Technical Research Plan 2014 - 2015

(Technical Research & Conservation Science)

Historic Scotland Conservation Directorate
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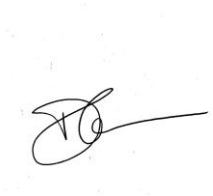
Foreword

The Technical Research and Conservation Science units form a key part of the capability of the Conservation Directorate of Historic Scotland. One of our priorities is the development of the knowledge and understanding of the techniques and skills involved in the custody of the historic and traditionally built environment. This knowledge underpins the work undertaken by Historic Scotland on our own estate and also the work done by the construction sector in Scotland and the wider world. To acquire, develop and sometimes re-learn such knowledge requires research; this research needs to be directed by current and emerging priorities on our own estate and other stakeholders in Scotland, including government and academic institutions. Such priorities may be set through legislation, by economic factors or through technical demands made by changing conditions. Ongoing scientific and technical research is crucial to safeguard Scotland's resource of traditional buildings and contribute to sustainable development. This research plan seeks to address these demands and identify the best ways to develop, deliver and communicate knowledge of our historic and traditionally built environment.



Dr David Mitchell

Historic Scotland Director of Conservation

The Research Plan

1. Research Context

The activities of the Technical Research and Conservation Science units are directed by the HS Corporate Plan and the Conservation Directorate Business Plan, which have identified a series of key objectives. Invariably there is some overlap with other business sectors within Historic Scotland; these represent opportunities for dialogue and collaboration where research themes are delivered jointly:

- We champion, increase understanding of, and raise awareness of the economic, social and environmental value of Scotland's historic environment
- We support and develop Scotland's traditional building skills and the use of traditional building materials
- We foster innovation and creativity, driving forward the development and application of new technologies, skill and research to support the historic environment
- We encourage and support collaborative research with institutions across Europe to maximise the benefits of academic research for conservation
- We provide work in partnership to build and share the story of Scotland's past
- We contribute strongly to Scotland's tourism sector, providing high quality experiences and content for all our customers
- We promote academic conferences and events and encourage the publication of peer-reviewed papers and reports
- We enable and support sustainable development
- We improve the condition of the historic environment in Scotland
- We support local regeneration and engage more effectively with communities
- We develop our research, knowledge and practical options to improve energy efficiency and climate change adaptation of Scotland's traditional buildings
- We enhance and improve the legislations, policy advice and guidance for the historic environment

2. Research Structure

The Technical Research and Conservation Science units are overseen by Dr Ewan Hyslop based at Longmore House in Edinburgh. The Conservation Science Unit is based at South Gyle, Edinburgh (moving to Stirling in 2016) and the Technical Research Unit is based in Longmore House. The Conservation Science Unit applies a range of analytical techniques to the study of building materials and is staffed by three conservation scientists. Many of the techniques are non-destructive and use portable equipment, so can be carried out on-site without damage to historic materials. The Technical Research Unit looks at buildings and structures in a more holistic and applied way; it is staffed by four building surveyors and architects, who also provide practical advice to practitioners and homeowners.

The remit for both units extends beyond the buildings, monuments and landscapes in the direct care of HS Estates, and assists in the protection and maintenance of a

broad range of older structures in Scotland that may or may not have specific protection through designation.

The work of the teams is for the benefit of the wider built environment and consists of:

- Undertaking technical and scientific research
- Supporting the perpetuation and understanding of traditional building skills
- Understanding and promoting the use and availability of traditional building materials
- Provision of specialist technical and scientific advice
- Provision and support of applied specialist conservation services
- Delivery of technical education and outreach

The technical and conservation science research in Historic Scotland involves and draws on expertise from a number of other units in Conservation Directorate as well as benefiting from engaging with staff from across the Agency. Work is overseen by the Conservation Managers Group representing technical research, conservation science, climate change, traditional skills & materials, digital documentation, and technical outreach & education. Overall responsibility lies with the Historic Scotland Director of Conservation.

All stakeholders in the building conservation sector need to base their practices on proven techniques – this requires research, testing and evaluation of present, emerging and future techniques in building conservation. This research plan will describe how research topics are considered and prioritised within the wider constraints of budgets and resources as well as how stakeholders can contribute to the research agenda. The challenges in this area are significant and require a range of specialist knowledge,. Therefore we will continue to work with others in the planning and delivery of our technical and scientific research.

This research programme aims to build upon the significant technical research undertaken by Historic Scotland's Technical Conservation Group and its predecessor TCRE. It also takes account, as far as possible, of ongoing projects and commitments at the time of development and the forecast resource requirements, both financial and staffing. The research topics takes account of Scottish Government programmes directing Historic Scotland to undertake specific types of research (e.g. Scottish Climate Change Adaptation Programme 2014; Energy Efficiency Action Plan 2009) and detailed in our Climate Change Action Plan (http://www.historic-scotland.gov.uk/climate-change-plan-2012.pdf).

Protection and enhancement of traditional buildings will continue to be supported by HS research, in particular by specific research focusing on the current gaps and shortages in knowledge and skills within the traditional building sector as detailed in Historic Scotland's Traditional Skills Strategy and Scottish Traditional Building Skills Audit (http://www.historic-scotland.gov.uk/skillstrategy). Historic Scotland research and its associated outreach also supports the expertise within the Agency to enable ongoing advice and guidance to be given to homeowners, building professionals, Local Authorities and developers in support of well maintained, well-designed and sustainable places.

Knowledge generated through research is disseminated through Conservation Directorate's Technical Outreach & Education Unit using a range of methods such as events (lectures, workshops, conferences); publications (Inform Guides for homeowners, Short Guides for practitioners, Research Reports, Technical Papers, Refurbishment Case Studies, Books etc.) in printed or digital format; exhibitions (e.g. Building Scotland); digital applications (e.g. Inform House, Energy House); and web resources (Technical Conservation Knowledge Base at http://conservation.historic-scotland.gov.uk/). Information is also disseminated through our research partners or other means (e.g. academic journals).

3. Stakeholders

The broad spectrum of interests in relation to the traditionally built environment is reflected in the wide range of stakeholders with an interest in engaging with the Research Plan and the broader activities of Historic Scotland. Many of those identified as stakeholders are also important partners in the delivery of our research, dissemination of results, and sharing of knowledge. The range of stakeholders, in general terms, comprise the following:

- National and local governments
- Heritage bodies
- The Education sector – further and higher education
- Professional bodies
- HS & RCAHMS Business Groups
- Practitioners and Industry
- Research bodies and Academic Institutions
- Sector Skills Councils

In order to access and interact with stakeholders Historic Scotland facilitates various Research Seminars for stakeholders in specific disciplines where progress, current activity and gaps in knowledge will be discussed -and discussion encouraged. . An example of this has been the series of workshops and seminars on stone, timber, metal, historic mortar and energy efficiency in 2011, 2012 and 2013 to discuss progress and identify emerging priorities. External and internal stakeholders are also welcome to suggest areas of research for consideration using the evaluation sheet at Appendix A.

4. Thematic areas of technical and scientific research

HS Conservation Directorate has a remit to undertake technical research in relation to materials, skills & techniques, technologies, conservation, and repair & maintenance. The technical research activities of the are grouped under the following primary themes, and indicative subject matter for each theme is outlined below.

Technical Research:

- **Traditional materials.** Stone, timber, metals, glass, brick and clay based materials, roofing materials, concrete, mortars and binders, paints and finishes. Source and supply, characterisation, specification and analysis, decay mechanisms. Methods of analysis, sampling and testing. Intervention, conservation, repair and maintenance.

- **Traditional structures and components.** Design and specification, uses and application, manufacture and supply chain, analysis of performance, decay mechanisms. Intervention, conservation, repair and maintenance, sustainability issues. Typological studies e.g. ecclesiastical, bridges, war memorials, shopfronts, etc.

- **Traditional building trades and skills.** Assessment of what skills remain and predicted shortfalls. Skills and qualification mapping. Recording of skills at risk. Quantifying training provision and demand. Investigating lost skills and techniques where relevant.

- **Energy efficiency in traditional buildings.** Thermal performance of building elements such as mass walls, windows, floors and roofs. Improvement options and testing. Testing of materials and benefits. Methodologies for assessment of traditional building performance.

- **Sustainability and embodied energy.** Embodied energy of materials and components. Embodied energy of existing structures versus replacement. Payback times, both in financial and carbon terms with regard to replacement products.

- **Climate change impacts and adaptation.** Physical effects of climate change and increasing resilience. The effects of future climate patters on traditional elements and structures. Performance of traditional coatings and surfaces. Performance of traditional mortars and binders. Drainage systems and durability. Augmentation and enhancement.

- **Facilities and building management functions and equipment.** Fire management, maintenance, heating, ventilation and air conditioning, energy conservation, use of micro renewables, environmental control, biological growth, scaffolding and access, building adaptation and re-use, natural hazards, direct impacts of climate change.
- **Evaluation of emerging technologies and techniques.** Recording equipment and innovative techniques and their application to conservation. Resource assessment, repair and maintenance, techniques and materials, technical education, developing themes in building pathology.

- **Regulatory control.** Evaluating technical impacts of regulatory changes on traditional buildings or their components.

Scientific research:

- **Materials characterisation. I**ncluding composition, mineralogy and chemistry of materials, changes in physical state, speed of reactions and implication for working methods and maintenance.

- **Response and resilience of building materials** Susceptibility to environmental and other factors (e.g. extremes of weather/climate change, biological growth, pollution, fire etc.)

- **Provenance of building materials** Characterisation and sourcing of sustainable and appropriate replacements

- **Conservation and repair technologies** Optimisation of specific treatments (e.g. desalination, cleaning, poulticing), including application of new technologies

- **Non-destructive testing** In-site application of new technologies to building materials and components to inform conservation and improve decision-making

5. Prioritisation

How we assess potential research areas or topics, and prioritises them is an integral part of this Research Plan. As part of the annual business planning process the Conservation Managers group assesses the value of a proposed topic by considering a series of questions about the project. The points that will be considered and evaluated from the evaluation sheet will seek to address the following matters/questions:

Requirement for the project:

- What is driving the need and who are the project partners?
- What are the research questions?
- Is this new or building on existing knowledge?
- Who will use the information and what penalty will there be on the historic or traditional environment if the research is not done?
- Anticipated area of application and how will the information be used?
- Is the research relevant to the HS Corporate Plan and HS Conservation Directorate Business Plan objectives?

Generally our focus is on generating knowledge that can be disseminated and applied to historic or traditionally built structures including for maintenance, repair or refurbishment, operational or other related functions or requirements.

Other factors for consideration:

- Duration of project?
- Funding required and funding sources?
- What if any funding has already been secured?
- What form will the outputs be in and how will these be disseminated?
- How long will publication of any findings take?
- What is the nature of Historic Scotland's support if not financial?

Such questions cannot be rigid, and the research topics will be adjusted as circumstances and conditions change, including availability of different funding streams. These questions do not seek "yes or no" answers as such; this process is not intended to act as a scoring or ranking mechanism, but prompts consideration of important issues, such as collaborative working, Government and Agency needs, and how this work fits in with existing research. The process allows for continued dialogue and development and shaping of a proposal over time.

Following initial consideration by the Technical and Science Research unit managers, the Conservation Managers group will assess how the project is fitted in with existing commitments and resources. Following assessment, projects will be judged as high, medium, low or not relevant. High, medium and low priority are self-explanatory; the not relevant option refers to proposed research projects that are outside the remit of HS, and is no reflection on its potential intellectual or practical use.

6. How is research carried out and delivered?

Technical and scientific research delivered by Conservation Directorate requires a range of research frameworks to be applied to take advantage of available expertise and resources, and to maximise impact and benefits. These will include:

- In-house research and analysis delivered by Conservation Directorate's Applied Conservation, Science and Technical Research units
- Commissioned research to external parties
- Collaborative research with external partners, particularly academic institutions and national bodies
- Part or fully funded studentships, normally at Masters level or above
- Sponsored student research projects
- Joint / collaborative research with other Historic Scotland units and business areas

An annual work programme (see Appendix for current projects) will be maintained with a forward look extending to ten years to assist with resource planning and horizon scanning.

7. Quality Control

Peer review and the use of technical steering groups around specific projects have proven to be effective in producing high quality and effective research, but also in improving stakeholder participation and ownership. Research progress is regularly reported to specialist workshops and seminars and feedback is used to further guide the projects. Ongoing progress is reported to and discussed by the Historic Scotland Conservation Managers group.

8. Outputs and dissemination

Outputs of the research will be disseminated using a broad range of media, including conferences, seminars, printed and -increasingly- electronic media in accordance with the Conservation Directorate Technical Outreach and Education remit and annual programme.

9. Current and Emerging Priorities

As a public body, Historic Scotland acts on the priorities and requirements of Scottish Government and other public bodies, reflecting the diverse roles of the Agency relating to the existing built environment. In this regard, current research priorities can be summarised as follows:

- **Climate change impacts and adaptation**; assessing the physical impacts of climate change on the historic environment, developing methodologies for assessing risk, and raising awareness of best practice in protection and adaptation of existing building systems.

- **Energy efficiency improvements in traditional and historic buildings**; including developing knowledge on appropriate materials and interventions, increasing awareness of existing passive systems, and low carbon alternatives such as microrenewables.

- **Traditional materials research**; analysis and characterisation of a range of materials producing baseline information to underpin industry practice and inform guidance and current and future research

- **Investigative techniques for traditional and historic fabric**; testing, development and application of existing techniques and new technologies to inform conservation and repair of traditional structures and heritage materials

- **Establishing best practice in the use of mortars**; including undertaking baseline characterisation and raising awareness of restoration mortars and hot limes

- **Addressing damp walls and other building components in Scotland**; investigating causes and developing case studies to inform the sector and improve understanding and practice.

Appendix A - Research Project Evaluation Sheet for Conservation Managers Group

Contact details	Applicant to complete	NCC comments
Proposed project name		
Sponsor or proposer		
Project partners		

Project details	Applicant to complete	NCC comments
Brief description of project		
Requirement for the project		
Project partners		
New or building on existing knowledge		
Anticipated area of application		
Who will benefit from this work?		
Risks of not doing this work?		
Relevance to NCC Objectives		
Duration of project?		
Project details	Applicant to complete	NCC comments
HS funding requested?		
Other funding achieved?		
What is the outcome?		
What media will the outcome be in and how will it be disseminated?		
Publication timescale?		
Nature of HS support sought if not financial?		

Director comments
Assessment
☐ High ☐ Medium ☐ Low ☐ Not relevant
Budget allocation
☐ New ☐ Existing ☐ Other

Allocated to Research Unit	Date	PID due

Appendix B – Technical & Scientific Research Programme 2013 – 2015

Traditional materials			
Project title	**Partners**	**Timescale/Status**	**Research Focus and output**
Building stone assessments / mapping historic sources	British Geological Survey	Ongoing / call off project	Map sources and web-based digital database of stone sources for historic and ongoing uses of stone in Scotland. To include HS Estate and materials requirements. Stone Matching Short Guide in draft
Provenance of lime in traditional buildings	University of the West of Scotland	Year 5 of 3, submission of report by end 2014	Collaborative research on historic lime mortars in granite buildings; PhD studentship on historic lime sources. Research report/thesis.,
Historic Glass	Heriot Watt University	2014 - 2015	Short Guide (history and significance, assessment and investigative techniques). Technical paper on chemical composition and dating technique.
Methodologies for evaluating and projecting decay and loss of masonry	Digital Design Studio (Glasgow School of Art)	2014 o be set up stemming for existing digital scanning data	Possible laser scanning / photogrammetry project
Architectural paint research	Lincoln University, local	Most on hold as Michael	Analysis of historic decorative

	authorities	Pearce on sabbatical; ad hoc progress through analytical work with Applied Conservation, Estates, NTS etc.	schemes to inform conservation and restoration works
X-ray diffraction analysis of building materials	National Museum of Scotland, British Geological Survey	Ongoing / call off project	Identify salts, alterations and deposits to inform conservation practices
Methods of cleaning coatings from wrought iron	Cardiff University	Ongoing, completion in 2014.	PhD – 3 year project
Corrosion of wrought iron and the influence of coatings	Cardiff University	Ongoing, completion in 2016.	PhD – 3 year project
Assessment of appropriate timber for use in repairs	University of Glasgow	Ongoing, completion in 2014.	PhD – 3 year project
Earth structures research	University of Stirling	Ongoing, completion in 2014.	PhD – 3 year project
Pine beam dendrochronology	AOC Archaeology	Draft received in 2014.	Explore art history, dating and source of pine beams c1580-1630. Research publication
Historic Cements	University of Dundee	2013-2016	PhD – 3 year project
Hydraulic lime mortars	Heriot Watt University	Begins 2014	James Watt Fellowship PhD – 3 year project
Hot Lime	Building Limes Forum	Begins 2014	Update the existing short guide, develop knowledge and good

			practice in the sector through events; inform “Standards of Repair”
Earth structures guidance development	University of Stirling	2011-2014, short guide to be published 2015	Fellowship to update current technical guidance
Thatch Survey	SPAB	2014-2015	Publish Research Report
Conservation of Scottish traditional brickwork	Internal (Moses Jenkins lead)	2012-2015 Short Guide published 2014	PhD

Traditional structures and components			
Project title	**Partners**	**Timescale**	**Notes / output**
Historic Concrete Structures	Denis Urquhart	2012 – 2014	3 Part Short Guide; gazetteer and resource material for RCAHMS
Historic Harbours	Ben Tindal Architects, David Narro Associates, Cove Harbour Limited, Stromness THI	2014 - 2015	Short Guide in draft form Site trials 2014 in Stromness, and 2015 at Cove
Wet Gables – Phase 1 Evidence gathering	Selected private properties Historic Scotland Estate	2014 – 2016	Material for Short Guides/Refurbishment Case Studies (Adaptation, masonry and pointing)
Site project: Wauchope Mausoleum	City of Edinburgh Council, (Services for Communities,	Summer 2014	Refurbishment Case Study ’Interim Repairs’ Short Guide

	East Area Office)		
Site project: Callander House Stables	Callander House Trust Falkirk Council	Spring 2014	Refurbishment Case Study Interim Repairs Short Guide
Site project: Hartshaw House; hygrothermal monitoring	Brucefield Estate Glasgow Caledonian University Locate Architects	Summer 2014 - 2015	Refurbishment Case Study Technical Paper on effects of cement removal on wall humidity

Energy efficiency			
Project title	**Partners**	**Duration**	**Notes**
Energy use and carbon emissions from traditional buildings in Scotland	Heriot-Watt University	Thesis submitted 2013.	PhD studentship; HS to selectively publish final thesis
Site project: Kirkton of Coul	McRobert Trust	2013 - 2014	Refurbishment Case Study
Site project: Tomintoul Bothy	Private Owner Richard Erdal Architects	Summer 2014	Refurbishment Case Study
Site project: Hartshaw House	Brucefield Estate Glasgow Caledonian University Locate Architects	Summer 2015	Refurbishment Case Study Technical paper on the efficacy of internal wall insulation (insulated lime plaster)
Site project: High Street Newtongrange, cold roof insulation	Castle Rock Edinvar Edinburgh Napier University	Summer 2014	Refurbishment Case Study

Site project: Newtongrange TBC, warm roof insulation	Castle Rock Edinvar Edinburgh Napier University	2014 - 2015	Refurbishment Case Study
Site project: Archibald Place	Lister Housing Co-operative	Summer 2014	Blown bead insulation; Refurbishment Case Study
Site project: 11 Annat Road	Gannochy Trust	Autumn 2014	Refurbishment Case Study
Site project: "4 in a block" rebuild, Ravenscraig Innovation Park	BRE Scotland, Scottish Energy Centre (Heriot Watt) Cruden Homes	2013 - 2015	Technical Paper; ongoing monitoring of indoor environments
Energy Consumption Data	Private Owners Castle Rock Edinvar Edinburgh Napier University	2012 – 2015	Technical Paper; identifying and quantifying energy use per m^2 by house type and occupation pattern
EFFESUS	Collaborative EU Funded project (Carsten Hermann lead)	2012 - 2015	A range of WP's, Site project in Glasgow TBC

Climate change impacts & adaptation			
Project title	**Partners**	**Duration**	**Notes**
The effect of climate change on Glasgow's sandstone buildings	University of Glasgow, British Geological Survey, Natural Environment Research Council (NERC)	Thesis submitted 2013	NERC CASE PhD studentship with HSCG acting as industrial partner LD

Binder migration – loss of lime binders through water penetration	Heriot-Watt University - Alan Forster lead	Thesis overdue	Interim reports annually.
Current mechanisms and future patterns of stone decay in cleaned sandstone and granite buildings	University of the West of Scotland, Robert Gordon University, British Geological Survey	Year 5 of 3, thesis overdue	Existing project, part funded by HSCG, remainder by other 3 partners
Flooding Advice/literature review	Internal (Jessica Snow lead)	2014 – 2015	Flooding Inform Guide Autumn 2014. Short Guide to follow
Moisture monitoring	University of Oxford	Begins 2014	MSc – 1 year followed by PhD – 3 years
Site project: Inverary Town Arch – drip details trial TBC	Inverary CARS Argyll and Bute Council	2014 - 2015	Refurbishment Case Study; proving efficacy of correct drip detailing
Site project: “The Resilient House”, Ravenscraig Innovation Park	BRE Scotland, Scottish Energy Centre (Heriot Watt) Cruden Homes	2014 - 2015	Technical Paper; ongoing monitoring
Climate change impacts: development of risk assessment methodology	BGS, SNH	Begins 2014	Part of Scottish Climate Change Adaptation Programme

Evaluation of emerging technologies and techniques

Project title	Partners	Duration	Notes
Evaluation of laser scanning and visualisation applications to building pathology, conservation practice and technical education.	Digital Design Studio (Glasgow School of Art), Royal Commission on the Ancient and Historical Monuments of Scotland, CyArk Foundation	2014 for 2 years	Utilises existing data from various smaller research projects
Evaluation of plastic repair techniques and materials	HS Research Fellowship; now internal (Clare Torney lead)	Feb 2011 – Feb 2013; ongoing	Plastic repairs and mortars. Inform guide in draft
Micro-renewables in the historic environment	HS Research Fellowship	2012-2014	Short Guide published 2014

Facilities management			
Project title	**Partners**	**Duration**	**Notes**
Fire in Historic Buildings	Fire Protection Association (Sharon Haire lead)	2013-2014	Inform Guide published 2014 Short Guide to be published Autumn 2014

Regulatory control			
Project title	**Partners**	**Duration**	**Notes**
Review of Guide For Practitioners 6 Conversion of traditional buildings: application of building standards.	Tender through public Contracts Scotland Building Standards Division	2014 - 2015	Update. New drawings etc.
