Guidelines

CAST IRON:

FIRMNESS, COMMODITY, AND DELIGHT

The Capitol Hill Historic District's more than 8,000 contributing buildings encompass a variety of late 19th-century architectural styles. Cast-iron entrance stairways and stoops are important connective tissue between many of these disparate buildings, reflecting the innovation, expediency, and fondness for ornament characterizing Victorian-era speculative development.

Many Capitol Hill property owners have realized that routine maintenance and repair of historic iron fences, security grilles, window hoods, stairs, and stoops will help to avoid future repair or replacement expenses. This guideline discusses the history of cast iron including cast iron on the Hill, describes causes of deterioration, and recommends methods for maintenance and repair, emphasizing stairs, stoops, and railings.

HISTORICAL USE OF IRON

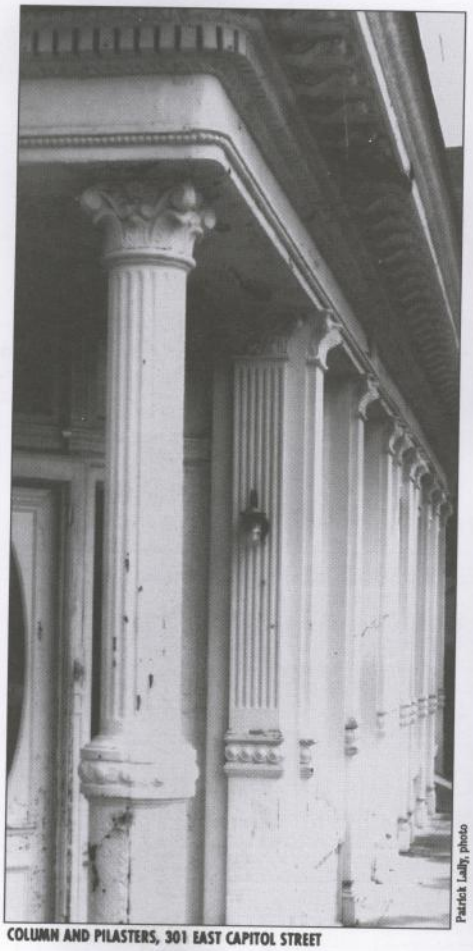
Iron is so important in human history it gave its name to the Iron Age.

More recently, relatively soft iron hammered by hand was essential to American colonists who used it for hinges, tools, door hardware, fireplace necessities, and conveniences. Virtually all the ironwork used in the Colonial period was imported. By the Revolutionary War some ironwork was fabricated in East Coast cities whose residents could afford the luxury of importing smiths and raw iron. Colonial ironwork, fences, railings, balconies, and other architectural flourishes were generally light in profile, reflecting frugality in use of an expensive imported material. By the end of the first quarter of the 19th-century, domestic production of wrought iron had increased significantly, reflecting in its forms the diversity of immigrants and their iron working traditions. Before the introduction of cast-iron pieces, lead rosettes and ornaments were fused on wrought iron by a process called "sweating." Examples of this may be seen on the railings and balconies of the 1800 Octagon house at 18th and New York Avenue, N.W. just two blocks from the White House. While southern cities like Charleston and New Orleans were noted for extraordinary ironwork early on, the iron age arrived on Capitol Hill with galloping industrialization and the 1870 to 1893 building boom.

THE GEORGE WHITE AND SONS FOUNDRY AT 460 MAINE AVENUE, SW, WAS A 19TH-CENTURY IRONWORK CATERING TO WASHINGTON'S BUILDING BOOM. THIS ADVERTISEMENT FROM THE 1892-3 WASHINGTON ARCHITECTS, CONTRACTORS, AND BUILDERS DIRECTORY, SHOWS PRODUCTS AVAILABLE FROM WHITE.

PATRICK LALLY AND JUDITH M. CAPEN, AIA

LATE 19TH AND EARLY 20TH CENTURY CAST IRON APPLICATIONS ARE UBIQUITIOUS ON CAPITOL HILL INCLUDING SOME SHOWN HERE. CAST IRONS' ABILITY TO BE MOLDED IN AN INFINITE VARIETY OF DECORATIVE SHAPES TO TAKE THE PLACE OF EXPENSIVE HAND-CARVED MATERIALS

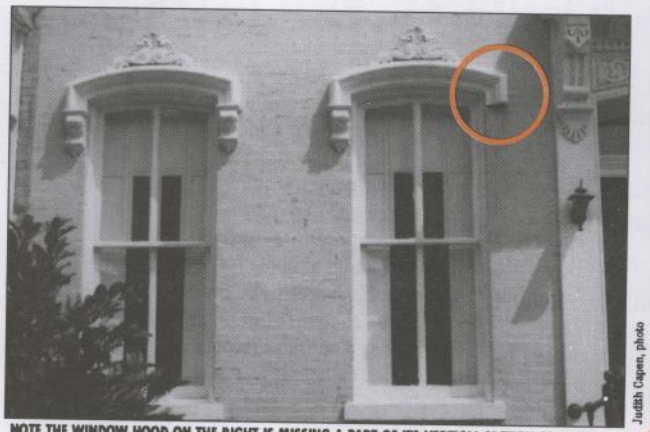


Patrick Lally, photo

COLUMN AND PILASTERS, 301 EAST CAPITOL STREET

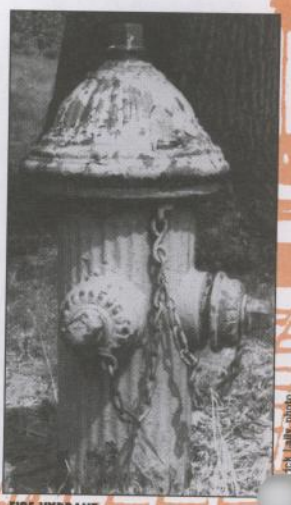
Judith Capen, photo

A BIT OF ROOF CRESTING ON A WOOD FRAME QUEEN ANNE ROW HOUSE.



Judith Capen, photo

NOTE THE WINDOW HOOD ON THE RIGHT IS MISSING A PART OF ITS VERTICAL SECTION OR DROP. THAT SINGLE MISSING ELEMENT COULD BE RECREATED IN A SUBSTITUTE MATERIAL OR A NEW CUSTOM IRON CASTING.



Patrick Lally, photo

FIRE HYDRANT

DEVELOPMENT OF IRON TECHNOLOGY AND IRON ON CAPITOL HILL

Capitol Hill's rapid post-Civil War development corresponds to accelerated use of cast iron in construction. The processes for reducing iron ore to iron, casting, and working iron were developed and widely applied in England from the 1600s. America, however, lagged in employing cast-iron technology. Readily available New Jersey and Pennsylvania hard anthracite coals were difficult to reduce to coke with Colonial era technology. The soft bituminous coals of Britain yield coke more easily.

By the 1851 construction of the Crystal Palace in London, British and European enchantment with cast iron as a visible architectural element had peaked and begun to decline, even as boom times for American iron were beginning.

Improvements in American iron technology and transportation created iron manufacturing capability to meet the needs of a burgeoning population. American pig iron production burgeoned after 1840 when the Lehigh Crane Company of Allentown, Pennsylvania, introduced a blast furnace that allowed domestic producers to use locally available hard anthracite coals. By 1856, the American iron industry was well on its way to full maturity, producing pig iron, cast iron, and rolled iron sections.

The cast-iron U.S. Capitol dome, completed as a gesture of hope during the Civil War, represented the cutting edge of technology, a prominent demonstration of the flexibility, relative lightness, and fire-resistance of the material.

While the distinct characteristics and appropriate uses of cast and wrought iron were not fully understood until the 1870s, both types of iron were extensively used by then.

By the post-Civil War period, the elements of technology and infrastructure were in place for American industry to produce great quantities of rough and finished iron demanded by those boom years. Pig iron was produced near iron and coal sources, then shipped to foundries close to water and rail connections near populated areas with markets for finished iron products.

The simultaneous maturing of iron technology and the city of Washington is illustrated by the proliferation of foundries in Washington, even though it was not a noted center of iron work such as Baltimore and Philadelphia. Washington had five foundries in 1870 and fifteen most years from 1895 to 1905. By the early 20th-century, iron founding was gradually superseded by steel; iron companies often shifting from iron to steel.

Iron, in common with many technologies, social movements, and materials in the second half of the 19th-century, demonstrated the confluence of a number of societal forces. Post Civil War prosperity, meteoric population growth, the creation and extension of transportation routes, and technological development, all combined to join capability with demand in construction, including structure, plumbing, and ornament. Techniques for rolling iron were developed in response to demand for thousands of miles of iron rails for a rapidly expanding national rail system. Once available, rolled iron sections were used for building structures allowing the construction of more fire-resistant buildings and ultimately the modern skyscraper.

Cast iron was available for the great municipal public works projects of the 19th-century, appearing as bathtubs, sewer and water pipe; bollards and light posts; street car rails; and fences separating front yards from sidewalks. As post-Civil War tastes for elaborate architectural styles developed, cast iron was there to provide affordable mass-produced ornamental and structural components.

This same confluence of forces is dramatically visible in Washington and on Capitol Hill in particular. The trouble-plagued C & O

CONTRIBUTED TO ITS 19TH-CENTURY POPULARITY FOR MANY ARCHITECTURAL APPLICATIONS INCLUDING WINDOW HOODS. THESE ARCHITECTURAL ELEMENTS NEED THE SAME CAREFUL MAINTENANCE AS IRON STAIRS AND STOOPS.

Patrick Lally, photo

MONUMENTAL ARCHITECTURAL LIGHTING AT UNION STATION

Patrick Lally, photo

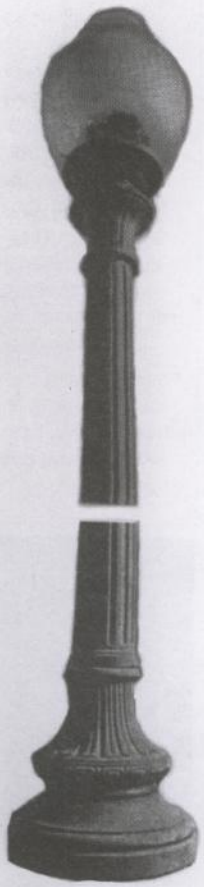
AN ORNAMENTAL URN, 213 C STREET, NE

Judith Capen, photo

HAIRPIN FENCE

Patrick Lally, photo

LIVERY HITCHPOST, SIXTH AND E STREETS, SE



Judith Capen, photo

STREETLIGHTS

Canal, linking inland coal and agriculture to the coast, had its best years in the 1870's, transporting 904,898 tons of coal in 1875 from Pennsylvania fields, bound not only for Washington but also as far away as New England foundries.

Washington foundries, dependent on rail and/or water connections for raw materials in the 1870s to 1890s, were usually in Georgetown, near the Canal terminus, or along Maine Avenue on the Potomac River waterfront, easily accessible to coal-laden canal boats via the Georgetown incline plane or the Rock Creek outlet. The 1860 to 1893 boom years of private, public, municipal, and Federal construction in Washington created great demand for manufactured products, including iron products. These years also witnessed the transformation of American cities.

Simultaneous with the maturing of iron as a material, the commercial building type emerged. Commercial structures, heretofore largely indistinguishable from residential building forms, first began to be differentiated in the 1870s by shop or display windows, later by the size of those windows, and light, open facades. Many of the building permits available for Washington in the years after the bay projection legislation of 1871 are for construction in public space and many of those permits are for show windows. First, a simple bay was built out from the masonry window opening, evolving to nearly full building width projecting shop window bays, possible because iron beams could support the weight of the building front above. As 19th-century commercial districts became denser, the desire for fire-resistant construction and bigger windows helped spur the development of cast, wrought, and rolled iron products. In the literature and advertisements of the era, iron was enthusiastically described as a virtual panacea for all construction challenges.

In these same years, cast iron perfectly fit the needs of Capitol Hill developers and residents. As a cast metal it could be formed into an infinite array of architectural applications. Stairs, shutters, fences and their decorative components, window hoods, sills, shutter pinions and dogs, cresting, drainpipes, sewer lines, urns, fountains, reinforcing stars, call boxes, bollards, street lights, and sewer covers are just a few products cast in iron.

Nineteenth century cast-iron molds reflected the tastes of the day, and produced interchangeable cast-iron parts with a vast range of ornament in every architectural vocabulary to satisfy a middle class Victorian consumer ravenous for decoration. Iron was strong, inexpensive to produce, manufactured quickly, and easily assembled with little on-site labor.

Washington, like all 19th-century cities, was susceptible to large-scale fires. In the 1870-73 period, the city passed increasingly rigorous ordinances limiting the use of flammable materials in construction. Our neighborhood, whose explosive growth begins in those same years, reflects those ordinances with its use of fireproof brick, cast-iron entrance stairs, and metal ornament.

Most Capitol Hill builders of the 1870s to 1900 would have ordered iron stairs, architectural ornaments, and fences from local companies such as the George White Ironworks in Washington or the Hayward Bartlett Company in Baltimore. Even as steel supplanted iron in architectural use, cast-iron foundries continued to supply Washington builders with stairs and ornamental iron well into the 20th-century.

PATTERNS AND PRECEDENTS: IRON STAIRS AND STOOPS

House Fronts. Most Capitol Hill houses are elevated two steps to a half-story above sidewalk level, necessitating front stairs and stoops, typically cast iron. Cast-iron railings are also found on some weighty Richardsonian masonry stairs and stoops. Cast and rolled iron appeared on:

- fences delineating the newly "parked" public spaces that are our front yards

CAST AND WROUGHT IRON

Cast iron, wrought iron, and steel are all metallic iron, made by reducing iron from its non-elemental combined form of ferric oxide ($F_{e2}O_3$) in iron ore in proximity with carbon in a blast furnace. The carbon used is commonly wood charcoal or coke, a partially combusted form of coal. When the iron in ore (F^{+3}) and carbon are heated together, a chemical process involving gain of negative electrically charged electrons occurs, resulting in elemental metallic iron ($F_e{}^0$). This iron is cast in ingots called "pigs," usually close to sources of iron ore and coal, heavy bulky materials more difficult to transport than finished pig iron ingots. Pig iron and cast iron are similar in composition. Pig iron becomes cast iron with a carbon content of 2-6% when remelted in a cupola or air furnace and cast in sand molds. These processes were developed and widely applied in England from the 16th-century.

The casting process produces uniform, standardized products easily assembled with screws, bolts, and other mechanical fasteners. Since the molten iron is cast in molds, seams, air holes, and rough edges are common. It is relatively rust resistant. Cast iron has a brittle, crystalline structure and performs well in compression, such as columns.

"Wrought" iron originates in the same material, pig iron, but is "worked" by hammering while hot, cooling, and sometimes cold, transforming its metallurgical properties in the process. Wrought iron may be hand or machine hammered and typically has about a .04% carbon content. The working of the iron incorporates slag in its structure, giving it a fibrous structure and a light gray color. It can be hammered out, twisted and stretched into softer, more curvaceous forms than heavier cast iron. Cold working hardens iron. Because wrought iron is hand-crafted, individual pieces do not look mass-produced and normally cost much more than cast iron, which can be mass-produced when quantities justify a production run. Wrought iron is normally joined by welded or hammered connections. Wrought iron's fibrous structure gives it great tensile strength, making it a good material in tension, such as for horizontal spanning members like beams.

Most of what is commonly referred to today

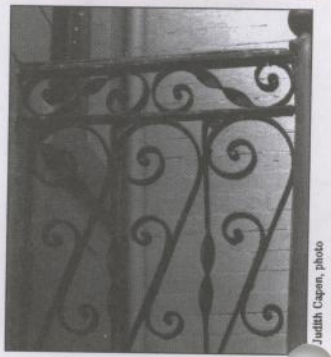
Judith Capen, photo

Judith Capen, photo

THE RICHNESS CONTRIBUTED TO OUR NEIGHBORHOOD BY THE AMAZING VARIETY OF IRON FENCES IS A PRODUCT OF 19TH-CENTURY IRON TECHNOLOGY, ALSO. THE FINIALS AND DECORATIVE PIECES ARE CAST IRON, THE HORIZONTAL AND ROUND VERTICALS ARE "MERCHANT IRON," OR A FORM OF MILD STEEL, SOFT ENOUGH TO BEND AND SHAPE. WROUGHT IRON, LESS BRITTLE THAN CAST IRON, IS SHAPED BY HAND - NOT MANUFACTURED.

Judith Capen, photo

THESE LIGHT BRACKETS FROM THE CAPITOL HILL PRESBYTERIAN CHURCH, INDEPENDENCE AND FOURTH SE, ORIGINALLY GAS FIXTURES, HAVE THE CURVACEOUS LINES TYPICAL OF WROUGHT WORK.



Judith Capen, photo

THE RAILING AT 630 EAST CAPITOL STREET IS A CHARACTERISTIC OF WROUGHT IRON WORK.

- stairs and stoops, usually running straight from the sidewalk to the front door, but sometimes parallel to the sidewalk
- basement security grilles
- window hoods
- decorative elements such as urns
- structural elements such as beams and tie rods, capped-off with stars visible on some house exteriors
- entire shop fronts, and even surprise elements like a window sill in a store front otherwise of wood and pressed metal.

In its years of astonishing growth, 1870 to 1893, the city was electrified and sewer and water systems were installed. In addition to the stairs and stoops walked on every day, we also walk over cast-iron manhole covers providing access to utilities below. Our streets are lit by cast-iron street lamp posts; we call the police from cast-iron call boxes; fire fighters connect to city water supplies at cast-iron fire hydrants.

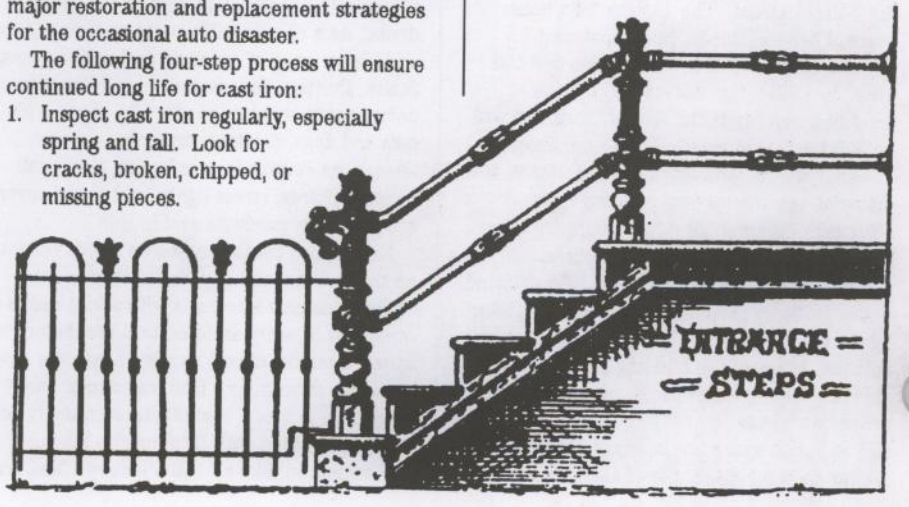
House Sides and Rears. Cast iron seems to be a material reserved for street or "Mary Jane" fronts while wood and brick predominate on the "Plain Jane" rear elevations. Some Capitol Hill row houses originally had wood front stoops, but virtually all of them had wood back or side stairs, not cast iron. While front wood stoops were often later improved to iron, concrete, stone, or combinations of these materials, back stairs were rarely upgraded as originals rotted.

RECOMMENDATIONS:

Maintenance and Repair of Cast Iron. Routine maintenance is the keystone supporting all of our historic building fabric. Modest outlays in time and money for routine maintenance will preserve hundred-year-old building elements for the next hundred years, reserving major restoration and replacement strategies for the occasional auto disaster.

The following four-step process will ensure continued long life for cast iron:

1. Inspect cast iron regularly, especially spring and fall. Look for cracks, broken, chipped, or missing pieces.
2. Keep cast-iron surfaces clean, free of dirt, grease, salts, and other damaging substances. You can occasionally clean well-painted cast iron with a mild detergent.
3. Immediately remove rust and repaint.
4. Keep cast iron adequately painted, touched-up, and caulked where applicable with good polyurethane or butyl caulk. Try to repaint and touch-up with similar paints from the same company. Frequent painting is essential to preserve cast iron.

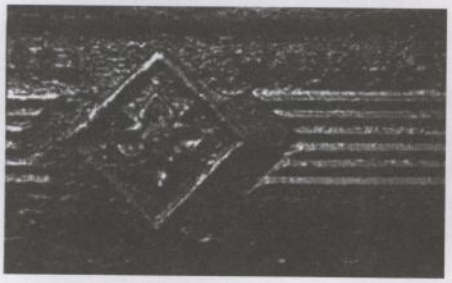


as "wrought" iron is actually "merchant" iron, a form of mild steel, hot rolled and soft enough to be bent into forms like our hair-pin fences. Stock merchant iron bars and castings are welded together to form fairly routine economical aggregations for railings, window guards and the like. The "iron", commonly used for the rods and bars in our fences and security gates is also "merchant" iron, although cast points and other decorative shapes are frequently applied. The term "merchant iron" may have its origins in 19th-century classifications of iron. Modern merchant iron, open hearth or Bessemer steel is iron with .2 to .6% carbon content, typically rolled into shapes like angles, "I's," "H's" rods, and bars.

Patrick Lally, photo

THIS BASE OF A NEWEL POST FROM THE UNIT BLOCK OF FOURTH STREET, SE SHOWS THE G. WHITE & CO. FOUNDRY STAMP.

ISTORIC IRON ADVERTISEMENT FROM J. BLATZHEIM, ORNAMENTAL AND ARTISTIC IRON WORKS, IRON AND WIRE WORK IN GENERAL.



Judith Capen, photo

JUST ABOVE THE FLORET ON THE FIRST RISER OF MANY CAPITOL HILL IRON STAIRS IS THE FOUNDRY MARK "FRED J WHITE WASH D C." THE FRED WHITE FOUNDRY WAS A SUCCESSOR TO GEORGE WHITE AND CONTINUED TO MANUFACTURE MANY OF THE SAME STAIR PATTERNS INTO THE 20TH CENTURY.

ORIGINAL OR HISTORIC?

Most of us on Capitol Hill assumed the cast-iron stairs and stoops on our row houses were original. A number of pieces of circumstantial evidence pointed that way, but it now appears that some of our iron stairs and stoops were added later.

The first riser of many grape pattern iron stairs on 19th-century houses is imprinted with "Fred J. White Wash. D.C." But, there was no Fred J. White foundry listed in the city directory until 1905, suggesting the cast-iron stairs and stoops found on some 19th-century row houses were added in the 20th-century. (The Fred J. White foundry is likely a successor to other White family foundries. A "White and Bro." on Maine Avenue appeared in the "Iron Founders" city directory listings in 1876, and the company name "White and Bro." evolved to George White and Co. to George White and Sons still on Maine Avenue. While listings in the city directories can be spotty and somewhat unreliable, there is a clear pattern and seemingly clear evidence that Fred White was not casting iron until significantly later than many of the buildings bearing his stairs were built.)

An original, hand written set of specifications from the construction of a pair of houses "on 9th Street near B" is a second piece of evidence. These houses were specified with wooden front steps. Today, a hundred years later, the houses have concrete steps with iron hand rails.

Thus, our picture of the stairs and stoops of Capitol Hill has become more complex. Some Capitol Hill Houses originally had wood front stairs and stoops, most of which have been replaced over the years with cast iron, concrete or stone steps with iron rails. The identical iron stairs and stoops of so many row house groupings on the Hill suggests those stairs are indeed original to many houses. Differing stair riser patterns on a group of otherwise identical houses could be an indicator that the group was not built at the same time, as is the case in the 902-920 group on Pennsylvania Avenue, built sequentially by the same builder, known to us from building permit records.BOX Most of us on Capitol Hill assumed the cast-iron stairs and stoops on our row houses were original. A number of pieces of circumstantial evidence pointed that way, but it now appears that some of our iron stairs and stoops were added later.

Problems with Old Cast Iron. All cast iron is subject to a number of threats. Historic cast iron has just had longer to be threatened by corrosion, cracks in individual pieces, missing pieces, failed anchorage, failed connectors between pieces, or deterioration from imperfections in the original casting.

THE RAILINGS ON THE GEORGE WHITE STOOP (BELOW TO THE LEFT) FROM THE 1892-3 BUILDERS' CATALOGUE ARE SIMILAR TO THOSE OF THE FOUNDRY IN THE UNIT BLOCK OF FOURTH STREET, SE (BELOW)

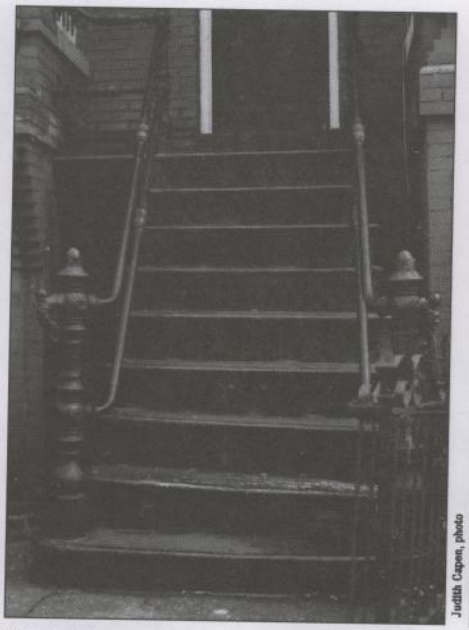
Patrick Lally, ph

Rust/Corrosion. Cast iron corrodes or rusts when exposed unprotected to the oxygen in air, salts, acids, chemicals, and incompatible metals. Acid rain, road salt, particulates in air pollution, and joining the iron to an incompatible metal such as copper or lead, all cause deterioration. Washington's humid climate facilitates the rusting of poorly maintained cast iron. Salt, tracked onto cast iron stair treads in the winter from city streets and sidewalks, becomes an accelerant to the rusting process initiated by moisture. Once corrosion begins, if allowed to continue, the rusted area will trap additional moisture, accelerating the process. Corrosion can lead to the total disintegration of a cast-iron object or can weaken it until it breaks. Too many of Washington's cast-iron stoops, entrance stairs, window hoods and other exterior cast-iron items have been lost to rust over the years.

Painting. Traditionally, Capitol Hill's cast-iron stairs, stoops, and fences were painted high gloss, jet black. Visual evidence suggests finials, newel post caps, and other ornament were painted in contrasting gold or silver such as found on radiators. Several hues of dark

Judith Capen, photo

FOUR ADJACENT HOUSES AND ORIGINALLY IDENTICAL SETS OF STAIRS: THE ORIGINAL HISTORIC IRON STAIRS AT THIS HOUSE WERE REPLACED WITH INAPPROPRIATE STEEL STAIRS.



Judith Capen, photo

THE BROKEN RISERS AT THE BASE OF THIS SET OF STAIRS CAN BE REPAIRED VERY FEASIBLY IF DONE BEFORE FURTHER DETERIORATION OCCURS.

Judith Capen, photo

THIS RUN OF STAIRS IS IN GOOD SHAPE EXCEPT FOR SOME SETTLEMENT.

elements varied. Victorians frequently painted manufactured items like iron to simulate the natural materials for which they substituted. The Capitol dome, for example, is painted white to blend with the marble of the House and Senate wings. Similarly, cast-iron urns might be painted terra cotta; decorative window hoods might be painted the color of brownstone or sandstone; columns might be painted to imitate marble. Cast iron brought a wealth of architectural detail to those who could not afford costlier handcrafted items. Restorationists wishing to replicate the historically appropriate cast-iron finish for their property may consult a professional paint analyst.

Surface Preparation. Surface preparation is the first step to ensure proper adhesion of paint when cast iron needs to be painted. The cast iron must be clean, stripped of loose paint, and free of dirt, grease, rust or anything that will interfere with paint adhesion. At a minimum, ironwork will likely need a thorough scraping, wire brushing, and sanding to get down to a sound substrate or bare metal. Only tightly adhered paint similar to that being applied should remain. Sand glossy surfaces to dull. Substantial paint removal may be required on neglected cast iron or on which built-up thickness of paint has cracked, allowing water in.

Begin surface preparation of cast iron with scraping and wire brushing, using caution not to damage fragile or brittle cast iron. Since most old cast iron has many layers of paint, scraping and wire brushing will likely only remove chipped or flaking paint. Detailed ornamental surfaces of cast iron often accumulate paint coats and rust.

Paint Removal. Many homeowners choose to remove paint themselves before employing an ironworker to repair damaged ironwork. Paint removal often involves toxic and caustic chemicals, so use caution and always follow manufacturer's directions. Test your method on a small inconspicuous area for effectiveness, potential effect on the iron, and implications for the overall job, before proceeding.

Virtually all paint manufactured before 1978 contained lead. Red lead was commonly used as an anti-rust primer for cast iron because of its excellent water-resistance and adhesion properties. Besides its extremely useful properties, lead is highly toxic and can hinder brain cell development in children and the unborn, and impair the health of adults exposed to high levels by breathing fumes from heat stripping or exposure to airborne particles from scraping or sanding.

Children can ingest lead as paint flakes or be exposed to it in the soil, air, and water of their environments. Much of our old cast iron has elevated levels of highly toxic lead from lead based coatings used before 1978, so take precautions, at the least using a respirator type mask when doing any sanding, wire brushing, or other work on painted cast-iron stairs that will potentially create air-borne paint flakes.

Make sure dropcloths cover the ground where paint removal is in progress and dispose of any residue or flakes immediately upon completion of each stage in the process. Wash off all flat surfaces nearby. Check with the District of Columbia for approved drop-off sites where toxic materials are accepted. Before large-scale paint removal such as on entrance stairs or stoops, property owners may wish to consult one of several certified lead-abatement contractors to test for lead in paint chips and remove any hazardous material in accordance with EPA-approved standards.

Chemical Paint Removal. Heavy paint buildup may require chemical removers found in commercially available liquid or gel strippers. These compounds usually remove only one layer at a time, so scraping or wire brushing first removes some paint to give the chemical remover a head start. Apply liquid or gel strippers to the painted surface according to the manufacturer's directions, then use steel wool, a scraper or a wire brush to remove the sludge. When down to bare metal, wash the entire surface with mineral spirits. Always wear protective clothing and goggles when using these products.

Abravise Cleaning. The National Park Service recommends low-pressure grit blasting

CORROSION, OXIDATION, AND RUST.

For this guideline, we use these terms interchangeably. "Rust" is a historical, non-technical term referring specifically to iron-based oxidation in exposure to moist air, resulting in a reddish-brown surface. "Oxidation," as the name implies, is a particular type of chemical reaction usually involving oxygen, which can be accelerated by moisture. "Corrosion" also involves oxidation, but, unlike rust, is not specific to iron, and can involve metals in general. Corrosion can occur through a process that does not involve oxygen but by galvanic action, called galvanic corrosion. In galvanic corrosion the contact of two dissimilar metals in the presence of an electrolyte, frequently water, causes transfer of electrons and the deterioration of the less stable metal in the Standard Electromotic Force Series.

THE MOST DISTRESSING OF ALL IS THIS SET OF STAIRS WHERE BRICK HAS BEEN INSTALLED ON TOP OF HISTORIC IRON STAIRS. IT IS A VERY POOR IDEA, DENYING THE NATURE OF THE IRON IN [illegible] OF ANOTHER MATERIAL. THE BRICK WILL HOLD WATER [illegible]NST THE IRON, GUARANTEEING CORROSION AND THE ULTIMATE DESTRUCTION OF THE HISTORIC IRON.

Patrick Lally, photo

REPAIR AND MAINTENANCE PRODUCTS: PAINT THINNER, SCRAPERS, BRUSHES, PAINT REMOVAL PRODUCTS, CAULK, SANDPAPER, PAINT, AND PRIMER.

Patrick Lally, photo

Patrick Lally, photo

INTERMEDIARY NEWELS WITH OLD PAINT REMOVED AND WITH NEW PRIMER, AND TWO COATS OF GLOSS BLACK ALKYD EXTERIOR PAINT APPLIED. NOTE FIRMLY ATTACHED RAILS - THE NEWEL CONNECTION CAULKED TO ENSURE A WATERTIGHT SEAL. ALSO NOTE BASE FIRMLY ANCHORED TO LANDING PLATE WITH RODS AND BOLTS AND RISER SECURELY SCREWED TO STRINGER.

as one of the most effective ways to remove rust and many layers of accumulated paint from cast iron. Interestingly, sand blasting was first developed as a paint removal technique for cast iron. It is fast, cost-effective, thorough, and allows ironwork to be cleaned in-place. Do not use excessive pressure (over 100 pounds per square inch), grit such as sand, other sharp or hard aggregates, or incompatible grits such as copper slag.

Normally this is not a homeowner job. It is best to hire a professional, with impeccable references. The result produces a clean, paint-free surface to which paint adheres well. Take care to avoid overspray on nearby brick, stone, wood, and glass surfaces, covering them for their protection. Permits for this procedure are limited in the District of Columbia; consult with the Historic Preservation Division before such work is begun. Never wet-pressure blast cast iron. The water will immediately begin the rusting process on the exposed surface.

Other Paint Removal Methods. Peel Away©, an extremely caustic product with the look and consistency of wet plaster, is advertised to remove dozens of layers of paint with one application. The painted surface is slathered with Peel Away©, and a protective paper is applied to the wet compound. After 24 hours the paint layers bond with the paper and the entire surface is peeled away, usually intact. Lead paint is safely contained in the waste for approved disposal at a DC hazardous waste drop-off facility. The remaining residue is water soluble.

There are merits to this product, but consider its disadvantages, too. Although the residue on the cast iron is water-soluble, water is not recommended for cleaning iron. The surface may be cleaned with mineral spirits, but not before neutralizing the Peel Away© chemicals with an approved agent. Failure to neutralize the chemicals in this product may cause discoloration of new paint. Finally, this product is best suited to flat elements because it is hard to get the paper to conform exactly to complex shapes. While it can be used without the paper, it is then just as messy as other chemical strippers.

Flame cleaning. An oxyacetylene torch can effectively remove light rust and paint from metal surfaces. It is potentially dangerous because of the open flame and heat-vaporized lead released into the air from old paint. Because of the hazards and equipment that can be prohibitively expensive, consider using aprofessional for this method.

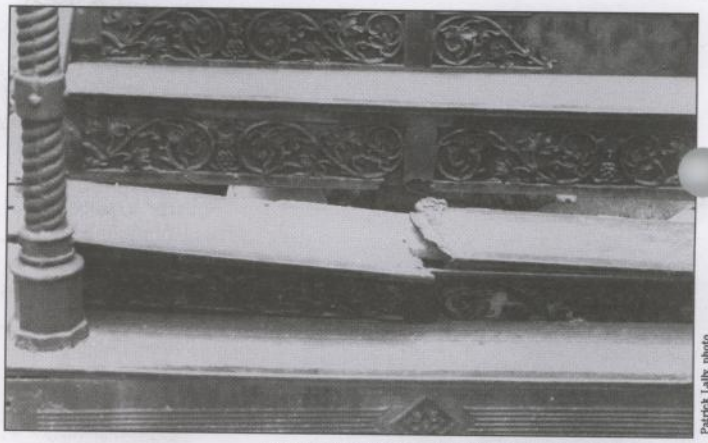
Acid pickling or dip stripping effectively removes rust from cast-iron parts that can be disassembled and taken to a shop where they are dipped in chemical vats. Cleaned components are then reassembled at the site after being neutralized.

A combination of paint removal treatments may be necessary to remove all the paint accumulation.

Rust Converters are an alternative to complete removal of all rust. They turn the rust (iron oxide) into iron phosphates or complex organo-metallic compounds, all stable and good undercoating for repainting. The great advantage of rust converters is that they brush on and, as liquids, find their way into tiny cracks and joints where rust may lurk. There are two categories of these rust converters: one is orthophosphoric acid-based and the other is tannic acid-based. Try to avoid those that contain resins as they are more expensive with shorter shelf-lives, and don't allow recoating. Inquire at your local hardware or paint store for these products.

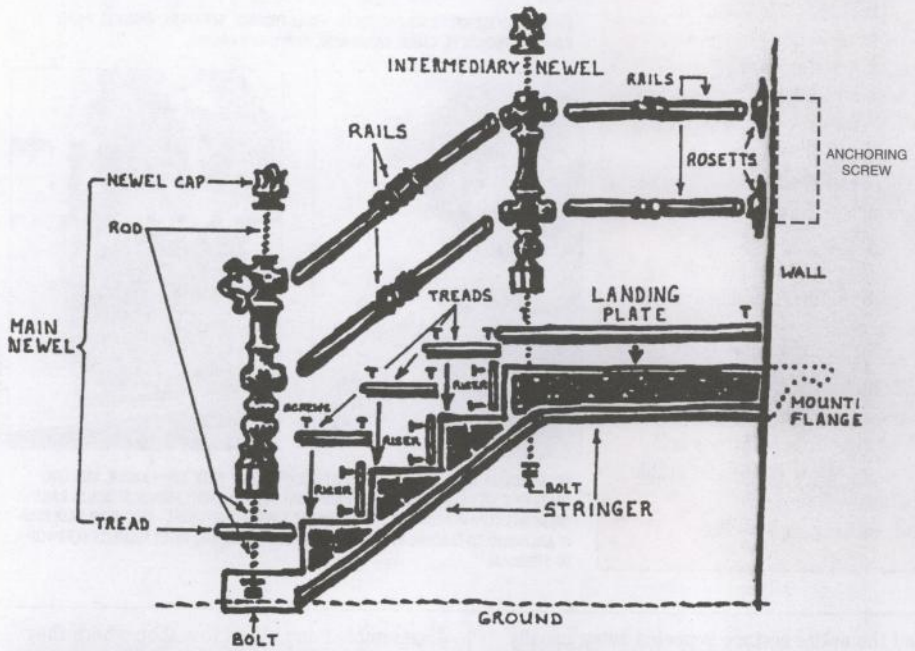
As with so many old-house projects, the first paint removal project on a set of cast-iron stairs and stoop is likely to be the most extensive. Once decades of accumulated paint comes off, subsequent painting and re-painting can become relatively routine.

Repairs to cracked, broken, or missing pieces of historic cast iron should be done by



Patrick Lally, photo

WHILE IN EXTREMELY BAD CONDITION, SHOWING EVIDENCE OF NUMEROUS FAILURES AND ILL-CONSIDERED REPAIRS, THIS SET OF FRED J. WHITE STAIRS CONTAINS ENOUGH INTACT MATERIAL TO WARRANT A CAREFUL RESTORATION AND REPAIR JOB. WHATEVER STRUCTURAL FAILURES ARE AT WORK HERE MUST BE ADDRESSED FIRST. THEN ALL INTACT FABRIC SHOULD BE SALVAGED WITH THE MISSING PARTS MADE UP FROM ARCHITECTURAL SALVAGE, REPLICATION, OR SYMPATHETICALLY INSTALLED NEW MATERIAL.



CAST-IRON STAIRS ARE AMONG THE MORE COMPLICATED 19TH-CENTURY FOUNDRY PRODUCTS. THE ENTIRE STRUCTURE, HELD TOGETHER BY SCREWS, RODS, AND BOLTS, RESTS ON TWO STRINGERS. THE STRINGERS ARE AFFIXED TO THE WALL, AND REST ON THE GROUND. A SINGLE-PIECE LANDING PLATE AND TREADS JOIN THE STRINGERS. THE NEWELS SIT BOLTED TO THE STAIR TREADS OR THE LANDING PLATE WITH RODS FROM THE NEWEL CAP, THROUGH THE NEWEL SHAFT AND THE TREAD/PLATE. DECORATIVE RISERS BETWEEN THE STRINGERS ARE SCREWED TO THE ASSEMBLY.

Patrick L

EMBEDDING THE NEWEL OF THIS STAIR IN CONCRETE IS INAPPROPRIATE. CONCRETE'S TENDENCY TO HOLD MOISTURE IN CONSTANT CONTACT WITH THE IRON WILL ACCELERATE THE CORROSION PROCESS ON THE EMBEDDED PART WHERE IT IS IMPOSSIBLE TO PROTECT IT WITH PAINT. NEITHER CAST NOR WROUGHT IRON SHOULD EVER BE EMBEDDED IN CONCRETE OR OTHER HYGROSCOPIC MATERIALS, SUCH AS BRICK AND MORTAR.

qualified ironworkers who can thoroughly assess the damage, ascertain the ironwork's structural integrity, and address the damage's remediation. Most damaged cast iron can be repaired, and many irreparable items can be replaced. Never alter, remove, or replace architectural cast iron without consulting a qualified ironworker and getting a building permit.

Cast Iron Disassembly. In some cases, architectural cast iron may need to be disassembled to replace, restore, or reinforce individual components. A professional iron worker should perform this task. Number and record all the parts carefully for reassembly.

Staircases and stoops are complicated structures to disassemble. Rods, screws and bolts used to join the elements are usually rusted or corroded beyond repair. These fasteners must be cut, sawed, or drilled and new ones fit to replace them. The entire unit must then be reconstructed exactly as it was originally.

A common assembly failure found on many Capitol Hill stairs is rusting through of the vertical rod running from the top of the newel through the newel and a stair tread. Often this is evident as a loose ball top on the newel allowing actual removal of the piece. The newel may still seem to be secure because of corrosion that has joined it to the stair tread on which it sits. However, corrosion does not create a secure joint. Subject to stress, as when a person begins to slip and grabs a handrail, the joint could fail, causing the newel to fall over, possibly shattering and also possibly causing injury to a person.

Sometimes, people ill advisedly pour concrete inside these newels, in an attempt to re-secure them. The concrete hastens corrosion of the newel from the inside. Pouring concrete, a hygroscopic material that absorbs moisture from the air and through which moisture can travel, inside a newel ensures moisture will be kept in constant contact with the iron, on a probably unpainted surface. For the same reason, it is not good to embed any iron elements, stairs, stoops, fences or the like, in concrete, brick, or mortar, all hygroscopic materials.

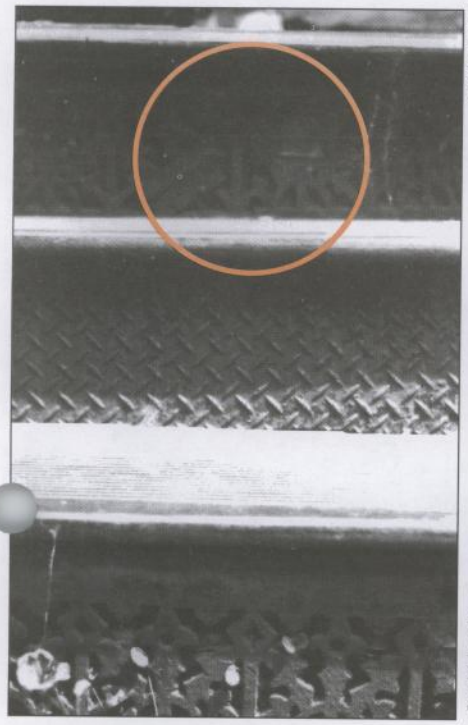
If the vertical newel rod rusts through, it is a relatively simple repair for a knowledgeable ironworker who will insert a new rod and re-bolt the newel assembly to its stair tread.

Remember, cast iron is brittle; cold weather, undue stress, temperature extremes created by welding, and hard blows can fracture the metal.

Welding Cast Iron. Depending on its carbon content, cast iron has slight variations in its resiliency, and almost always contains imperfections from the casting process making welding difficult. Badly done welding can cause permanent damage to the part being repaired. Intense heat from the welding torch and uncontrolled cooling can fracture historic iron.

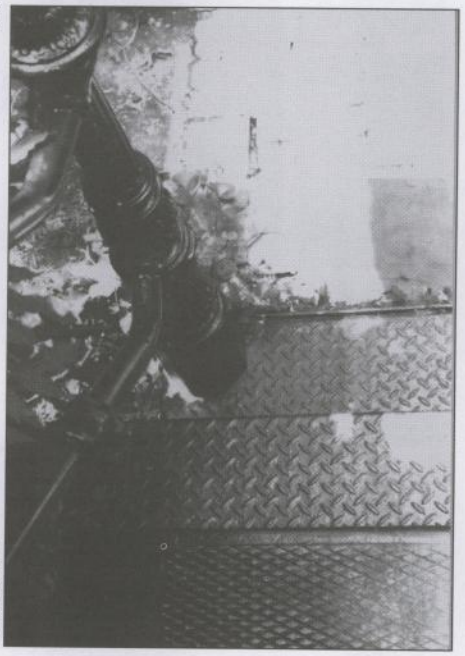
The challenge posed by historic iron to ironworkers is attested to by how often one sees cast-iron stair parts improperly tacked together with a raised, sloppily built-up weld joint at a crack. If the part is structural a poor weld will invariably fail and may result in further damage to adjacent intact cast-iron compo-

Patrick Lally, photo

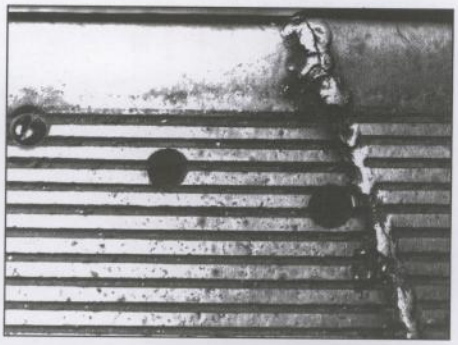


Patrick Lally, photo

LEFT: THIS PHOTO AND DETAIL SHOW SEVERAL UNFORTUNATE REPAIR ATTEMPTS. POORLY MAINTAINED AND BADLY REPAIRED CAST COMPONENTS WILL ULTIMATELY FAIL AND LEAD TO THE DETERIORATION OF ADJACENT PARTS. AS ANY PART OF THE CONSTRUCTION FAILS, IT PUTS STRESS ON ADJACENT PARTS CAUSING OR ACCELERATING THEIR FAILURE IN TURN. APPLICATION OF "CHECKER" PLATE SUCH AS ON THE BOTTOM TWO STEPS IN THE LEFT PICTURE AND BELOW, HAS BEEN A COMMON REPAIR ON MANY CAPITOL HILL CAST IRON STAIRS. IT IS NOT A SOLUTION TO STRUCTURAL PROBLEMS THAT MAY HAVE CAUSED CRACKING OF TREADS IN THE FIRST PLACE. IT IS BETTER TO PROVIDE NEW STRUCTURAL SUPPORT UNDER A CRACKED TREAD, KEEPING IT IN PLACE, AND FILLING THE CRACK TO PRESERVE VISIBLE HISTORIC FABRIC.



Patrick Lally, photo



Patrick Lally, photo

Patrick Lally, photo

THESE PICTURES SHOW SEVERAL INEFFECTIVE ATTEMPTS AT REPAIRS. TOP: THIS WELD JOINT IS AS INEFFECTIVE AS IT IS UNSIGHTLY. ALTHOUGH WELDING CAST IRON IS SOMETIMES SUCCESSFUL IN LIMITED APPLICATIONS, IT IS RARELY A LONG TERM SOLUTION FOR STRUCTURAL COMPONENTS LIKE THIS TREAD BECAUSE IT DOES NOT ELIMINATE THE WEAKNESS ALONG THE CRACK LINE.
BOTTOM: TEMPORARY REPAIRS SHOULD BE TEMPORARY. SOMETIMES TEMPORARY REPAIR MEASURES ARE IN ORDER WHILE PERMANENT SOLUTIONS ARE RESEARCHED, BUT IF LEFT TOO LONG, MAY THEMSELVES FAIL, SUCH AS THIS ONCE BOLT-SECURED CRACKED TREAD. THEN, SURROUNDING UNDAMAGED COMPONENTS OF HISTORIC IRON ARE IN JEOPARDY. GET TO THE ROOT OF THE PROBLEM - IN THIS CASE FAILED SUPPORTS - AND DON'T CONSIDER TEMPORARY REPAIRS PERMANENT SOLUTIONS.

nents. Welds are, also susceptible to failure from rust in hairline cracks at the weld joint. Variations in the expansion coefficient between weld joints and the iron can cause welds to fail in extreme weather.

Iron castings can be welded satisfactorily if the proper techniques are rigidly followed. The most typical acceptable welding method is use of shielded metal arc welding using nickel and nickel-iron or usually coated cast grey iron electrodes.

Welding cannot return a structural member, such as a stair stringer or tread to its original single member integrity. Thus, a weld is inherently less strong than the original iron piece, and subject to the deterioration enumerated above. Furthermore, if whatever caused the tread to crack in the first place is not corrected, a welded repair cannot be anything but temporary. The preferred repair to a broken or failed cast iron member is to use a mechanical repair, bolting a new structural piece to the failed member as inconspicuously as possible, using welding only cosmetically if at all.

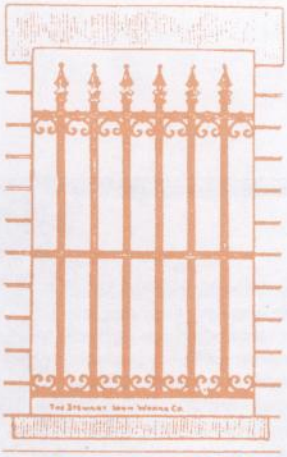
Besides using improper welding techniques, much poor craftsmanship is visible on iron stairs and stoops. Welding is, by its nature, difficult to control often leading to splatters and lumpy-looking welds. Furthermore, the weld, once made, is very hard. This makes grinding smooth extremely difficult to accomplish, especially in light of the Hill's richly molded and striated risers and treads. Before proceeding with welding as an option for broken cast iron, check the iron worker's references and inspect samples of his work. Try to find corresponding repair samples and applications.

Cleaning. Once all the paint removal and repairs are done, clean your cast iron thoroughly before painting to ensure the longevity of the finish. Don't use water because it immediately reacts with bare iron to produce rust. Instead, clean iron with steel wool or cheesecloth dipped in mineral spirits.

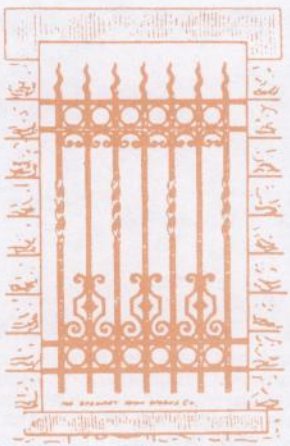
Painting. Once cast iron has been thoroughly cleaned and repaired it must be finished immediately with a primer and final coat of the desired color. A premium system you might specify from a professional would be a zinc-rich organic primer followed by a top coat of polyamide epoxy resin. These coatings have hot solvents so care must be exercised to insure adequate ventilation. The products themselves must be used strictly according to manufacturer's instructions. However, such a system will provide superior chip and wear resistance. These generically identified coatings are available in brand-name versions at local paint stores.

Brand-name, oil-base, red oxide rust-inhibitive primers followed by alkyd or oil-base enamels are typical products used by many property owners. Very roughly speaking, a premium coating system might last up to seven years, while the more typical red oxide and enamel system might last three to five years. Because so much of the maintenance expense is in preparation, hiring a professional and using the more expensive and technically demanding two-part epoxy resin type systems can well be cost effective.

Never use latex paint. Its water base will cause rusting as soon as it is applied.

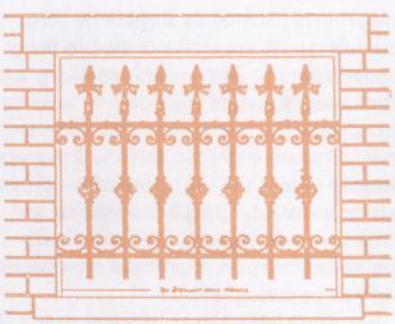


No. 241-A—Vertical bars ⅝ to ¾-inch.



No. 244-A—Vertical bars ⅝ to ¾-inch.

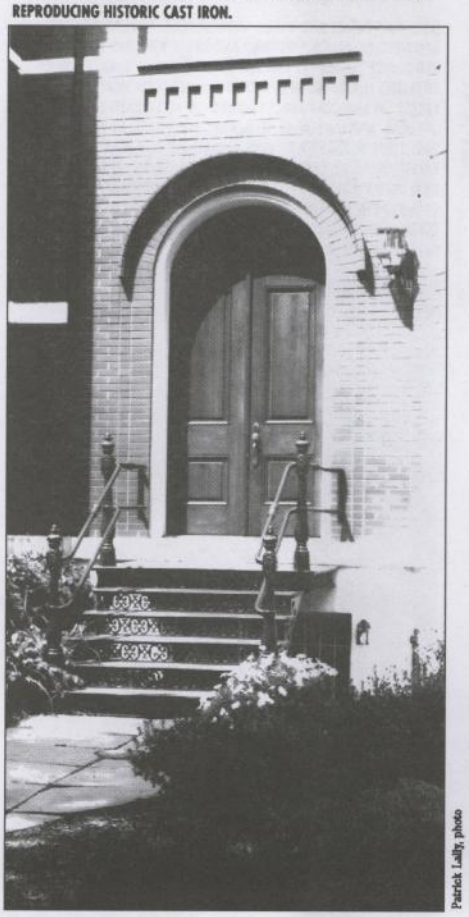
No. 249-A—Vertical bars ⅝ to ¾-inch.



No. 236-A—Vertical bars ⅝ and ½-inch.

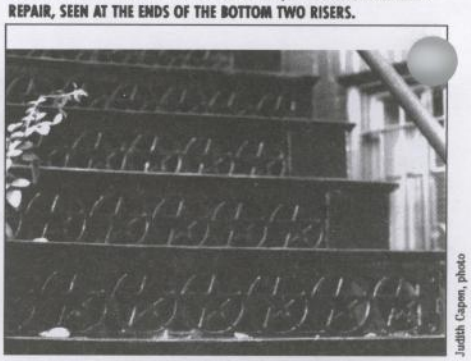
LEFT: THESE IRON GRILLES ARE MANUFACTERED AND AVAILABLE TODAY, DEMONSTRATING THAT A THOROUGH SEARCH WILL OFTEN TURN UP SUPPLIERS MAKING REPRODUCTION 19TH CENTURY PRODUCTS OR WHO MAY HAVE BEEN MAKING THESE PRODUCTS CONTINUOUSLY SINCE THE LATE 1800'S.

REPLACEMENT STAIRS APPROPRIATE FOR CAPITOL HILL ARE NOT NECESSARILY LIMITED TO THE HISTORIC PATTERNS FOUND IN THE HISTORIC DISTRICT. THIS NEW STOOP REPLICATES THE PROFILE, CONFIGURATION, HEFT, AND DESIGN LANGUAGE OF ITS HISTORIC NEIGHBORS WITHOUT REPRODUCING HISTORIC CAST IRON.



Patrick Lally, photo

THE ENTIRE GROUP OF HOUSES FROM 606 TO 614 C STREET, NE, HAVE IDENTICAL STAIRS OF THIS UNUSUAL STAR DESIGN SUGGESTING THE PATTERN IS ORIGINAL TO THE HOUSES. ALSO, NOTE THE EVIDENCE OF REPAIR, SEEN AT THE ENDS OF THE BOTTOM TWO RISERS.



Judith Capen, photo

THE RISERS AT 815 C STREET, NE TESTIFY TO THE POSSIBILITIES OF REPLACEMENT. CAPITOL HILL IRONWORKER FRED MASHACK FABRICATED THEM NEW, REPRODUCING THE HISTORIC PATTER

Judith Capen, photo

The best finish is likely achieved with a combination of spray and brush. Paint spray is more likely to get into the corners and intricacies of detail where brush applied paint might built up, leading to future breaks and cracks in the paint surface. Brushes can apply a sufficiently thick coat on wearing, relatively simple surfaces to provide longer lasting protection than a sprayed finish.

NEW AND REPLACEMENT MATERIALS

Some local ironworkers have substituted non-historic materials for cast iron in recent years. The Secretary of the Interior's Standards emphasize that "every means of repairing deteriorating historic materials or replacing them with identical materials should be examined before turning to substitute materials." Since much of Capitol Hill's historic cast-iron elements, especially entrance stairs and stoops, are exposed to the elements and rest on the ground, replacement of individual parts is sometimes unavoidable. Avoid replacing cast-iron stairs and railings with steel stairs. They lack the heft of cast iron and are clearly incompatible with the design, profile, and composition of the original material.

Cast-iron replacement materials and their sources vary. Some neighborhood ironworkers have developed sources for custom castings for some of the small cast pieces found on our fences and stairs. Often, a single missing or broken stair riser, tread, or railing for an otherwise intact stair can be replicated.

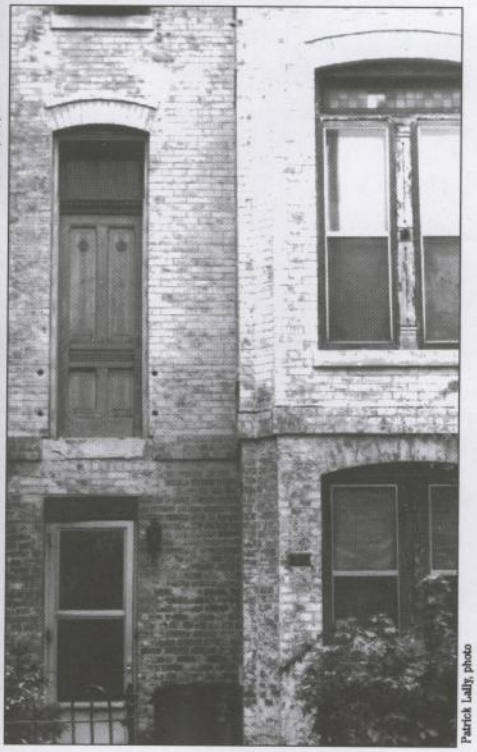
Some modern foundries can or will produce new entrance stairs. Although new materials rarely match historic Capitol Hill cast-iron patterns, a new casting with Victorian Era-inspired motifs can be a good option in new construction or to replace completely missing elements. Good replacement iron is available although not always easily found. Nor is new iron work economical, reinforcing the fact that maintenance to preserve historic fabric is always the most economical strategy. Several sources for replacemet iron are listed at the end of this piece.

Sadly, cast-iron architectural details are

Judith Capen, photo

THESE STEEL REPLACEMENT STAIRS ARE POOR SUBSTITUTES FOR THEIR CAST-IRON PREDECESSORS. THESE STAIRS, WITH THEIR ATYPICAL PROFILES AND CONFIGURATIONS, LACK OF HEFT, AND ABSENCE OF PERIOD ORNAMENT, BEAR NO RESEMBLANCE TO HISTORIC CAST-IRON STAIRS. WHILE THESE MIGHT BE SUITABLE REPLACEMENTS FOR THE REAR OF A HOUSE, THEY SHOULDN'T BE CONSIDERED FOR THE FRONT.

REMOVAL OF THE CAST-IRON STAIR (UNLIKELY TO BE ALLOWED TODAY IN THE HISTORIC DISTRICT) IS ALL TOO OBVIOUS ON THIS BUILDING. THE ABSENCE OF THE STAIRS COMPLETELY ALTERS THE RELATIONSHIP OF THE BUILDING TO THE STREET..



Patrick Lally, photo

PRESSURE-TREATED WOOD TREADS, RISERS, NEWELS, SPINDLES, AND RAILS ARE INAPPROPRIATE SUBSTITUTES FOR HISTORIC CAST IRON. IN THIS EXAMPLE, REPLACEMENT MATERIALS DAMAGE THE OVERALL HISTORIC APPEARANCE OF THE HOUSE AND DETRACT FROM THE HISTORIC INTEGRITY OF THE ADJACENT PROPERTIES.

Patrick Lally, photo

being removed and replaced, often illegally, throughout the metropolitan area. But, these regrettable removals can benefit our historic district when we look for replacement parts. Local salvage companies and ironworkers often know where to find matching cast-iron components to replace damaged or missing pieces.

If in-kind replacement materials cannot be found, several substitute materials, notably aluminum, epoxy, and fiberglass, may be acceptable. Assess each substitute material's specific application carefully, however, since none of them have the structural characteristics of iron.

Some epoxies can be formed to replicate exactly small cast-iron ornaments such as fence finials, newel post caps, and applied ornament. Epoxies are not structural, do not rust, must be painted, and are flammable. Custom-cast-aluminum parts can be made, but re very expensive. Aluminum is lightweight and more corrosion resistant than cast-iron. It does, however, corrode in contact with cast iron and has limited structural strength.

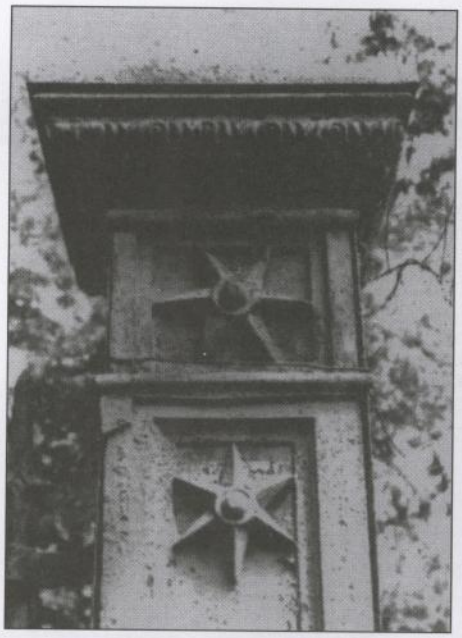
Fiberglass replacement materials consist of epoxy resins with fiberglass reinforcement. It is the most fragile of these replacement materials, but is lightweight, rust-resistant, can be formed into complex shapes such as window hoods, and finishes well. Fiberglass must be painted, is non-structural, and is expensive when only one or two pieces are needed.

Well-maintained architectural cast iron lasts indefinitely and contributes significantly to the 19th-century ambiance of the Capitol Hill Historic District. Its durability, strength, fire resistance, and availability in a variety of popular styles made cast iron highly appealing to Victorian speculative developers whose row houses largely define the historic district. It is, however, one of Capitol Hill's endangered materials. The 20th century has given us other materials and style preferences.

Consequently, the lack of replacement parts, a dwindling number of foundries and craftsmen, deferred maintenance, and a distaste for Victorian design have taken a toll on historic cast iron.

Surviving examples of this material and other elements of Capitol Hill's historic fabric are protected by the 1978 District of Columbia Historic Landmark and Historic District Protection Act. Under the Preservation Act, property owners must preserve historic structures and components such as cast iron through proper maintenance and repair. New construction or replacement materials must be compatible with the defining characteristics of the historic district.

Cast iron, touted as a 19th-century miracle material, turned out not to be the solution to every architectural problem. But, living closely to it, we on Capitol Hill can certainly appreciate its sterling qualities of beauty, durability, and substance and can demonstrate that appreciation by ensuring the continued longevity of our cast iron.



WIRED TOGETHER, WITH BROKEN AND MISSING PIECES, THIS CORNER POST AT THE OLD NAVAL HOSPITAL AT NINTH AND PENNSYLVANIA AVENUE, SE, IS A RATHER INTACT PORTION OF THE FENCE, OTHER PARTS OF WHICH ARE MISSIG ALTOGETHER OR LYING ON THE GROUND. WILL THE HISTORIC DISTRICT LOSE ONE OF ITS FINEST CAST IRON PERIMETER FENCES TO NEGLECT?

THE SAME BOLLARD PICTURED AT THE RIGHT WAS A CASUALTY OF 1996 WINTER SNOW REMOVAL, DRAMATICALLY ILLUSTRATING THE CONTINUING ASSAULTS ON OUR HISTORIC FABRIC WHETHER FROM SNOW PLOWS OR NEGLECT.

HISTORIC BOLLARDS AND CHAINS DEFINE A VESTIGIAL TRIANGULAR BIT OF PUBLIC SPACE AT NINTH AND A STREETS, SE.

THIS INTACT ROW OF TWELVE ENTRANCE STAIRS DEMONSTRATES THE PRECISE RHYTHM, AESTHETIC UNIFORMITY, AND SUPERIOR MAINTENANCE THAT SETS THE STANDARD IN THE HISTORIC DISTRICT.

ADDITIONAL INFORMATION

Gayle, Margot, David W. Look, AIA, and John G. Waite. *Metals in America's Historic Buildings: Part I. A Historical Survey of Metals; Part II. Deterioration and Methods of Preserving Metals.* Washington, D.C., Preservation Assistance Division, National Park Service, U.S. Department of the Interior, 1980

The *Preservation Briefs*, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., are excellent sources of additional material on this topic, in particular:

Waite, John G. *"The Maintenance and Repair of Architectural Cast Iron."* Brief #27.

The *Capitol Hill Restoration Society Design Guidelines*, published by the Capitol Hill Restoration Society, available from the Society, have several related articles:

Capen, Judith; Nancy Witherell. *"The Hows, Whens, and Whys of Getting a Building Permit."*

Capen, Judith. *"Windows: The Eyes of a Building."*discusses design of security iron.

"Entrance—When a Door is More Than a Door." helps place entrance stairs and stoops in context with the entire entrance.

And, keep an eye out two future iron-related guidelines. One will be a catalog of cast-iron stair riser patterns and the other will focus on edges of our front yards to the public sidewalk with emphasis on iron fences.

You may contact the authors at the CHRS phone number listed below for local iron worker contacts.

PRODUCT SOURCES

Always useful, full of good information and pertinent advertisements is *The Old House Journal.* P.O. Box 50214, Boulder, Colorado. 80321-0214. (508) 283-3200.

A newspaper-magazine format, bi-monthly publication with articles and extensive source listings is *Traditional Building.* (718) 636-0788.

Steptoe and Wife (for new cast-iron stairs) Toronto, Canada M6H 2C7, (415) 530-4200.

ACKNOWLEDGEMENTS

This publication has been prepared by the Capitol Hill Restoration Society, a private, non-profit community organization. The content of this document has been reviewed by the staff of the D.C. Historic Preservation Division, technical advisers, and interested members of the community. The content of this document is consistent with review practices of the D.C. Historic Preservation Review Office and the Standards of the Secretary of the Department of the Interior.

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