Szerelmey

Restoration and conservation guide

Cleaning and repair of buildings

Specialists in stonework and restoration since 1855

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Michelin House
Fulham Road, London

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Szerelmey is a leading specialist contractor in the field of stone masonry and building restoration services, drawing on over 150 years of experience in the construction industry.

Introduction

Szerelmey was founded in 1855 and has established an unrivalled reputation for excellence and highly specialist restoration across the whole of the construction industry. One of the Company's earliest commissions was to advise on the treatment of the decaying stone fabric of the Houses of Parliament, marking a tradition for working on national monuments and prestigious historic buildings that has perpetuated and expanded to the present day. There are in fact few notable buildings within London's famous skyline that have not been cleaned or restored by Szerelmey at some point during the last two centuries.

At Szerelmey we are dedicated to the restoration and preservation of our magnificent buildings to secure their future and our heritage for generations to come.

We believe in:

- Understanding our clients' needs and exceeding their expectations.
- Preservation, restoration and cleaning through the use of our highly skilled specialist restoration team.
- Enriching the society and environment surrounding each of the projects our team engages with.
- Collaborative teamwork that produces the highest possible results.

We have produced this technical information guide to enable clients to understand more about the restorative processes we offer for the cleaning, repair and conservation of buildings.

This page:
Victoria House
Bloomsbury, London

Our services

Solid craftsmanship and traditional skills combined with innovation.

- Pre-contract consultation services and specification development.
- Complete envelope defect and condition surveys.
- Exemplar sample cleaning.
- Specialist cleaning and paint removal.
- Repair and replacement refurbishment works.
- Structural repairs, modifications and remodelling of historic facades.
- Façade dismantle and store capabilities.
- Additional services for full envelope projects include: access, roofing, windows and decorations.
- Associated façade elements.
- Conservation and preservation of historic buildings.

Services overview

Pre-tender consultation

- We offer advice during the early stages on specification development, detailing, cost plan advice and procurement.

- Our technical team will provide RIBA accredited CPD seminars on cleaning and façade repair in addition to hosting individually tailored design work shops to meet the client's specific needs.

Defect and condition surveys

- Detailed surveys of the façade fabric are very important. We advise undertaking these investigations at early stages to avoid unforeseen costs that may result as a consequence of not understanding the correct level of cleaning and repair required for each individual project.

Exemplar sample cleaning

- This process determines the correct methods for subsequent cleaning and repair.

- In addition this enables more accurate costing for the restoration project.

- Undertaking sample areas of cleaning identifies the construction materials used and can indicate where previous repairs have been carried out.

- Szerelmey will absorb the costs for sample cleaning, where possible, if awarded the contract for the full scope of works.

Below left:
Szerelmey design team

Below right:
Somerset House
Strand, London

Specialist cleaning and paint removal

- From all types of natural stone, masonry, terracotta and stucco.

Repair and replacement refurbishment works

- For all natural stone, terracotta, stucco render, faience, brickwork, external paving and hard landscaping.

Structural repairs, modifications and remodelling of historic facades

- Such as the insertion of new entrances and retail frontages.

Façade dismantle and store capabilities

- This includes comprehensive catalogue and crate service, stone salvage and rebuild of salvaged materials including re-design/ configuration services.

Additional services for full envelope projects

- These include: access, roofing, windows and decorations.

Conservation and preservation of historic buildings

- Our specialist team undertake Conservation works to stabilise, repair and preserve the fabric of historic buildings.

Below left:
Alexandra Restaurant
Ramsgate Kent

Below right:
Stained glass window by
Cox & Barnard, St Leonard's
church, Seaford

Services overview

Associated façade elements

- External ground work elements - repair and replacement of paving, planters and water features.

- Structural alterations – these include cutting new doorways into existing walls, new staircase voids through floors and alterations to steps and access areas with stone finishes.

- Lead work – repair and replacement of lead finishings to roofing elements and capping to cornice and parapets.

- Ironwork – repair and replacement of railings and balustrades. Cleaning back to bright steel, rust prevention coating application and redecorating. Making good interface and connection points to building substrate.

- Decoration – isolated elements of repainting such as façade features and timber window frames carried out in-house. Whole façade painting would typically be subcontracted to specialist paint companies.

- Architectural glass - repair and replacement of stained glass windows and feature glazing - this specialist skilled work would be subcontracted and managed by Szerelmey.

- Roofing – all types of roofing repairs and replacement works undertaken.

- Rainwater goods – the repair, replacement and redecoration of gutters, down pipes and connections with cleaning and relocation (if necessary) for the prevention of damp penetration.

STONE

1. Stone decay
2. Combatting stone decay
3. Cleaning methods
4. Elements of repair

1. Stone decay

Common causes

- Water penetration is the leading instigator of stone decay and the three major causes of stone decay are:
  1. Crystallisation of soluble salt
  2. Frost
  3. Pollutants

- The individual structure of the stone is the most important factor in its ability to resist decaying processes.

- The more porous the stone (softer) such as limestone, the greater susceptibility it has to decay.

- Less porous stone (harder) such as granite is less subject to decay.

Frost

- Like salt crystallisation, frost damage to stone is directly influenced by the stone's porosity – the more porous the stone, the more susceptible to frost damage it will be.

- Frost damage occurs due to the expansion of water during freezing; the expansion puts stress on the stone structure leading to cracking and damage.

- Frost damage can also be the 'final straw' that dislodges fragments of stone that have been subjected to other types of decay.

Crystallisation of soluble salts

- Salts occur naturally in the environment and can soak in to porous stone as a result of rainwater, groundwater, sea spray; sometimes salts can be left as a by-product of unsuitable cleaning solutions.

- When salts crystallise within stone pores they can generate sufficient stress to cause fragmentation.

- The concentration of salts and the damage they incur is increased due to the chemical reactions between limestone and acid pollutants in rainwater such as sulphuric acid, which produces gypsum (calcium sulphate). It is this gypsum that is most frequently associated with stone decay of limestone.

- The salt is soluble and passes into solution when the stone is wet through heavy rainfall, then crystallises on drying out. This repeated process causes damage to the stone.

- Sheltered parts of the building that are out of direct rainfall are exposed to moisture in the form of mist, fog or dew. This moisture is invariably pollutant-heavy and known as occult deposition. This encourages the formation of gypsum which forms a hard, filthy crust over the stone. Often the stone will begin to crumble underneath this surface crust.

- Gypsum or calcium sulphate can leach from limestone and cause damage to other building materials.

- Crystallisation damage caused by freely soluble salts such as sodium chloride, sodium sulphate or sodium hydroxide normally consists of a powdering and crumbling of the entire surface of the contaminated stone.

- In this country wind erosion of stone is negligible and when it does occur is in direct relation to a high concentration of crystallising salts.

This page:
Crystallised salts can be seen clearly on the facade of this building

Pollutants

- Water penetration is the leading instigator.

- The chief pollutants influencing stone decay are acid rain and air born pollutants.

- Limestone and marble are primarily composed of the mineral calcite (calcium carbonate) which dissolves readily in weak acid, making both these substances prone to decay from acid rain or air born pollutants.

- Granite on the other hand is chiefly composed of silicate minerals such as feldspar and quartz which are resistant to acid. Some sandstones are similarly resistant.

- The main components that contribute to both acid rain and air born pollution are sulphur dioxide, carbon dioxide and nitrogen oxide, both of which are a by-product from burning fossil fuels like coal and oil. When these sulphuric, sulphurous and nitric acids react with the calcite in limestone and marble the calcite dissolves.

Contour scaling

- While some sandstones are more resistant to acid rain than other types of stone, they can be prone to a type of decay called contour scaling.

- A crust forms following the contours of the surface of the stone and the surface flakes away sometimes up to a depth of 20mm due to differences in moisture movement between crust and body stone, or differences in thermal expansion.

- The pores of the crust layer will be blocked with calcium sulphate deposits even though sandstone does not contain calcium carbonate.

- This is believed to occur as a result of direct pollution with calcium sulphate and can be precipitated by the use of lime mortars.

Rusting

- Rusting and the subsequent expansion of iron including cramps, ties and steelwork hidden in stonework can lead to fractures in the stone.

- The presence of iron within stonework is detected by rust stains emerging from cracks produced by the expansion.

- In these cases the iron needs to be replaced by stainless steel or galvanised cramps or ties.

- If this is not possible then the metal surface is exposed, scraped back, primed and coated with an anti-corrosion treatment.

  Please refer to section Steel Work Corrosion see page 39.

- In the case of railings where the metal is partially embedded it should be caulked with a bituminous mastic or silicone based compound.

Below:
Stone cracking due to steel work corrosion

Other factors

- Sedimentary rocks have a natural bed and blocks of stone should be laid so that the bed is normal to the load.
- If this is not done then there can be areas of weakness, which can potentially lead to greater susceptibility to different types of decay, unless measures are taken.
- Dense pointing mortar can also cause increased crystallisation damage by restricting the movement of water through it so that little evaporation can take place at the joints. Moisture in the wall must then evaporate from the stone itself and any salts will accumulate in the stone.
- Since it is normally cheaper to repoint than to replace decayed stone, it is advisable to use a slightly permeable mortar which will deteriorate in preference to the stone.
- The corrosion of steel or cast iron fixings can cause spalling of stonework. Dowels and fixings should, therefore, be made of non-ferrous metal or stainless steel.

2. Combatting stone decay

Removal of soluble salts

- Removing the cause through cleaning is the most obvious and effective method.
- This can be done through simple washing with water.
- A more effective method for removing salts from the fabric of the stone is the use of clay poulticing (see page 19 Chemical Cleaning and Poultices).
- This is a lengthy process and will need to be repeated a number of times for the best results.

Deep impregnation treatments

- These involve the deep impregnation of stonework with specific, suitable resins.
- These treatments secure the decaying surface to the solid stone beneath and should prevent further crystallisation damage.
- Given the costs involved with these treatments they are generally recommended for small areas.

Restoring stonework

- Loose stone and flakes are removed and the stonework redressed until a solid face is exposed and repointing carried out where necessary.
- In more complicated cases where architectural detail or mass has been lost the stonework is restored to its original line through the application of artificial facing or natural stone, or by building up with re-constituted mortar.
- Individual damaged architectural elements can be removed, repaired or replaced with like carved by craftsmen.

Below:
Before and after – replacement of decorative string course

3. Cleaning methods
Preserving the building fabric

Selection and approach

- Each building should be assessed individually and in relation to its construction material.

- Initial investigations, sample cleans and testing should be carried out in appropriate positions on the façade, which may include samples on different elevations to ascertain the degree and type of soiling.

- Following testing and sample cleans the specialist team can ascertain the appropriate cleaning technique to use.

- It is essential that cleaning is sympathetically undertaken to avoid serious, long-term damage to the building.

Typical methods:
- Water cleaning (Washing)
- Steam cleaning (DOFF)
- Wet abrasion (JOS/TORC)
- Air abrasion
- Chemical cleaning and poultices
- Laser cleaning

"Cleaning is an important and essential part of conservation and preservation which can be carried out without damage to the substrate."

~ Mark Chivers, Szerelmey

Below left:
Conservation cleaning of tracery

Below right:
Steam cleaning 17th century lettering

Water cleaning using nebulous spray

- This is the traditional and most widely used method.
- Only clean potable water is used and applied at variable pressure.
- Generally specially designed water heads or nozzles are used which vaporise the water creating a mist that is sprayed onto the dirt until it dissolves.
- Where soiling is heavy natural bristle and/or phosphor bronze bristle brushes are used. Alternatively the area may be rubbed with a soft gritstone if appropriate.
- Generally residual soiling is removed using a high pressure water lance set at a pre-determined operating pressure established during the initial trials.
- The water pressure and type of nozzle is adjusted to suit the condition and fabric of the building.
- The washing sequence should commence from the upper level of the facade to be cleaned, working vertically so that the action of water run-off from the immediate area of cleaning softens the soiling on the level beneath.
- The speed of cleaning depends on the following factors:

1. Degree of and type of soiling
2. Water pressure and volume available at the façade
3. Optimum coverage of facade with available water

Below left:
Nebulous spray rig in progress

Below right:
Preparing for dry abrasion clean

Protection

- To protect the building during water cleaning any visible defects in the external fabric are temporarily caulked, as are any open vents or ducts. Windows are sheeted and securely taped.

- At the end of each day of cleaning all the temporary protection measures are removed leaving ducts clear and windows serviceable.

- While every effort is made to provide complete protection, this is not always possible due to the volume of water.

Licensed specialists and approved systems

- Szerelmey uses the DOFF and TORC (formerly JOS) cleaning systems. These systems represent technical developments in the industry and use the least abrasive approach possible; they complement each other and are invariably used together.

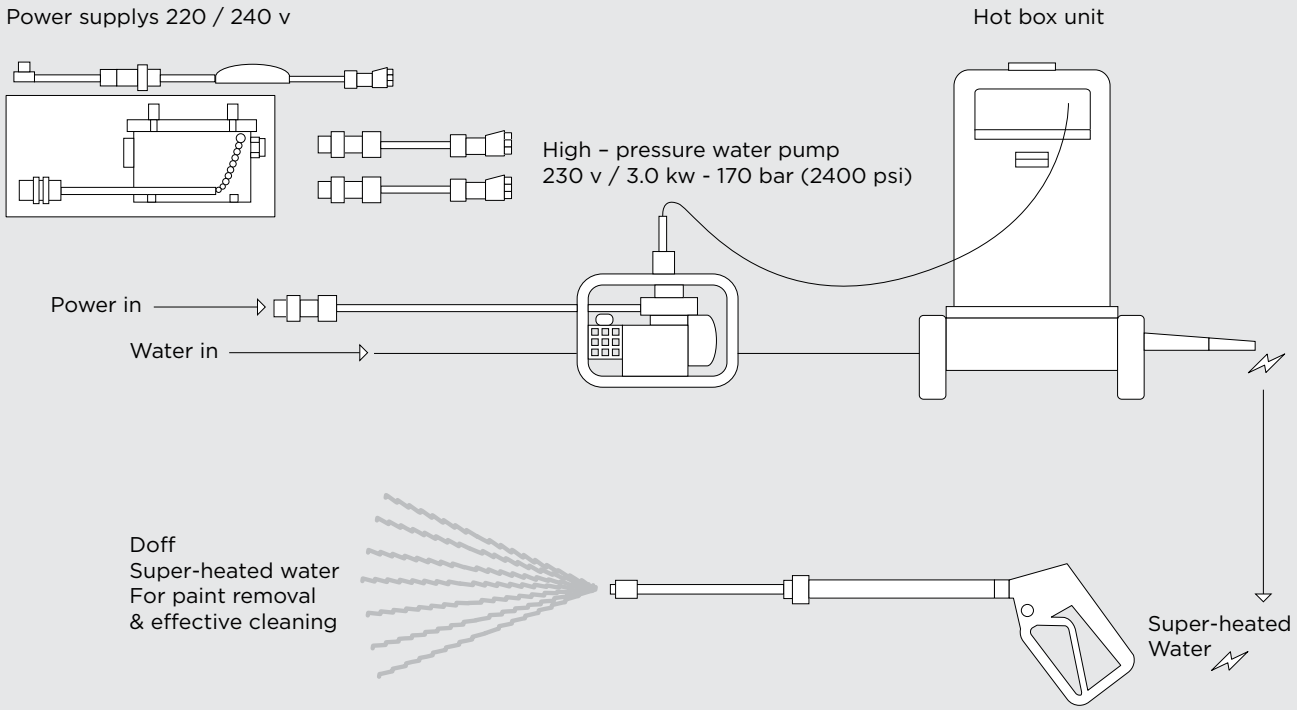
- Szerelmey work closely with Stonehealth, a UK based company that offers products and consultancy for sensitive stonework restoration and conservation. Stonehealth provide training in both the DOFF and TORC systems to the Szerelmey team to optimise results.

- Szerelmey are included on the 'Approved Register' of trained and inducted operators of the DOFF and TORC systems, giving peace of mind to architects and surveyors to the proper use of the systems and products.

- The DOFF and TORC systems are the chosen methods of specialists and are routinely used on prestigious projects.

Below left:
Dry abrasion cleaning

Below right:
Doff (steam) cleaning in progress



Steam cleaning

The DOFF method

- The DOFF system uses steam and super-heated water in a unique way to remove many paints and coatings including thermoplastic and bituminous mastic materials - even chewing gum and thick layers of grease and oil are easily and effectively lifted.

- DOFF is also effective in removing algae matter whilst killing off bacteria, as well as in the removal of bird droppings and other unwanted deposits.

- DOFF also kills off spores negating the need for chemical biocide.

- The DOFF system is cost effective and has no negative environmental effects.

How DOFF works:

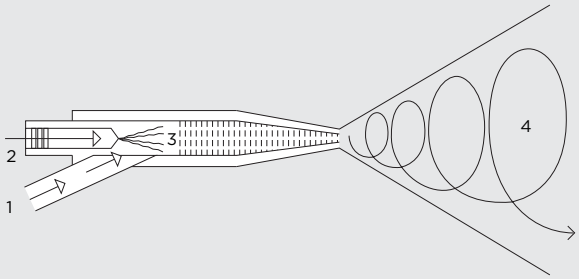
- The DOFF system works on a variable combination of high temperatures and pressure. Temperatures can reach up to 150°C at the nozzle end and the operator can vary the temperature and pressure according to the type of material that needs to be removed.

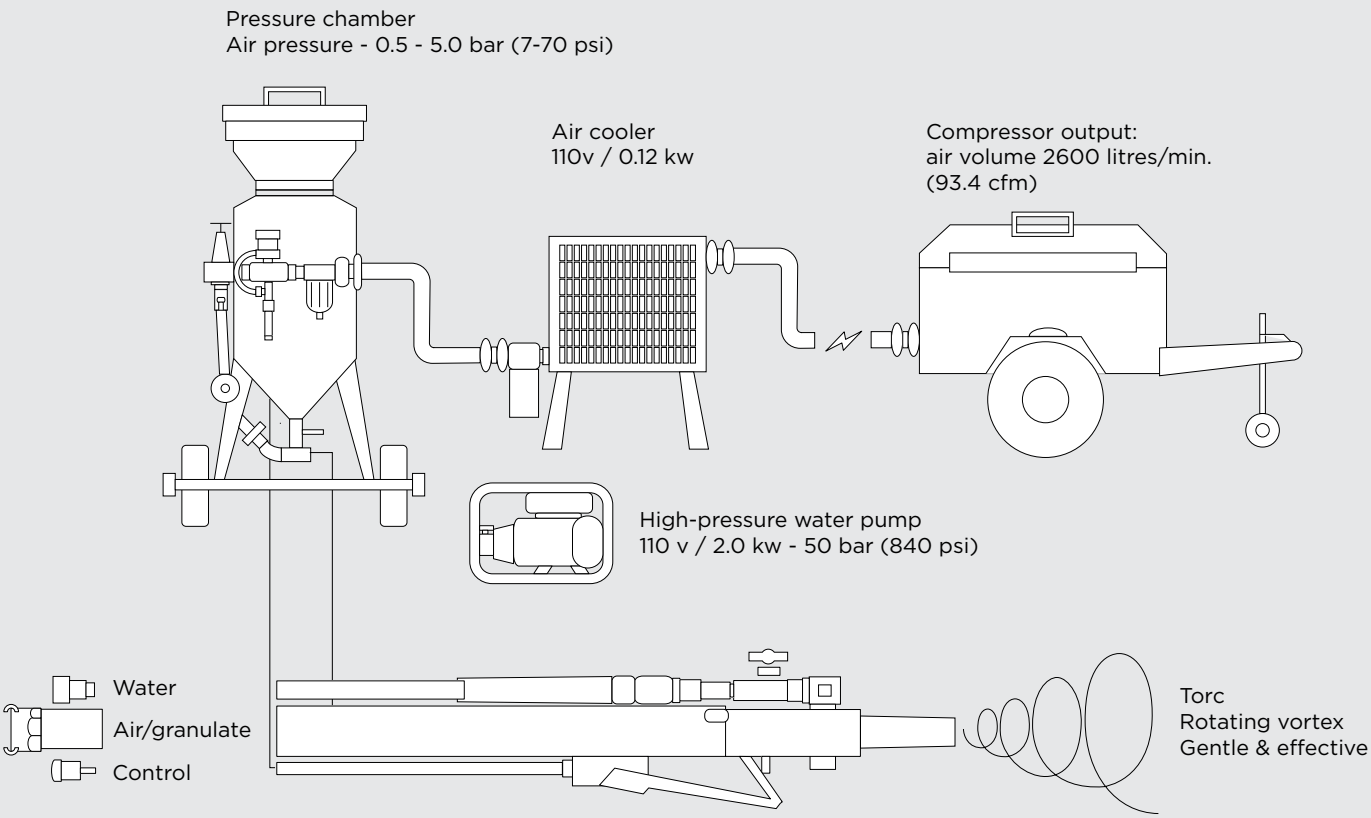
- When the temperature in the system is high the pressure on the surface being cleaned is gentle and the volume of water low. This means the surface does not become saturated and therefore dries very quickly.

- For removing paint and heavy coating the DOFF system can be operated on high pressure/high temperature.

- The system operates using a variety of lances and nozzles appropriate to different project requirements.

The patented JOS principle
1. Granulate & air inlet
2. Water jet
3. Mixing chamber
4. Rotational vortex





Wet abrasive

The JOS/TORC method

- The JOS/TORC system was developed to enable gentle, safe and effective cleaning of historic buildings with their inherent problems, such as delicate or friable surfaces.

- JOS was first in use over 20 years ago and has been recently updated to the TORC system, which is even more efficient and gentle.

- The TORC system creates a soft swirling vortex using a mixture of low air pressure, low volume of water and a safe, inert fine granulate (crushed marble).
- The TORC nozzle, which is a patented design, creates this unique swirling vortex via a system of modularised separate components in the head. The head and nozzle can be changed easily and come in a range of sizes to clean large areas such as ashlar or small intricate areas.

- The TORC system will remove all unwanted material including carbon, dirt, scale, graffiti and some types of paint from a range of construction materials including stone, brick, metals, wood and even plaster.

Air abrasion

- In the past air abrasion, when mis-used, caused extensive damage, but modern air abrasives are more sophisticated with volume and pressure of delivery controllable at the nozzle.

- Different abrasives have been developed for different types of stone and degrees of soiling.

- One of the most common is aluminium oxide powder, or chalk or calcium carbonate powder for softer stones.

- A great draw back to air abrasion is the amount of dust it generates.

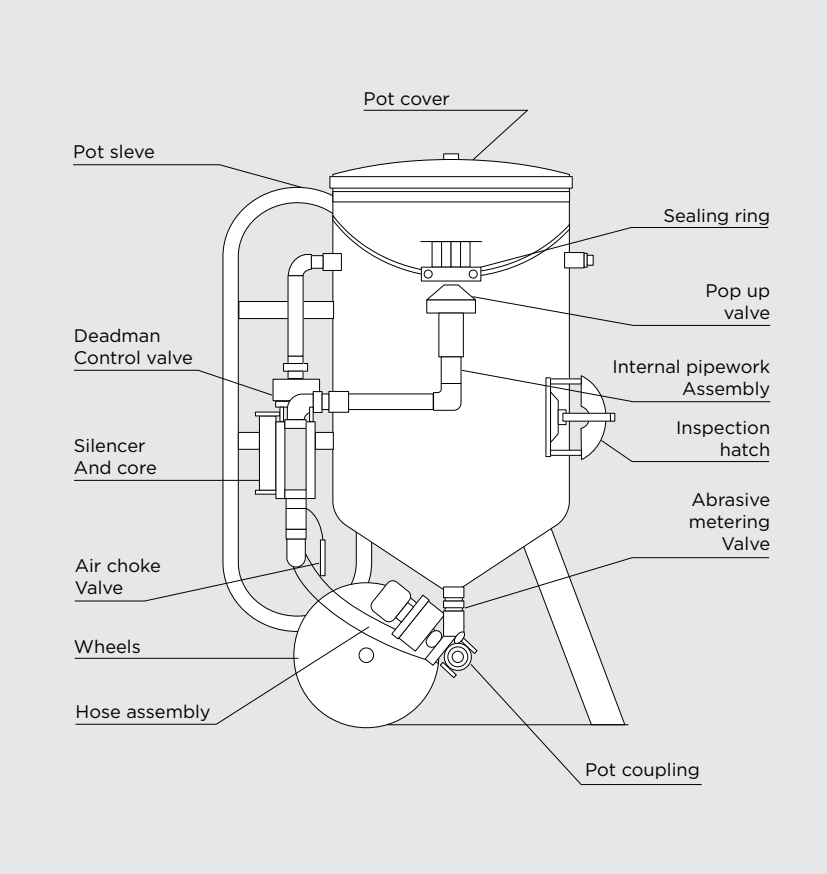


Image right:
Air abrasion cleaning in progress

Chemical cleaning and poultices

General

- Chemical cleaning is the application of specific chemicals to soiled areas, generally in the form of a type of poultice.

- Poultice formats vary but can consist of a 'medium' that contains water or alkaline based cleaning agents. These agents are chemical solutions designed to remove various types of water-insoluble surface contaminants such as paint and grease. Chemical cleaners work on the principle of dissolving dirt by combining chemical reactions.

- Sequestering agents such as ETDA are used for the removal of metallic stains from iron or copper oxide.

- Surfaces are pre-wetted to minimise penetration of the cleaning solution into the masonry surface and covered with plastic film to prevent the poultice drying out.

- Incorrect use of chemical poultices can cause damage by the mobilisation of new staining material in the substrate or through inadequate neutralisation/rinsing.

- The process of neutralisation with clean water to remove potentially damaging residues must follow any chemical cleaning procedure.

- All poultice materials must be used in accordance with COSHH (Control of Hazardous Substances to Health) and CDM (Construction [Design and Management]) regulations.

- Poultices are traditionally used for localised areas on detailed façades; typically they are used to draw out specific stains/soiling from a small area.

- However, the development of spray applied poultices has also made them useful and cost effective for larger façade areas.

- Poulticing can also be combined with less expensive methods like water cleaning to soften deep seated water-soluble contaminants beforehand. This combination of cleaning methods on one facade can provide more control with less risk of damage or over-cleaning than using a single cleaning method.

- Poulticing can be used in areas where water cleaning is not appropriate (interiors for example). Soiling that has penetrated deep into the masonry substrate is often more easily removed by a poultice than by other cleaning methods.

- Poultice cleaning can also be used as a post-cleaning treatment to remove areas of staining that may have emerged following the general cleaning of the facade.

- Poultices can be used to remove soluble salts, insoluble contaminants and metallic staining from porous masonry surfaces such as sandstone, limestone, terracotta and render.

- Site trials are essential prior to any facade cleaning programme to establish which method will be most effective and to indicate the 'level of clean' that can be achieved without risk of damage to the masonry surface.

- The cleaning of historic masonry facades should only be carried out by suitably qualified specialists, from the specification stage through site trials and execution of the work.

Gel poultices

- Gels containing ammonium carbonate or alkaline cleaning agents are often applied to the building substrate, particularly for the removal of paint and/or graffiti. The poultice is covered with sheeting to prevent it drying out and neutralised by after-washing at the end of the process. Several applications may be required at varying levels of strength in order to remove the contaminant without damage to the building fabric.

Clay based poultices for desalination

- The most traditional and typical poultice is clay based and generally one of the following: attapulgite, sepiolite, Fuller's earth clay or Kaolin and Bentonite.

- These are chiefly used for desalination of masonry suffering from soluble salt-related decay – the clay draws the salt particles away from the masonry.

- Initial testing through drilling and removing samples should be done to determine the depth and degree of salt contamination prior to beginning the treatment.

- Once the depth of contamination is established sufficient water is applied to the surface to soak in, reach and mobilise the salts within the masonry.

- Next the clay poultice is applied to the damaged area and held in place with wire mesh or similar reinforcement.

- Once the poultice dries it is removed and a sample checked for salt content.

- The procedure will be repeated until the salt levels are significantly reduced.

- This is a long process and can take periods of months for thorough desalination.

- Plain clay poultices will usually mobilise and remove water soluble staining such as the brownish staining or discoloration sometimes left on Portland and other pale-coloured limestone facades by water cleaning methods.

- Desalination of some sculpture and architectural details with vulnerable porous surfaces should be referred to an experienced conservator. In these cases clay based poultices might not be appropriate and an alternative poultice recommended.

Below:
Clean film
gel poultice

4. Elements of repair

Natural stone

Replacement

- It is best practice to try to keep disruption to the original structure and materials to a minimum, but this is not always possible depending on the extent of deterioration.
- Stone replacement should only be undertaken if the stone has decayed to such extent to be structurally unsound or unsafe, or if the deterioration is causing other issues.
- A full evaluation of the building and the damage should be undertaken by a restoration/conservation expert before embarking on a course of action.
- If the deterioration is extensive then the entire unit of defective stone can be cut and replaced with a new unit of geologically compatible stone.
- The compatibility of the replacement stone is most important to ensure that it does not cause or contribute to the decay of adjacent masonry, in addition there is an aesthetic consideration.
- Ideally the replacement stone should be sourced from the same quarry as the original piece.

Stone indenting

- This repair process is used in cases where it is not possible to remove the entire block of defective stone i.e., if removal causes structural instability.
- Before indenting can take place the existing structure is carefully evaluated and the exact dimensions for the replacement piece established.
- In addition the replacement piece will need to appear visually similar to the existing pieces in relation to the surface details such as the original tooling marks, grooves or borders.
- Particular care is taken when cutting the damaged stone out to ensure the adjacent masonry is not also damaged.
- In addition the damaged stone needs to be cut away to a sufficient depth to allow the new piece to sit securely in place.
- The rear of the new stone piece is secured to the existing stone using non-ferrous or stainless steel dowls that are chemically anchored.
- It is very important that geologically compatible stone is selected for the replacement piece, preferably sourced from the same quarry as the original stone.
- Indented pieces should maintain the original pattern of the building so the structural strength of the wall is not compromised.

Image left:
Stages of mortar repair

Structural stone repair

- Structural repairs need to be undertaken when the soundness or stability of the building is threatened and it is not possible to replace the damaged stone.
- Structural repairs are generally required when significant cracks appear within the stone walls, lintels or window cills.
- The structure should be thoroughly evaluated by specialists before undertaking a course of action.
- Slots are cut into the structural cracks and filled with epoxy resin. Then stainless steel reinforcements are used to pin the two cracked pieces together.
- The area is then filled by indenting (as on previous page) or using surface repair techniques.

Stone surface repair

- This type of repair is used for aesthetic improvement to areas that have suffered superficial damage to the surface.
- These are carried out using stone mortar, of which there are a number of different types.
- These repairs are only suitable for small, localised areas.
- It is very important that the correct type of mortar is used and that is has the same porosity as the stone being repaired, in addition to being colour matched.
- If incorrect mortar is used it can expedite the building's decay.
- Lime based mortars are used most frequently, blended with sands/ aggregates and mixed with potable water.
- These surface repairs are fixed using non-ferrous cramps with successive layers of mortar build-up to form a composite repair.
- Synthetic mortars are occasionally used and these are manufactured using a mixture of polymers and aggregates with a catalysing agent. These mortars dry extremely fast.

BRICK, CONCRETE, RENDER

1. Brick decay
2. Elements of repair
3. Concrete repair
4. Render repair
5. Moisture penetration

1. Brick decay

Common causes of brick decay

- Water penetration (ingress) see page 8 Stone Decay Common Causes.
- Crystallisation of soluble salts see page 8 Stone Decay Common Causes.
- Frost see page 8 Stone Decay Common Causes for more info.
- Structural faults, often caused by structural movement.
- Original construction defects caused by poor building methods.
- Vegetation, particularly ivy and moss.

Common signs of decay

- Spalling (deterioration) of the brick surface.
- Efflorescence (white, powdery residue on the brick surface.
- Surface growth and staining.
- Loose bricks becoming dislodged.
- Cracks in the bricks or mortar crumbling mortar.

Spalling of the brick surface

- Spalling is the crumbling, flaking and deterioration of the brick surface due to moisture penetration and the accompanying crystallization of soluble salt.
- This can be caused by rising damp (see section on moisture penetration) or brickwork being exposed to continual direct water.
- All bricks (and other building materials such as stone, concrete) can be affected but some bricks are softer than others and will therefore be more susceptible.

Efflorescence

- This is a powdery deposit of salts that forms on the surface of bricks and mortar – it is usually white but can also be yellow, green or brown.
- Soluble salts are carried into brickwork via rising damp or direct water penetration. The amount of efflorescence to occur is directly related to the amount of water in the bricks and their drying time.
- The more water in the bricks and the longer it is there increases the chance of salts dissolving and being brought to the surface as the bricks dry out.
- Efflorescence is an indication that water is entering a wall and there is the potential for brick deterioration.

Surface growth and staining

- Vegetation can be very harmful to brickwork and can penetrate into the wall core.
- Growth such as moss is an indication of long standing water penetration and will encourage further water ingress.

- Staining is a further indication of water penetration in particular rust. Rust staining indicates the corrosion of underlying metal structures. If corrosion is serious enough it can create instability due to the fact it expands creating pressure on surrounding brickwork which can lead to flacking and cracking.

Loose bricks becoming dislodged

- As brickwork suffers damage and bricks are dislodged the wall is exposed to further water penetration which compounds the problem.

Cracks in the brick and mortar

- Cracks in bricks and mortar can indicate structural problems and should be investigated immediately.

- Cracking can be caused by the above factors, most significantly water ingress, frost, crystallization of soluble salts and structural failure.

Below:
Repair of brickwork to roof pediment

2. Elements of repair

Replacement

- Damaged bricks should be removed very carefully to prevent damaging adjacent areas.
- When replacing brickwork new bricks should be sourced to match existing bricks as closely as possible.
- Historic bricks were not often a standard size so in some cases it may be necessary to have replacements specially manufactured.
- It is possible to secure second hand bricks from salvage yards, which might better match the area to be repaired. These need to be carefully checked for damage before using.
- Some bricks were stamped with a markers mark, enabling their date and source to be identified. This can help in finding replacement bricks.
- Often 'harder' bricks were used on exposed areas such as corners, while 'softer' bricks were used for walling. When replacing bricks it is important to take this into consideration.

Above:
Conservation of late nineteenth century perimeter wall

Brick slips

- In some situations, where it is not possible to remove the entire brick, it may be necessary to repair small areas of brickwork using brick slips.

- This repair method is mainly used for individual brick repairs and is not intended for large areas.

- Brick slips should match the existing brick and be a minimum of 25mm (preferably 50mm) thick.

- The slip is applied to the clean, even and pre-wetted brick surface of the damaged brick with a bed of lime mortar to finish flush with the surrounding brick work to avoid losing historic details and profile.

Pointing

- Mortar will weather and decay and it will be necessary to replace (repoint) at times during a building's lifetime.

- Before repointing the old mortar is carefully removed to avoid damage to adjacent bricks. This should be done by hand using a thin chisel and pointing tool.

- Specialist tradesmen are the best option for undertaking this and are essential when working on a historic building.

- The appropriate mortar should be used to repoint and this is usually a lime based one.

- Cement mortar was often used from Victorian times on to replace lime mortar, to the detriment of the building.

- Cement mortar is non-breathable and removes the ability of the wall to allow water to escape.

- When repointing the same mortar should be used that was originally used (i.e., not what was replaced).

Crack repairs

- Areas of crack repairs should be determined by a structural engineer.
- Minor cracks can be repaired by carefully cutting out the affected areas of brick, replacing fractured bricks, and repointing using a mortar appropriate to the existing brickwork.

- Where major cracking has occurred, or where bricks are displaced or out of alignment due to structural movement, specific repair works will be undertaken in accordance with a structural engineer's specification.

- Szerelmey's approach to this element is to employ solutions developed by Helifix Systems at the heart of which is the unique Helibeam System of structural reinforcement and repair.

- The Helibeam System uses pairs of long HeliBars bonded into mortar to form deep masonry beams that reinforce and stabilise existing masonry while redistributing the structural loads.

Cleaning

- Cleaning should be done by specialists to prevent damage to the brickwork.

- Before cleaning commences tests should be undertaken on a small area to assess the type and effectiveness of the cleaning to be carried out.

- Washing with a bristle brush to remove surface deposits can be done providing care is taken not to saturate the brickwork.

- High pressure washing is not advised as it drives water too deep into the brickwork and can damage the surface.

3. Concrete repair

- Concrete damage and defects are generally caused by either mechanical, physical or chemical exposure such as mechanical impact, abrasion damage, freeze-thaw action, expansive alkali aggregate reaction (AAR), acidic liquid, water leaching, gaseous attack etc.

- The damaged concrete surface must be prepared before being repaired and must be clean, dry and free from loose material or oil.

- Where extensive repairs are required the damaged concrete is cut away until sound material is exposed.

- We use a multi-purpose polyester resin repair system. The product is supplied as a resin and hardener and suitable for jointing, patching and repairing, and is available in two grades. This can be used for bedding, jointing, profiling of concrete, repair of damaged concrete in precast units, jointing between precast units, repair of stair treads, fixing tiles, cladding, repairs to kerbs, man hole covers and door and window frames.

- It can be poured, trowelled and filled with coarse aggregates and cures in dry, wet, damp and under water conditions.

- The resin is mixed and applied firmly for good adhesion with a maximum mortar thickness of 12mm for a single layer.

- Following the concrete repair process the surface finishes are coated and finished using anti carbonation coating. This is a high performance, crack accommodating elastomeric acrylic providing protective and decorative coating for concrete and masonry and is available in a range of colours.

Below left/right:
Concrete cleaning and repair

4. Render repair

- Render is applied to the exterior of buildings for waterproofing qualities (the building's raincoat) it controls the ingress of water while allowing for evaporation.
- Renders vary in composition from low strength based on lime to high strength based on Portland cement.
- When renders deteriorate there is accompanying water/damp penetration to the building fabric.
- If the incorrect type of render is applied to a building such as non-breathable renders to historic buildings then the building will be compromised.
- The type of building, its age and importance will dictate the type of render, method of application and extent of work to be carried out.
- In cases where render has deteriorated very badly it will need to be entirely replaced.
- Before an area of render is repaired a test area is removed so the fabric of the building beneath can be assessed.
- If there is evidence of dry rot for example, then this needs to be addressed and in some cases stainless steel mesh is fixed to the backing structure to add support.
- Reinforcements or mesh are always stainless steel and must have a minimum covering of 20mm.
- Consideration must be given to the differential in thermal movement between the stainless steel and the render so that cracks do not form.
- Render is normally applied in three coats.
- Prior to the application of any render coat the backing must be thoroughly wetted.
- Render, also known as stucco, can be built up into complex architectural forms through the use of a reinforcement mesh cage.
- Finished render can be painted with specific, suitable paints.

Below left/right:
Images showing cleaning and render repair of Gordon Square UCL

5. Moisture penetration

General

- Modern buildings are designed to exclude water through a system of barriers.

- Old buildings were designed to breathe; in theory moisture that comes in should evaporate out.

- Historic buildings were protected in a number of ways including:
  1. Lime-rendering
  2. Lime-washing
  3. Tile-hanging
  4. Weatherboarding
  5. Use of projecting cills, pentice boards or string courses

- Water will penetrate buildings in various ways including:
  1. Gravity
  2. Air/wind pressure
  3. Capillary suction

- Water penetration will damage the fabric of the building and creates unhealthy conditions for occupants.

- Water penetration should be addressed quickly with standard maintenance work, remedying any obvious apertures, reinstatement of lime render or traditional tile-hanging or weatherboarding where appropriate.

- In some cases ventilated dry lining systems may be installed internally.

Rising damp

- The signs of rising damp are:
  1. General dampness along the bottom of external and internal walls
  2. Discolouration
  3. Mildew
  4. Peeling paper and paint

- Modern buildings are built with a damp-proof course near ground level to protect against rising damp, but historic buildings were not.

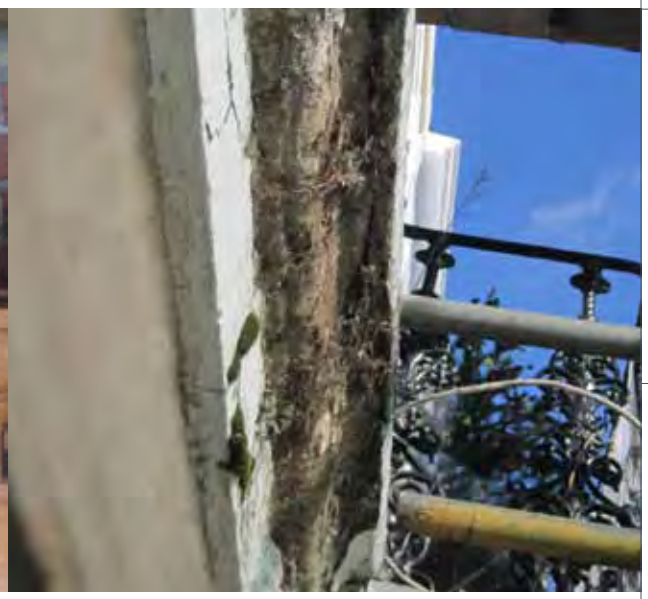
- If there is no damp course the only certain remedy is to insert one if possible.

- Sometimes the damp course becomes ineffective through being 'bridged' which is when earth or a pavement for example is laid at a higher level.

- Damp courses should be not less than six inches above final ground/pavement level.

Rain penetration

- Exposed parts of buildings such as roofs, chimneys and parapets are most susceptible to rain penetration, also any openings such as windows and doors and overflow from gutters and downpipes.



- Rain penetration is different from rising damp and condensation and requires different actions.

- Simple maintenance such as cleaning guttering, replacing slipped or missing tiles and regular care of the buildings external envelope can help to prevent rain penetration.

- In more serious cases replacing lime-rendering, weatherboarding or tile-hanging is an option.

- Given the design of old buildings to be 'breathable' attempts to 'seal' them completely with hard render, plastic-based paints or tanking can lead to further issues and decay.

Pointing

- Mortar used to bind together brick, stone or block walls is subject to gradual erosion from frost, rain, the elements and other causes of decay as discussed above.

- If the mortar cracks, crumbles or recedes behind the outer face of the wall and the mortar joints become too worn, there is a high chance that water will penetrate and saturate the wall.

- This will lead to further damp related problems and should be addressed through repointing the damaged area.

Condensation

- This is one of the leading causes of damp in house interiors and occurs when warm air, which carries moisture in it as vapour, cools.

- It happens when warm air inside a house meets colder elements of the structure such as the windows, roof, areas of walling and floor voids.

- It is particularly prone in areas where ventilation is poor.

- Condensation will lead to mould and timber decay.

- Since old buildings are 'breathable' they contain a certain level of moisture, which was balanced through good ventilation (open doorways and loose fitting windows and doors). When ventilation is restricted i.e., old buildings are sealed (use of double glazing for example or when the exterior is rendered in non-breathable materials), then there is an increased risk of condensation.

- To reduce condensation in old buildings increase ventilation and reduce moisture producing activities i.e., do not hang wet washing up, keep lids on pans in the kitchen, keep bathrooms well ventilated.

- Keeping heating at a regular low level and lagging cold pipes also helps.

Cavity walls

- Cavity walls are the subject of much current debate.

- These walls are composed of an outer and inner layer with a cavity between the two and are generally brick, block or concrete in construction. They were originally designed to 'breathe'.

- Recent government initiatives have encouraged filling the cavity with insulation material to conserve heat and therefore energy within the home; this prevents the walls from 'breathing'.

- In many instances the insulation acts as a medium through which damp invading the exterior wall is able to permeate through the interior wall.

- Not all cavity walls will lead to damp, but there are many instances where this is the case.

TERRACOTTA, FAIENCE

1. General
2. Causes of deterioration
3. Cleaning
4. Repairs

1. General

Terracotta and faience are composed of high quality clay that can be moulded into shapes and fired at a high temperature. Both are used for architectural purposes and once fired, are extremely strong and durable.

You can obtain a hardness and sharpness of detail not obtainable in brickwork with terracotta and faience.

The difference between the two is that faience is glazed and terracotta is not. Terracotta can be used in a structural or semi-structural context whereas faience is most typically used as cladding
Once terracotta has been fired it develops a 'fire skin' which acts in a similarly protective way to the glazing on faience. If the fire skin on terracotta or the glaze on faience is compromised the underlying structure becomes susceptible to deterioration, soiling and decay. Improper cleaning has been a leading cause of damage to terracotta and faience in the past.

Terracotta and faience became popular as a building material because they were a cheaper alternative to stone since many units could be produced from one mould. Also by using specific glazes on faience the effect of stone could be recreated.

Typically terracotta and faience was used as a cladding material attached via metal ties or anchors to the load bearing structure behind.

In some cases terracotta and faience are also load bearing.

2. Causes of deterioration

- Poor manufacturing
- Glaze defects
- Water damage/surface spalling
- Salt crystallization
- Rusting staining
- Poor joints
- Stress/structural issues
- Poor repairs

The outward signs of decay on terracotta and faience do not always reveal the extent of decay within. Sometimes it is necessary to inspect each unit at close range, methods can include drilling a small hole and using an endoscopes.

Poor manufacturing
Inadequate firing can lead to rapid surface deterioration, this is because a complete fire skin is not formed so the surface remains partially permeable and water and frost damage can occur.

Poor pressing in the moulds prior to firing can result in lamination, which can again lead to frost damage.

If the clay mix has too much water in it, or the firing temperature is not correct, warping and cracking might occur.

Glaze defects

Cracking
The main cause of deterioration in terracotta and faience is water ingress through cracks in the material's surface. These can occur due to structural movement in the building; stress caused by loads or human intervention in the form of accidental blows or when drilling the surface to fix signs, cables etc.

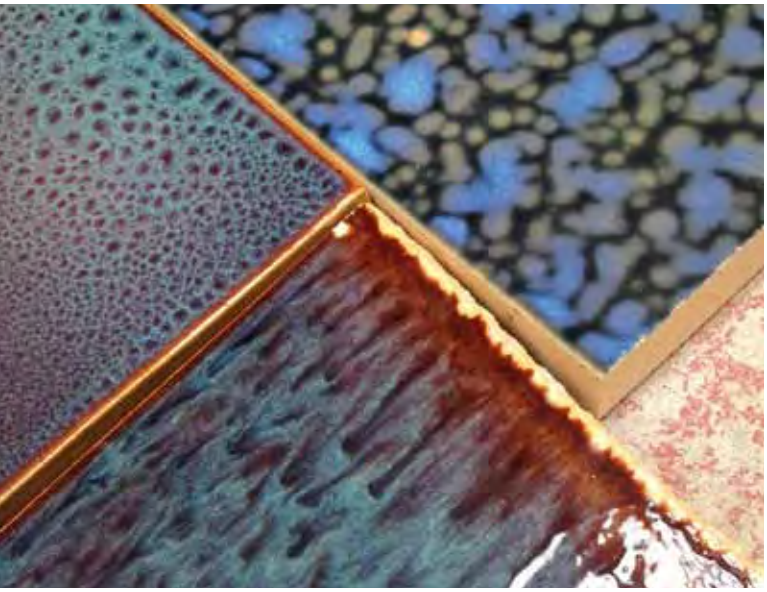
- Before the cracks are repaired, the cause should be thoroughly investigated.

- Small cracks can be repaired on site using waterproof caulking.

- If the damage is extensive the element will need to be replaced which is a highly skilled job.

- Elements should be replaced with new pieces of like material that are hand crafted to the original pattern. In these cases completely new pieces will be made from scratch by an artisan and new moulds created. Only specialist companies can undertake this, and there are a few in the UK.

- Replacement pieces should be anchored using stainless steel or non-ferrous fixings.



Glaze crazing

- Crazing in the glaze on faience can happen relatively frequently and is not always a serious issue.

- It only becomes a problem if the crazing results in deeper cracks or spalling.

- If deeper cracks appear and/or the surface begins to flake away then it will need to be re-glazed to prevent water ingress.

- Re-glazing can be done on-site using an acrylic based re-glazing product, although this will not be as durable as the original glaze.

Water damage/surface spalling

- If water penetrates the unit from the unglazed back or through joints, the glaze will prevent it evaporating. Water will build up and the increasing pressure behind the glaze will eventually lead surface spalling.

- Spalling, or flaking of surface material is also caused by water freezing; it expands and fragments break off.

- When large areas become damaged or large pieces break away it will be necessary to replace the damaged piece.

- If this problem is not addressed water will continue to penetrate the material and the damage will quickly become more extensive.

Salt crystallization

- Soluble salts are transported into the terracotta/faience via water penetration, the water evaporates and deposits the crystallized salts either on or beneath the surface.

- This can cause blistering, powdering and sloughing of the surface.

Rust staining

- If the fixings behind the terracotta or faience are ferrous and they become wet they will be subject to rusting.

- This form of decay will only become apparent when rust stains begin to leak through the cladding material.

- Rusting can indicate that the fixings are no longer secure or safe, and should be investigated immediately as a matter of public safety.

- Damaged fixings will need to be replaced.

Poor joints

- Historically mortar in joints was often stronger than the units it joined and unable to accommodate thermal movement or moisture. This results in hairline cracks that allow water in but not to evaporate out. This leads to problems when it freezes; the dense mortar tolerates the expansion pressure, but the clay is subjected to spalling.

- Rainwater runoff from terracotta and faience is considerable so the joints have to be sound.

Stress/structural issues

- Historically where terracotta was sued as a semi-structural curtain wall fixed to a concrete or steel frame the two may have experience different thermal movement.

- This can lead to flaking, cracking and crumbling of the surface.

- Cracks running through multiple units can indicate tension/structural related issues and should be addressed immediately.

Poor repairs

Bad repairs such as the use of inappropriate mortar and bonding agents, and abrasive cleaning will inevitably result in greater long term damage.

3. Cleaning

- Terracotta and faience is easy to clean, but has in the past been much abused in this respect.
- Moderate water and soap with a soft bristle brush on obstinate soiling should be sufficient.
- Where dirt is particularly heavy steam cleaning can be undertaken.
- Any type of abrasive cleaning or the use of acid and chemicals should be avoided as they will irreparably damage the fire skin or glaze.
- Once the fire skin or glaze has been compromised as such the piece will need to be replaced and cannot be repaired.

4. Repairs

Repointing

- Repointing will need to be undertaken on occasion.
- If the mortar begins to crack or crumble then the internal structure of the terracotta/faience will be open to water penetration.
- Repointing should only be done using appropriate mortar i.e., a lime based mortar with a fine sand aggregate.
- Waterproof caulking of joints should not be undertaken, nor should cement mortar be used for pointing terracotta/faience. Both of these are non-breathable and therefore unsuitable.

Replacement

- Terracotta and faience units that have been damaged through spalling and have therefore lost their structural integrity and water proof quality should be removed and replaced with like.
- This can only be under taken by specialists, such as Szerelmey in conjunction with the terracotta manufacturer.

"All work dealing with terracotta and faience should be undertaken by specialists such as Szerelmey. Szerelmey has extensive experience with these materials and works closely with specialist terracotta and faience suppliers."

~ Jon Wilson, Shaws of Darwen

STEEL WORK CORROSION

1. General repair methodology
2. Steelwork preparation
3. Cathodic protection

1. General repair methodology

- Cleaning – elevations are cleaned prior to work commencing in accordance with contract specification.
- Redundant fittings and fixings – all damaged and redundant fixings and fittings are removed with minimal possible disturbance to surfaces.
- Preparing drawings – marked up existing elevation drawings showing jointing layout, sizes, shapes and numbers to a scale of 1:20, prepared in consultation with design team and showing fixings and methods of support. These are submitted to the Contract Administrator for comment.
- Reveal steelwork – cracked masonry is opened up to reveal the steelwork. The opening is wide enough to allow the exposed edge of the steel to be cleaned and painted.
- Masonry to be reused – masonry units that are to be reused are carefully removed and stored. Each unit is clearly marked to indicate their original position. Old mortar, dirt and organic growth is cleaned off.
- Rebuilding – this is done using existing materials where possible, or replacement materials to match face and joint lines.
- Preparation for rebuilding – defective material is carefully removed and surfaces thoroughly cleaned in preparation for replacement materials.
- Corroded metal fixings – these are carefully removed along with associated rust debris and replaced with compatible stainless steel fixings.
- Sealing steel interface – the interface between the steel and masonry is pointed with mastic to prevent water sitting against the steel.
- Junctions with concrete/masonry – where exposed steelwork is partially embedded or encased in concrete, apply two coats of an approved bituminous coating locally to the steel/concrete junction.

2. Steelwork preparation

- All laminate corrosion is removed. Where laminate corrosion extends into the masonry the masonry is also removed to allow the cleaning of the corrosion.

- The opening up and paint treatment will extend until there is only light rusting which can be removed with the finger, except where excluded for access of phasing reasons.

- Laminated rust is chipped or scraped off prior to grit blasting.

- The size and shape of the grit used is determined by the extent of the laminate corrosion.

- The paint system is applied to all corners, particularly at the edges of flanges.

Applying coatings

- Multiple coats of the same material are each of a different tint to ensure that each coat provides complete coverage.

- Coatings are applied to clean, dust free, dry surfaces after any previous coats have cured adequately.

- Coats are applied evenly with surfaces kept free of dust/dirt during coating and drying.

General surface preparation

- All surfaces are cleaned and dried before painting with burrs and sharp edges removed from steelwork.

- Steel surfaces should be blasted free from all mill scale, rust and all other contaminates to at least “2nd Quality” B.S. 4232.

- After blasting the surface amplitude should not exceed 100 microns unless stated otherwise.

- All laminations or other surface defects exposed on the steel surface after blasting are removed by mechanical means.

- Prepared steel surfaces are vacuum cleaned and all dust residues and detritus removed before priming.

General paint application

- Coatings are only applied to clean, dried and prepared surfaces.
- Coatings are not applied during fog, mist, rain or snow.
- The paint manufacturer's specified limitations on temperature and humidity are followed and where there are no limitations the following should be followed.
- Coatings should not be applied when the surfaces are less than 3°C above dew point, when the relative humidity of air is greater than 86%, when the air is below 6°C or when there is likelihood of a change in weather conditions within two hours after application which would result in air temperatures below those specified.

Brick masonry, concrete, stone, terracotta and faience can all be subject to cracking and displacement caused by the corrosion of underlying metal structures. As these metal frameworks succumb to rust their volume increases putting pressure on the cladding materials eventually leading to cracking and/or displacement. This cracking/displacement in turn allows water to ingress which compounds the corrosion process.

Each individual case merits specific consideration and is carefully evaluated by a specialist team to assess and evaluate before proceeding with the appropriate measure of treatment.

Szerelmey is licensed to install systems designed by specialist engineers in this field.

Below:
Cracking due to steelwork corrosion

3. Introduction to cathodic protection

Elements of cathodic protection

There are two types of Cathodic Protection (CP): Sacrificial or Galvanic CP and Impressed Current Cathodic Protection (ICCP):

1. Sacrificial CP is the older of the two methods and involves connecting a more corrosive metal such as zinc or magnesium to the steel. The attached metal corrodes in preference to the steel and generates a protective current that prevents corrosion of the steel in contact with the sacrificial anode material. This method is most commonly used in wet/aqueous environments.

2. ICCP involves placing an inert non corrosive anode material in the structure or soil with the protective current forced onto the steel surface through a power supply.

Below:
Stone removed to examine steelwork

Impressed current cathodic protection

The benefits of this ICCP system are:

1. The current can be pushed through concrete, stone, mortar etc., by the higher drive voltages available from power supply.

2. The inert catalytic anodes are not consumed and are therefore more durable.

The limitations of ICCP are:

1. ICCP cannot be applied to buildings without an appropriate electrolyte such as damp mortar in contact with the steel frame.

2. Therefore it is not viable for protecting steelwork in buildings with large cavities or insulation between the steelwork and external masonry cladding.

3. Some large voids or gaps can be modified through grouting to make ICCP viable.

Electrochemical reactions are prevented at the steel surface through blocking ferrous ion formation on the steel surface and the removal of reactive negatively charged ions.

Great care must be taken in the design process to prevent damage to the structure, which is why this is a highly specialised system.

Factors for consideration before using ICCP for steel framed buildings

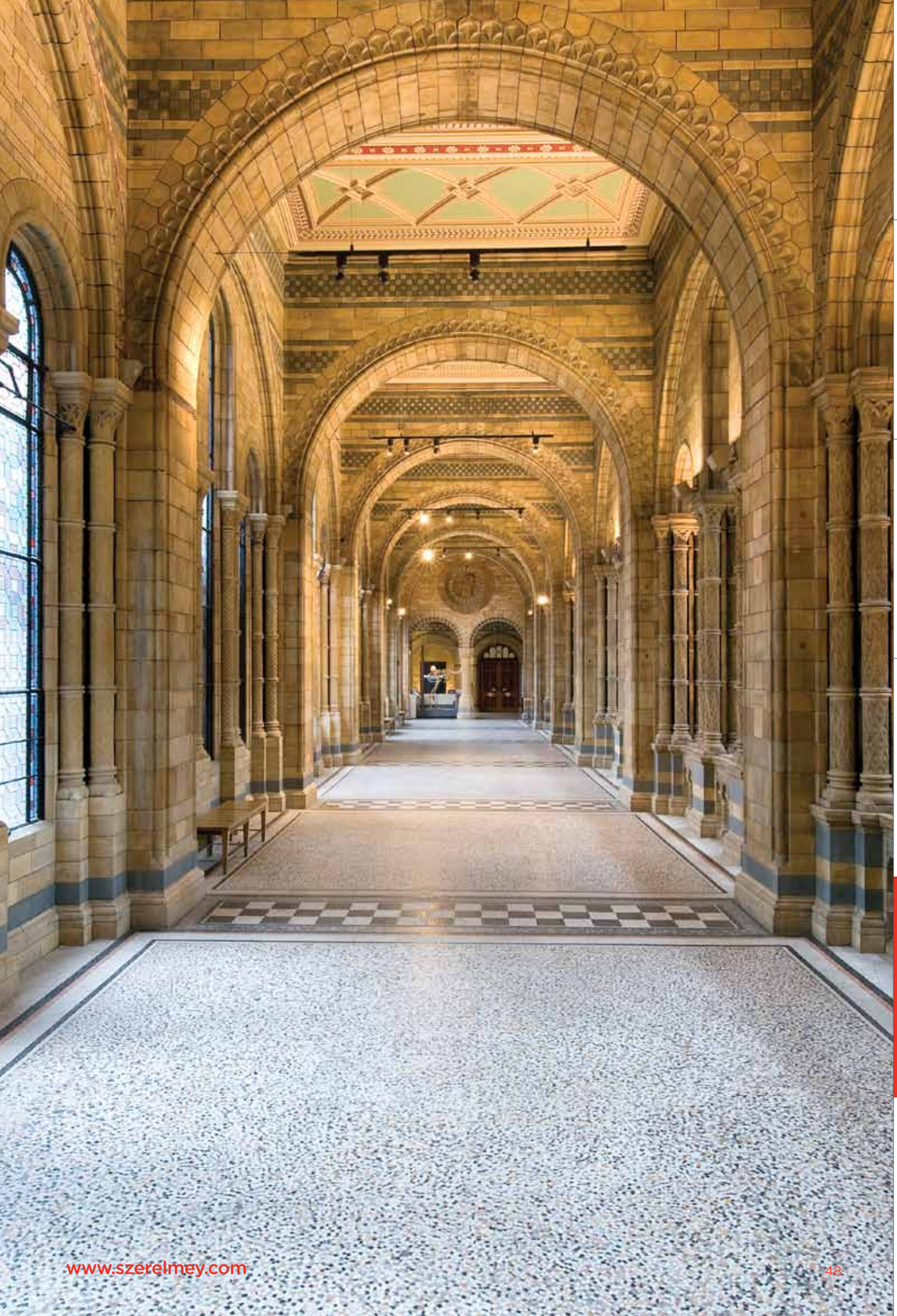
Cathodic Protection specialist engineers will carefully evaluate a building before designing an ICCP system for it; Szerelmey are licensed to install these systems. Some of the factors are as follows:

- Continuity of the steel frame, fixings and other metallic items.
- Contact between steel and mortar.
- The current distribution controlled by the mortar and stone resistivity.
- Location of anodes, joint details and steel work detailing.
- Aesthetic constraints.

Longevity of ICCP systems

Longevity of the systems will depend on the performance of the individual components. All component parts should be able to be maintained and replaced with the exception of the anodes and monitoring electrodes embedded in the structure.

An ICCP system should provide in excess of 20 years minimum operational life and with maintenance of component parts the system should provide a life in excess of 50 years.



Contact us

Project enquiries
The Szerelmey business development team are the first point of call for all new project enquiries. Our business development manager is available to attend meetings and consult regarding all of our services.

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"Quality in a service or product is not what you put into it. It is what the client or customer gets out of it."

~ Peter Drucker


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