

Short Guide

MAINTENANCE AND REPAIR TECHNIQUES FOR TRADITIONAL CAST IRON



HISTORIC SCOTLAND
ALBA AOSMHOR

NATIONAL CONSERVATION CENTRE
IONAD GLÉIDHTeachais Náiseanta



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1. Introduction

Through the course of the late 1800's and early 1900's, cast iron became an increasingly popular and fashionable building material. Decorative cast iron building embellishments were more affordable thanks to the ability to mass produce castings and became a typical feature of 19th century Scottish architecture. Much of this cast ironwork still survives. The retention of such traditional features can enhance the character and appearance of traditional buildings and neighbourhoods, and with good care cast ironwork will continue to enhance the built environment.

This Short Guide focuses on exterior decorative architectural cast ironwork, offering practical guidance on maintenance and repair issues. For further guidance on structural ironwork, please refer to *Historic Scotland's Guide for Practitioners 5 - Scottish Iron Structures*.

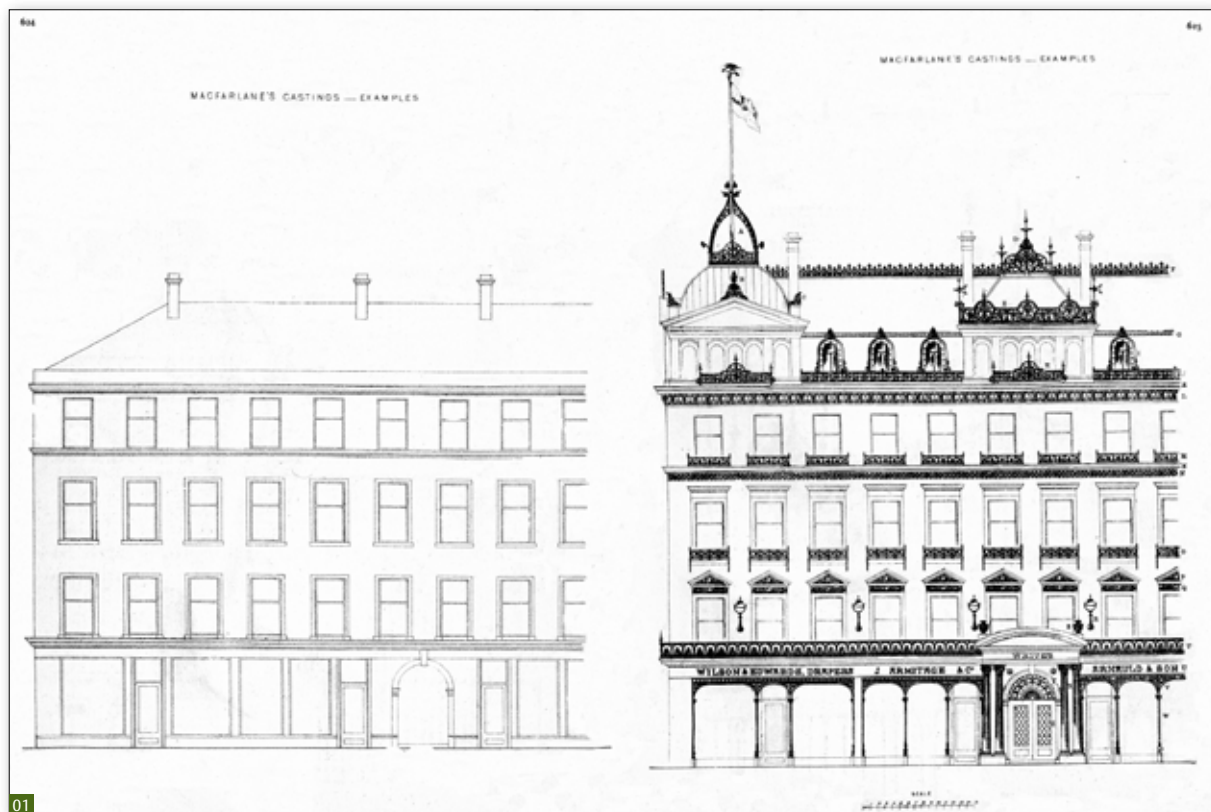


Fig 1 The building on the right is the same as the building on the left but with the addition of cast iron embellishments. Detail from Walter Macfarlane & Co's 19th century 6th Edition catalogue.



A brief history

The availability of mass produced cast iron from the late 18th century revolutionised the way in which buildings were designed, engineered, constructed and embellished. The strength of cast iron columns limited the need for solid walls, contributed to fire proofing and allowed larger and more numerous window openings, while the versatility of the material enabled the mass production of lavish structures and building ornamentation (Figs 1 and 2). These qualities, combined with cast iron's portability and growing reputation as a sanitary material, made it a popular choice for street furniture such as public benches, drinking fountains and public conveniences (Figs 3 and 4).

19th century iron manufacturers produced extensive catalogues of designs which ranged from the plain and refined to the more elaborate, fanciful and often bizarre. Manufacturers were quick to pick up on the potential of the material and were soon producing goods of all sizes, from flower pots and saucepans, railings, and ornamental fountains to bandstands, structural and engineering components and agricultural implements (Fig 5).

The Carron Company, established in Falkirk in 1759, was one of the world's first large-scale industrial operations. This paved the way for the development of a massive iron founding industry in Scotland. The discovery of indigenous iron ore, combined with the development of technology and increasing demand led to a rapid expansion of the industry across Scotland from 1828 until the country eventually became one of the most important centres of cast ironwork production of the 19th century.



Fig 2 Large cast iron windows let in more daylight, important before the availability of electric lighting. Image from Walter Macfarlane & Co's Book of Examples. Courtesy of The Scottish Ironwork Foundation.

Fig 3 Many 19th century castings still perform their original function.

1. Introduction

The industry reached its peak in the 1890's. By this time, there were hundreds of Scottish foundries across the country, focussed predominantly in the Central Belt. Many were shipping their products around the globe to countries including South Africa, South America, Malaysia, India and Australia. Scottish foundries were renowned for the quality of their castings, and the many thousands of 19th century castings that survive to this day across the world are testament to the skill of their Scottish manufacturers.

By the early decades of the 20th century, tastes were beginning to change. Many Scottish foundries diversified their output to include increasingly fashionable cast iron windows, breast panels and fire escapes to stay in step with the market. Other firms prospered by producing telephone boxes, post boxes and other infrastructure components for the General Post Office (GPO). By the end of the Second World War however, the demand for decorative cast ironwork had all but disappeared. Speed and simplicity of construction was the most desirable commodity in the decades following the war. The design of cast ironwork became increasingly utilitarian and less appealing.

By the 1960's, Scottish foundries were struggling and the majority of traditional foundries had closed by the 1970's. Today, a handful of foundries continue to produce castings in the traditional way, using the green sand techniques described in the following chapter.

Fig 4 Cast iron bus shelter, Rothesay, Isle of Bute dating to some time around the 1950s. Manufactured by the Lion Foundry, Kirkintilloch

Fig 5 Cast iron revolutionised the design and construction of buildings. Ca'D'oro, Glasgow.



2. Material characteristics

Traditionally, decorative architectural castings were made using grey cast iron. Grey cast iron is a ferrous metal derived from iron ore. It is crystalline in structure which gives it excellent strength in compression, though it is weaker in tension. Cast iron typically has a carbon content of around 2 – 4%. Its crystalline structure and high carbon content make it relatively brittle in nature.

How castings are made

Cast iron is made by pouring molten iron into a sand mould (Figs 10 to 20). It cannot be shaped by hammering.

Traditionally, the mould was made using a mould box (composed of two halves) and “green” sand (round grains of sand encased in clay which helps the material cling together and hold its shape). No chemicals were added to make the sand set or harden.

A pattern, often carved in timber, was used to leave an impression in the sand. The pattern was then removed from the sand and the two halves of the mould closed together leaving a void in the shape of the desired casting in the interior. Molten iron was then poured into this void.

Patterns could be reused again and again, and it was this fact that led to the ability to mass produce ironwork. Wrought ironwork was more time consuming and labour intensive to make as it required each individual piece to be shaped mechanically.

Identifying cast iron

The type of ferrous metal that an object is made from, i.e. cast iron, wrought iron or steel, will influence the repair methodology. It is therefore important to be able to distinguish one metal type from another.

Cast ironwork is usually composed of identical repeating sections. Typically, cast ironwork was assembled as a kit of parts, in much the same way as flat-pack furniture is assembled today. Component parts were not welded together, but instead held together by means of bolts and interlocking arrangements such as lugs (small flat projections into which other flat sections could be slotted) (Figs 6 and 7). It can often have a two dimensional appearance reflecting the method of manufacture, although the best examples of the craft can be highly intricate.



Fig 6 Interlocking system used to fit railing panels together. Many different systems were used.

Fig 7 Mating flanges that have been bolted together.

2. Material characteristics

Corrosion

Cast iron is a processed form of iron ore which is the naturally occurring form of iron, and relatively stable. The processed iron seeks to return to its natural state through corrosion. There are two main types of corrosion that occur to cast iron:

Chemical corrosion occurs when iron oxidises, i.e. the metal loses electrons to a non-metal substance such as oxygen. When cast iron is exposed to water and air for a prolonged period of time, electrons in the iron combine with oxygen in the air in a process known as oxidation: the water lying on the metal surface acts as an electrolyte - a substance that enables the release of electrons from the iron. These released electrons are then free to combine with oxygen in the air – this is chemical corrosion (Figs 8 and 9).

Ironwork is usually painted or coated in an attempt to prevent moisture and air coming into contact with the metal surface and driving this chemical corrosion process of oxidation .

Galvanic corrosion (also known as bi-metallic or sacrificial corrosion) occurs when two dissimilar metals are placed in direct contact with one another in the presence of water – this is a form of electrochemical corrosion. In these circumstances, one metal will corrode sacrificially to the other (and will corrode more quickly). Water (rainwater, condensation or moisture in soil) acts as an electrolyte, establishing an electrical current between the two metals (forming what is effectively a battery). The current flows from the anodic metal (the more reactive/ less “noble” metal) to the cathodic metal (less reactive / more “noble” metal), slowly removing material from the anodic metal. For example, zinc will corrode more quickly if placed outdoors in direct contact with steel (and the steel will corrode more slowly).

This level of reactivity of metals is laid out in the Galvanic Series:

Metal	Reactivity
Magnesium Zinc Aluminium 1100 Steel Iron Cast Iron Lead	Less noble (More likely to act as anode and be attacked)
Tin Brass Copper Bronze Copper-Nickel Alloys Stainless Type 316 (Passive) Silver Gold Platinum	More noble (More likely to act as cathode, and less likely to be attacked)

A more complete galvanic series table can be found in publications such as *Metals and Corrosion: A Handbook for the Conservation Professional*, Lyndsie Selwyn, Canadian Conservation Institute (2004) or *Corrosion: Understanding the Basics*, Joseph R. Davis (editor), ASM International (2000).

The potential for galvanic corrosion should always be considered when repairing cast iron; introducing dissimilar metals can have serious consequences for the longevity and effectiveness of repairs. Similarly, this is a consideration when selecting fixings; relatively stable metals such as bronze or stainless steel should be used.



Fig 8 Cracked and flaking paint will trap water and accelerate corrosion.

Fig 9 Chemical corrosion occurring where water has become trapped between each component.

The casting process



10

Fig 10 A pattern is placed in one half of a moulding box.



11

Fig 11 Sand is poured on top and 'rammed' into place.



12

Fig 12 The first half of the moulding box is flipped over so that the underside is now on top.



13

Fig 13 The timber backing board is removed to reveal the underside of the pattern.



14

Fig 14 The second half of the moulding box is placed on top and the process of 'ramming' sand is repeated.



15

Fig 15 The two halves of the moulding box are separated.



16

Fig 16 The pattern is removed to leave a void in the sand.



17

Fig 17 Channels are cut into the sand to allow molten iron to reach every part of the mould.



18

Fig 18 The two halves of the moulding box are put back together again and molten iron is poured into the mould.



19

Fig 19 Once the iron has cooled and solidified, the moulding box is opened to remove the casting.



20

Fig 20 The 'runners' and 'gates' have to be removed in order to finish the casting.

3. Researching ironwork

Identifying significance and character

When commissioning or specifying repairs, it is important to understand the historical significance, character and aesthetics of the ironwork so that any interventions can be planned in the most sympathetic way.

Historical significance - How old is the ironwork? Is it contemporary to the building with which it is associated? Is the cast iron typical of the locality or is it unusual? What firm made it and is it a rare example? Is it associated with a significant person, event or place?

If the ironwork is part of, or associated with, a listed building, list descriptions - found on the Historic Scotland website under "Listed Buildings" - may provide useful information. If the ironwork lies within a Conservation Area, a Conservation Area Appraisal may be available which would provide more general information about the character and significance of cast iron features in the area (available from the local authority and often published on their website).

Character and aesthetics - Is there anything special about the design? How does the ironwork fit together? What do the joints look like? What type of fixings (screws, dowels, pins etc) were used? Collectively, all of these small details make up the character of traditional cast ironwork.

Physical evidence

Railing stubs: A large amount of ironwork, particularly railings, was removed during the Second World War and many building owners are keen to replace them. Much can be learned from examining the remains of ironwork, particularly railings. Surviving stubs will indicate the spacing of bars, the location and spacing of newel posts (thicker uprights which added stability) and other valuable information (see below for more information). While much ironwork was removed during the Second World War, samples of railings were often left as a point of reference for the future. Such material may survive in less visible areas such as boundaries between gardens or hidden in hedges. The local area should be explored to see if there was a particular style or pattern that was popular in the locality.

Surviving ironwork: Castings often had the maker's name, pattern number and size as well as design registration mark cast into them. Registration marks indicated the day, month and year that a design was registered (not manufactured). Further guidance on interpreting diamond registration marks can be found on The National Archives website at www.nationalarchives.gov.uk.

Archive / other sources of information

Local archives may hold photographs of the ironwork, while local newspapers are also a good source of information, particularly for larger ironwork structures such as bandstands and fountains which were often celebrated with official opening ceremonies.

Placing an article in the local newspaper can be a good means of sourcing additional information from members of the public.

Historic Scotland's technical conservation online Knowledge Base contains a range of 19th century foundry catalogues and other technical publications that can be viewed for free: www.historic-scotland.gov.uk/conservation.

Colour analysis

Taking paint samples for analysis can be useful, and is particularly recommended if all of the existing paint is to be removed, or if there is a desire to reinstate an original or earlier colour scheme. A professional may be able to determine earlier colour schemes by examining the sample under a microscope (Fig 21).

Earlier colour schemes can also often be identified by cutting a diagonal slice through the paint layers. Bear in mind that primers, build coats and top coats were usually deliberately selected in different colours to aid the painting process.

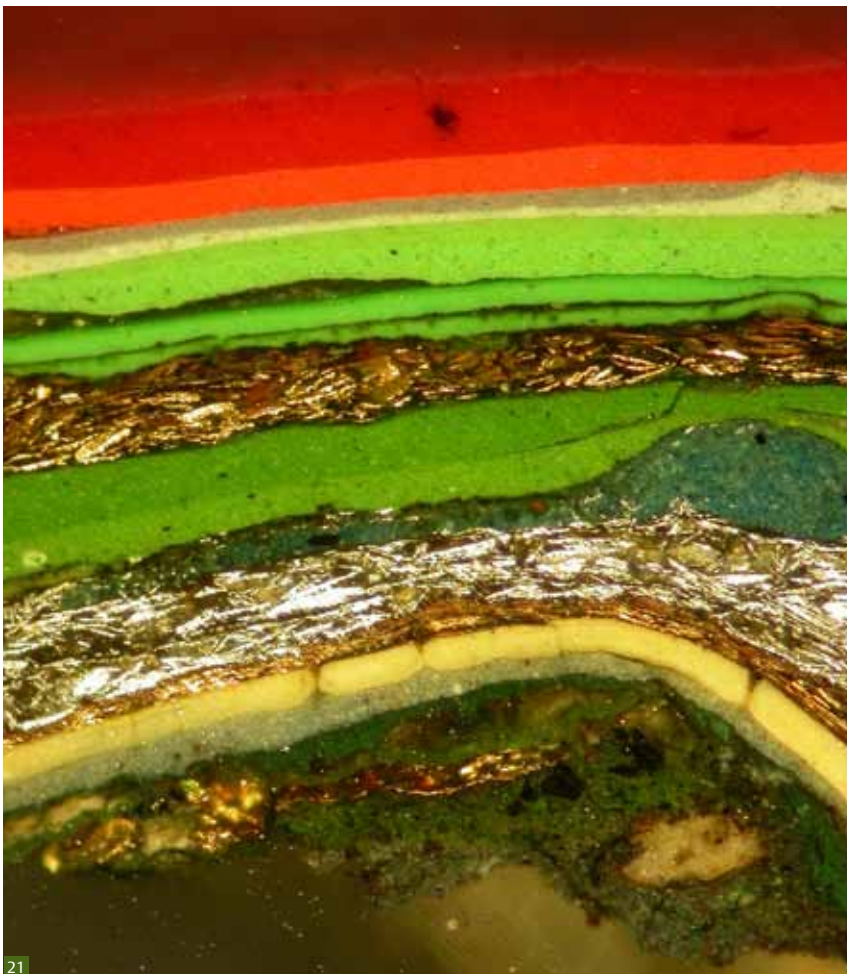


Fig 21 Analysing paint samples under a microscope can reveal earlier paint schemes. Layers of earlier gilding can be seen in this example.

4. Professionals, consultants and contractors

Finding the right contractor is one of the most important aspects of any repair project. Always ask to see examples of a contractor's previous work before hiring them. The Conservation Officer at your Local Authority, your local Heritage Trust or Building Preservation Trust or the online Conservation Register may be able to advise on contractors working in the local area. See also the list of contacts at the back of this publication.

The contractor should have previous experience of working with traditional cast ironwork and should have a sound knowledge of basic conservation principles. They should be able to demonstrate that they have the appropriate skills to carry out repairs sensitively.

Before choosing a contractor

Look carefully at examples of their work in person, noting:

- The quality of joints, fixings and surface finish
- Welding: welded joints should be neat and free of "blobby" weld spatter. Welding should be a last resort for cast iron.
- Masonry sockets: where ironwork sits into stone, the hole should be filled with lead that is flush or a little raised above the level of the stone. There should be no cavities or water traps.
- Paint: should be finished to a high standard (paint condition will also depend on how recently it was applied and its location (high traffic areas, for example, will see damage occur to paintwork more quickly)

If ironwork is to be removed to the workshop, the contractor should have premises that are suitable for storing the ironwork without risk of damage and have a good environment for painting (Fig 22).

The contractor you choose will also depend on the scale of the project. However, no matter how big or small the project, the above guidelines apply.



Fig 22 This workshop is not large enough to store a dismantled iron structure of this size without serious risk of damage. The iron components have also not been stacked securely. If ironwork is to be removed to a workshop, ensure that the contractor has suitable premises to store the ironwork and carry out works.

The role of the Contractor

Foundry: A foundry makes castings. Most foundries generally do not install castings or carry out repair work though many can recommend local blacksmiths or other practitioners who specialise in working with historic metalwork, who can fit / install new castings.

Look for a foundry that specialises in traditional decorative cast ironwork. They should make crisp, clean castings with good sharp details – ask to see examples. They may have a pattern which matches your design.

If you pay for a new pattern to be made, some foundries are happy to come to an agreement on its subsequent use or perhaps sharing the cost of manufacture if they can use it thereafter.

Blacksmith: Generally work with other ferrous metals such as wrought iron or steel – materials that are shaped using a hammer. They also often carry out repair work to cast ironwork, buying in castings from a foundry which they then fit.

The skill sets required for wrought and cast iron are similar but different – make sure you are content with their level of experience and skills working with castings before contracting a blacksmith.

Specialist Consultant: For larger projects, the services of a consultant specialising in traditional ironwork or conservation engineering (in the case of bridges or buildings) is advised, certainly for the initial stages of a project. A consultant can carry out an initial inspection, report on the condition of the ironwork and areas of concern. They can also help draft the initial specification for tenders.

Conservation Professional: Where ironwork forms only one part of a larger-scale refurbishment project, it is likely that a conservation professional or building contractor will be leading the project. Depending on the scale and complexity of the ironwork, it may still be advisable to bring in a metals consultant at the initial stages to carry out a detailed inspection of the ironwork and to advise on specification.

The services of a conservation engineer are particularly important for large scale structures as they will have a good working understanding of the material. This is an advantage where the aim of the project is to retain as much original material as possible.

Specialist Contractors: Any medium to large-scale project should be carried out by an experienced conservation engineering firm or metals conservation firm. Repairs to iron structures require specialist expertise, skills and equipment. Firms that do not specialise in traditional metal structures or conservation engineering are unlikely to have the knowledge to conduct sensitive and informed repairs.

5. Recording

5. Recording

It is advisable to create an accurate survey drawing of ironwork before planning repairs. For small, non-complex domestic ironwork such as railings, a hand drawn diagram or marked up photograph may be sufficient (Fig 23). Photography is a cost effective but efficient tool.

A drawing or photograph can be used to:

- Identify location of damage, corrosion or missing parts
- Mark up areas where repairs or maintenance are planned
- Assist in tracking repairs
- Assist in the re-erection of ironwork if it has been moved off-site
- Resolve disputes

Larger, more complex ironwork will require a professional survey drawing that numbers each individual element. If the structure is to be dismantled, metal tags with corresponding numbers can be attached to the ironwork as it is dismantled (Figs 24 and 25). Numbered tags are an invaluable tool when it comes to tracking repair work and reinstating ironwork.



Fig 23 Producing a record drawing.

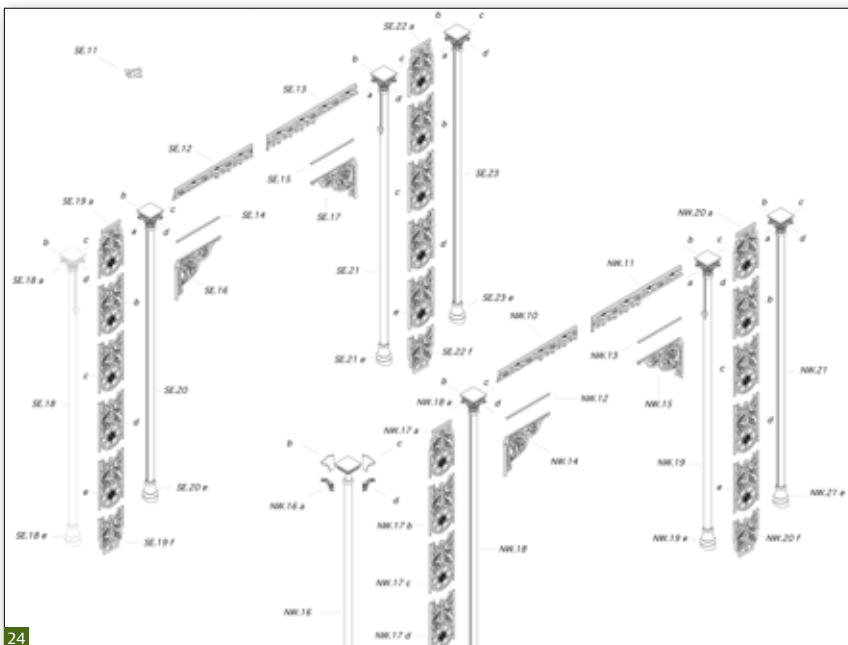


Fig 24 Metal tags can be numbered according to a record drawing and attached to the ironwork as it is dismantled.

Fig 25 Numbered metal tags attached to ironwork.

6. Planning repairs

Retention of original fabric should be the primary goal of a conservation project.

A repair methodology should only be prepared once the history, significance and character of the ironwork has been established. These three factors may influence the methodology. This section outlines the series of steps that should be followed at the start of a repair project.

Depending on the location, extent and nature of the programme of works that is planned, it is possible that planning consents may be required (for example, changes in paint colour, or the removal of ironwork for repair may require permission). Advice on the requirement for listed building consent, conservation area consent, building warrants, and other permissions / consents should be sought from the local planning authority.

Bear in mind that a key factor in the success and longevity of any repair project is the maintenance regime that follows the completion of the project. No repair or coating system will last forever, and neither will perform to optimum levels if not regularly checked and maintained.

General Maintenance

All cast ironwork, whether it is a large structure or a set of domestic railings, requires periodic maintenance and protection against corrosion. Paint and other coating systems are applied to ironwork to slow the corrosion process by preventing moisture and air coming into contact with the metal surface. Over time, such coatings degrade and eventually fail if not regularly maintained by cleaning and repainting (Fig 26).

Ironwork should be inspected annually. Joints and fixings (screws, pins, bolts, washers, nuts etc) are more vulnerable to deterioration than other parts because they tend to form natural water traps (trapped water accelerates the rate of deterioration). These should be inspected carefully for signs of corrosion. If the ironwork is in reasonably good condition it may just require light cleaning and chipped areas of paint to be touched up (see later in this guide for details on cleaning and painting).

Ironwork will usually need to be repainted every 5 years or so.

Repair projects should include a plan for future, on-going annual inspections and maintenance.

Annual inspections should check for:

- Damage to paint
- Corrosion to parts fixed into masonry
- Corrosion to underside surfaces
- Corrosion to joints, fixings and other water traps
- Signs of movement or instability in either the ironwork or supporting foundations and masonry



Fig 26 Annual inspections and regular painting will reduce the need for more expensive repairs in the future.

Condition Assessment

The Condition Assessment acts as the main guide for planning repairs by identifying areas that are missing, corroded or otherwise damaged. It should:

- Include both written and illustrated information (photographs, drawings)
- Include an accurate diagram of the ironwork
- Identify precisely where each problem occurs
- Identify the severity and nature of each problem
- Identify causes for each problem

Strength testing

When it comes to planning repairs, particularly to load-bearing structures such as bridges, traditional cast ironwork can be challenging for some professionals. It is important to find an engineer who is comfortable working with traditional iron structures and is inclined to find innovative solutions rather than seeking to replace original fabric.

Estimating costs

It is good practice to secure a fixed cost for dismantling, re-erection and coating. Ask for sample costs for repairs but allow a provisional sum to be allocated once full inspection is possible. This is fairer for both you and the contractor, and will generally be more economical.

Method Statement

Once the problem areas have been identified, a detailed method statement should be drawn up. The statement will outline:

- Health and safety requirements
- Which problem areas will be treated and how - this should be specific
- Cleaning methods (which may differ from one component to another)
- What materials will be used for repairs
- How ironwork will be transported (and protected during transportation)

As with all specialist conservation work, it may be more cost effective to pay a conservation specialist to write a specification of works and method statement before the project goes to tender. This allows all tendering companies to price on the same basis and will produce more accurate quotes.

Further assessment

It is advisable to re-assess the method statement after ironwork has been cleaned as the removal of paint will often reveal problems that were previously hidden. If the ironwork is structural, it may be advisable for the specialist contractor to carry out dye penetration, ultrasonic or metal particle intrusion (MPI) testing to evaluate fractures (Fig 27).

Off-site versus in-situ repairs

A number of factors will influence whether ironwork is cleaned and repaired in-situ or off-site.

Repairing in-situ is best suited to ironwork that is not suffering from severe deterioration. By leaving ironwork in situ there is less risk of damaging adjacent masonry or fracturing castings through the dismantling process or during transport.

Disadvantages:

- Does not allow inner faces of joints or hidden sections of components to be cleaned thoroughly.
- Weather-dependent: it is difficult to keep ironwork dry if painting in humid or damp conditions
- May require covered scaffolding to protect ironwork from weather
- Adjacent materials can be stained or damaged by cleaning and repair works
- Specialist may require accommodation and travel costs

Advantages:

- Less risk to adjacent masonry as ironwork does not need to be removed from sockets
- Less risk of fracture to castings
- No dismantling and transport costs
- No additional time required for dismantling and re-erecting

Repairing off-site is most appropriate when severe corrosion and paint deterioration has occurred, or there are areas of structural failure.

Disadvantages:

- Can cause damage to surrounding masonry if ironwork needs to be cut out of sockets
- Risk of fracture to castings during dismantling process
- Fresh paintwork can be damaged during transport to site and re-erection process. Touch ups are usually required after re-erection.
- More time required to dismantle and re-erect the ironwork
- Additional costs for dismantling and re-erecting

Advantages:

- Allows more thorough cleaning and painting by enabling access to hidden surfaces such as joints and mating surfaces
- Allows paint to be applied in a controlled environment
- Complex repairs are easier to carry out



Fig 27 Dye penetration testing can reveal cracks that are not easily visible to the naked eye.

7. Dismantling

Health and safety measures should be put in place to ensure the safety of members of the public during the dismantling phase.

As iron components are removed they should be numbered by attaching a metal tag using wire.

Cast iron structures were generally held together using interlocking sections, lugs, mating flanges, bolts and pins. They are therefore usually possible to dismantle (Fig 28).

Every effort should be made to remove fixings by hand. Great care should be taken if applying heat to release seized fixings as this can fracture thin section castings. It may occasionally be possible to re-use fixings, but they are often too badly corroded to reuse. It may be necessary to cut and drill out a seized fixing.

Castings should be well protected during transportation to the workshop to prevent damage.



Fig 28 Dismantling in progress. Each element should be tagged according to survey drawings.

8. Cleaning

Choosing the right cleaning method

The cleaning method used will depend on the degree of corrosion and paint deterioration and required surface finish. Getting the balance right between removing corrosion material thoroughly enough to form a stable surface for fresh paint, whilst still preserving the surface integrity of the ironwork without damaging it is the primary consideration. The aim is to clean the ironwork with the least aggressive method possible, but to clean it enough that most of the corrosion material has been removed, leaving a surface that paint will adhere well to.

The choice of cleaning method should depend on:

- Degree of corrosion
- Location and accessibility of ironwork
- Significance of existing coatings
- Age and significance of the ironwork
- Thickness and strength of the ironwork
- Paint manufacturer guidelines

Cleaning methods (from least to most aggressive)

- By hand – bronze wire brush, chisel & hammer, emery paper
- Power tools (not recommended)
- Flame cleaning (use with caution, experienced professional required)
- Chemical cleaning: topical preparations / dipping in chemical bath
- Dry ice
- High pressure water blasting
- Blast cleaning (wet and dry, various blast mediums available)

Cleaning by hand

If ironwork is generally in good condition it may be sufficient to clean ironwork by hand, as more aggressive methods, such as power tools, can cause damage by scoring the surface of the iron.

Begin with water and a cloth to remove general dirt and grime or moss growth. Light areas of corrosion can be removed using emery paper, taking care to remove any residue before applying paint.

Areas of chipped paint should be sanded down using emery paper, feathering the edges into good surrounding paint in preparation for paint application.

Vary cleaning techniques on different areas of the ironwork according to need. It may be sufficient to remove upper layers of paint until a stable layer is reached, then apply fresh paint. Avoid painting over corroded areas as corrosion will continue to develop under paint and will compromise the efficacy of fresh paint. The weather is of critical importance in cleaning and coating iron - low temperature and high moisture content in the atmosphere will often lead to failure.

8. Cleaning

A bronze wire brush, chisel and hammer can be used to move more aggressive areas of corrosion. Finish off by sanding down all surfaces using emery paper, taking care to remove any dust left on the surface. All dust, dirt and grease should be removed before applying fresh coatings, as per manufacturer's advice.

Where corrosion and paint deterioration are both extensive and severe, it will be necessary to clean ironwork more aggressively using mechanical methods.

Health & safety considerations

Old layers of paint are likely to contain lead, which is a hazardous substance if ingested. To reduce the risk of lead ingestion, paint should be dampened with water sprays before using emery paper or hammer and chisel. Appropriate personal protection equipment should also be worn to prevent ingestion of lead.

Additionally, wind or water-borne waste resulting from cleaning can be harmful to the environment and should be disposed of responsibly.

Power tools

Power tools can be used if necessary, but only by experienced technicians.

Flame cleaning

Flame cleaning involves heating the surface of the iron with a propane or oxyacetylene torch to loosen corrosion and soften paint (Fig 29). A bronze wire brush is then used to brush away corrosion and paint.

This method is relatively gentle but should be used with caution as heating thin sections of cast iron can lead to fracturing. A professional experienced in working with historic cast ironwork should carry out such work.



Fig 29 Flame cleaning ironwork using an oxyacetylene torch.

Chemical cleaning

Chemical baths or chemicals applied to the surface of ironwork can be used to remove corrosion material and old paint without the risk of causing mechanical damage to the surface of the metal.

However, great care should be taken to wash or steam clean ironwork thoroughly after treatment to prevent chemicals from lodging in the microstructure of the iron and causing longer term damage.

Hydro-blasting / high pressure water blasting

Water under high pressure (pressures greater than 30,000 psi) is blasted onto the surface of the ironwork to remove paint and corrosion. The advantage of this method is that it is relatively effective at removing surface salts, and there are no blast particles to become lodged in the surface of the ironwork. However, the moisture can sometimes cause rapid gingering (light, flash corrosion that occurs in damp or humid conditions) to the ironwork surface.

Blast cleaning

Blast cleaning is a common method of cleaning cast ironwork and is useful if a bare metal finish is required for a new coating system. However, this is one of the most aggressive methods of cleaning and should be used with caution; fragile ironwork should not be blast cleaned.

Blast cleaning involves firing tiny particles onto the surface of the ironwork under high pressure to remove corrosion and paint (Fig 30). There are a variety of blast mediums that can be used. Chilled iron and copper slag are not recommended. Sand blasting is no longer permitted by law due to the health risk of silicosis. Inert mediums, such as aluminium oxide, garnet and glass beads work well but are quite sharp and therefore may alter the surface texture of the ironwork. Crushed walnut and plastic beads, although expensive, are among the most effective blast mediums for use on traditional cast iron as they are gentler than many other mediums.

A good contractor will experiment with different mediums at different pressures and angles in order to identify the most effective, least damaging combination.

Wet blasting (using water and a blast medium) is an effective means of removing soluble salts from the surface of ironwork but similar care should be taken to ensure the correct pressure and blast medium is used to avoid damage. As with hydro-blasting, the moisture can cause gingering to the surface.



Fig 30 Blast cleaning.

9. Repair techniques

When planning repairs, there are a few basic questions to ask before deciding on the repair techniques to be used:

- Will doing nothing lead to further deterioration? If the answer is 'no', should the ironwork be repaired?
- Is there damage or corrosion that compromises the ironwork structurally? If the answer is 'yes', repair is more critical.
- Will repairing the ironwork create the potential for future problems? (such as galvanic corrosion). If this is the case, can a different technique or a 'do minimum' approach be used instead?
- Will replacing missing decorative elements require drilling into or damaging original castings?
- Does the proposed repair technique respect the original detailing?

As with cleaning, the minimal level of intervention necessary is preferred – balanced against the need to prevent further corrosion or remedy structural instability. There are a wide variety of repair methods available, the most common of which are outlined below.

Welding

Cast ironwork is often composed of a number of individual castings joined together. Traditionally, this was not done by welding. Castings were most commonly joined by interlocking via lugs or bolts. These jointing techniques are part of the character of cast ironwork and it is important to preserve and replicate these during repair works. Generally, welding is not a good solution for fine or delicate cast iron, although it can in some circumstances work well - usually in heavier castings. Welding is a difficult and specialised repair technique that should only be carried out by a professional with experience of working with historic cast ironwork (Fig 31).

If a weld repair is unavoidable: preheat the castings slowly and uniformly. This helps to reduce the risk of thermal 'shock' on cooling. The join should be finished by a specialist contractor so that it is as smooth and unobtrusive as possible.



Fig 31 Welding ironwork in-situ.

Brazing

Where a traditional repair is not practical, or would require the loss of too much original material, brazing may produce a more successful repair. Brazing uses a bronze alloy filler rod and may form a more successful joint than standard welding.

Preheat the castings slowly and uniformly. This helps to reduce the risk of thermal 'shock' on cooling. The join should be finished by a specialist contractor so that it is as smooth and unobtrusive as possible. This is a specialised repair technique that should only be carried out by a professional with experience of working with historic cast ironwork.



Fig 32 Pinning can be an effective repair where replacement castings need to be joined to original castings.

Pinning

Pinning is a useful method for repairing fractures or attaching two castings to each other. This method results in a barely-visible joint, with none of the raised material left by welding.

Pinning is achieved by drilling a hole into each of the castings that are to be joined together. A stainless steel threaded pin, bedded in epoxy, is used to join the two halves together (Fig 32).

Once the two sections have been joined by the pin, no brazing or welding is required to secure or seal the joint. The joint should be thoroughly painted and kept well maintained.

This type of repair is ideal for decorative castings and is typically used for repairs such as attaching finials to bars, reattaching missing sections of cast panels or the broken arms of finials. If the cast iron is too thin in section it is not possible to carry out this type of repair, brazing is an alternative repair method in this instance (see above).

The disadvantage of this method is that it requires holes to be drilled, but this is likely to be outweighed by the benefit of being able to retain the original casting.

9. Repair techniques

Plating

Plating is useful for joining together larger sections of cast iron that have fractured, enabling the original casting to be retained. Plate repairs can also be a useful method of structural reinforcement.

Plating is carried out by bolting a flat section of stainless steel to the fractured cast iron plate. The cast iron should be clean and painted (including the fractured surfaces). The steel plate should also be well painted and should also be isolated from the cast iron by an insulating material such as nylon or PTFE (Polytetrafluoroethylene) to separate the steel from the cast iron and prevent galvanic corrosion. Stainless steel bolts should be used to fix the plate in place.

Another version of this repair uses a steel tube rather than flat plate. This is particularly useful for fractured columns. The steel tube is inserted into the central hollow of the column and bolted in place. Again, it is important to isolate the steel tube from the cast iron using an insulating material.

Again, the disadvantage here is that drilling into original cast ironwork is necessary. However, as with pinning, this repair method enables the original, fractured casting to be retained.

Stitching

Stitching is another method of joining two fractured castings together.

The broken surfaces of the fracture should be well painted before joining together. A series of holes are drilled along the length of the fracture. Next, a line of holes is drilled at right angles to the fracture, on each side of the fracture. A special “key” is inserted into this line of holes to bridge the gap made by the fracture and is hammered into place. This is done at regularly spaced intervals along the length of the fracture.

The disadvantage of this method is that it requires a considerable number of small holes to be drilled into the cast iron; if not properly maintained and painted, water can seep into the fracture and / or holes and begin the process of corrosion.

Epoxy repairs

Epoxy is useful for re-profiling pitted sections of ironwork and preventing water from pooling. The advantage is that it is a relatively inert material and forms a reversible repair; epoxy can be removed by blast cleaning. It can also help to isolate smaller areas of different metals from each other, for example if bronze is incorporated into a cast ironwork design. It can also be used to secure pin repairs in place.

Epoxy is not recommended for filling masonry sockets.

Fixings

Fixings are screws, bolts, nuts, washers and other items that help hold castings together (Fig 33). New fixings should be made of either high grade stainless steel or bronze. They should be painted before fixing in place and should be isolated from the surrounding casting by a nylon ‘top hat’ and a nylon washer. Isolation is inexpensive but very important.



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Fig 33 A 19th century iron fixing. The small dark lines of slag (silica) which are visible in the ground-back section of the fixing indicate that it is made of wrought iron.

10. Repairs in practice

Preventing galvanic corrosion

Each component should be thoroughly painted and separated from different metals using an inert isolating material such as nylon. Corroded wrought iron fixings can be replaced with bronze or stainless steel. These materials are more chemically stable than wrought iron and will not corrode as quickly when placed next to cast iron. Nevertheless, they should still be thoroughly painted and isolated from the surrounding casting using nylon insulating material. Nylon washers should be used with fixings, never galvanised steel washers.

Packing bars (flat bars placed between components such as a railing and handrail): should be thoroughly painted, and isolated from surrounding cast iron using nylon insulating material.

Fractures

Fractures are common in cast iron which is a brittle material. Some fractures can be repaired, using a variety of methods as outlined above, though occasionally it may be necessary to replace all or part of a fractured element if the degree of fracturing is too extensive.

Bear in mind that not everything that looks like a fracture necessarily is. Some original casting flaws can look like a fracture but may be merely cosmetic. Inspect cracks and fractures closely.

Fractures to non structural elements: Fractures that have occurred to non load bearing elements, particularly small elements, may be possible to repair using fibreglass which is applied to the reverse side of the element, holding the broken sections together. This repair method enables the original element to be retained and is unobtrusive. Another option is to pin the fractured sections together as described above. Pinning is not always possible, particularly where the section thickness is low.

Fractures to structural elements: Fracturing often occurs to components that serve to drain water away; for example, many bandstands and drinking fountain canopies are composed of supporting columns that also serve as rainwater downpipes. If these downpipes become blocked, water cannot drain away and freezes during the winter. As the water freezes it expands in volume and exerts pressure on the downpipe, eventually causing it to fracture.

Mechanical damage, such as a heavy blow or overloading of load bearing components will also cause fractures.

Plating or metal stitching are useful repair methods for structural components.

Casting flaws

Original casting flaws are relatively common and can appear as holes (ranging from tiny to quite large) and occasionally as folds (which can look like cracks) (Fig 34). These were sometimes hidden by foundries using various filling materials which are usually removed during the cleaning process.

Flaws should be filled with either a red lead paste (especially good) or polysulphide mastic prior to the application of paint to prevent water from lodging at these points and accelerating the rate of corrosion. Red lead paste may require more time to cure than polysulphide mastic.



Fig 34 Casting flaws are often revealed by cleaning.

Fractured masonry

Problems often arise at the interface where ironwork has been fixed into masonry. Lead, poured into the masonry socket while molten, was the most common material used to fix ironwork into place. Over time, lead can fail and allow moisture to saturate the foot of the ironwork which then begins to corrode. Corrosion of the ironwork exerts pressure on the surrounding masonry socket until it eventually fractures.

Where a fracture has occurred, a number of approaches can be taken depending on the severity of the fracture:

1. Clean the ironwork as far as possible in-situ and repaint. If water is pooling in the socket, re-fill it with hot-poured lead.
2. If the fracture has not caused loss of stone or structural damage to the masonry, repeat step one and fill the fracture with a lime mortar.
3. Drill out the original lead, thoroughly clean as much of the ironwork as possible, paint the ironwork and re-fill the socket with lead.
4. If part of the stone has been lost or requires replacement, indent new stone and create a new socket for the ironwork to sit into. New stone should be carefully matched, not just by colour but by petrographic composition (determined by analysis). Though a stone may match in colour, its other properties, such as hardness and porosity, may not be compatible with the original stone and will cause accelerated deterioration.

Iron fixings which have caused fractures to masonry should be replaced with stainless steel fixings.

Thinning and corrosion holes

Thin sections of cast iron, such as frieze panels, are susceptible to thinning and eventual perforation (through loss of surface material) by the corrosion process (Fig 35). If thinning does not compromise the strength of the component it should just be cleaned and repainted. If thinning and perforation is severe, it may be possible to patch holes using fibreglass or re-profile thinned sections using epoxy, depending on the complexity and design of the casting.

If thinning compromises structural integrity, a plate repair might be considered, otherwise the entire casting may need to be replaced.

Fractured lugs

Fractured lugs can be repaired by brazing, welding or pinning. If the lug has been lost, a new one can be cast and attached to the original casting using the same techniques. This repair technique is not suitable for all broken lugs, such as those that are load bearing, in which case the entire casting may need to be replaced.

Gates

Gates are functional objects which can become difficult to operate over time for a variety of reasons including wear and tear or rising ground levels (Fig 36). This section gives advice on how to address some of the more common issues.

Base of gate dragging against ground: This is a common problem and is usually caused by rising ground levels beneath the operational arc of the gate (for example where new tarmac has been laid). Worn out gate heels (the lower corner of the gate closest to the gate post) and gudgeons (the “female” part of the pivoting mechanism) are another common cause of this.



Fig 35 A severe example of corrosion thinning to a thin section of cast iron (in this case a gutter).



Fig 36 Gates can become difficult to use for a variety of reasons, including raised ground levels and worn components.

Laying new tarmac in entranceways raises the level of the ground beneath the operational arc of the gates, eradicating the clearance room and consequently causing the gate to scrape against the ground. Where possible, the ground level should be lowered to allow the gate to swing freely.

The gudgeon and pintle (the “male” part of the pivoting mechanism) were often designed to be replaced as they wore down over time. This wear and tear can cause a gate to drop and scrape against the ground. Worn gudgeons or pintles should be replaced by an experienced contractor. Larger gates may have soft metal ‘bushes’ inserted in the gudgeon which can be replaced. Bushes were usually made of a bronze alloy and were inserted into the gudgeon to aid movement and were designed to wear down sacrificially to the cast iron and be periodically replaced.

On a larger scale, gate piers and pillars can settle and lean, which will throw the gate out of alignment. This will necessitate either an adjustment of the gate hanging, or more substantial works to re-align the gate piers to a plumb position.

Widening gates: The local planning authority should be consulted before carrying out such works as they may be subject to planning regulations. Widening gates may compromise the historic and aesthetic integrity too much to be permitted.

Cast iron gates are difficult to widen as the material is difficult to weld. Where a larger entrance is essential, it may be more feasible to retain the original cast iron gate as a pedestrian access point, and install a new, wider gate based on the design of the original gate.

Railings

Replacing missing railings: Many railings were removed during the Second World War. As a result, many of Scotland’s streets are lined by low walls with cast iron stumps instead of railings. These stumps are useful as they provide information on:

- Whether railings were composed of panels (widely spaced stubs) or individual bars (closely spaced stubs)
- Spacing of bars or panels
- Where newel posts (thicker bars which increased stability) were placed
- What the feet of railings looked like (straight or with a bulb or other decoration)
- What the shaft of bars were like (fluted, square, round etc)

A few bars or a panel were often deliberately retained for reference or safety. Check behind hedges and in hidden corners of gardens. If no stubs or panels survive, check the local area for examples of typical patterns used locally. See guidance below on recasting ironwork.

Fractured bars: Cast iron railing bars are vulnerable to fracture from impact. If a bar has been fractured and the two halves survive, it should be possible to repair by either pinning, brazing or welding in combination with dowelling. Alternatively, a replica bar can be cast and inserted.

Replacing missing finials: Finials are frequently lost due to impact damage. It is not normally necessary to replace the entire bar. A newly cast replacement finial should be reattached by pinning rather than welding or brazing.

Balconies

Decorative balconies were a common feature of 19th Century houses; they offered an additional platform for decoration as well as providing protection to house occupants using the windows.

General surface corrosion should be removed using the cleaning methods outlined above depending on the severity of corrosion. Safe access is an important consideration when carrying out work in situ to balconies or other decorative ironwork above ground level. An experienced contractor with appropriate safety gear and access equipment may be required if cleaning is required to less accessible areas such as the outward face, underside of the floor or supporting brackets.

If the balcony is in a poor state of repair, it may be advisable to employ the services of a conservation engineer to check that it is securely fixed back into the masonry.

Rainwater goods

The ability to mass produce cast iron rainwater goods in a wide variety of designs from the early 19th century made them an affordable and desirable building feature. Rainwater goods comprise of rhones (gutters) and rhone pipes (downpipes) which carry water away from the building. Hopper heads were used to funnel water from horizontal rhones to vertical rhone pipes. All of these elements were produced in a wide variety of designs and were often quite ornate (Fig 37), as were the brackets which fixed them to the building. Rhones and rhone pipes were typically cast in sections and then slotted together.

Cast iron rainwater goods are easier to repair than commonly assumed. As they are composed of component parts, damaged sections can usually be replaced and slotted into the existing system. Badly fractured sections may need to be replaced by new castings with a matching profile – plastic replacements are not a suitable replacement material and are not as durable as cast iron. Replacement sections should match the original in size and appearance and it is generally possible to match most designs to the original. Plain castings can be obtained from most builders' merchants, while more ornate or unusual rainwater goods can usually be obtained through foundries specialising in traditional casting or rainwater goods specialists.

Where downpipes are missing, existing gutter outlets will usually indicate where downpipes were located. Replacement downpipes should be fixed away from the wall to facilitate repainting and to allow any leaking water to run down the back of the pipe rather than down the wall where feasible. Cast iron rhone pipe brackets and rhone hooks should be re-used where possible. These were often decorative and should be replaced with matching replicas.



Fig 37 Cast iron rainwater goods were often highly decorated.

11. Replacing castings

Ethical considerations

Replacing surviving original castings should always be a last resort as this diminishes the historical significance of ironwork. A cast iron structure which is composed mostly of its original castings has greater historical significance than a similar structure composed predominantly of replica castings.

If part of a casting is missing, as much of the original casting should be retained as possible, and only the part(s) which is missing should be replaced. In some cases an entire casting will be missing in which case replacement is the only option. The year of manufacture should appear on the reverse side of new castings so that they can be distinguished from original castings (fig 38). The name of the manufacturer of the original cast ironwork should not be cast into replica castings as this provides false physical evidence.

Replica castings

Always ask to see examples of castings before commissioning work with a foundry. For larger projects, an exemplar casting should be produced and set aside as the agreed benchmark of quality for the rest of the project.

Historic ironwork was made in grey iron and should be replaced with grey iron. Ductile iron, also known as 'spheroidal graphite' or 'SG' iron, is sometimes used as a modern alternative to grey cast iron due to its greater tensile strength. However, it is a different metal, and in keeping with the conservation principle of replacing like with like, grey cast iron should be used in preference.

Getting the pattern right: A casting is only as good as the pattern used to make it, so it is important to ensure that new castings are made using high quality patterns (Figs 39 & 40). Foundries specialising in traditional castings may well have a matching pattern in stock, particularly if it is a missing railing panel common to the local area.



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Fig 38 New castings should be marked with the year of manufacture to distinguish them from original castings.



39

Fig 39 New patterns should be accurate in their design and finished to a high standard.



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Fig 40 Poorly finished, inaccurate patterns will result in poor quality castings.

11. Replacing castings

If no foundry has a matching pattern, it may be worth contacting Heritage Trusts or Building Preservation Trusts as they may have grant aided or know of another project that used similar patterns which could be borrowed.

Alternatively, a new pattern will need to be designed and carved by using an existing example, catalogue illustration or archive photograph as a reference.

Pattern-making is a specialist skill - if a new pattern is required, a professional that is used to making patterns for decorative cast ironwork should be contracted.

Quality control is essential during this process to ensure that the new pattern matches the original castings as closely as possible and is crisp in detail and free of surface imperfections.

As a last resort, a surviving casting can be used as a pattern for a replica casting. However, there are a number of drawbacks with this:

- a) The new casting will be slightly smaller than the original as molten iron shrinks as it cools (1/8 of an inch per foot). This can cause problems if the casting must be slotted into place as it may not fit properly.
- b) Using an old casting that has been weathered may create a new casting with inferior detail and surface finish.

Nevertheless, this can be a practical option provided the original casting is in good condition and a slight variation in size does not create assembly problems.

Replacing a portion of a casting: Careful consideration is required before deciding to attach a casting of missing fragments to an original casting. While this will restore the visual continuity, the process of attaching a new casting usually requires irreversible interventions such as drilling into the original casting. Sometimes it is better to leave castings as they are than to reattach missing portions. This is a judgement that needs to be made on a case by case basis.

As a general rule of thumb, if a significant portion of the original casting survives, missing parts should not be replaced. Instead, the casting should either be left as it is (depending on factors such as its structural stability and historic significance) or a replica of the missing portion can be recast and attached to the original casting.

If a portion of the casting has fractured but has not been lost, it can be reattached (depending on size and structural function) either by pinning, stitching or plating (as described above).

12. Painting

Paint (and a variety of other coatings such as oil) has traditionally been applied to ironwork to decorate it and protect it from corrosion by preventing moisture and air accessing the metal (Fig 41). Galvanised cast iron is extremely rare and of historical interest.

Over time, coatings degrade and eventually fail if not regularly maintained. All cast ironwork, whether it is a large structure or a set of domestic railings, therefore requires periodic maintenance to protect it against corrosion.

Periodic inspections should be carried out at least once a year and paint should be touched up where required. Inspections should check for chipped or deteriorating coatings – loss of adhesion, blistering, flaking or an oil-like residue on the surface. Inspections should also check for signs of corrosion, particularly in areas of ironwork that are fixed into masonry. The underside of surfaces should also be inspected.

When applying fresh paint, follow the paint manufacturer’s guidelines – manufacturers usually supply good application advice. Never paint in damp, windy or extremely cold conditions. Be sure to apply paint in thin coats, taking care not to let any drips form. Overly thick layers of paint take longer to dry, tend to drip, are more prone to cracking, and obscure decorative detailing.

Retaining existing coatings

If paintwork is stable, it is often best to leave it in place and paint on top, thereby retaining all of the historic evidence that earlier coatings can provide. Additionally, the more layers of sound paint that exist, the better ironwork is protected. The disadvantage of a heavy build up of paint layers is that they eventually begin to obscure decorative detailing.

However, where corrosion and paint deterioration is severe, it may be necessary to fully remove coatings. Wherever possible, a strip of these early coatings should be retained – choose the best preserved area of paint (usually found on sheltered areas).

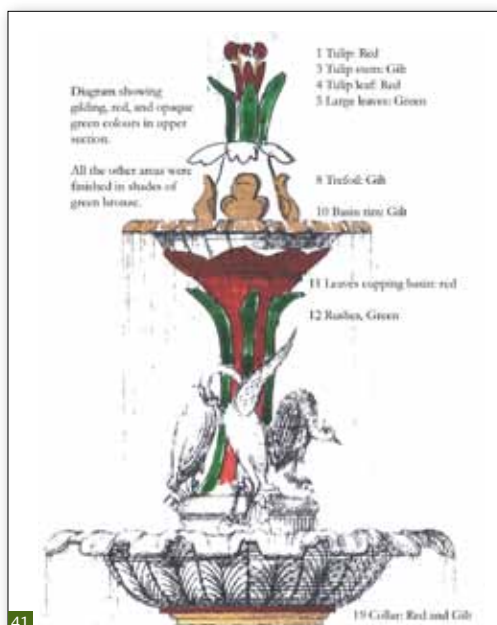


Fig 41 Polychromatic colour schemes were common during the 19th century.

12. Painting



Fig 42 Casting flaws are common in traditional cast ironwork. Care should be taken to fill these before painting to prevent corrosion. Corrosion has begun to develop in the small casting flaws illustrated here.

Paint application

Good surface preparation is the first step in ensuring fresh coatings perform well. Cleaning ironwork has already been covered earlier in this publication (Fig 42). Paint should ideally be applied in a controlled, indoor environment. Iron should be completely dry before coatings are applied. Ample drying time should be allowed between coats to prevent solvents from layers below damaging freshly applied layers of paint.

If an entirely new paint system is being applied, the ideal dry film thickness (DFT) is between 200 and 250 μ (microns) – this can be measured using a simple hand-held device.

Periodic touch ups: Touch ups to chipped paint are often required as part of a regular maintenance programme. Before applying fresh paint, check its compatibility with the existing coating by either contacting the paint manufacturer for advice or by applying fresh paint to a small, inconspicuous test area (the paint manufacturer may be able to advise on this).

Areas of chipped paint should be sanded down using emery paper, feathering the edges into good surrounding paint in preparation for paint application. An undercoat of primer should then be applied, taking care to overlap the existing sound paint. Next, apply one or two top coats, allowing adequate drying times between coats. Apply stripe coats on the edges of ironwork.

Painting in-situ: The advantage of painting in-situ is that surrounding masonry does not need to be disturbed by removing ironwork, and the costs and inconvenience of dismantling and removing ironwork are avoided. If the ironwork is in reasonably good condition, this may be a viable option, particularly in dry weather.

The disadvantages of painting in-situ are that the ironwork will not be dismantled, and the hidden surfaces within joints will therefore not be cleaned or repainted. These areas are vulnerable to continued corrosion. If ironwork is damp when it is painted this can cause the coating to fail within a short period of time (sometimes within a year). By painting on top of damp ironwork, moisture becomes trapped and cannot evaporate. This trapped moisture may initiate the process of corrosion.

Paint should not be applied in-situ in windy conditions as wind-blown debris will stick to wet paint and compromise the effectiveness of the coating. Very low temperatures will also compromise coatings performance.

Selecting a coating system

A number of factors will influence the type of paint system chosen:

Colour and finish

Is the intention to replicate the colour and finish of earlier coatings? Consider colour, surface texture and sheen level. Original paint schemes were often polychromatic – taking paint samples from a variety of locations around the structure will confirm if this is the case. Paint manufacturers that specialise in traditional paints will be able to advise on suitable colour and finish matches.

Traditional or modern system

Before choosing a traditional system, it is important to consider the ownership of the ironwork and compatibility of a traditional paint system with modern paints. If the ironwork is likely to change ownership frequently this increases the chances that a modern gloss paint will be applied at some point in the future. Speak to the paint manufacturer about paint compatibility.

Traditionally, oil-based lead (white lead) paints were most commonly used for outdoor ironwork, applied on top of a red lead primer. While lead-based top coats are no longer used (except in exceptional cases), oil based paints are still available and can be used as part of a traditional paint system. Red lead primers are also still available from specialist traditional paint manufacturers and chandlers; they perform well and their use is not restricted.

If a new paint system is to be applied to existing paint layers, small trial areas should be painted to check compatibility. The paint manufacturer will also be able to advise. It is advisable to select a system that is suited specifically to traditional ironwork. Epoxy paint systems are not recommended. Paint systems designed for modern steels are also not always the most suitable for historic cast iron.

If a modern paint system is required, current best practice recommends:

- Two coats of a metal rich primer (often zinc based)
- One coat of micaceous iron oxide or other build coat
- Two coats of gloss paint

However, some structures may require a more bespoke system, for example if in a particularly exposed location or access for maintenance is restricted. Again, a paint manufacturer specialising in traditional paints can advise.

Guarantees that are issued with many modern coating systems should be viewed as indicative only. The longevity of a paint system depends on many factors and will vary from structure to structure. Ironwork that has a new coating system applied should still be inspected annually.

13. Re-installation

Transport to site

Ensure that ironwork is protected during transport to site to prevent damage occurring to castings or paintwork. In the case of larger structures, it may be necessary to construct a bespoke jig to load ironwork onto for protection during transport to site.

Installation

Survey drawings and a numbered tagging system will assist in the process of re-installation by indicating precisely where individual components were originally.

Joints, mating surfaces and voids between component parts should be caulked (filled) where required, using either a red lead paste (best) or polysulphide mastic, to prevent water becoming trapped.

Fixings should be tightened by hand (not mechanically) to avoid the risk of fracturing castings by over-tightening (Fig 43). Nylon washers should be used instead of mild steel ones to isolate the nut from the cast iron and reduce the risk of galvanic corrosion.

Finally, any paintwork damaged during transport or installation should be touched-up on site.

Fixing Ironwork into Masonry

This was traditionally done by pouring molten lead into the masonry socket (whether on a vertical or on a horizontal surface). Adjacent surfaces should be protected while lead is being poured. It is inadvisable to pour molten lead into damp stonework as it is likely to spit.

A cup should be formed around the hole using clay to prevent the lead from running over the surface of the stone cope (Fig 44). Lead should be allowed to cool and solidify before tamping down.

The contractor should take appropriate health and safety measures when working with lead due to the toxic nature of the material.



Fig 43 Over-tightening fixings can cause irreversible damage such as cracks and fractures.



Fig 44 Clay cups are used to prevent molten lead spilling onto surrounding masonry.

14. Summary

Traditional cast iron represents centuries of Scottish innovation and skill and is a wonderfully versatile and durable material. Small steps, such as a simple, regular maintenance regime, can greatly increase the life of cast ironwork and will minimise the need for more costly repairs in the future.

Where repair is required, the aim should be to retain as much of the original cast iron as possible, and not necessarily to restore it to its original condition. The repair methodology should always be judged on a case-by-case basis; some components may require different approaches to others. Overly aggressive cleaning and the use of inappropriate modern repair techniques can irreversibly damage cast ironwork and lead to longer-term problems.

This Short Guide aims to provide some basic guidelines to help anyone wishing to maintain or repair cast ironwork. Ultimately, finding the right contractor or specialist, early research and careful planning are the key drivers of a successful project.



Fig 45 Traditional cast ironwork can enhance the character and appearance of traditional buildings and will survive for a considerable time if well maintained.

15. Contacts and further reading

Contacts

British Artist Blacksmith Association

www.baba.org.uk

BuildingConservation.com

www.buildingconservation.com

Conservation Accreditation Register for Engineers

www.careregister.org.uk

Conservation Register

www.conservationregister.com

Funds for Historic Buildings

www.ffhb.org.uk

Historic Scotland Technical Conservation Knowledge Base

www.historic-scotland.gov.uk/conservation

Institute of Cast Metal Engineers

www.icme.org.uk

The Institute of Conservation

www.icon.org.uk

Institute of Historic Building Conservation

www.ihbc.org.uk

National Heritage Ironwork Group

www.nhig.org.uk

The Scottish Ironwork Foundation

www.scottishironwork.org

Historic Scotland

Longmore House
Salisbury Place
Edinburgh
EH9 1SH
Tel: 0131 668 8600
www.historic-scotland.gov.uk

Historic Scotland Technical Research

(Technical enquiries)
Tel: 0131 668 8668
hs.conservationsgroup@scotland.gsi.gov.uk

Historic Scotland Heritage Management

(Planning / listed building matters)
Tel: 0131 668 8981 / 668 8717
hs.listingsandconsents@scotland.gsi.gov.uk

Historic Scotland Investment Team

(Funding options)
Tel: 0131 668 8801
hs.grants@scotland.gsi.gov.uk

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