s. Today, the castle is in a ruinous, delicate condition. Much of the external ashlar facing stones were robbed following its abandonment, leaving behind only the internal rubble wall core, which was never meant to stand up on its own.

The castle has had a long and varied conservation history, with significant interventions by our predecessors to try to stabilise the remains. It is a fascinating case study in conservation practice and philosophy. Conservation



works include substantial consolidation and rebuilding of the south curtain wall in the 1950s, and the most dangerous sections of high-level masonry were dismantled in the 1980s. The arch to the curtain wall was rebuilt in the 1990s, when an innovative render was also applied to high-level sections to stabilise the masonry.

Today, the masonry remains very delicate – the mortar holding the rubble together is being washed out by rain, meaning the walls are receding and in danger of collapse.

Consequently, the site has been partially fenced off from visitors for health and safety reasons. Higher winter rainfall over the last few decades has exacerbated the problem, and climate change research indicates that these pressures will only increase.

The Lochmaben Castle Loch Community Trust approached HES in 2015 after a community buy-out of the castle loch and completion of a new path around it. The Trust was interested in improving the appearance of the castle and our long-term plans for its future. During an on-site meeting, we discussed the challenges, and agreed to hold a

The workshop achieved a shared understanding of the site to form the basis of a joint plan of action

Above: Lochmaben Castle is in a delicate state

Centre: The castle in the spring of 1952

Below: New interpretation panels at Lochmaben Castle are unveiled by HES Chief Executive Alex Paterson and David Rose of Lochmaben Community Trust



community workshop to explore local aspirations for the castle and opportunities for improvements.

The workshop, held in June 2015, was successful and achieved a shared understanding of the site to form the basis of a joint plan of action. The Trust set about improving the access road to the castle and HES coordinated the installation of new interpretation panels explaining its conservation history.

We plan to make visual improvements to the high-level safety fencing and manage the vegetation in places. Following a suggestion made at the workshop, the HES Cultural Resources Team ran a ground-penetrating radar resistivity survey with involvement from local archaeologists and the community.

The partnership is a forum for developing options to give the castle a sustainable future, and has improved the community's engagement with and understanding of their local heritage.

MORE INFORMATION

The Community Trust's website is at www.castleloch.org.uk

Joint effort to improve Linlithgow Loch



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Linlithgow Palace, Loch and Peel constitute one of the most culturally significant sites in Scotland. One of only two natural lochs in the Lothians, the loch is part of the scheduled area and a Site of Special Scientific Interest (SSSI). It also makes a spectacular setting for tourism, and community and recreational activities, bringing social and economic benefits locally and nationally.

The water quality in the loch has been deteriorating for several years due to multiple factors in the surrounding landscape and environment. Weather conditions trigger algal blooms of varying toxicity in the nutrient-rich water. HES is responsible for the loch, but not the many tributaries feeding nutrient-rich water into it, so a joined-up approach is needed to tackle the issue.

HES has worked with West Lothian Council, the Scottish Environment Protection Agency (SEPA) and Scottish Natural Heritage (SNH) among others to scope out the problem and develop a forward action plan. From this, the Linlithgow Loch Catchment Management Group was formed to take forward the action plan with the partner organisations and the local community.

Community involvement has been key, making a positive contribution through projects such as removing invasive species, improving footpaths, managing biodiversity, marking road drains and raising awareness on using the loch sensitively.

Thanks to community influence, HES has brought together a summit of users, individuals and executives from interested organisations to agree a structured management framework. It was agreed that a source apportionment survey should be undertaken in 2017 to inform key decisions on how we progress improvements to the loch. The community's dedication to and passion for their environment is vital in driving this project forward.

MORE INFORMATION

See www.westlothian.gov.uk/article/5860/Linlithgow-Loch for the loch catchment management plan

Below: Canoe trips on Linlithgow Loch led by HES ranger service





Teaming up on thermal improvements

Historic Environment Scotland (HES) joins forces with partners to provide training on thermal improvement of traditional buildings, as Dr Moses Jenkins explains



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Above: Moses using training rigs to demonstrate practical improvement methods at our Energy Efficiency course

Energy efficiency improvements to traditionally constructed buildings can significantly improve their thermal performance, but require care and consideration. For example, reducing the natural ventilation routes can lead to the build-up of moisture, which can ultimately cause the decay of traditional materials and finishes.

The HES Technical Research Team continues to lead the way in carrying out innovative research on best practice approaches to improving the energy efficiency of Scotland's traditional buildings.

Since Scotland's Energy Efficiency Action Plan was launched in 2010, HES has delivered more than 150 energy efficiency training events throughout Scotland. Building on a solid foundation of both site-based and scientific research, this training allows people at all levels – from homeowners to professionals – to understand the issues surrounding the thermal improvement of our traditional building stock.

An integral part of this work has been the continued delivery of training to staff at Scotland's network of Energy Advice Centres, overseen by the Energy Saving Trust (EST).

Over the last five years, training took place for approximately 120 energy advisors in Edinburgh, Inverness and Kirkcaldy.

Staff are given two days of focused training on measures and materials appropriate for improving the energy efficiency of traditionally constructed buildings without compromising the fabric over the long term. HES has an ongoing commitment to train EST staff going forward. In addition to this, HES has been active in a wide range of other training initiatives that are related to energy efficiency improvements.

A number of events have been organised with Home Energy Scotland to provide advice and raise awareness among homeowners. Two events have been held so far in Inverness and Kirkwall, with further events planned in Dumfries, Glasgow, Lanarkshire and Ayrshire.

A training day for local contractors has also been held in Kirkwall with considerable success. Partnership events for homeowners have taken place in conjunction with local Townscape Heritage Initiative (THI) and Conservation Area Regeneration Scheme (CARS) groups in various locations, including Portsoy, Selkirk and Elgin. Further, a professional development event around energy efficiency in traditional buildings was delivered with the Royal Institute of Chartered Surveyors (RICS) in Glasgow.

By providing a lead on both research and training, HES works in partnership with a number of other key organisations, such as the EST and Home Energy Scotland, to ensure knowledge is disseminated as widely as possible. This both protects our built heritage and ensures it performs well for those who live and work in it.

MORE INFORMATION
We run our Energy Efficiency training periodically throughout the year. To register your interest, please contact technicaleducation@hes.scot

Making Europe's historic cities more energy efficient

Carsten Hermann reflects on the findings of the EFFESUS project to improve the energy performance of traditional buildings in Europe's cities



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Europe is home to many historic cities, each with its own identity and appeal to tourists. Improving the energy efficiency of historic urban districts, while protecting what makes them culturally important, can be challenging.

To help make informed decisions on energy performance improvements, a Europe-wide project called Energy Efficiency for EU Historic Districts' Sustainability (EFFESUS) was started in 2012 to develop retrofit options and strategies specifically for historic cities.

Led by the Spanish foundation Tecnalia Research & Innovation, the project was a collaboration of 23 European partners, three of which were from Scotland: industry supplier A. Proctor Group, heritage consultant Dennis Rodwell and Historic Environment Scotland (HES).

With funding from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration, the £5.5 million project has developed both a software tool to support the

strategic planning of retrofits at an urban scale and new retrofit technologies specifically for use in historic settings. The developed retrofit measures include insulating lime mortar, advanced window upgrades and energy management systems.

Scottish involvement in the project was diverse. A. Proctor Group, a manufacturer of high-performance insulation from Perthshire, worked with other EFFESUS partners to develop a novel cavity-fill insulation made with aerogel. This was created to be suitable for use behind traditional wall finishes, such as historical plaster on laths.

This new product was successfully trialed in 2015 and 2016 in a Glasgow tenement building, and showed an outstanding performance. This year, it will become available as 'SpaceFill'.

In addition, a conceptual method to assess the impacts of retrofit on cultural significance was developed jointly by Dennis Rodwell and HES, along with other project partners. This was integrated into a software tool to ensure that retrofit recommendations are appropriate for historic buildings.

The web-based tool has been tested in the World Heritage cities of Genoa in Italy, Santiago de Compostela in Spain and Visby in Sweden. The project's new retrofit measures were trialed in Glasgow, and also in the German city of Benediktbeuern, Budapest in Hungary and Istanbul in Turkey.

EFFESUS partners presented the project results at UNESCO Summer and Winter Schools in Dubrovnik in 2014 and Venice in 2015, and at various conferences and trade fairs. The project concluded in the summer of 2016 with a conference in Dordrecht in the Netherlands.

The EFFESUS project has been instrumental in propelling the sector forward in improving energy efficiency in historic buildings, and providing the tools to do so. This is an issue that will become more important over time, and we at HES are committed to ensuring that traditional buildings play their part.

MORE INFORMATION

See www.fffesus.eu and www.historicenvironment.scot/fffesus for more on the EFFESUS project and HES involvement

Above right:
EFFESUS software tool

Below: The EFFESUS project team included representatives of 23 European partners





Surveying Scotland's thatched buildings

A collaborative survey of Scotland's thatched buildings is informing a strategic approach to their conservation, explains Jessica Hunnisett-Snow



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Scotland has a long tradition of roofing with thatch, and can claim an unusually rich heritage in terms of techniques and materials. Straw, reed, marram grass, heather, bracken and rush are among more than 15 different historic thatching materials identified by Historic Environment Scotland (HES). But with such inherently perishable roofing materials, thatched buildings are particularly vulnerable to decay.

A recent nationwide survey of Scotland's thatched buildings by the Society for the Protection of Ancient Buildings (SPAB) provided an unrivalled opportunity to learn more about the history of these buildings, record regional variations and celebrate the best examples.

The need for a comprehensive survey in order to inform a



Many buildings lay in ruins, while the thatched roofs of others had been replaced with more durable materials

strategic approach to their conservation and protection was identified as far back as 1996 in Technical Advice Note 4 *Thatch and Thatching Techniques*. As a result, we at the Technical Research Team

welcomed an approach by SPAB to collaborate, and in 2014 we offered grant funding to carry out the extensive fieldwork required. The task was given to Zoe Herbert, a trainee architect and SPAB Scotland Officer, with oversight from HES.

Zoe's fieldwork revealed a significant decline in the number of thatched buildings in the latter half of the 20th century. On many of the 305 sites recorded as having thatched buildings, no thatch survived at all. Many buildings lay in ruins, while the thatched roofs of others had been replaced with more durable materials. Happily, however, she also found a number of previously unrecorded thatched buildings.

The resulting *A Survey of Thatched Buildings in Scotland* was published by HES and

Top: Old Leanach Farmhouse, Culloden Moor

Above right: Bell a'Phuill's House, Auchindrain, Argyll

On the road

Zoe Herbert reflects on her year-long journey seeking out Scotland's thatched buildings



ZOE HERBERT
Former SPAB Scotland
Officer and HES Technical
Research Intern

When I was asked whether I would like to spend a year travelling Scotland in search of thatched buildings, I naturally jumped at the chance. The task of a nationwide survey was a daunting one: I was to travel to hundreds of different locations, some very remote, and document what I found.

I began my journey in May 2014, with guidance from the HES Technical Research Team and the GIS team, and using a standard survey method that I developed with HES. The farther afield I ventured over the months, the more I became aware of regional variations, often subtle, in both the techniques and materials that had been, and still were, used across the country.

In some locations, particularly in the Western Isles and in small mainland villages such as Kirkoswald and Collessie, there was a strong local awareness and appreciation of the area's thatching heritage. The memories and anecdotes of local people I met gave the survey so much more substance and value.

In the Western Isles, where the majority of sites were identified, I found many of the buildings I sought were ruins. However, I found just as many more that we had previously not known about. I travelled widely around these islands, including Tiree, Mull, Jura and the Outer Hebrides, often spending weeks at a time hopping from one to the next.

It was an unforgettable year. Among the highlights was being offered a stay in a charming thatched cottage on the Isle of Tiree, where several such cottages are still in use – a real taste of island life.

Since the publication of the survey, a number of people have been in touch to tell us of thatched buildings we missed during the survey. We were delighted to hear this, as this kind of engagement was exactly what we had hoped for.

We plan to follow up on these leads and survey the buildings in the same manner. They will be added to the survey as an addendum and the online publication will be updated periodically. The survey is an evolving document that will continue to draw attention to the importance of these traditional vernacular buildings.



Drover's Cottage
Isle of Tiree



Seann Taigh Cottage,
South Uist, Outer Hebrides

SPAB in September 2016. It attracted considerable attention from the press, showing that the cultural significance of thatched buildings is still very much appreciated.

We are now developing an action plan to safeguard the remaining thatched buildings and support those who care for them.

This includes reviewing the statutory listing to ensure that the best examples are fully protected, reviewing the existing grants scheme to improve support for materials and skills, developing further technical guidance and engaging with other stakeholders – including heritage bodies and landowners – to develop a strategic response to challenges such as the supply of suitable materials and skills training.

MORE INFORMATION

A Survey of Thatched Buildings in Scotland is available at www.historicenvironment.scot/thatch-survey. Do you know of a thatched building that is not included in the survey? We would like to hear about it. Email technicalresearch@hes.scot

Balevullin Cottage on
the Isle of Tiree



Bringing the Antonine Wall to life

Collaborative digital heritage initiatives are providing visitors with pioneering new ways of experiencing ancient Rome's northern frontier, say Dr Lyn Wilson and collaborators



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Nearly 2,000 years ago, the Antonine Wall was the most northerly frontier of the Roman Empire, stretching across central Scotland. Today, it is part of the serial transnational Frontiers of the Roman Empire World Heritage Site (FREWHIS).

To improve interpretation and accessibility, Historic Environment Scotland (HES) is undertaking several digital heritage initiatives, working collaboratively with the Centre for Digital Documentation and Visualisation LLP (or CDDV, a partnership between HES and the Glasgow School of Art); the Bavarian State Department for Monument Protection (BLfD); and Austrian firm Edufilm und medien GmbH.

The foundation of our digital heritage projects is accurate 3D spatial data, captured as part of the Scottish Ten project in 2013.

We commissioned aerial laser scans (LiDAR) for the entire length of the Antonine Wall and used ground-based laser scanners to digitally document Rough Castle and Bar Hill forts at high resolution.

More recently, collaborations between HES, local authority museums and the Hunterian Museum in Glasgow have enabled CDDV to digitally document a large number of artefacts found along the wall to create accurate interactive 3D models.

Because all the data captured is at the highest possible resolution, it will remain usable for many years to come. The architecture of the Roman forts is represented as accurately as possible in the 3D models, thanks to academic advice from archaeologists who excavated them.

Recent advances in gaming technologies mean we can now combine all the 3D data we hold – from the wide landscape scale down to small, intricate objects,

plus virtually recreated models – into one 3D interactive digital environment. This has opened up many exciting new ways we can share and disseminate our digital Antonine Wall – from immersive virtual reality experiences to digital games.

With the use of virtual reality headsets, people can explore the buildings within Bar Hill fort for themselves, and gain an idea of the original scale of the structures, spaces and fortifications. The digital game uses motion capture technology (commonly used in CGI films) to accurately simulate characters who may have lived in and around the fort.

All are based loosely on real people identified on grave slabs and altars nearby. One character is Verecunda, a slave girl aged about eight, who has to navigate her way around the fort and the *vicus* (civilian settlement) to collect items for the cook.

By carrying out these tasks, the





Visitors explore Bar Hill fort with virtual reality

player can find 3D models of objects Verecunda would have come across – quernstones for grinding grain, amphorae for storing wine and more. The tasks help users learn in a fun way what life in the Roman fort must have been like. We are testing the game and feedback from schools groups has been really positive. We hope to launch the game as a

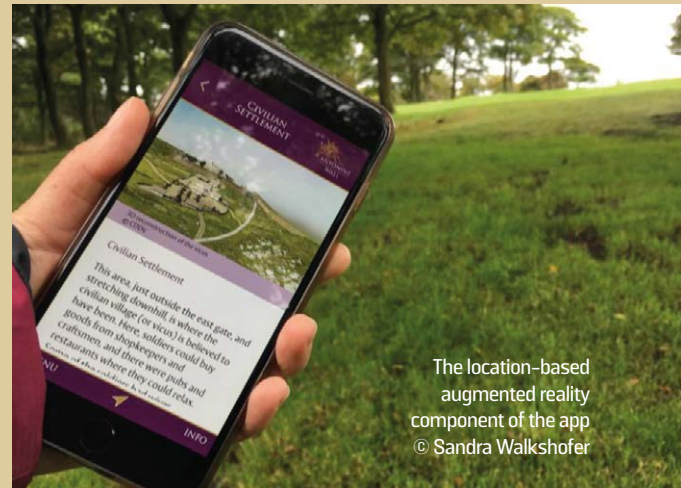
free digital resource in early 2017.

MORE INFORMATION

Find out more about our collaborative digital documentation projects at www.enginshed.org/about-us/the-scottish-ten and www.alapp.eu, and about the Antonine Wall at www.antoninewall.org



3D model of Bar Hill Roman fort, virtually reconstructed using aerial LiDAR data and expert archaeological advice © CDDV



The location-based augmented reality component of the app © Sandra Walkshofer

Mobile app is a virtual museum

In 2016, we were fortunate to secure funding to develop a free mobile app from the European Union's Creative Europe programme. The European funding enables us to run a three-year project working more closely with our Bavarian and Austrian partners in the FREWHS.

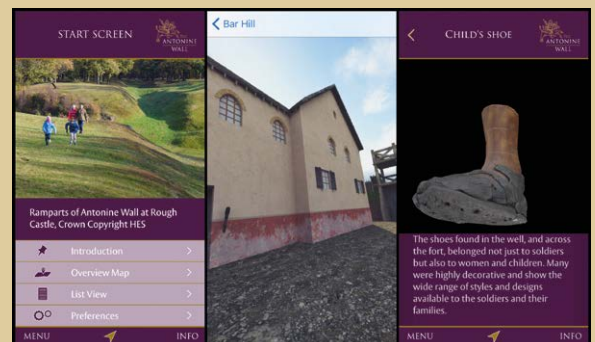
The Scottish app launched in late autumn 2016 and focuses initially on Bar Hill fort. It combines visitor information delivered through maps and points of interest, with content such as video clips, text and images. Excitingly for us, we have been able to incorporate our 3D virtual reconstructions of fort buildings and interactive models of artefacts found on site.

These can be downloaded and viewed anywhere, but, when visitors are actually at Bar Hill, the app uses location-based augmented reality to bring the site to life on a mobile phone or tablet. In this way, the app acts as a virtual museum – digitally repatriating the Roman artefacts to the places they were found.

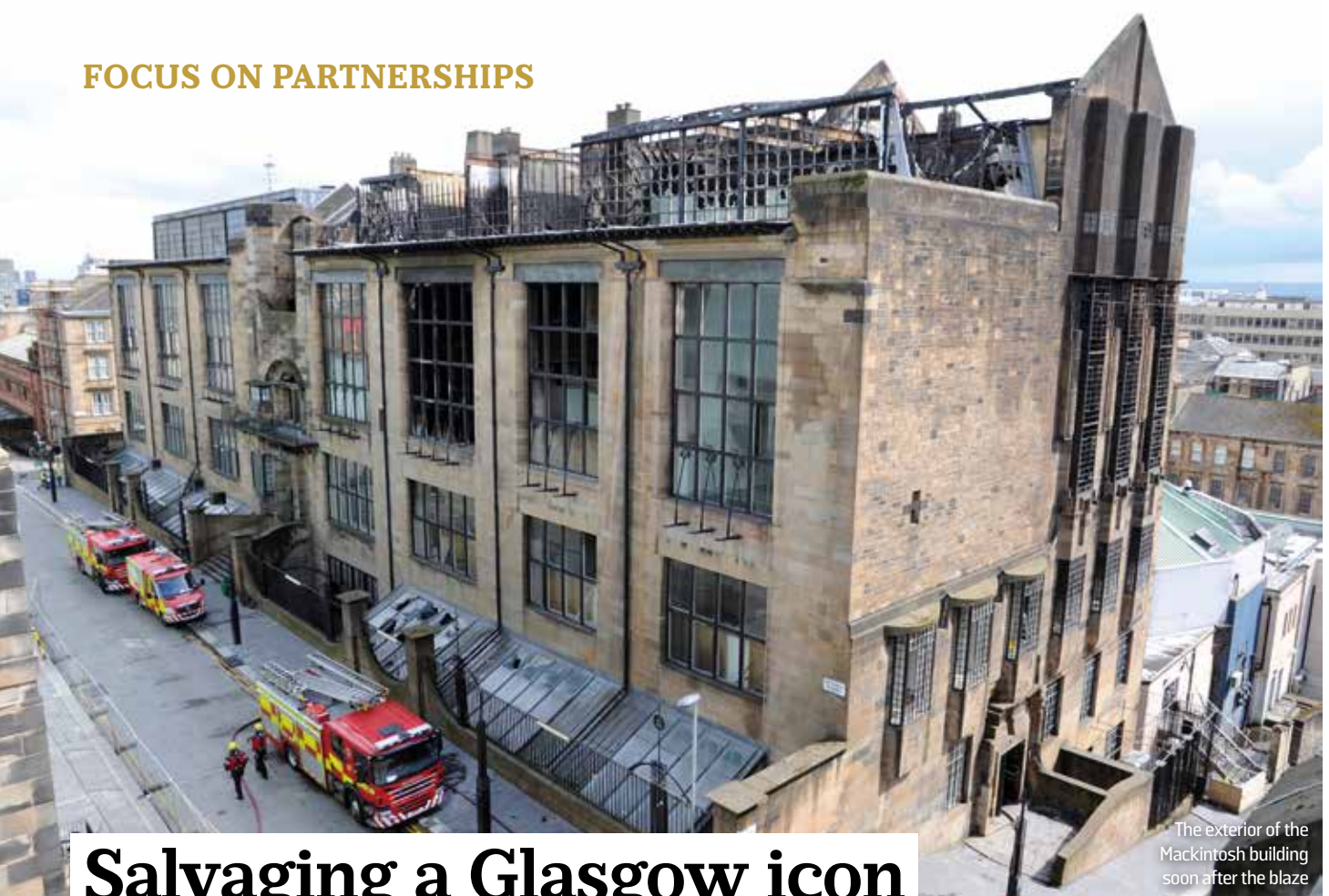
Edufilm developed this feature of the app, and it has been a great learning experience working with the company to figure out the technical details. Over the next three years, new app content will not only be produced for more Antonine Wall sites, but also for a Roman fort in Bavaria. The platform will be developed further to enable the addition of even more augmented-reality elements.

The partnerships established have been of great benefit to the digital initiatives and have enabled us to share our expertise whilst learning from others. We look forward to growing these collaborations to help us deliver more exciting interpretive and learning resources for the Antonine Wall, and the Limes in Bavaria, over the coming years.

To download the app, search 'Antonine Wall' in the iOS or Google Play stores.



The free Antonine Wall mobile app includes interactive 3D models and virtual reconstructions © Edufilm and medien GmbH, HES and CDDV



The exterior of the Mackintosh building soon after the blaze

Salvaging a Glasgow icon

Historic Environment Scotland (HES) is working closely with the Glasgow School of Art (GSA) on the salvage and restoration of its famed Mackintosh building, severely damaged by fire in 2014

The devastating blaze at GSA's iconic Charles Rennie Mackintosh building on 23 May 2014 sent shockwaves throughout Scotland and beyond. Thankfully, there were no human casualties, but the fire left irreparable damage to the unique building, including the destruction of the renowned Mackintosh Library.

HES was among the first organisations on the scene when the fire began, and directed the initial salvage and conservation operation. It has continued to work with GSA to support conservation ambitions for the building and its objects in years to come. Here, HES colleagues reflect on the salvage operation and the ongoing support being provided to the restoration.

MORE INFORMATION

For more about the restoration, see www.gsa.ac.uk/mackintosh-restoration or to find out about the Engine Shed's upcoming exhibition about the fire, visit www.engineshed.org



A firefighter douses the flames in the library

An immediate response



DR DAVID MITCHELL
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Like many others on that day, I watched with a heavy heart as one of my favourite buildings went up in flames. We have a close working relationship with GSA, so quickly offered to help in any way we could. They asked us to lead the salvage operation around the library and furniture store above, and to liaise with the emergency services on the damaged building fabric.

We first entered the building early the next day after the fire.

For a week thereafter, we worked with the fire service and GSA staff to salvage what we could and provide technical advice on the building fabric. HES staff responded instantly, and a team of 50 worked tirelessly and quickly as circumstances dictated.

Our digital and photographic survey teams were quickly deployed – their work will be vital in progressing the restoration – and we continue to support the restoration with specialist advice and scientific

analysis. The experience has posed many questions around cultural significance and value, which are worthy of continued discussion.

Although the circumstances were traumatic, we have learned many things that have practical applications across our sector. I'm immensely proud of how my colleagues responded, but also of the magnitude of public reaction to events. It demonstrated the depth of feeling for some of our treasured buildings – a positive and inspiring experience.



DR ALICK LESLIE
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Ongoing expert analysis

The Conservation Science Team has been closely involved with materials conservation following the GSA fire. We have carried out analysis of iconic objects such as the lights from the Mackintosh Library, and of materials, including stone, mortar and plaster, to provide advice on the best methods for restoration.

One important aspect of our work is determining the extent of the damage to the stone. The building stones from part of the west gable were taken to our Stirling works depot for storage and, in collaboration with the University of the West of Scotland (UWS), we have carried out some basic geotechnical measurements to assess damage to them.

Although this gave us some useful information, further analysis was needed. So UWS, HES and the University of the West of England successfully bid for EU funding to bring eight researchers from France, Germany, Italy and Greece. In June 2016, they spent a week analysing the stone inside the library.

This work has already been presented at international conferences and will provide invaluable data on the condition of the stone as the west gable is being rebuilt. It is hoped that all of the materials analysis will form the subject of an academic conference in the second half of 2017.



Above: X-ray fluorescence analysis of the fire-damaged library light fittings

Right: Library lights prior to the fire

A home for salvaged artefacts



RICHARD WELANDER
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Collaboration was the key to successfully salvaging the surviving objects. The building housed a large amount of rare original Mackintosh furniture, fittings and books, along with GSA's own stored archive and textile collections, so it was incredibly important to save what we could.

The initial salvage began as soon as the flames were extinguished. The HES Collections Team worked with GSA, National Galleries of Scotland and National Records of Scotland colleagues to pack salvageable items safely and move them to a secure location nearby. Ensuring that heavily fire-damaged items were recovered sensitively was challenging indeed.

Unfortunately, not everything could be saved. Left behind in the debris were the remains of much of the internal fittings, including the iconic library periodical desk. Further research was done in partnership with Kirkdale Archaeology, which carried out a forensic assessment of the debris in the library as part of a detailed excavation and survey of surviving building structures.

We continue to work with AOC Archaeology on the conservation assessment of retrieved items. We are also assessing items selected for inclusion in the forthcoming Engine Shed exhibition to ensure they are in a stable enough condition to be moved and displayed.

We hope to keep finding homes for objects and are planning to work with GSA to help them incorporate surviving artefacts into the rebuilt and restored building.



Periodical desk destroyed in the fire
Above: Sorting through salvaged remains



Craft skills taster events go local

A partnership with the Scottish Traditional Building Forum is encouraging more young people to consider a career in traditional crafts through taster events, writes **Katie Carter**



KATIE CARTER
Senior Outreach Officer
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Promoting traditional skills apprenticeships to the next generation is a priority for Historic Environment Scotland (HES) and is at the forefront of our outreach programme. Maintaining a skilled workforce in areas such as stonemasonry, joinery, lead working, dry stone dyking and slating is important to ensure the ongoing maintenance and repair of Scotland's historic buildings, which make up 20% of its total building stock.

To raise awareness of careers in traditional skills, we have been running a series of craft skills tasters for school pupils at our works depots throughout Scotland over the last few years. These tasters are a golden opportunity for our skilled staff and apprentices to pass on their expertise and passion for their craft to school pupils.



Above: School leavers from Loudoun Academy in East Ayrshire try their hand at traditional skills at the HES Lesmahagow depot

Right: Glasgow school pupils with the brick archway they built at a craft skills taster

Recently, the Scottish Traditional Building Forum (STBF) network has taken the craft skills taster model under its wing, transforming it to be delivered at a more local level. Regional forums are made up of local stakeholders within the industry who share a vision to promote traditional skills and to encourage cooperation and partnership working across the sector. Now, with HES support, the forums are taking the lead on these events, and we have been able to expand the reach and deliver more of these events throughout Scotland.

In 2016, over 10 craft skills taster events took place, organised by the forums in town centres such as Perth, Falkirk, Callander, Glasgow and Edinburgh. Local colleges and trades bodies have been running sessions alongside HES stonemasons, giving pupils the chance to try their hand at a trade and find out more about a career in traditional skills.

MORE INFORMATION

Many more tasters are planned for 2017. If you know of a school that would like to get involved, email technicaleducation@hes.scot

For more about STBF activities near you, see www.stbf.org.uk

About the STBF

The forum started when a few stakeholders across the traditional construction supply chain decided to do something positive to promote the traditional building industry. It aims to empower property owners to undertake appropriate maintenance and repairs to their buildings, to share information across the industry and to inspire the next generation to join the industry that maintains Scotland's rich built heritage.

There are regional forums in Edinburgh, Fife, Tayside, Forth Valley, Aberdeen, and Highlands and Islands, with each putting on events to promote issues most relevant for their area. Alongside craft skills taster events, they run information stands for home-owners and CPD events to share best practice with architects, surveyors, local authorities and other key stakeholders.

We are truly fortunate to have developed a strong working relationship across the supply chain, with many people donating their time for the benefit of the traditional building sector.

John McKinney, STBF representative
www.stbf.org.uk/contact

2016: Our year in numbers

HISTORIC ENVIRONMENT SCOTLAND IN OVERVIEW



Largest employer of traditional craftspeople in the UK



340 sites, amounting to 800 standing structures



40,000 objects in our collection



36 apprentices, including 29 stonemasons



365 skilled conservation staff based in 28 locations

CONSERVATION EVENTS AND OUTREACH



30 events organised by us



2,504 delegates attended our events, a 15% increase on 2015



206 pupils taught by an HES Technical Education Officer



Insight Tours attracted 193 participants



25,000+ people reached through our outreach activities

OUR PUBLICATIONS ONLINE

www.engineshed.org/publications

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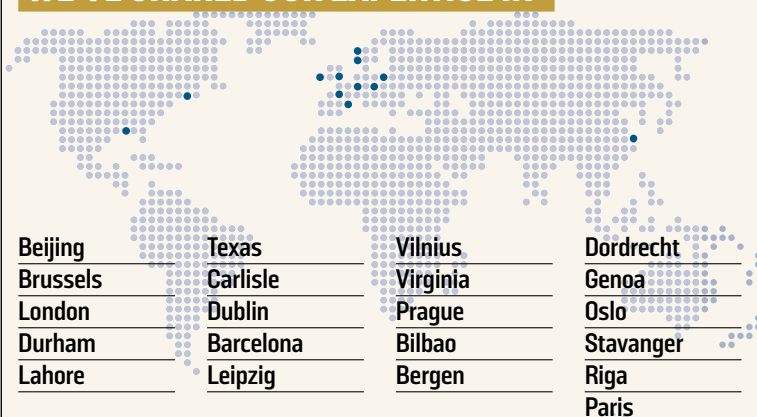
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