



CONSERVATION PRINCIPLES WITH ILLUSTRATED GUIDELINES

FOR
HERITAGE FORGED & CAST IRONWORK





Cover:
Crossness Pumping Station, Bexley, London, constructed in the Victorian era to pump London's sewage.

Acknowledgements

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About the author

Geoff Wallis has four decades of experience in metalwork, machinery and mills conservation.

About the NHIG

The National Heritage Ironwork Group (NHIG) was formed in 2009 to raise awareness and promote understanding of heritage ironwork in the historic environment.

Traditional forged and cast ironwork is an important and integral part of the historic environment, used widely in structural, architectural and functional applications.

The NHIG intends to set up a nationally accredited training and development programme to ensure that the skills of the Heritage Ironworker and Blacksmith are recognised, preserved and promoted.

It is the duty of all professionals and practitioners to promote good conservation practice in order to safeguard the long term survival and integrity of heritage ironwork. This document has been developed to help owners, professionals, blacksmiths, and conservation metalworkers to uphold best practice in the care of heritage ironwork.

Endorsements

The Conservation Principles have been peer reviewed and endorsed by the membership of the NHIG and the leading conservation organizations below:



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Cast iron gate-panel at Piece Hall, Halifax.

THE CORE PRINCIPLES OF CONSERVATION

The six NHIG Core Conservation Principles, below, are followed on the next pages by 15 good practice guidelines illustrating how they may be interpreted in practice. These guidelines are not a comprehensive list of every solution and therefore should be viewed only as an introduction to the subject.

The original text-only version of the NHIG Conservation Principles is available at www.nhig.org.uk

- ▶ Analyse, understand and assess the significance of the object prior to undertaking any decisions regarding intervention.
- ▶ Record the object as found, and at all stages of work.
- ▶ Care for and maintain the object to halt or minimise ongoing deterioration
- ▶ Retain the maximum amount of original/existing material
- ▶ Any interventions should be reversible where possible, but where this is impossible, interventions must respect the significance of the object.
- ▶ Professionals and practitioners must be competent in ironwork conservation and source other specific expertise where needed.



A simple wooden pattern for an expressive cast iron mask.

GOOD PRACTICE

Guideline 1: *Understanding significance and value is fundamental to the practical application of these Core Principles.*

Significance or value has been defined by Historic England (formerly English Heritage*) as the sum of technological, historic, aesthetic, or social values for past, present or future generations as follows:

- Technological values:** The potential of the fabric of the building to yield primary evidence.
Historical values: The way in which the building provides a means of connecting the present to past people, events, and aspects of life, both by illustrating social history, and its association with notable people and events.
Aesthetic values: The way in which people derive sensory and intellectual stimulation from the building; and
Social values: The meaning of the building for the people who identify with it and whose collective memory it holds.

In practice the significance of metalwork can be assessed in terms of its:

- ▶ Age.
- ▶ Uniqueness of design, scale, materials, etc. when originally made.
- ▶ Rarity as a survivor of its type.
- ▶ Example of past style, design, innovation, use of materials, constructional practice, etc.
- ▶ Association with people, places or events.
- ▶ Contribution to its setting or context.
- ▶ Spiritual, political, or cultural significance.
- ▶ Exceptional aesthetic qualities of form, colour, decoration, etc. and the contribution made to the immediate environment or landscape.
- ▶ Condition, extent of the original material and ability to perform its function.

In some circumstances, particularly when comparing different sites or structures, ranking may help to focus on features of greater and lesser importance and provide overall comparison, perhaps using the following descriptives:

Level of significance	Ranking	Score
Exceptional	E	4
Considerable	C	3
Some	S	2
Little	L	1
Neutral	N	0
Intrusive	I	-1



Clifton Suspension Bridge, Bristol

(*Conservation Principles, Policies, and Guidance, English Heritage (2008). Some terminology has been amended)

Guideline 1: Case study

The Forcing House, Hilton Hall, Staffordshire, provides a case study. The following is not a full analysis, but demonstrates a technique for identifying and ranking features of significance prior to restoration.



Characteristic		Desc	Score
Age	C 1830, early phase of glass-house construction, predates majority of iron glasshouses in UK	E	4
Uniqueness	Relatively small glass-house. Double brick arch structure with internal flue possibly unique.	E	4
Rarity	Only a small number of early wrought iron glasshouses in UK survive, few with timber and iron construction	C	3
Design, innovation, materials, construction	Follows J C Loudon recommendations for plant-house design published in 1824.	C	3
	Copper glazing bars rare. Must retain all originals, including damaged ones.	E	4
	Glass, almost all has been replaced.	N	0
	Brick plant-tables are a later addition, so could consider removing them.	N	0
Associations	Estate owned by the Vernon-Graham family for four centuries	S	2
Setting, context	South facing, probably once had an open vista across the lake. Consider removal of trees. Typical late 18 th /early 19 th C garden feature	S	2
Spiritual, political, cultural	Evidence of vogue amongst gentry in 18 th century for growing exotic imported plants.		
Aesthetic	An elegant/popular/romantic structure in demand as a venue and photo backdrop.	C	3
Condition, functionality	Poor condition, but potential for wedding events, recitals, meetings, etc.	C	3

The importance of genuine wrought iron

The large scale manufacture of new wrought (ie puddled) iron ceased in the 1970's, but recycled material is still available. Wrought iron is a unique soft, ductile, relatively corrosion-resistant, hand-made material with a strong fibrous grain, particularly well suited to the requirements of the blacksmith. New genuine wrought iron is no longer made commercially anywhere in the world so is historically important. The significance of wrought iron increases as the amount of extant material gradually diminishes through corrosion and scrapping, so, whether used decoratively or in a large structure it must be preserved.

Poor condition does not reduce heritage value

Rust expands by a factor of five to seven so the loss of original metal is less than it first appears, and parts may be structurally adequate despite being wasted. Rusty ironwork is not necessarily less important historically than uncorroded metalwork.



▲ Wrought iron is fibrous, with iron and iron silicate material running the length of as-rolled sections. Nicking and bending this bar reveals its nature. Traditional smiths were mindful of this structure and took care to forge in such a way that the grain followed the stress lines of the structures they made.



◀ An example of rust-jacking - the element in the centre has been deformed by the growth of rust in the join.



Early 18th Century wrought iron gates attributed to Robert Bakewell rusted severely in an exposed location, collapsed and were reduced to fragments. They looked to be beyond repair, but the listed parts were carefully recorded, packaged and removed to store. Once funds were in place they were reassembled with traditionally-made new components and re-erected on their original site.

DEFINITION OF TERMS

A more comprehensive glossary of ironworking terms is available at www.nhig.org.uk

Alkyd oil	A single-pack polyester resin commonly used in varnishes, paints and adhesives.
Alloy	Physical mix of two or more different metals.
Aluminium	Soft, lightweight, malleable versatile metal, resistant to corrosion, often used as an alloy when it may be heat-treatable.
Annealed/annealing	Softening a metal by heating it to a specific temperature/colour and subsequently cooling it.The metal must be heated to above its re-crystallization temperature, and then cooled or quenched to allows it crystals to realign without strain.
Anode	The area of metal surface in a corrosion cell that yields electrons and becomes positively charged.
Anodizing	A process in which a corrosion-resistant oxide layer is electro-deposited on aluminium. Surfaces are usually sealed and tinted by use of inorganic metal salts.
Arc welding	'Manual metal arc welding' Joining metal by fusion. A molten weld-pool is created by an electric arc/plasma formed between two electrodes or between the workpiece and an electrode.
Architectural bronze	A commercial term for some brass alloys which may not strictly be bronze if they do not contain tin.
Arris	An external corner.
Austempered ductile iron	(ADI) A form of ductile iron in which heat treatment modifies microstructure to promote the formation of ausferrite increasing strength and toughness.
Austenitic stainless steel	A type of stainless steel containing at least 18% chromium and 8% nickel, plus one or more precipitation-hardening elements such as niobium, titanium, copper and molybdenum.
Back stile	Vertical bar of gate to which hinges are attached.
Baluster	Vertical bar of a balustrade, often decorative.
Balustrade	Fencing formed of palings or balusters and a top- rail used to protect against falls from an exposed edge.
Barrier coating	Surface coating applied to prevent oxygen and water reaching a metal surface and causing corrosion.
Bedding	Setting on a flexible or plastic material to provide stability or sealing.
Benzotriazole (BTA)	An aromatic compound used as a chelating agent and corrosion inhibitor in conjunction with a protective wax treatment to slow the corrosion of outdoor copper-based metals.
Bessemer converter	A tilting vessel, now obsolete, in which air was blown through molten pig iron to burn out enough carbon to convert it to steel.
Bimetallic corrosion	See: Galvanic corrosion
Black wax	The generic term for any dark wax used as a coating on outdoor sculpture, especially bronze. Recipes vary, but a popular treatment for English public sculpture in the 20th century was a mixture of lamp black with lanolin or beeswax and paraffin or turpentine.

Blast furnace	An air-blown smelting furnace charged with ore, flux and fuel at the top, discharging molten metal at the base.	
Blister steel	See Cementation.	
Bloom	A block of metal produced in a bloomery or puddling furnace shaped and purified by hammering.	
Bloomery	A furnace charged with iron ore and charcoal blown with a bellows.The temperature is not high enough to melt the ore, but it is reduced by to a spongy mass (or bloom) that can be consolidated by hammering to make 'wrought iron'. See: shingling.	
Bossing, embossing	Shaping the face of malleable sheet metal (such as lead or copper) at room temperature using hand tools.	
Brass	An alloy of copper and zinc, often with other metals such as tin, nickel and lead added. Architectural brass is typically 70% copper and 30% zinc.	
Brazing	Welding using oxy-acetylene flame and filler rod of brass, bronze or nickel-silver alloy. Carried out at around 600 degrees Celsius, brazing is not generally used structurally.	
Bronze	A castable copper-tin alloy, often also containing lead and other metals which provide a range of properties.	
Bronzing	A 19th-century oil-paint finish for architectural ironwork to imitate exterior bronze.	
Build coat	An intermediate paint coat which provides thickness, toughness, opacity and tint. In oil gilding, a red, yellow or ochre-tinted base for the gilding size and gold leaf.	
Burnishing	Smoothing a metal surface to a lustre or polish with a smooth hand-tool.	
Cast iron	► Flake, grey	An alloy of iron and 2-4% carbon and crystalline matrix which is relatively brittle, but corrosion- resistant, easily machined and performs well in compression.
	► Spheroidal graphite	Cast iron treated with magnesium or (ductile, or nodular cerium while molten which forms graphite) the carbon content into small spheres resulting in ductile, easily welded castings.
Cast iron, cold repair	► Pinning	Use of a pin or bolt to repair a broken or cracked component.
	► Plating	Bedding and bolting a flat piece of steel to a fractured casting, usually on the back.
	► Stitching	Repair to fractured castings by drilling holes at right angles to fracture on each side and inserting a steel key or stitch. Interlocking studs are inserted along the fracture to seal and stabilize it.
Cathode	The area of metal surface in a corrosion cell that receives electrons and becomes negatively charged.	
Cathodic protection	Protection of a ferrous material embedded in a damp medium (e.g., masonry) by application of a reverse current applied via a separate sacrificial anode.	
Cementation, carburization	A traditional method of making steel by heating wrought iron in contact with charcoal to increase its carbon content.	
Charcoal iron	Early wrought iron made in a charcoal fire, common to the end of the eighteenth century and superseded by 'puddled' iron.	



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