REFURBISHMENT CASE STUDY 29

FALKLAND HOUSE STABLES FIFE

MAINTANENCE AND ADAPTION WORKS

HISTORIC ENVIRONMENT SCOTLAND | ÀRAINNEACHD EACHDRAIDHEIL ALBA

This case study is published by Historic Environment Scotland, the lead public body established to investigate, care and promote Scotland's historic environment.

This publication is available digitally and free to download from the Historic Environment Scotland website:

www.historicenvironment.scot/refurbishment-case-studies

All images unless otherwise noted are by Historic Environment Scotland.

This publication should be quoted as:
Historic Environment Scotland Refurbishment Case Study 29
Falkland House Stables, Fife: Maintenance and adaption works

Any enquiries regarding this document should be sent to:
Historic Environment Scotland
Longmore House
Salisbury Place
Edinburgh
EH9 1SH
+44 (0) 131 668 8600
www.historicenvironment.scot

HISTORIC ENVIRONMENT SCOTLAND REFURBISHMENT CASE STUDY 29

FALKLAND HOUSE STABLES, FIFE

MAINTENANCE AND ADAPTATION WORKS

ROGER CURTIS

Acknowledgements:

With thanks to the Falkland Stewardship Trust

CENTRE FOR STEWARDSHIP

CONTENTS

1. INTRODUCTION

This Refurbishment Case Study describes a series of interventions and repairs to the rear elevation of a Category B listed early 19th-century stable block located on the Falkland Estate in Fife. The works were supported by Historic Environment Scotland (HES) to demonstrate how repair works can be specified, procured and delivered on a traditionally built structure. The building had undergone a series of repairs some five years previously, but certain key details had not been identified or had been poorly delivered. Resulting defects included faulty and inadequate rainwater goods, failed lime pointing and decayed stonework.

Some of the defects appear to have arisen from changing weather patterns, where a changing climate is putting the traditional fabric and roof drainage under greater pressure from heavier and more sustained spells of rainfall. The relatively sheltered elevation of the stable block appears to be getting more wind driven rain and accelerated decay of the masonry was evident, compounded by the various failures in its repair and maintenance. Taking a 'whole elevation approach' also required consideration of other components, such as the care of the windows, where an opportunity was taken to trial the use of linseed oil paint. The re-pointing and masonry repair works were carried out using a traditional quicklime-based mortar (or 'hot-mix') as part of wider HES trials with this material. This method of mixing mortar was new to both the client and the contractor and enabled the development of traditional skills.

The client, the Falkland Stewardship Trust, wanted to better understand the requirements for routine maintenance and repairs. This involved using local and retained labour, rather than relying on intermittent, larger projects. HES wished to demonstrate to owners of historic assets such as local groups or community trusts how this might be achieved. There are also lessons to be learned from the nature of the specification of the previous works that left some defects unaddressed.

2. THE SITE

The project covered repair and upgrade works to an area at the back of the stable courtyard (Figure 1), where the adjacent ground had recently been cleared for the construction of a shelter and public seating. The elevation faces northeast and is reasonably sheltered, but does not get much direct sun, especially in the winter. Extensive works had been carried out to the principal elevations of the stables in 2009, including ground works associated with drainage.

Figure 1. View of the north elevation of the stable block where the works took place. Note the poor condition of the stonework at lower levels.

The works of 2009 included work to the profiled cast iron rhones but these were leaking at the joints. The run, or 'fall,' that governs the direction of water flow was inconsistent, while the connection with the downpipe was undersized and did not meet the downpipe. These defects (Figure 2) meant that the wall masonry was saturated for extended periods following rainfall. The rainwater disposal arrangements had evolved in a haphazard fashion and resulted in a complex series of junctions of various sized cast work. A single downpipe was taking run-off from both the stable roof to the right, but also from the workshop roof to the left – a considerable volume of water. The outflow discharged arbitrarily, missing the entry point for the below ground drainage.

A former hayloft entrance had been renewed in timber to a good standard, but water run-off from the timber and glazed areas was causing damage to the masonry below. This was exacerbated by the additional water from the leaking joints in the rhones. The masonry needed to be protected from this run-off by a new lead drip, chased into the joint below the stone cill of the hayloft opening.

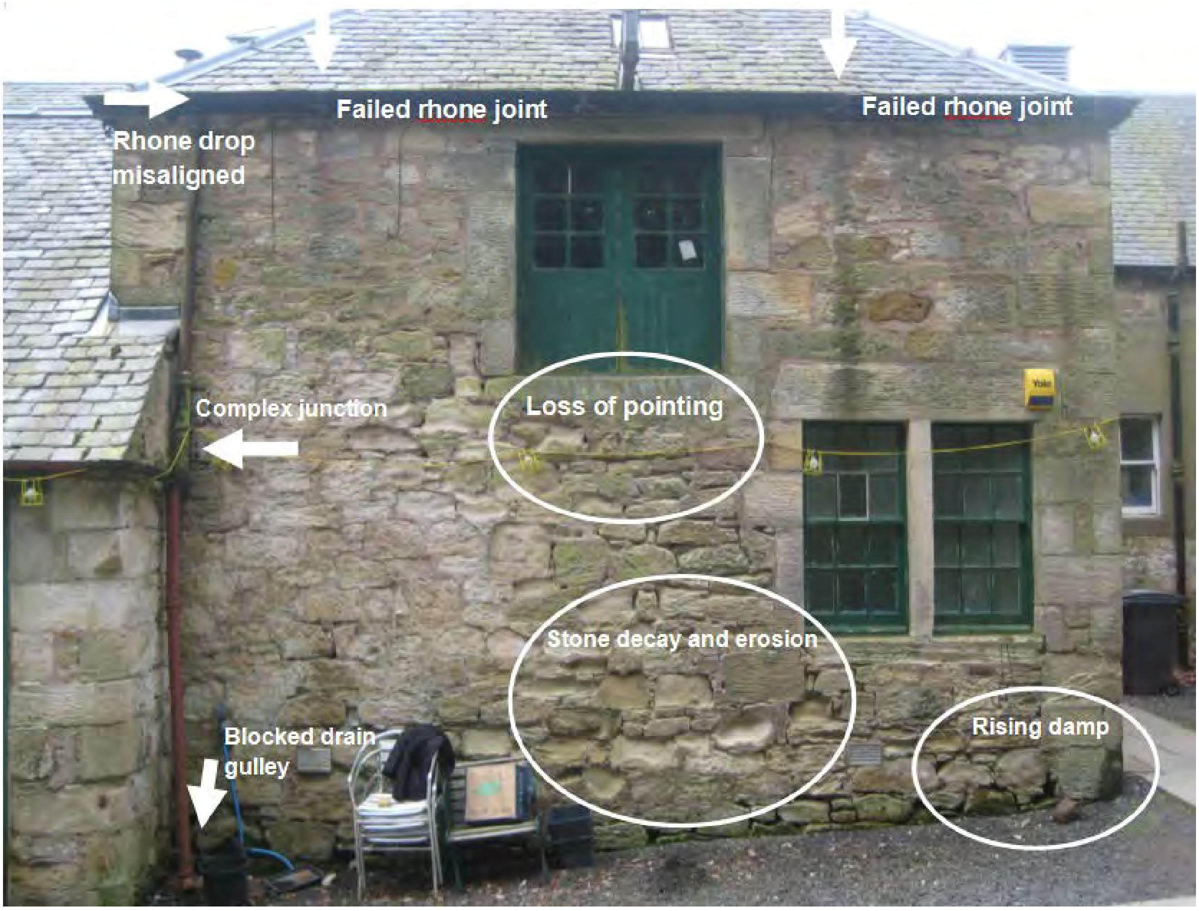

Figure 2. The stable block elevation – key defects from water overflow and leakage are marked in white.

There was extensive loss of the mortar pointing, and erosion of the sandstone masonry (Figure 3). All materials will suffer if subjected to increased water saturation and in this case the relatively soft sandstone is showing such effects. The cause of the deterioration had been much deliberated in the past, with complex and costly masonry repairs proposed. However, without first identifying and rectifying the root cause of the problem it is inevitable that any repair works would be unsuccessful and at risk of early failure.

Figure 3. Extensive stone decay at the lower part of the wall. Greening of the masonry due to damp at the base of the wall can be seen bottom right.

The lime mortar of the wall core was damp to touch and areas of the surface mortar supported moss and algal growth (Figure 3). This can indicate continuously wet masonry and sometimes a high nitrate content.

The reasons for the damp were likely caused by a combination of factors. The re-worked ground had been raised a few inches and covered with a non-woven geotextile layer (permeable membrane), which had trapped a layer of fine sediment or soil on the upper side. This hindered the natural drying of the ground. Secondly, a new internal concrete floor did not allow vapour dispersal across the whole floor area, resulting in concentrations of moisture in the wall footings. The presence of green algae and moss in the joints also suggested that the moisture coming through may have had a higher than normal nitrate content. This might indicate drain water coming from a leak in a grey or sewage water pipe, the subject of recent works, or nitrate salts leaching from the soil.

3. PLANNING THE WORKS

Following an initial site visit a planned scope of the works was agreed with the client. Two trustees had extensive building conservation experience and were able to contribute to discussions on mortar works and stone replacement. They also knew of locally available sources of similar stone. As the works were like-for-like repair using a lime-based mortar for the walls, and repainting the windows to the original Estate colour without affecting the appearance significantly, the local authority advised that Listed Building Consent (LBC) was not required.

The timing of the works had to be carefully considered and arranged for mid-summer; the defective rainwater goods requiring repair first in order to let the wall dry before the mortar work was carried out. The Estate staff reviewed and repaired the roof drainage and other plumbing issues before a contractor, who had previously done masonry work for the Trust, undertook the works. Access was obtained using two bays of a system scaffold at a time, moved along the wall as works progressed.

4. REPAIRS TO ROOF DRAINAGE

The profiled cast rhone had been replaced in the 2009 works, but it appeared that the joints had either failed quickly or had not been installed correctly. Inspection by staff highlighted that the jointing compound, a linseed oil putty, had deteriorated. Cast iron rhones are subject to thermal movement and therefore a flexible jointing compound, or 'plumbers mait,' was selected as a better material to absorb this movement. The defective junction with the downpipe was repaired with a larger lead sleeve. The workshop roof was given a new downpipe on the left hand side, removing the need for the complex junction with the stable roof downpipe, and reducing the intake to the existing downpipe.

5. MASONRY WORKS

It was decided early on to test various additives in a hot-mixed lime mortar to achieve the best visual and performance match. A hot-mixed mortar is prepared by mixing quicklime with aggregate and water, which produces heat. A mortar analysis was not carried out as the existing mortar was not believed to be original and one of the objectives of the trial was to empower the contractor to make an informed judgement on the mix whilst guided by HES. Trial mixes were based on one part quicklime to three parts sharp sand, with the addition of brick dust (trial 1) and crushed shell (trial

2) made in small test batches using a hand-held mixer (Figure 4). From visual analysis of other original mortars throughout the Estate, this was considered to be fit for purpose, both technically and aesthetically. The methodology for the repair of the pointing sought to replicate a flush point in the style and finish of the existing work, including the use of pinnings (small stones used to pack out the joints). This style is common in Scotland and examples are found in other parts of the Estate. The sharp sand was supplied in a ton bag from the local builders' merchant. The quicklime, crushed brick and shell came from a specialist lime supplier.

The criteria for stone replacement was based on if the stone had weathered back more than 25% of its depth and if the stone was not considered robust enough to last until the next major maintenance cycle. Using this criteria, only two eroded stones were removed and new sandstone from the Estate stocks were cut and dressed to fit.

The contractor was familiar with lime mortars but not experienced with hot-mixed lime mortars, and was given instruction by HES staff before the pointing work began. The instructions given can be found in Annex A. Batching of the bulk of the mortar was done with a small (20 litre) electric forced action mixer (Figure 5). The contractor was quickly able to judge water content and produce good, consistent mortar.

Figure 4. Trial mixes being prepared using a hand-held mixer.

Figure 5. The small forced action mixer used for the preparing the hot-mixed lime mortar.

Previous areas of cement pointing were removed and the wall brushed down before being re-pointed (Figure 6). The trial mortars with different additives were applied first, with two small areas below the window selected for testing. The first trial mortar had brick dust added at 10% and the second had crushed shell at 15%.

Figure 6. Re-pointing the wall with hot-mixed lime mortar.

Brick dust and crushed shell are both traditional additives for lime mortars, probably used historically to initiate a quicker set. Both mixes took an initial set after four or five hours, and were pressed back to close any shrinkage cracks. The brick dust had little apparent effect on the curing time, which was not really discernible in site conditions[1]. The crushed oyster shell, however, gave a good texture and final appearance to the mortar. It also seemed to give a slight improvement in setting time and the stiffness of the initial set. Therefore, it was agreed that the shell mix would be used for the remainder of the work.

The new mortar was finished by scraping the mortar with the back of a trowel, work normally carried out the following morning. This finish textured the surface of the mortar and increased vapour release, assisting the carbonation process through a more open surface. Where stones had

---

[1] It should be noted that the percentage of brick dust used probably wasn't enough for the site and location, and a trial at a higher percentage would have been more effective.

lost parts of their face, they were partially coated with the mortar to bring them flush with the external wall face, eliminating water traps.

The main re-pointing work took place in late summer, during reasonable temperatures of around 15°C. Care was needed in the management of the curing, to prevent rapid drying. Hessian protection was used, along with spraying with water twice daily following the initial cure. After three days the wall mortar was left to cure without further intervention (Figure 7). As the mortar cured and dried it took on a creamy grey colour. Typically a properly cured lime mortar will be a grey or off-white cream, however, this can be affected by the fines (fine aggregate and dust) within the aggregate and any other additives. Bright white lime mortars normally indicate a mortar that has dried quickly and not properly cured.

Figure 7. The replaced stones and the finished lime mortar surface following the final scrape back of the mortar.

6. LINSEED OIL PAINT TRIAL

It was decided that a linseed oil paint would be used to redecorate the windows. Linseed oil paint is a traditional material and its use served as a trial for the redecoration of the windows on Falkland House. Painting was programmed to take place after the limeworks.

The bulk of the work was in the preparation. All layers of previous paint were removed down to bare timber using a hot air gun and a hook scraper. A record was taken of the lower layers to understand how the colours used in the painting of the stable external woodwork had evolved. In this case the base layers were a dark forest green colour, which had been replaced with a brighter lighter green. Therefore, the opportunity was taken to revert to a darker green, in keeping with the original paint scheme. Once the sash was stripped to bare wood (Figure 8), two coats of plain boiled linseed oil undercoat were applied, with a few days between each coat to allow the layers to cure.

Figure 8. The sash removed ready for painting with the linseed oil paint. All previous layers of paint had been removed down to bare wood.

In warm weather curing generally takes 36 to 48 hours. At Falkland, however, with this part of the works running into October, the cooler conditions meant that the top coat did not cure fully for some weeks. This could be a problem at sites where time pressures will oblige the removal of scaffold quickly. In addition, the extended curing time in lower temperatures means that dust, grit and insects can get caught in the final surface paint layer, especially in windy conditions. The final layer is the pigmented coat. Linseed oil paint is much more fluid than most modern paints, and although it has considerable depth and cover (due to its high pigment content) if the layers are not kept thin it will ‘run’ and leave ‘tears’ of excess paint. A linseed oil paint can take quite a high sheen and this was evident on the finished sashes (Figure 9). The finish will progressively become more matt in appearance over several years.

As the trial was carried out in a sheltered location it is difficult to assess the suitability of linseed oil paint for use on the main house. Therefore, a further trial will be carried out on a large window at Falkland House as the next stage in the evaluation process.

The lesson from this part of the trial is that linseed oil paint work needs to be undertaken in reasonably warm conditions. This could be achieved by taking the sashes to the workshop for painting, or by enclosing the window case behind protection, with some form of heating. Some practitioners use an ultra violet lamp to speed up the curing.

Figure 9. The lower windows of the stable block windows painted with linseed oil paint.

7. COMMUNITY ENGAGEMENT

Community partners and other stakeholders were invited to participate for a half-day session in the preparation and the application of the hot-mixed lime mortar. This included Trustees, Estate staff and other volunteers who wanted to acquire masonry and lime skills (Figure 10). This turned out to be successful not only in explaining what was happening to the stable wall, but also in demonstrating the practical process of re-pointing, showing that reasonably skilled or even inexperienced people could do good work with the right training. Importantly, it ensured that the community was included in the process and therefore able to assist on subsequent phases of re-pointing work. This involvement was especially relevant as a hot-mixed lime mortar was used. This is a method of mortar preparation that has been largely overlooked by the wider conservation sector, despite evidence for it being commonly used for traditional and historic mortars.

Figure 10. Pointing demonstration during the half-day training session at the start of the project.

8. CONCLUSION

The project aims of delivering a small-scale suite of building works to address maintenance issues and climate change adaptation measures were successful. The client and contractor learnt about, and are now comfortable with, the use of traditional hot-mixed lime mortars, rubble masonry repairs and linseed oil paint. The Estate staff gained an insight into hot-mixed lime mortars and are now well placed to do straightforward repairs themselves.

Limited insight was gained as to the exact effects of the additives used in the lime mortar. Therefore, further research is warranted under lab conditions where the variables can be better controlled and observed. Every site poses a different set of conditions, and the specification and use of additives needs to be considered on a case by case basis.

ANNEX A

Outline Description of Work for the Falkland House Stable Re-pointing

1. **Investigate existing mortar mix.** The original mix appears to be a rich hot-mixed lime mortar, well carbonated, with a fine aggregate of pale sand with traces of charcoal or coal. Some lumps (3-5mm) of unburnt lime are present.

2. **Wall preparation**. Remove existing cement pointing with hand tools. Joints to be taken back 50mm or to sound original mortar, and washed clean with water. Defective stone may be replaced; generally if the face has weathered back more than 25% of its depth, a new stone should be used, matched from local stockpiles.

3. **Mortar preparation**. Replicate the original mix using a sharp sand of a light colour. The mortar is to be batched with kibbled quicklime ratio one part quicklime to three sand/aggregate; an electric 20 litre forced action mixer is to be used. Aggregate and quicklime is mixed dry and allowed to partially slake. Water is added until a porridge-like consistency is achieved. The mortar should be mixed in the pan until the mix has largely cooled, and stiffened up.

4. **Additives**. As part of the trial, some batches will have additives. Two materials will be added to the basic mix: crushed soft brick at 10% or crushed shell at 15%. These trial mixes will be applied in metre square sections at the base of the wall.

5. **Maturing the mortar.** The mortar is to be taken out of the mixer into a plasterer's tin bath or similar, further mixed by hand and used. The pointing mortar should be malleable and capable of forming into a tennis ball sized lump; the mortar may still be warm at this stage. Bedding mortar should be wetter and more malleable but may still be warm.

6. **Trial panel**. This mix to be trialled on a $1m^2$ section below the ground floor window. The area of wall should be dampened down. The mortar is to be pushed to the back of the joints; closely packed sandstone pinnings are to be used to minimise the mortar volume. The pointing to the final wall plane should be done in one application. In general no joint should be wider than 20mm.

7. **Pointing finish**. The mortar is to be applied proud of the wall plane; on scraping back this will result in a pointed face flush with the masonry of the wall. The surface will undulate slightly. Approximately one hour after application (earlier/later depending on conditions), once an initial set has been achieved, the mortar is to be pressed back to close any shrinkage cracks. A further period of set should be allowed, between four hours (summer) and 24 hours (winter) or as required, and a second press back and scrape carried out. This will rough up the surface and allow

carbonation to progress. If the mortar smears and deforms then it will need to be left for longer.

8. Protection. During curing a light spray to the wall is needed and protection given against rapid drying by the use of damp hessian. The damp hessian should be fastened to the wall with vine eyes or large nails fixed into mortar joints, with the hessian touching or close to the wall surface.

9. Dampening down. Spraying should result in the dampening of the wall, not excessive wetting. Depending on temperature, wind and relative humidity, further dampening of the mortar and the hessian may be required, probably the following morning. Once the pointing has hardened and initially cured, the hessian should be removed and the mortar allowed to dry slowly, with intermittent spraying, probably twice a day. For summer working this will normally happen 24 – 36 hours after first application. Most mortars will be cured after 48 hours, but areas at the base of a wall or in cold conditions may take longer. Properly cured and carbonated mortar should be a cream/grey colour and be resistant to scratching with a point. A very white mortar indicates excessive drying and a failed cure.

10. Post work observation. Following the works the new mortar will be monitored. At the base of the wall a degree of surface spalling following a frost is to be expected. The trial panels will be assessed for frost resistance and other durability characteristics. Rhones and downpipes are to be kept clear. Limework will likely fail in areas of saturated masonry if the cause is not addressed; the failure will not be caused by the mix but the conditions to which the mortar is being subjected.

REFURBISHMENT CASE STUDIES

This series details practical applications concerning the conservation, repair and upgrade of traditional structures. The Refurbishment Case Studies seek to show good practice in building conservation and the results of some of this work are part of the evidence base that informs our technical guidance.
All the Refurbishment Case Studies are free to download and available from the HES website www.historicenvironment.scot/refurbishment-case-studies

TECHNICAL PAPERS

Our Technical Papers series disseminate the results of research carried out or commissioned by Historic Environment Scotland. They cover topics such as thermal performance of traditional windows, U-values and traditional buildings, keeping warm in a cool house, and slim-profile double-glazing.
All the Technical Papers are free to download and available from the HES website www.historicenvironment.scot/technical-papers

INFORM GUIDES

Our INFORM Guides series provides an overview of a range of topics relating to traditional skills and materials, building defects and the conservation and repair of traditional buildings. The series has over 50 titles covering topics such as: ventilation in traditional houses, maintaining sash and case windows, domestic chimneys and flues, damp causes and solutions improving energy efficiency in traditional buildings, and biological growth on masonry.
All the INFORM Guides are free to download and available from the HES website www.historicenvironment.scot/inform-guides

SHORT GUIDES

Our Short Guides are aimed at practitioners and professionals, but may also be of interest to contractors, home owners and students. The series provides advice on a range of topics relation to traditional buildings and skills.
All the Short Guides are free to download and available from the HES website www.historicenvironment.scot/short-guides

THE ENGINE SHED

The Engine Shed is Scotland's building conservation centre. Run by Historic Environment Scotland, it is a hub for everyone to engage with their built heritage. We offer training and education in traditional buildings, materials and skills. For more information, please see our website at www.engineshed.scot

THE ENGINE SHED
AN SEADA EINNSEIN
SCOTLAND'S BUILDING CONSERVATION CENTRE

HISTORIC
ENVIRONMENT
SCOTLAND

ÀRAINNEACHD
EACHDRAIDHEIL
ALBA

Historic Environment Scotland is the lead public body established to investigate, care for and promote Scotland's historic environment.

Historic Environment Scotland
Longmore House, Salisbury Place
Edinburgh EH9 1SH
T. 0131 668 8600

Scottish Charity No. SCO45925
VAT Number: GB 221 8680 15