Figure 1: View of Crescent Avenue Presbyterian Church looking east down Watchung Avenue around 1906

HISTORIC HOMEOWNER STEWARDSHIP & SUSTAINABILITY MANUAL

September, 2022

CITY OF PLAINFIELD,
COUNTY OF UNION
STATE OF NEW JERSEY

Barton Ross & Partners LLC
BRPA Architects

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ABBREVIATIONS

CA: Certificate of Appropriateness

BIPV: Building Incorporated Photovoltaic

BRPA: Barton Ross & Partners, LLC

DGHDS: Design Guidelines for Historic Districts and Sites

FSITC: Federal Solar Investment Tax Credit

HPC: Historic Preservation Commission

LEED: Leadership in Energy and Environmental Design

NJCEP: Nw Jersey's Clean Energy Program

NJRHP: New Jersey Register of Historic Places

NRHP: National Register of Historic Places

NPS: National Park Service

PV: Photovoltaic

USEPA: United States Environmental Protection Agency

USDOE: United States Department of Energy

CONTENTS

EXECUTIVE SUMMARY

The 2022 Historic Homeowner Stewardship and Sustainability Manual was prepared by Barton Ross & Partners, LLC, in collaboration with the Plainfield Historic Preservation Commission (HPC). The manual serves as an addendum to the 2007 Design Guidelines for Historic Districts and Sites (DGHDS), which are accessible on the City of Plainfield's website, www.plainfilednj.gov.

Building practices focused on environmental sustainability have been at the center of combatting climate change. The preservation and reuse of historic buildings is recognized as the one of the best methods of conserving energy and materials. This manual is a resource to guide homeowners through the process of maintaining historic properties and adapting them to increase energy efficiency.

The report contents of the 2022 Historic Homeowner Stewardship and Sustainability Manual are organized into 7 sections.

Chapter I: The Introduction includes a brief history of Plainfield and its architectural development that is specific to the designated historic districts of the city.

Chapter II: Stewardship of Historic Buildings concentrates on the responsibility of owners of locally designated landmarked properties, and those properties within locally designated historic districts. This chapter describes what it means to be protected and regulated under the City's Preservation Ordinance.

Chapter III: Sustainability and Historic Buildings explains Plainfield's goals for reducing energy consumption and what homeowners can do to help achieve that in their own properties.

Chapter IV: Resources and Contacts is intended to provide the most resources and assistance possible to homeowners.

Chapter V: Frequently Asked Questions addresses common questions regarding energy audits, air sealing, insulation, windows and doors, heating, ventilation, and air-conditioning, and renewable energy.

Chapter VI: End Notes shows the resources consulted to create this manual.

Chapter VII: Appendices includes references to a variety of useful resources drawn upon throughout this manual.

The City of Plainfield is committed to advancing historic preservation of the City's distinct community character; it is with good intention that this manual serves as a valuable resource for the City's future preservation planning.

City of Plainfield HPC, June, 2022

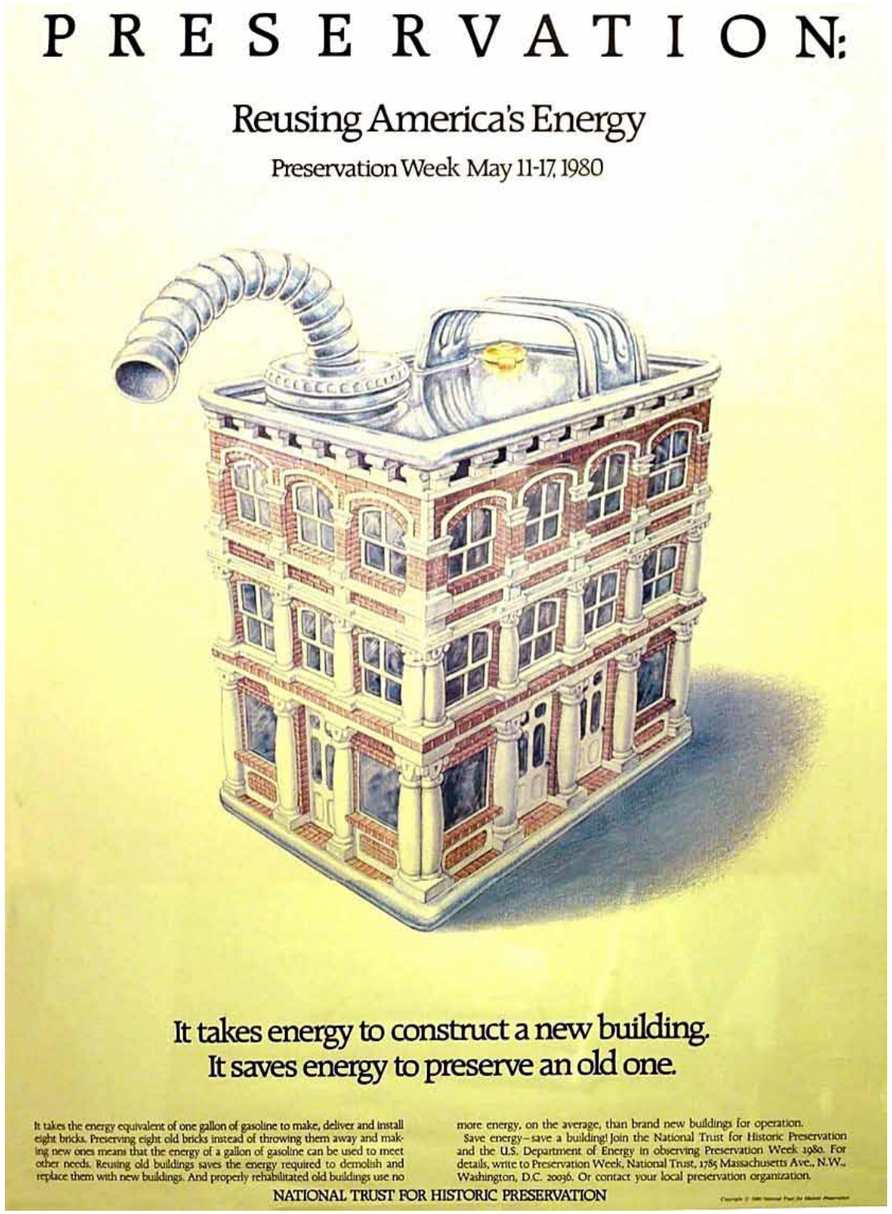

Figure 2: This rendering was created by the National Trust for Historic Preservation in 1980

I. INTRODUCTION

A. Purpose
The largest contributor to the creation of carbon dioxide, caused mainly by the burning of fossil fuels, is the building industry, followed by the transportation industry which is correlated to how materials are moved to and from building sites.[1] Historic preservation and the reuse of the existing built environment is the ultimate form of recycling. The demolition of buildings increases pressures on landfills and requires the demand for raw materials and fossil fuels needed for the transportation of materials and the construction of new buildings.[2] The practice of reusing existing buildings is a sustainable practice that can help mitigate these negative impacts that contribute to climate change.

The information in this manual is meant to be a resource for property owners in Plainfield's historic districts, as well as individual, locally designated landmarked properties located outside the historic districts, to assist in making informed decisions in accordance with the city's Historic Preservation Ordinance and the municipal Design Guidelines.

This manual will also clarify the project review and submission requirements by the property owner to the HPC for approvals of adaptations meant to improve a property's sustainability. The historic significance and characteristics of Plainfield's historic districts and local landmarked properties will be conveyed throughout this manual by drawings, photographs, and diagrams.

B. A Brief History of Plainfield
Plainfield's first settlement dates from the late 1600s; the City today was shaped largely between 1870 and 1930, when the railroad and the accompanying demand for new housing in the New York metropolitan area transformed the small farming and milling village into a fashionable commuter suburb of tree-lined avenues and comfortable homes. These commuter-workers and builders have left the City with an irreplaceable stock of valuable housing, residential neighborhoods, churches and civic buildings, and commercial areas.

Rural Settlement and Mill Village: 1680-1869
European settlement in Plainfield dates from the 1680s, when a number of ethnic Scots from Perth Amboy established farmsteads along Cedar Brook. Throughout the 1700s population was sparse, numbering less than one hundred persons by the time of the Revolutionary War. Settlement was comprised mainly of dispersed farms and landholdings. The Green Brook provided the waterpower for milling, which determined the location and early development of the town's center.

The first railroad was completed through Plainfield in 1837. Between 1800 and 1835 Plainfield's population increased tenfold to 1,030. The ethnic and racial composition of early Plainfield has not been well studied, but certainly African Americans numbered among Plainfield's early residents, as both free blacks and slaves are enumerated in the censuses prior to the Civil War. By the mid 19th century, building and population was concentrated in the area bound by Green Brook, Plainfield Avenue, Sixth Street, and Roosevelt Avenue. The rest of the town was still predominantly agricultural, but the 1850s and 1860s saw the first appearance of stylish country estates on the landscape, sign of impending social and economic change that would alter Plainfield dramatically.

Victorian Railroad Suburb: 1869-1900

Plainfield was incorporated in 1869, shortly after the rail connection with New York City was completed. A wave of land development and building activity hit Plainfield in the 1870s and 1880s, producing compact residential neighborhoods filled with substantial Victorian period dwellings from pattern book designs of the period. Larger residential properties, including a number of sizable country estates, characterized new development along several major corridors that cross the city. The scale, architecture and function of the central business district also changed dramatically during the late 19th century downtown streets, lined with low-rise wooden shops and stores intermingled with wooden dwellings, were replaced by larger brick stores and office buildings to serve the growing population.

Figure 3: Postcard showing the East Front Street in the late nineteenth century

Suburb to City: 1900-1950

During the first three decades of the 20th century, Plainfield evolved from an outlying suburb to a regional hub of transportation, trade and industry, a change that mirrored growth patterns in Union County and northern New Jersey as a whole. Plainfield's central business district enlarged and industrial activity along the railroad corridor also expanded. While local jobs in business and the professions increased, a substantial portion of Plainfield's residents continued to commute by railroad to workplaces in New York and Newark until after World War II. Residential development of the early 20th century equaled the scale and grandeur of Victorian era building in selected areas of the City but despite the continuation of mansion building, the number of upper-income residences declined in proportion to the middle-class housing that was constructed throughout the City. Following the 1930s Depression and World War II, the return to prosperity and peace created an enormous demand for new housing. Plainfield's large estates were subdivided during the post-war years, and the former estate grounds were

Figure 4: Historic postcard depicting the Richmond Towers high rise apartment buildings built in the mid twentieth century

built up with new cape cod houses, ranch houses, and apartment complexes. In addition, many other Victorian mansions in older neighborhoods were demolished in the 1940s and 1950s. By the mid 20th century, Plainfield became a dense, urban community that characterizes the City today.

C. Plainfield's Architectural Development Specific to the Locally Designated Historic Districts

There are over 600 historic properties locally designated in Plainfield that are protected and regulated by the City's historic preservation ordinance. This includes 10 locally designated residential historic districts and 18 individual historic landmarks.

Crescent Area Historic District (City 1979; NRHP/NJRHP 1980)

The Crescent Area Historic District was developed in the 1870s as an early planned development of upscale residences. Developer, Job Male, Plainfield's first mayor, was a philanthropist and resident of the Crescent area. The district contains a variety of Victorian styles including Italianate and Second Empire.

Hillside Avenue Historic District (City 1981; NRHP1982; NJRHP 1980)

The Hillside Avenue Historic District features generously sized lots along a wide street. The district is known for its turn of the twentieth century houses in the Colonial Revival, Queen Anne, and Shingle-style.

North Avenue Commercial Historic District
(City 1981; NRHP/NJRHP 1984)

Most of the buildings in the North Avenue Commercial Historic District were constructed between 1875 and 1925 and are in mostly in the Italianate, Greek Revival, Romanesque, and Renaissance Revival styles. These buildings are typically mixed use with commercial space on the first floor and office or residential space on the upper floors. Similarity in height, scale, and mass give this commercial center a cohesive feel and maintains the character of a turn of the century downtown.

Van Wyck Brooks Historic District
(City 1981; NRHP/NJRHP 1985)

Architecturally, the Van Wyck Brooks Historic District represents a cross-section of the residential building history of Plainfield. The oldest structure in the district, the Stelle Farmhouse, is a survivor of Plainfield's earliest days as a rural farming village. The farmhouse property originally covered much of the present-day district. The majority of the buildings date from 1875 to 1925, and are representative of Plainfield's prosperity as a affluent commuter railroad suburb. Substantial two and three story single-family residences designed in the Italianate,

Figure 5: Romanesque style corner store located in the North Avenue Commercial Historic District
Source: BRPA

Second Empire, Queen Anne, Shingle Style, and Colonial Revival styles predominate the district. Buildings constructed after the district's period of significance include: ranch houses, bi-level residences, and apartment buildings.

Putnam-Watchung Historic District (City 1987)
The Putnam-Watchung Historic District primarily contains houses built as single family dwellings during the emerging commuter era at the turn of the 20th century. Owned by an affluent middle class clientele, these homes typify the Late-Victorian styles popular from 1875 to 1925.

Figure 6: An example of the Queen Anne style architecture found in the Van Wyck Brooks Historic District
Source: BRPA

Netherwood Heights Historic District (City 1988)
The Netherwood Heights Historic District was an early planned residential suburb and was laid out with streets following the natural contours of the hilly terrain. This Late-Victorian development included the Netherwood Hotel and several country estates built from 1876 to 1900. Tudor Revival homes were built in a second wave of construction in the 1920s.

Figure 7: An example of the Tudor Revival style architecture found in the Van Wyck Brooks Historic District
Source: BRPA

Broadway Historic District (City 1992)
The Broadway Historic District features the substantial single family residences built between 1895 and 1910, during Plainfield's development as an affluent railroad commuter suburb. Shingle-style architecture largely defines the character of this district.

Plainfield Civic Historic District (City 1993; NRHP/NJRHP 1993)
The Plainfield Civic Historic District is described on the New Jersey and National Register of Historic Places nomination as a good example of the "City Beautiful Movement" of the early 1900s. Notable structures include the 1917-18 Georgian Revival City Hall; the 1922 Neoclassical Revival YMCA; the War Monument in the City's triangle at Seventh St. and Watchung Avenue; and the 1929 Jacobean Revival City Hall Annex.

Cedar Brook Park (City 2010; NRHP/NJRHP 2007)
Cedar Brook Park is a well-preserved Olmsted Brothers- designed scenic and recreational park that is a key element of the Union County Park System. Designed in 1924, the park was referred to as the "Garden Park" because of the once numerous herbaceous perennial (iris, daffodil, lily and peony) plantation plantings, dogwood plantings and the formal Shakespeare Garden.

Green Brook Park Historic District (City 2010; NRHP/NJRHP 2004)
The park was the site of the Blue Hills military post, a large earthworks fort guarding the paths to the American stronghold in the Watchung Mountains during the America Revolution. Multiple New Deal agencies later worked to redevelop Green Brook Park beginning in 1933. The project involved the construction of a fish-stocked 1.55-acre artificial lake; dams; foot baths; and the planting of 2,000 trees, shrubs, and other plants.

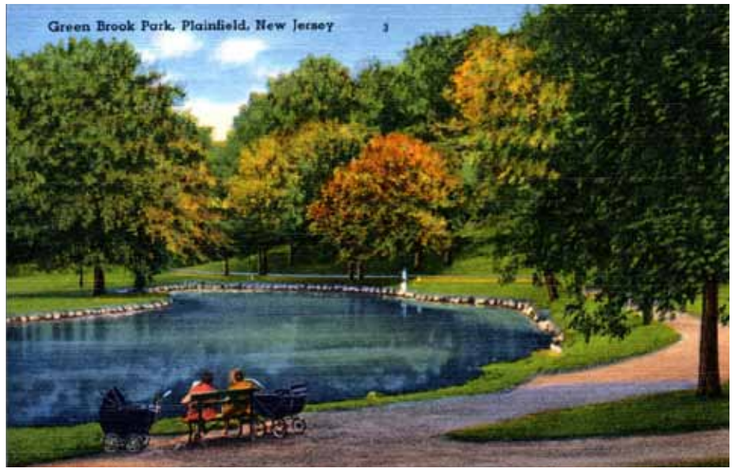

Figure 8: Historic post card depicting Green Brook Park

D. Glossary of Architectural & Historic Preservation Terms.
See also the 2007 DGHDS, pages 47 and 48, and See Article X Historic Preservation Controls, Sections 17:10-1 through 17:10-31, in Chapter 17 Land Use of the City of Plainfield Municipal Code.

Adaptive use – changing an existing, often historic, building to accommodate a new function; may include extensive restoration or renovation and removal of some building elements.

Apron – panel or wide trim under a windowsill.

Architrave – beam running on top of a row of columns; also, moldings around doors and windows.

Asbestos shingle – an exterior shingle composed of cement reinforced with asbestos fibers; popular siding material in the early to mid 20th century.

Asphalt shingle – a shingle composed of rag felt or (after 1970) fiberglass, saturated with asphalt.

Baluster – a spindle or post supporting the railing of a balustrade.

Balustrade – a railing with upper and lower rails and spindles or posts that is installed on a porch or above a roof cornice.

Bargeboard – decorative or plain trim attached to the eaves of a gable.

Bay – the regular external division of a building marked by windows or other vertical elements (as in a three bay façade). Also an external projecting feature (a bay window).

Bracket – a curved or saw-cut projecting element which supports a horizontal member such as a cornice, window or door hood.

Capital – the top element of a column or pilaster.

Cast iron – molten Iron that is poured into a mold to achieve a design.

Classical – pertaining to the architecture of Greece and Rome, and to the styles inspired by this architecture (Georgian, Greek Revival, Neoclassical).

Column – a vertical pillar or shaft, usually supporting a member above.

Corner Boards – mitered or butted vertical trims at the junction of two walls.

Cornice – a projecting molding at the top of a roof, wall or other element.

Cupola – a small structure projecting above the roof that provides ventilation or is used as a lookout.

Dentil – molding composed of equally spaced rectangular blocks; from the French for tooth.

Dormer – A small window with its own roof projecting from a sloping roof.

Eave – the projecting overhang at the lower edge of a roof.

Façade – the front face or elevation of a building.

Fanlight – semicircular window with radiating muntins, often placed over a door or window.

Fascia Board – trim covering rafter ends at the end of a roof pitch.

Finial – projecting ornamental element at the top of a gable, spire or pointed roof.

Frieze – the middle part of the deep flat boards under a classical cornice.

Gable Dormer – gable-ended structure with a window that projects from a roof.

Gable roof – a roof with a central ridgepole and one slope at each side. A gable is the triangular section of wall under the roof edge.

Gambrel roof – a roof with a central ridgepole and two sloping roof sections.

Hip roof – a roof with uniform slopes on all four sides of a building.

Hood – shallow overhang above a door or window.

Lattice – open work produced by interlacing of laths or other thin strips of wood used as screening, often on the base of a porch or on fencing.

Leaded glass window – composed of pieces of glass that are held in place with lead strips; the glass can be clear, colored, or stained.

Light – transparent portion of a window; also, single pane of glass.

Mansard roof – a roof having a double slope on all four sides, the lower slope being much steeper than the upper slope.

Meeting Rail – top member of lower sash and bottom member of upper sash in double-hung window.

Modillion – an ornamental horizontal block or bracket placed under the overhang of a cornice.

Mullion – a vertical divider in a window.

Muntin – the wood dividing strips between the panes or "lights" in a multi-paned window.

Newel – Decorative structural post at either end of a stair rail. The post at the top or bottom of a flight of stairs, supporting the handrail.

Newel Cap – Decorative element atop a newel.

Palladian Window – assembly of windows in which two lights flank one with an arched top.

Parapet – low wall or barrier railing at a balcony or roof edge.

Pediment – the triangular gable end of a roof; also, any similar crowning element used over doors and windows, usually triangular but may be curved.

Pier – load-bearing element that rises from a footing.

Pilaster – A shallow pillar attached to a wall, resembling a classical column; used commonly on windows and doors.

Portico – a columned entrance porch.

Preservation – 1. the protection of a material from physical deterioration or disintegration because of natural elements or human activity by various technical, scientific, or craft techniques. 2. the process of protection and enhancement of historic sites, structures, and objects.

Rail – horizontal structural member of a door or sash.

Raking Cornice – molding that follows the slope of a pediment or gable.

Reconstruction – the process of duplicating the original form, materials and appearance of vanished building or structure at a particular historical moment through historical research.

Rehabilitation – the act or process of returning a property to a state of utility through repair or alteration which makes possible an efficient contemporary use while preserving those features which are historically significant.

Restoration – the process of returning an existing site, building, structure or object to its condition at a particular time in its history.

Riser – vertical part of a stair step.

Sash – the frame in which a window is set; may be moveable or fixed; may slide vertically (as in double-hung window) or pivot (as in casement window).

Sill – the lower horizontal member of a door frame, window frame or wall.

Soffit – the exposed underside of any overhead component of a building, such as the undersurface of an arch, cornice, eave, or stairway.

Spindled Frieze – band of spindles attached under the eaves of a porch.

Stile – vertical structural member of a door or sash.

Transom – windows or panels, usually operable, above a window or door.

Transom light – a small window over a door or another window; may be rectangular, fan-shaped or elliptical.

Tread – horizontal part of a stair step.

Turret – curved projection with windows, often topped with a conical roof.

Water Table – horizontal drip-edge that prevents water from running down a wall.

Wrought Iron – heating iron until it can be hand beaten and twisted into a design.

Source: Dictionary of Building Preservation, ed. Ward Bucher
(John Wiley & Sons, 1996)

II. STEWARDSHIP OF HISTORIC BUILDINGS

A. Being Part of a Locally Designated Historic District or Landmarked Site; What it Means to Be Protected; What are the Responsibilities of the Owners
The purpose of locally designated historic districts and landmarked sites is to promote the educational, cultural, economic, and general welfare of the City through the preservation of historic buildings, structures, places and districts; to develop and maintain appropriate settings for such resources; and to document and promote the public enjoyment of such resources which impart a distinct aspect of the City, and which serve as visible reminders of the historical and cultural heritage of the City, the State, and the nation.

An owner of a historic building should keep the following in mind when planning a project:

1. Find out if the property is in a locally designated historic district or is a locally landmarked property. This can be done by accessing the HPC's website at www.plainfilednj.gov, where a map of the City's historic districts and sites can be found, and if also shown here as Figure 9. If the property is within a historic district or is landmarked, consult with the HPC early on to clarify any restrictions that apply to your project. Consider projects that are reversible, rather than alterations that could permanently alter the historic fabric of the building. This manual should serve as a guide to assist in the design and development of a project. Before any work is begun an application for a Certificate of Appropriateness (CA) from the HPC will be required. This application is available in the office of the Administrative Officer, the office of the City Clerk, or on the HPC's website. Completed applications shall be delivered or mailed to the HPC at City Hall.

2. Learn about the house and its building systems. Use the information in this section to better understand the building and how each of its systems functions. Each building is different, so if you do not feel confident doing so yourself, hire a preservation consultant. Professional services may be recommended by the HPC.

3. Determine which improvements should be completed first, before other steps (for example, maintenance, followed by air-sealing and insulation improvements, before tackling renewable-energy projects). Which projects will be most efficient when paired with others? What is the payback time on each system and which are most cost-effective? Remember to develop a "whole house plan" for best results.

B. The Secretary of the Interior Standards: How They Apply to a Project
The Secretary of the Interior's Standards for the Treatment of Historic Properties were developed by the National Park Service to protect and preserve our nation's historic resources. The four treatment standards or approaches provide a basic framework depending on the needs and goals of each individual project. Any program administered by the Secretary of the Interior through the National Park Service is required to use the Standards. The four treatment approaches are Preservation, Rehabilitation, Restoration, and Reconstruction, outlined below in order of preference:

Preservation retains historic fabric, especially character-defining features, through conservation,

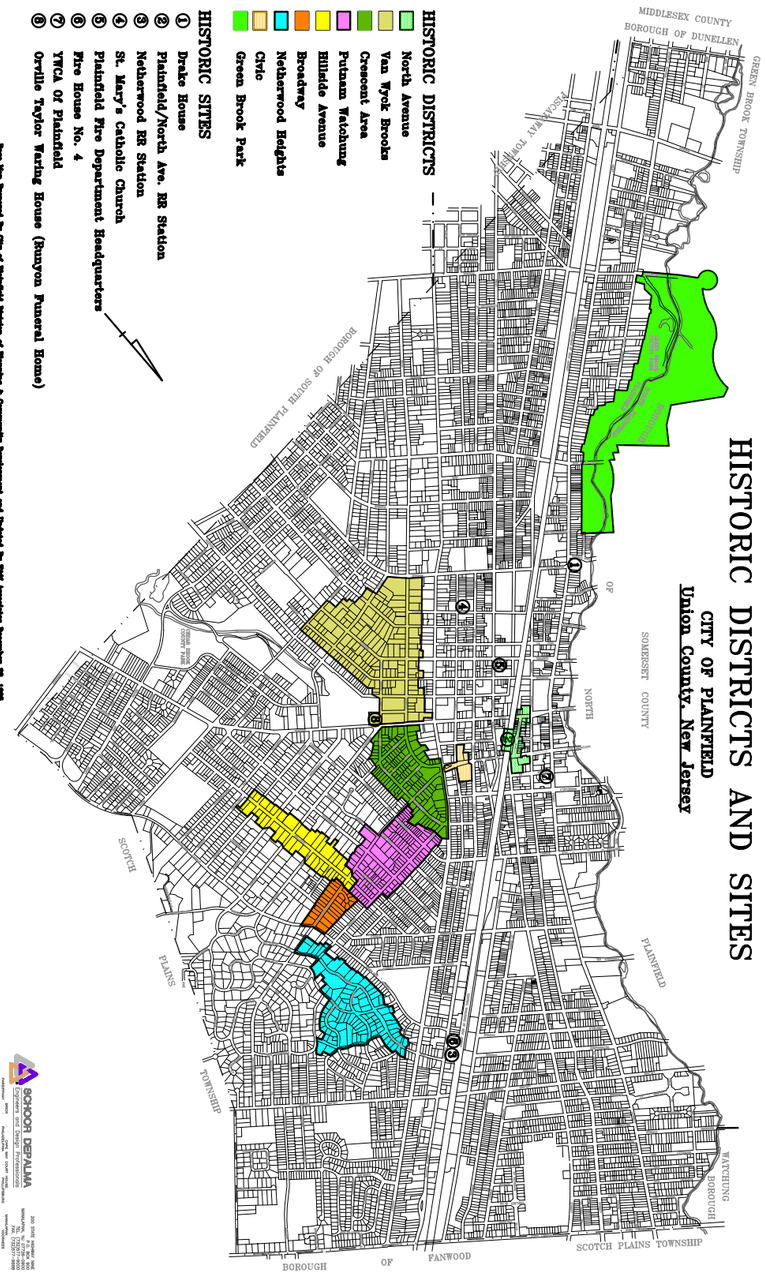

Figure 9: Map from the City of Plainfield's website showing the designated historic districts and sites
Source: Plainfield HPC

HOMEOWNER STEWARDSHIP AND SUSTAINABILITY MANUAL

maintenance, and repair. It reflects a building's continuum over time, through successive occupancies, and maintains respectful changes and alterations.

Rehabilitation emphasizes the retention and repair of historic materials and character-defining features, but more latitude is provided for alterations necessary for continued or changing use of the property.

Restoration focuses on the retention of materials and character-defining features from the most significant time in a property's history, while permitting the removal of materials from other periods.

Reconstruction involves the recreation of a non-surviving site, landscape, building, structure, or object (or portions thereof) with new materials.

Most projects related to energy upgrades fall into the preservation or rehabilitation categories. Retention of historic materials and character-defining features is the key. That means making every effort to repair historic windows instead of replacing them, for example. If you know that your energy-efficiency upgrade or renewable energy project will be reviewed by the HPC, then it is important to be familiar with the Standards for the Treatment of Historic Properties and to follow their basic approach as outlined above.

C. The Design Review Process

The Plainfield HPC was created in 1986 by municipal ordinance to promote historic preservation in Plainfield and to review building permit applications for proposed repairs, additions, alterations, new construction, demolition, and relocation. HPC members have expertise in architectural design, construction, and local history. The HPC reviews all work that will change the exterior appearance of properties within historic districts or those that are individually landmarked, including principal buildings, garages, carriage houses, gazebos and other auxiliary buildings, fences, walls, driveways, sidewalks, signs, and parking lots. The HPC applies the "Standards for Rehabilitation Projects," as outlined in the historic preservation ordinance and the DGHDS to each application review. The HPC requires repair of historic features over replacement unless the severity of deterioration requires replacement. If replacement of materials is necessary, the HPC requires that the new material match the old in design, color, texture, and other visual qualities, and, where possible, materials. Once the HPC has determined that the proposed work is appropriate to the historic property, they will direct the Administrative Officer to issue a CA.

When Does a Project Need HPC Approval?

A CA issued by the HPC shall be required before a permit is issued for any of the following, or, before work can commence on any of the following within a historic district or on a historic site:

1. Demolition of any building, site, place, or structure.

2. Relocation of any building, site, or structure.

3. Change to the exterior appearance of any contributing building or structure by addition, reconstruction, alteration, maintenance or repair, if such change would be subject to view from a public street. This also includes exterior changes for all primary and accessory buildings visible from

a public street, and shall include but are not limited to additions and changes visible from a public street, such as the removal, repair or replacement of windows, doors, shutters, balustrades, railings, columns, cornices, moldings, trim, stairs, steps, porches, walks, siding, gutters, signs, and solar panels.

4. Any addition or new construction of a principal or accessory structure subject to public view.

5. Changes to existing sidewalks within the public right-of-way and changes to existing walls, fences, signs, solar panels, or parking lots, or the construction of any new sidewalks within the public right-of-way, or of any new fences, walls, signs, solar panels or parking lots, if subject to public view.

6. The removal of living trees measuring (18) inches or more in diameter at breast height located within the public right-of-way.

When Does a Project NOT Require HPC Approval?

1. Changes to the interior of structures.

2. Changes not visible to the public.

3. Ordinary maintenance that does not require the replacement of existing materials.

4. Exterior or interior painting of existing structures.

How does the HPC Review Process Work?

Property owners that are looking to begin a project and have determined that their property is located within a historic district or is individually landmarked, can request informational hearings with HPC to explore appropriate options for their renovations and improvements.[3] The HPC consists of nine regular members and two alternates who are appointed by the Mayor and confirmed by the City Council for four-year terms. The commission reviews all work that will change the exterior appearances of designated historic sites and properties that are located within historic districts in order to ensure that the distinctive character of historic sites is preserved. The HPC follows the 2007 DGHDS, which is available on the HPC's website (www.plainfilednj.gov). These guidelines do not impose designs or architectural styles, rather they encourage work that is compatible with historic sites and districts in scale, materials, and related features.

After initial consultation with the HPC, property owners should thoroughly plan for their project. It is recommended that homeowners hire an architect or contractor who specializes or has experience in working with historic buildings. The HPC should be consulted with before final designs are completed, and the DGHDS should be reviewed to make sure that all proposed changes are appropriate. Once this is done, property owners should apply for a CA from the HPC by following these steps:

1. Prepare a list of proposed work, and compile plans prepared by the architect or contractor along with photographs of the building and site.

2. Apply for a construction permit if required.

3. Fill out the application for the CA, which is available at City Hall in the office of the Administrative Officer, the office of the City Clerk, or directly from the HPC on its website. The application should include sketches, drawings, photographs, descriptions, and other information necessary to show the proposed alterations, additions, changes, or new construction.

4. Property owners must provide ten days notice of the time, date, location and subject of the HPC meeting in writing to each property owner within 200 feet of the subject property.

5. Once the application is complete and submitted, the property owner must attend their scheduled HPC public hearing to present the proposed work. All necessary documents should be brought to the meeting in order to show the proposed changes.

6. Once approved, the HPC will issue the CA within ten business days of the property owner's hearing.

Non-Contributing Properties

Properties in historic districts are categorized as "contributing" or "noncontributing." A contributing structure is a part of the historic association or exemplifies the architectural characteristics that contribute to a district's significance, while a non-contributing property does not. If a property is non-contributing, alterations could still have an impact on surrounding resources. For example, a 20-by-20-foot solar array placed in the front yard of a late twentieth-century house within a local historic district would likely be problematic. Although the house not contribute to the historic or architectural character of the district, the solar installation would have a negative effect on the overall character of the street or "streetscape." It is always best to coordinate early and often with the HPC when planning a major project.

D. Common Maintenance Conditions and Repairs

Deferred maintenance is the leading cause of deterioration of historic buildings. In order to better preserve historic buildings, routine maintenance should be performed including:

Gutters and Down Spouts. Clear blockages and look for leaks and repair as needed.

Roofing and Flashings. Remove all debris from the roof surface and valleys. Inspect roof sheathing for worn, broken, or missing shingles. Check flashing for damage or openings where water may enter.

Chimney Tops. Inspect masonry for loose units caused by deteriorated mortar joints. Where necessary, repoint mortar joints with appropriate mortar mixes that match the existing mortar in terms of color, texture, hardness, and joint profile. Chimneys flues should be inspected for leaks as well as inner mortar loss.

Chimney Bases and Foundations. Inspect masonry for loose mortar and damaged units. Where necessary, repoint mortar joints with appropriate mortar mixes that match the existing mortar in terms of color, texture, hardness, and joint profile. If cracks are visible and expanding, a structural engineer should be contacted.

Painted Wood. Inspect painted wood surfaces for exposed wood, blistering, peeling, and biological growth. Wash biological growth with fungicide, sand, scrape, and remove loose paint. In dry weather conditions, prime and paint wood with matching paint.

Painted and Unpainted Masonry. Decaying masonry, cracks or scaling should all be monitored. Keep masonry clean using a soft bristled brush and water. Use a masonry cleaning acid solution for cleaning if necessary.

Mortar Joints. Inspect mortar joints for loose or missing mortar. Where necessary, repoint mortar joints with appropriate mortar mixes that match the existing mortar in terms of color, texture, hardness, and joint profile.

Windows and Doors. Check for air and water leaks and repair immediately. Repair broken or loose panes. Reglaze cracked glazing putty and maintain paint to prevent deterioration from sun and moisture.

Cladding (Siding). Check wood siding for cupping, splitting, or deterioration. These symptoms may be a sign that siding should be repaired or replaced.

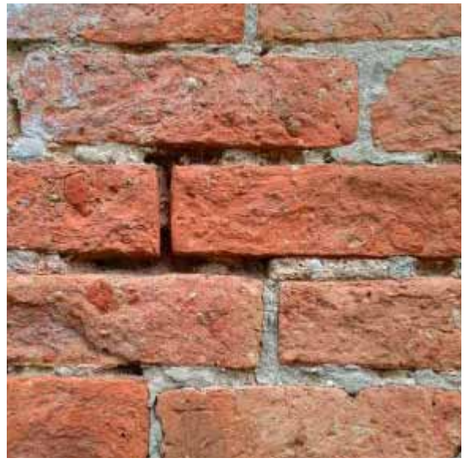

Figure 10 (top): Deteriorated and eroded mortar joints in need of repointing. Source: Historic England
Figure 11 (bottom): Existing mortar should be analyzed in order to repoint with mortar that is the same color, texture, and hardness. Source: Historic England

E. Windows and Doors Guidelines and Tips

1. Maintain older windows and doors to ensure functionality.

2. Improve thermal efficiency by adding weather stripping and sensitively installing storm windows that matches the existing window trim.

3. Make transom windows operational to improve air flow and ventilation.

4. Make shutters and awnings operational in order to prevent the overheating of interior spaces.

5. Repair and retain historic windows an doors where possible. If windows and doors must be replaced, be sure to replace in kind, matching the openings, pane and panel configurations, dimensions and profiles, finishes and character.

F. Walls and Roof Guidelines and Tips

1. Through a home energy assessment, as described in Chapter III of this manual, identify areas in need of insulation.

2. Maintain the inherent thermal properties that a historic building may have.

3. identify the materiality of wall and roof cladding and its approximate lifespan. Take the material's lifespan into consideration when repairing, rehabilitating, or replacing cladding.

4. Maintain and repair character defining features, namely finish materials and functional and decorative characteristics.

5. Limit the amount of penetrations through exterior surfaces. Adequately seal necessary penetrations to prevent air and moisture from entering the building.

6. Sensitively install insulation and ventilation components to minimize the damage or loss of character defining features.

7. If wall and roof materials must be replaced be sure to replace materials in kind, matching the scale and tecxture of the replaced material in order to maintain the historic appearance of the building.

G. Do-It-Yourself Air-Sealing Measures

1. In order to locate major air leaks, hire an energy aessor or other weatherization expert to perform an energy assessment, a proccess that is explained in detail in Chapter III of this manual.

2. Stop air and water leaks around doors and windows by sealing gaps with caulk or weather strips.

3. Add pliable sealing gaskets to the bottoms of door and thresholds to better seal them.

4. Use foam sealants on gaps around windows, baseboards, and other areas that are leaking air.

5. Seal areas where mechanical, electrical, plumbing components penetrate through walls, between floors, and soffits over cabinets.

6. Add foam gaskets behind outlet and switch plates on walls to better insulate them.

7. Check insulation where possible for evidence of air or moisture leaks shuch as, dirt, mold, or moisture. Leaks should be sealed with low expansion spray foam or install new flashing.

8. Look for evidece of dirt or staining on painte surfaces or carpet as this may indicate air leaks between walls of floors. When the source of the leak is found, use caulk to seal the opening.

9. Check that dryer vents are not blocked. This may also prevent a fire.

10. Chimney flues are a common source for air loss. Be sure to fully shut dampers to mitigate this.

11. Air leaks around heating systems, such as fireplace chimneys, furnaces, and gas fired water heater vents should be carefully sealed with fire resistant materials including sheet metals, sheet rock, and furnace cement caulk.[4]

H. Landscape and Site Features Guidelines and Tips

1. Identify and preserve significant character defining landscape features when looking to add new sustainable features to the site.

2. Identify and maintain existing sustainable lanscape features including storm water management features, such as gutters downspouts, and cisterns, as well as topogrpahical and landscape features that may contribute to the sustainability of the landscape.

3. Maintain or plant shade vegetation to protect a building from overheating in warmer seasons.

4. Add permeable paving surfaces where appropriate to manage storm water.

Figure 12: Example of a rain barrel collection system. Source: This Old House

5. Avoid paving up o a building's foundation to reduce retention of heat around a building, increasing its internal temperature, or creating a heat island effect, and to prevent damage to the foundation or trapping moisture.

6. Plant navive vegetation where appropriate.

7. Enance storm water management by adding bioswales, rain gardens, rain barrels, and large collection tanks for on site water reuse. These features should be sensitively placed out of the public view and not disturb the character of the building and its site.[5]

III. SUSTAINABILITY & HISTORIC BUILDINGS

A. Energy Audit

1. **What is an energy audit?**
An energy audit is an assessment of a building, conducted by a professional auditor, to determine where a building is lacking in energy efficiency.[6] The auditor will gather information specific to the building, conduct an assessment, and then provide a comprehensive report. This report will show what energy upgrades will improve the energy efficiency of a particular building.[7]

2. **Preparing for an energy audit.**
After the energy audit is scheduled, property owners should be prepared for the assessment by:

a) Having a list of known existing issues that the building is experiencing.

b) Having copies of the building's energy bills over the past one-to-two years.

c) Be prepared to provide information to the auditor, such as how many people occupy the building, is anyone occupying the building during the day, the average thermostat settings in summer and winter, and what rooms are used and at what frequency?

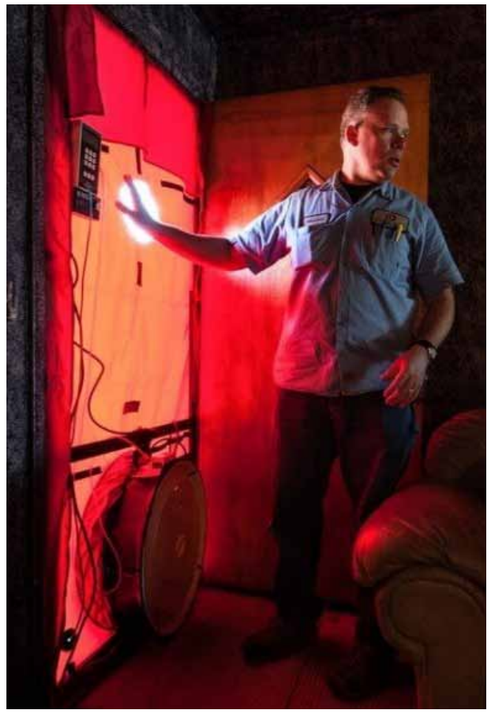

Figure 13: A blower door depressurizes a building by exhausting air at a rate that allows pressuse gages and tracer smoke to measure the amount and location of air leakage. Source: USDOE

d) Be prepared to have the auditor do a walk through the entire building and an examination of the building envelop, as well as perform various tests to determine a building's energy efficiency.[8]

3. **The Audit Process**.
An auditor will begin an audit by tracking the current use patterns of the building in question. This is done first by obtaining billing history from the local utility company over a one-to-two year period, documenting the building's use, its number of occupants, and confirming the type of fuel that the building uses. Existing insulation is documented, noting its location and thermal capacity, or R-value, of all components of the building envelope. Then a building inspection is done, noting areas of air infiltration or loss, and reading the efficiency of existing mechanical system.[9]

Auditors may run tests, such as a blower door test or use infrared thermography to help identify

areas of inefficiency where there may be air leakage or heat loss.[10] Blower door tests check the air tightness of a building by using a powerful for that is mounted into a doorway to pull air out of the building, and lowering the air pressure inside. This draws air from outside into the building through openings. During this test, the auditor may use infrared cameras or non-toxic smoke to determine where air leaks are located.[11]

Figure 14: Infrared thermography scanning allows energy assessors to determine where air leaks and inefficiencies are in a building.
Source: USDOE

B. Air Sealing

1. **Outside the Building**.
On the exterior of a building look for gaps or openings where different building materials meet including:
   - All exterior corners
   - Outdoor faucets
   - Where siding and chimneys meet
   - Where foundations and the bottom of exterior brick or siding meet[12]

2. **Inside the Building**.
Inspect these locations for air leaks:
   - Electrical outlets
   - Switch plates
   - Door and window frames
   - Electrical and gas service entrances
   - Baseboards
   - Weather stripping around doors
   - Fireplace dampers
   - Attic hatches

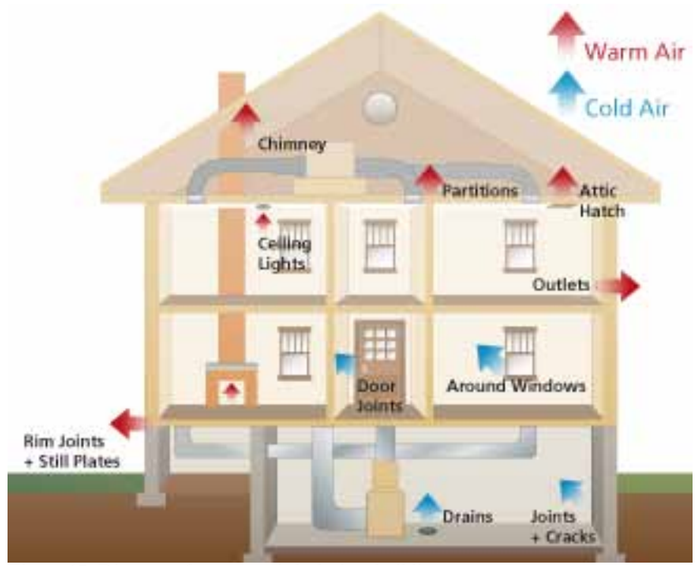

Figure 15: Diagram of common air leaks in a building.
Source: NPS

- Wall or window mounted air conditioners
- Cable TV and phone lines
- Where dryer vents pass through walls
- Vents and fans[13]

3. **Simple Air Sealing Materials and Treatments**
Historic buildings are important resources, and in order to maintain and better preserve them, materials and treatment options should be thoroughly considered so as not to remove the historic building fabric or harm a building's character. A key concept when making decisions on improving a building is that of reversibility. Before making changes, think about whether the person who owns the building in 15, 25, or 50 years will be able to undo them without harming the building and its character defining features.[14,15]

a) Caulking
Caulk is a flexible material that can be used to seal air leaks, as well as prevent water damage inside and outside a building. It is best used on openings less than one-quarter-inch wide between stationary components and materials.[16] There are a variety of caulking compounds that have different properties and strengths for their particular uses.[17] Be sure to select the best option for a building's particular needs. The following is a list of common caulking compounds, and their recommended uses for air sealing, provided by the U.S. Department of Energy. More information on these products can be found on the department's website, www.energy.gov.[18]

- **Silicone: Household** - Seal joints between bathroom and kitchen fixtures and tile. It is an adhesive for tile and metal fixtures, and seals metal joints such as those in plumbing and gutters. It is flexible and allows joints to stretch up to three times normal width or compression to one-half the width.

- **Silicone: Construction -** Seal most dissimilar building materials, such as wood and stone, metal flashing, and brick. It permits joints to stretch or compress, and will stick to painted surfaces, but paint will not adhere to most cured silicones.

- **Butyl Rubber** - Seals most dissimilar materials, including glass, metal, plastic, wood, and concrete. It seals around windows and flashing, and is used to bond loose shingles. It is durable and has a lifespan of ten or more years. It can be painted after one week of curing. It Does not adhere well to painted surfaces. These products are toxic and precautions on the label should be followed.

- **Latex -** Seals Joints around plumbing fixtures, and fills cracks in tile, plaster, glass, and plastic, and is often used to fill nail holes. It is easy to use, as seams can be trimmed or smoothed with a moist finger or tool. It is water resistant when dry, can be sanded and painted, and has a lifespan of ten to twenty years. It does not adhere to metals, had little flexibility once cured, and should be painted when used on the exterior of a building.

- **Oil or Resin Based -** Seals exterior seams and joints on building materials. This is the most

readily available and least expensive of the options. The oils will dry out and cause the material to fall out. It is not very durable and has a short lifespan of one to four years. It has poor adhesion to porous surfaces, such as masonry. It has a limited range of temperature in its application. When used, precautions on the label should be taken as these products are toxic. They should be painted after application

b) **Spray Foams**
Spray foams should generally be avoided in historic houses, except in small areas, such as around gaps cut for plumbing lines, for example. Although spray-foam sealants are frequently used for air sealing, especially in basements and attics, they are not recommended for use in historic houses because spray foams are not reversible- they are very difficult to remove without damage to historic building materials. Over time spray foams can mask developing maintenance issues, so that problems are not detected until they are more serious.

c) **Weatherstripping**
Weatherstripping is a good option for sealing air leaks around movable building components, such as doors and windows. There are numerous weatherstripping products that are readily available, and include foams, felts, vinyls, and metals. Choose the best product that will withstand the friction, weather, temperature changes, and wear and tear unique to its location.[19]

C. Solutions for Improving Energy Efficiency

1. Attics and Roof

Reducing the transfer of heat through the attic and roof should be one of the top priorities. The first step should be air sealing the attic, particularly in those spaces around furnace flues, duct penetrations, and around attic hatches or doors.[20] Adding the appropriate insulation to an unfinished attic space is a simple, noninvasive way to improve energy efficiency. The U.S. Department of Energy has determined what insulation should be used according to various climate zones around the country. In unfinished attic spaces, insulation, such as blown in, batt, or rigid foam is placed between floor joists and rafters.[21]

Another solution is adding radiant barriers in the attic space. Radiant barriers are a flexible material that have a highly reflective coating on one side of them, and are meant to be applied to the underside of the roof. With the reflective surface facing toward the exterior, thermal radiation from outside is reduced and limits the heat gain to the building. They should not be installed over insulation on an attic floor as they may trap moisture.[22]

Attic access points are often responsible for heat loss and can be easily sealed using weatherstripping or by installing a pre-made insulated attic stair cover.[23]

2. Basements and Crawlspaces

Basements and crawlspaces are a major point of cool air infiltration. The "chimney effect" draws cool air inside openings to the area below a building and travels into the upper floors resulting in drafts and higher energy bills.[24] To mitigate this, moisture related issues that allow water to enter

into a basement or crawlspace should be addressed first, along with air sealing, which may require caulking gaps, cracks, and openings or repointing masonry walls.[25]

Then, it must be determined weather or not the space will be conditioned. If these areas are to be left unconditioned, the underside of the sub floor, between floor joists, should be insulated. Alternatively, rigid foam insulation can be installed on the bottom of the floor joists.[26] Moisture barriers should be installed on exposed dirt floors to prevent ground moisture from entering into the building. Pouring a concrete slab over a moisture barrier over earthen floors should be considered.[27]

3. Windows

Windows are important architectural features of historic buildings; they provide a sense of scale, craftsmanship, and architectural style. Historic windows come in a variety of forms and configurations and are typically constructed of wood with a painted finish or metal. They should be maintained and repaired when possible, and if not, replaced with compatible alternatives.

Figure 16: This house in the Van Wyck Brooks Historic District exemplifies how historic buildings were designed to control solar heat gain inside of the building. Its large porch with awnings, shutters, and deep eaves were meant to block sunlight to help keep the building cool. Source: BRPA

For more information on the repair of historic windows, see the National Park Service Brief 9: The Repair of Historic Wood Windows. The best practices to optimize a building's efficiency with historic windows include:

- Maintaining windows and ensuring functionality and operability.
- Retain and repair deteriorated windows. If windows are beyond repair they should be replaced with compatible, energy efficient replacements that match the appearance, size, design, proportion, and profile of the existing window. They should also be durable, repairable, and recyclable.
- Make historic windows air tight buy applying weather stripping and caulking.

- Retrofit windows with high performance glazing or clear, low-emissivity glass or films, without noticeable color, over glass panes to reduce solar heat gain inside a building.

- Install interior or exterior storm windows that are compatible with existing historic windows and match existing window trim.

- Maintain existing, reinstall or install new, historically-appropriate shutters or awnings to help reduce heat gain inside a building.[28]

4. Doors

Like windows, doors are often significant features of historic buildings that should be maintained, repaired, or replaced in kind if necessary. Doors can be made more energy efficient by adding weatherstripping around openings to make them airtight. Thermal performance can also be improved on residential properties, in cold climates, with the addition of a storm door. Storm doors should be compatible with the historic character of the historic door, matching it in color.

In some instances, storm doors should not be installed if it detracts from a highly significant existing door. Additionally, storm doors should not be added in entrances that experience intense sun exposure as this could add to a building's heat gain, and it may also degrade the material or finish of the existing door.[29]

5. Walls

Only after adequately improving the thermal efficiency of the attic and basement or crawlspace, should adding wall insulation be considered. Prior to deciding to add wall insulation, property owners should consider if their energy goals can be met without the use of wall insulation, how much loss of historic building material will there be, and whether or not it would be cost effective. It is recommended that a professional, such as a architect or contractor, who has experience working with historic buildings be consulted before any decisions are made.[30]

a) Wood Frame

Historic wood frame buildings that are uninsulated allowed more air infiltration. While this is thermally inefficient, this allowed for the building to "breath" and dissipate moisture, and ultimately keep the building dry. Numerous factors make it difficult to understand how the addition of wall insulation will reduce the breathability and air flow in a building. Aside from air flow and moisture related issues, accessing the interior cavities of frame walls will be difficult unless interior or exterior finish materials, such as plaster, paneling, or siding, have already been lost. Removal of interior or exterior finishes for the purpose of installing insulation is highly discouraged.[31]

If moisture related issues are resolved, and there is access to wall cavities, blown-in cellulose, or batt insulation should be used.

Blown-in cellulose fiber is a common insulation used. Its R-value, ability to absorb and diffuse moisture, impediment to air flow, simplistic installation, and low cost make it a popular choice. When using this in historic buildings be sure to use the boric acid only or "borate only" grade as other grades have sulfates that can create sulfuric acid that corrodes metals when exposed to moisture.

Batt insulation is another commonly used insulation. If the wall is open and cavities are accessible, batt insulation can be installed in strips that fully fill voids. Batt insulation is easy to install and is a readily available product.[32]

b) Solid Masonry

The insulation of masonry walls is complex and should largely be avoided, as insulation can lead to damaging the masonry. Masonry walls can absorb a significant amount of water when it rains. These walls dry both toward the interior and the exterior. Adding insulation to the interior of the wall reduces the drying rate of the wall toward the interior and causes the wall to stay wet. The presence of this trapped moisture can result in damage to historic masonry, damage interior finishes, and damage wood or metal structural components in the wall.[33]

Masonry walls of buildings that are heated during the winter are benefited by the transfer of heat from the interior to the exterior of the wall. This transfer of heat protects the exterior of the masonry wall by reducing the possibility of trapped moisture from freezing on the outer layers of the wall and causing damage. By adding insulation to the interior, this transfer of heat cannot take place, and thereby allows the trapped moisture on the outer layer of the wall to freeze and thereby causing damage to the masonry.[34] Therefore, insulation to the interior of masonry walls should be limited and consultation with an architect or contractor who has experience in working with historic buildings should be consulted before any decisions to insulate are made.

6. Mechanical Systems

a) **Low Cost Energy Saving**

Before central heating air conditioning, historic buildings were heated and cooled through passive and manual regulating features. In order to keep buildings cool, windows, doors, and vents were often left open to allow for air flow, while shutters, awnings, and wide eves and porches were used to block sunlight and keep buildings cool. To keep rooms warm, fireplaces and stoves were used until the arrival of hot air furnaces, boilers, and radiator systems arrived in the late 19th century, and air conditioning was not added in residential buildings until the mid twentieth century.[35] The inherent passive designs of many historic buildings should be taken advantage of by property owners in the effort to reduce energy consumption from running mechanical systems. Measures that have little cause but may have a big payback include:

- Lowering the thermostat in cool weather, and raising it in warm weather, and using a programmable thermostat to modify temperatures based on building occupancy patterns.

- Establish "climate zones," or areas throughout the building that have regulated temperatures based on how frequently they are used. In other words, reduce the heating and cooling of spaces that are unused.

- Maximise natural light and switch light bulbs to energy saving fluorescent bulbs, and reduce the overall number of lights used and rely on natural light.

- Use operable windows, shutters, awnings, and vents to moderate interior temperatures.

- Clean radiators and forced air registers.
- Have boilers and furnaces cleaned and serviced yearly.
- Clean furnace filters, which can often be done by yourself.
- Check that ducts and pipes are sealed and insulated.
- Turn off lights when leaving a room.[36]

b) **Advanced Energy Saving**
Upgrading and improving the mechanical systems of a building may also significantly improve energy efficiency, but these are typically substantial upgrades that require thoughtful planning and greater expense. Adding or replacing mechanical systems in historic buildings is often complex, and an architect or contractor with experience working with historic buildings should be consulted, as often times the installation of modern climate control in historic buildings can be detrimental to its historic materials and finishes.[37] These experienced professionals and property owners should then consider the following:

- **Assess the condition of the building and its existing systems.**
Assess the existing mechanical systems, if any, and determine their condition and energy efficiency. Consider where efficiency can be improved. Also look if hazardous materials are present , such as asbestos, and plan for its abatement.

- **Identify and prioritize architecturally significant spaces, finishes, and features.**
Significant architectural details and character defining features of a historic building should be prioritized. These include interior finishes, such as plasterwork or wood paneling, but also consider preserving unique components of existing mechanical systems, such as hot water radiators, elaborate switch plates, or registers with decorative designs. Identify the nonsignificant spaces that can house mechanical equipment and its modern components.

- **Become familiar with building and fire codes.**
Building and fire codes may influence decisions for additions or changes to systems. Legal requirements should be checked and followed.

- **Evaluate options.**
Look at the pros and cons of various systems. Consider fuel types, distribution, control devices, generating equipment, filtration, humidification, as well as the cost. Also, be sure to consider the invasiveness of the system and its impact on the building as a whole.[38]

c) **Types of HVAC Systems**

1. **Water Systems**

Hydronic Radiators
Radiators or baseboard radiators and looped together and are typically set under windows or

along perimeter walls. Installing new boilers and circulating pumps may upgrades these systems. Historic radiators and their components, including piping, can be reconditioned.

Fan Coil Units
These systems use terminal cabinets in each room. A fan blows over heated or chilled coils to heat or cool spaces.

2. **Central Air Systems**

Basic HVAC
These systems typically include a furnace with a cooling coil set in a large unit, with a condenser unit located outside the building. These systems typically include shared heating and cooling ductwork, and can include dehumidification systems.

Heart Pump/Air Systems
This includes a basic HVAC system, but the system operates by extracting heat from the air which is used to evaporate refrigerant vapor under pressure. These systems are typically less efficient in cold climates. See more information on ground-source heat pumps in the following section, D. Renewable Energy.

3. **Combined Air and Water Systems**
These systems are popular in building restoration projects because of component flexibility, and air handler units can fit into small spaces. Small air handler units may be located throughout a building with service from a central boiler and chiller. These systems, being smaller, are often quieter and cause less vibration in a building.

4. **Portable Air Conditioning**
these are typically set in windows or through exterior walls, which can detract from the appearance of a historic building. New portable units are available that can be placed in a room and exhausted through a raised window sash.

5. **Fans**
Fans can improve ventilation. They can be installed throughout a building, and can eliminate the need for a central air cooling system.

6. **Dehumidifiers**
For buildings with central air, these systems can resolve moisture issues in humid climates, such as removing moisture from damp basements and reduce fungal growth.

7. **Portable Heaters**
These may provide temporary heat, but they can be fire hazards of systems are wired improperly or not monitored.[39]

D. Renewable Energy

The Green Building and Environmental Sustainability Element of the 2020 City Master Plan (pages 168-178) is a contributing resource to this Sustainability Manual. The Element's strategic vision is to *"create the foundation for a sustainable and healthy future by proposing and implementing sustainable strategies and responsible development guidelines to reduce negative impacts and increase efficiency in a way that enables the city to meet the needs of the present population without compromising the ability of future residents to meet their needs."*

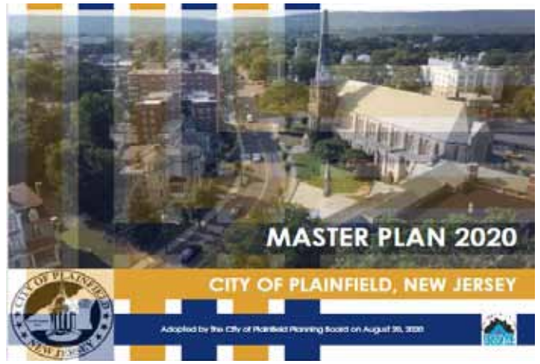

Figure 17: Cover of the 2020 City of Plainfield Master Plan

Steps to sustainability in Plainfield include preserving its historic districts, increasing the use of renewable energy alternatives, encouraging Green Building and Design techniques. Strategies to execute sustainability policies begin with fiscal responsibility, developing sustainability plans/ pilot programs, and utilizing the the Leadership in Energy and Environmental Design (LEED) construction rating system.

1. Choosing the Best Renewable Energy Technology.

Renewable energy technology can help reduce consumption of fossil fuels and can often be incorporated into historic buildings. The use of alternative, renewable energy should only be pursued after all other upgrades have been made to make the building more energy efficient, as installation of renewable energy systems can be costly.[40]

In planning for renewable energy systems for a building, property owners should analyze their existing electricity use, study and understand local ordinances and requirements that may regulate placement of these technologies.[41] They should also consider energy source availability, the economics and cost, the size of the systems, and installation and maintenance considerations.[42]

2. Solar Energy

Solar energy technology on existing buildings is becoming more common as technology improves. Common forms of solar technology for buildings include photovoltaic (PV) and building incorporated photovoltaic systems (BIPV). A PV cell is a device that converts sunlight into electrical energy, and the greater the intensity of the sunlight, the greater the production of electricity. A PV panel is the part of the system that is normally seen on the roofs of buildings.[43] BIPV systems are where PV panels are integrated into the roofing material to be less intrusive and visible than traditional PV panels. These may only be compatible with certain types of roofing materials, such as slate shingles or tiles.[44]

When considering solar technology on a historic building, property owners should understand:

- Solar technology should benefit the building without compromising its character, or the

character of the site or surrounding historic district.

- Solar technology should be installed where it will have minimal visual impact.
- It should only be installed on a historic building when all other locations on the property have been investigated and determined infeasible. Solar technology can be installed on non-historic additions or accessory buildings as long as it does not visually impact the historic building.
- It should be installed in a low profile so that it is not visible to the public.
- The installation should not damage historic roofing materials or negatively impact a building's historic character, and it should be reversible.[45]

Common Terms Used in Solar Technology Installations

The following is a list of terms relating to solar technology installations that property owners may encounter, and can be found in Historic England's, "Energy Efficiency and Historic Buildings."[46]

Alternating current (AC) Electric current in which the direction of flow is reversed at frequent intervals of 50 or 60 cycles per second, or 50 or 60 hertz (Hz).

Array Any number of photovoltaic modules connected together to provide a single electrical output.

Charge controller An electronic device which regulates the voltage applied to the battery system from the PV array. Essential for ensuring that batteries obtain maximum state of charge and longest life.

Conduit/trunking Enclosed, mechanically protected channels or pipes, either galvanised, painted or enamelled.

Deep cycle battery A battery with large plates that can withstand many discharges to a low state-of-charge.

Deep discharge Discharging a battery to 20% or less of its full charge capacity.

Direct current (DC) Electric current in which electrons flow in one direction only. Opposite of alternating current.

Electrical distribution system Cabling, distribution board and such like, needed to get the electricity generated to where we want to use it.

Grid-connected system A solar electric or photovoltaic (PV) system in which the PV array acts like a central generating plant, supplying power to the grid.

Inverter An inverter converts the energy from the PV panel from direct current (DC) into useable alternating current (AC).

Isolator A device that can switch off the power from the PV array when carrying out maintenance or in an emergency.

Kilowatt (kW) 1000 watts.

Kilowatt-hour (kWh) One thousand watts over a period of 1 hour. The kWh is a unit of energy.

Kilowatt-peak (kWp) The 'rated' amount of power a solar panel will produce in optimum conditions.

Lead acid battery A general category that

includes batteries with plates made of pure lead, lead-antimony, or lead-calcium immersed in an acid electrolyte.

Load Anything in an electrical circuit that, when the circuit is turned on, draws power from that circuit.

Microgeneration Certification Scheme (MCS) A scheme to accredit installers and designers of heat pump systems to prove they are competent.

Network operator Operator of the power grid.

Orientation Placement with respect to the cardinal directions, north (N), south (S), east (E), and west (W).

Tilt Angle The angle at which a photovoltaic array is set to face the sun relative to a horizontal position.

3. **Ground-Source Heat Pumps**

Ground source heat pumps, also known as geothermal heat pumps, is an efficient renewable energy technology that can be used to heat buildings, as well as their water supply. These systems utilize the constant temperature beneath the surface of the earth, that is stable year-round. Geothermal heat pumps transfer the heat in the earth or ground water into a building during the winter, and transfer the heat out of a building during and back into the earth during the summer. Heat can also be transferred from geothermal heat pumps to hot water tanks to heat a building's water.[47]

These systems include three main components:

Earth Connection System
A series of pipes, commonly called a "loop," is buried in the ground near a building to be conditioned, and can be set in the ground either vertically or horizontally. These pipes circulate water that absorbs heat from the earth, or releases it back to the surrounding soil.

Heat Pump Subsystem
In order to heat, a pump removes the heat from the fluid in the earth connection, then transfers this heat into the building. This process is reversed to cool a building.

Heat Distribution System
Conventional ductwork is installed to distribute the heated or cooled air through the building.[48]

There are four types of ground source heat pump systems. Three of these are "closed loop systems," and the other is an "open loop system." Factors, such as climate, soil conditions, available land, and installation costs, should help to determine which option best suits a building.[49] Ground source heating systems should not be installed if there is no evidence that the system will improve the energy efficiency of a building, or if a significant landscape could be damaged.[50]

a) **"Closed Loop"**

Most closed loop systems circulate an antifreeze solution through a closed loop, which is typically made from a high density plastic tubing. This is buried or submerged in water. The three types of closed loop ground source heat pumps are: horizontal, vertical, and pond/lake. Information on

these individual systems can be found on the U.S. Department of Energy's website, www.energy.gov.[51]

b) **"Open Loop"**

Open loop systems uses well or surface body water as the heat exchange fluid that circulates through the system. Once the water circulates through, the water is returned to the ground, well, or is discharged to the surface water. This option is practical where there is an ample supply of clean water. More information on these systems can be found on the U.S. Department of Energy website, www.energy.gov.[52]

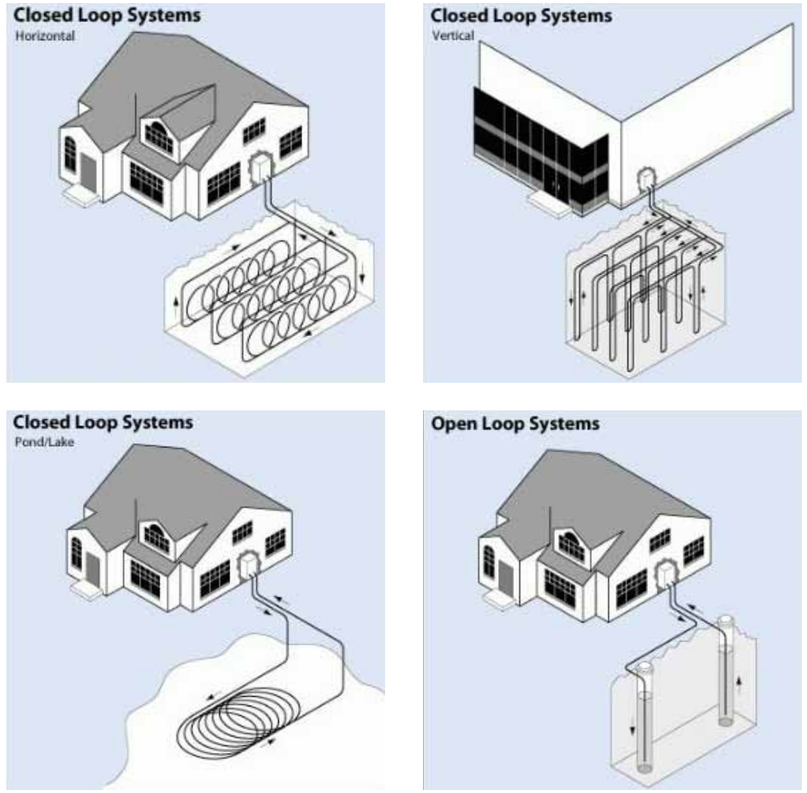

Figure 18: The various types of Closed loop and Open loop ground source heat pumps available for residential properties.
Source: USDOE

4. **Electric Vehicle Charging Stations**

There are many benefits to the use of electric vehicles, particularly the lack of dependency on fossil fuels. Owners of electric powered vehicles typically charge them overnight at their homes. Residential charging equipment is typically installed inside of garages, but can also be safely installed outdoors as long as the equipment is outdoor rated.[53]

While the use of electric powered vehicles is encouraged in order to limit the burning of fossil fuels, charging stations should be sensitively placed if they must be located outdoors. The installation of the charging station should be located out of the public view, should not cause irreversible damage, and should not impede upon the visual character of a historic building.

Figure 19 & 20: A resident's outdoor properly placed electric vehicle charging station that is at the back of the building and under a porch. This charger is far enough back on the building that it is out of public view.
Source: BRPA

IV. RESOURCES & CONTACTS

A. Financial Incentives, Tax Credits, Loans, or Grants

NJBPU and New Jersey's Clean Energy Program™ (NJCEP) offer a variety of programs to help offset the cost of making your home more comfortable and energy efficient. Our programs guide you through the decision-making process by offering the most economical solutions and providing incentives and rebates for many purchases. https://nj.gov/bpu/residential/program/

COOLAdvantage and WARMAdvantage Programs
These programs offer rebates for energy efficient heating and cooling equipment such as central air conditioners, heat pumps, furnaces, boilers, or water heaters.

Comfort Partners
This program helps income-eligible customers lower their utility bills by installing free efficiency measures that save energy and money while improving the home's safety and comfort.

Appliance Rebates and Lighting
This program offers rebates on qualifying ENERGY STAR® appliances such as clothes washers, dryers, refrigerators, air purifiers, dehumidifiers, and room air conditioners. Discounted ENERGY STAR qualified lighting products are available through many New Jersey retailers.

Home Performance with ENERGY STAR
Get 0% financing and incentives up to $4,000 for energy efficient upgrades throughout your whole house. Certified contractors will come to your home to identify health and safety issues and sources of wasted energy. You will receive a detailed plan with recommended measures, costs, and payback analysis.

New Jersey SmartStart Building
Can be implemented when starting a commercial or industrial project from the ground up, renovating existing space, or upgrading equipment. SmartStart Buildings can provide a variety of free support to yield substantial savings in the short and long term. If an interested party contracts with an outside firm to implement a full-phase energy audit, the utility can pay up to 50 percent of the study cost with a maximum reimbursement of $10,000. https://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

Appliance Recycling Program
Do you have a refrigerator or freezer sitting in the garage wasting energy? NJCEP will pick it up for FREE and provide you with a $50 incentive. NJCEP also offers a $25 incentive for each room air conditioner or dehumidifier picked up at the same appointment.

Oil, Propane, Municipal and Co-Op Electric Customers
New Jersey municipal electric, oil, and propane customers are eligible to receive incentives from certain programs. Please check NJCEP for more information and availability of funds.

Solar Transition Incentive Program
Register your solar project(s) to earn Transition Renewable Energy Certificates (TRECs).

New Jersey Clean Energy Program
provides financial incentives (rebates of 30% - 70% of system costs) to owners who install qualifying clean energy generation systems such as fuel cells, photovoltaics (solar electricity), small wind and sustainable biomass equipment. https://www.njcleanenergy.com/

Federal Solar Investment Tax Credit (FSITC)
The ITC is a tax credit that homeowners can claim on their federal tax return. Solar PV systems installed in 2020 and 2021 are eligible for a 26% tax credit. In August 2022, Congress passed an extension of this and raised it to 30% for installations between 2022 and 2032. It will decrease to 26% for systems installed in 2033 and to 22% for systems installed in 2034. The tax credit expired in 2035 unless Congress renews it.

New Jersey Solar Tax Exemptions
Solar panels are exempt from the 7% sales tax in New Jersey and is exempt from property taxes.

B. Links to Pertinent Preservation Resources

- NPS Tax Incentives for Preserving Historic Properties
  https://www.nps.gov/tps/tax-incentives.htm
- New Jersey Historic Trust. https://www.njht.org
- State of New Jersey Department of Environmental Protection Bureau of GIS
  https://www.nj.gov/dep/gis/
- The Secretary of the Interior's Standards for Rehabilitation
  https://www.nps.gov/tps/standards/rehabilitation/rehab/stand.htm
- New Jersey Office of State Planning Memo on Historic Preservation
  https://www.nj.gov/dep/hpo/hpo_article.pdf
- Sustainable Jersey Historic Preservation Element Guidelines
  http://www.sustainablejersey.com/actions-certification/actions/

The Secretary of the Interior's Standards for Rehabilitation
http://www.cr.nps.gov/tps/standards/four-treatments/treatment-rehabilitation.htm

The National Park Service Technical Preservation Briefs
https://www.nps.gov/tps/how-to-preserve/briefs.htm

NJ Municipal Land Use Law, Historic Preservation Related Sections
https://www.state.nj.us/dep/hpo/3preserve/mlul_02_2017.pdf

C. Organizations to Guide You

Local Organizations

Plainfield Historic Preservation Commission
Plainfield City Hall
515 Watchung Avenue
Plainfield, NJ 07060
(908) 753-3580
www.plainfieldnj.gov

The Historical Society of Plainfield
Drake House Museum
602 West Front Street
Plainfield, New Jersey 07060
(908) 755-5831
www.drakehouseplainfieldnj.org

Local History Collections

Plainfield Library
850 Park Avenue
Plainfield, New Jersey 07060
(908) 757-1111
www.plainfieldlibrary.info

State Organizations

Historic Preservation Office
P.O. Box 404
Trenton, NJ 08625-0404
(609) 292-2023
www.state.nj.us/dep/hpo

New Jersey Historical Commission
225 West State Street, 4th Floor
Trenton, NJ 08625-0305
(609) 292-6062
www.newjerseyhistory.org

New Jersey Historic Trust
P.O. Box 457
Trenton, NJ 08625-0457
(609) 984-0473
www.njht.org

Preservation New Jersey, Inc.
30 South Warren Street
Trenton, NJ 08608
(609) 392-6809
www.preservationnj.org

National Organizations

National Trust for Historic Preservation
1785 Massachusetts Avenue, NW
Washington, D.C. 20036
(202) 588-6000
www.nthp.org

National Park Service
1849 C Street, NW NC400
Washington, D.C 20240
(202) 343-9500
www2.cr.nps.gov

Figure 21: View of East Front Street around 1904


Figure 22: View of Belvidere Avenue around the turn of the century

V. FREQUENTLY ASKED QUESTIONS

A. Energy Assessments

Who should perform my building's energy assessment?

If your building has poor energy efficiency, it is best to contact your utility or state energy office and inquire if they offer discounted or free energy audits. Also consider hiring a Home Energy Rater, which is a specialized contractor who can perform a standardized evaluation of your building's efficiency. Home Energy Raters can be found using Energy Star's Partner locator online at: https://www.energystar.gov/partner_resources/partner_locator.[54]

How long does an energy assessment take?

Those audits that do not require specialized equipment are generally inexpensive and take roughly an hour. More thorough assessments that do require the use of specialized equipment can take up to four hours and are typically more expensive. These longer tests can be beneficial as they provide more detailed results on a building's energy use, and therefore, they can be better guides for what upgrades should be made to improve efficiency.[55]

Can I perform an energy assessment on my building myself?

You can do your own energy assessment using the U.S. DOE and U.S. EPA supported sources, such as the Home Energy Saver tool. This can also help to guide your next steps to improving your building's efficiency after the energy assessment. The Home Energy Saver tool can be accessed through this link provided by the DOE: https://hes.lbl.gov/consumer.[56]

Additional Resources:

National Park Service's Preservation Brief 3: Improving Energy Efficiency in Historic Buildings

https://www.nps.gov/tps/how-to-preserve/briefs/3-improve-energy-efficiency.htm#moisture.

U.S. Department of Energy: Home Energy Assessments

https://www.energy.gov/energysaver/home-energy-assessments.

Energy Star: General Home Improvements

https://energystar-mesa.force.com/ENERGYSTAR/s/topic/0TOt00000008fIkGAI/general-home-improvement.

B. Air Sealing

Do I need contractor to seal air leaks air leaks or insulate my building?

Sealing and insulating can be done yourself using resources, such as Energy Star's "Do-It-Yourself (DIY) Guide to Sealing and Insulating," https://www.energystar.gov/sites/default/files/asset/document/DIY_Guide_2016.pdf.[57] Otherwise, contractors have experience and equipment to find problem and address problem areas with the appropriate materials.[58]

Where are the biggest air leaks in my building?

Typically, the most common place for air leaks in buildings are in attic spaces. These leaks are often

found under insulation, or around holes for ducts, plumbing, recessed lighting cans, attic hatches, and uncovered whole house fans. Address the big air leaks first as they will help make your building comfortable and most noticeably reduce your energy bill.[59]

Basements are another common area for air leaks. The most typical air leaks in a basement are found along the top of foundation walls where the masonry comes in contact with the wood frame. Other areas are include holes for plumbing, furnace flues, and ducts that go throughout the basement ceiling to the floors above.[60]

Is it possible to make my historic building too air tight?
While energy can be saved in reducing a building's major air infiltrations, it is possible to make a historic building too air tight. Historic buildings were designed to "breathe," allowing air to circulate throughout and reduce moisture. The key with historic buildings is having a balance where some air movement is allowed to prevent problems associated with moisture accumulation, such as wood deterioration, mold growth, and insect infestation. In order to better understand how to prevent moisture infiltration and the proper amount of air flow for historic buildings, see the "National Park Service's Preservation Brief 39: Holding the Line, Controlling Unwanted Moisture in Historic Buildings."[61]

Additional Resources:
National Park Service's Preservation Brief 3: Improving Energy Efficiency in Historic Buildings
https://www.nps.gov/tps/how-to-preserve/briefs/3-improve-energy-efficiency.htm#moisture.

National Park Service Brief 39: Controlling Unwanted Moisture in Historic Buildings
https://www.nps.gov/tps/how-to-preserve/briefs/39-control-unwanted-moisture.htm

U.S. Department of Energy: Air Sealing
https://www.energy.gov/energysaver/air-sealing-your-home.

Energy Star: "Do-It-Yourself Guide to Sealing and Insulating with Energy Star: Sealing Air Leaks and Adding Attic Insulation"
https://www.energystar.gov/sites/default/files/asset/document/DIY_Guide_2016.pdf

C. Insulation
How much insulation should I add?
The performance of insulation is measured by its "R-value," or an insulation's ability to resist heat flow. A higher R-value means better thermal performance. In Central and Northern U.S. Climates, a minimum R-value of R-49 is recommended.[62]

Can I add new insulation on top of old insulation?
New insulation can be added on top of old insulation, unless the existing insulation is wet, rotted, or infested. If existing insulation is wet or appears to have been wet at one time, look for the cause and repair the problem. Remove any wet insulation, as this can result in mold, mildew, or the deterioration of wood framing members. If there is evidence of pests, such as ants, termites, mice, or squirrels, remove the insulation and treat the space before adding new insulation.[63]

What is Vermiculite and what do I do if I find it in my building?
Vermiculite is a naturally-occuring mineral that resembles mica, and, when heated, expands greatly in size. Expanded Vermiculite is light weight, fire resistant, and odorless, and it has been used in insulation of walls and attics.[64] The insulation is recognizable as it is pebble-like, is grey-brown or silver-gold in color, and was poured into walls and ceiling cavities. A mine near Libby, Montana was the source of over 70% of all Vermiculite sold in the United States from 1919 to 1990. The mine was also a source of asbestos, so the Vermiculite was contaminated with asbestos.[65] If you discover Vermiculite insulation in your attic, have it tested for asbestos before beginning any kind of work in that space. If the insulation is contaminated with asbestos, have it removed by a certified removal expert.[66]

Additional Resources:
National Park Service's Preservation Brief 3: Improving Energy Efficiency in Historic Buildings
https://www.nps.gov/tps/how-to-preserve/briefs/3-improve-energy-efficiency.htm#moisture.

National Park Service Brief 39: Controlling Unwanted Moisture in Historic Buildings
https://www.nps.gov/tps/how-to-preserve/briefs/39-control-unwanted-moisture.htm.

U.S. Department of Energy: Insulation
https://www.energy.gov/energysaver/insulation.

Energy Star: Seal and Insulate
https://energystar-mesa.force.com/ENERGYSTAR/s/topic/0TOt00000008fIiGAI/seal-and-insulate.

D. Windows
Should I replace my historic windows to improve energy efficiency.
No. Perform an energy assessment on your building and address other issues first. After other issues have been taken care of, consider retrofitting historic windows with weatherstripping, cellular shades, or interior or exterior storm windows. These simple, cost effective actions can help achieve energy savings comparable to window replacements.[67] Saving historic windows also preserves the appearance and character of historic buildings.

How do I maintain my historic windows?
Typical maintenance on historic windows includes:

Paint. Keep exterior surfaces on windows painted. Paint protects wood from water and helps prevent wood deterioration. Keep the moveable surfaces, such as the inside of the jamb or parting bead free of paint so the sashes can open and close.

Glazing. Glazing putty around window panes will dry out and has to be replaced over time. Prime glazing with an oil-based primer before repainting.

Sash cords and weights. Replace broken cords and appropriately hang the sashes with weights so that the windows are balanced. Keep the cords unpainted.

Cracks or checking in sills. If cracks are visible on the window sill fill them with epoxy, followed by

coats of primer and paint. This will prevent water from collecting on the sill, which can result in wood deterioration.

Storm windows. Storm windows should have weep holes to reduce condensation on the inside and allow trapped moisture to escape. Make sure weep holes are open to improve the window's performance and prevent moisture related issues, such as mold, mildew, and deterioration of wood.

Weather stripping. Monitor weather stripping wear and replace as needed.[68]

If you are uncomfortable or unsure of how to handle these maintenance practices, look for a contractor that has experience in working with historic buildings.

Where can I learn more about repairing historic windows?
There are numerous resources that are available that cover the repair of historic windows. Some notable sources include:

Additional Resources:
National Park Service's Preservation Brief 9: The Repair of Historic Wooden Windows
https://www.nps.gov/tps/how-to-preserve/briefs/9-wooden-windows.htm.

National Park Service's Preservation Tech Note: Windows 1: Planning Approaches to Window Preservation
https://www.nps.gov/tps/how-to-preserve/tech-notes/Tech-Notes-Windows01.pdf

National Park Service's Preservation Tech Note: Windows 3: Exterior Storm Windows - Casement Design Wooden Storm Sash
https://www.nps.gov/tps/how-to-preserve/tech-notes/Tech-Notes-Windows03.pdf

National Park Service's Preservation Tech Note: Windows 4: Replacement Frames and Sash - Protecting Woodwork Against Decay
https://www.nps.gov/tps/how-to-preserve/tech-notes/Tech-Notes-Windows04.pdf

National Park Service's Preservation Tech Note: Windows 9: Interior Storm Windows - Magnetic Seal
https://www.nps.gov/tps/how-to-preserve/tech-notes/Tech-Notes-Windows09.pdf

National Trust for Historic Preservation:
https://savingplaces.org/stories/preservation-tips-tools-retrofitting-historic-windows#.Yys3m6TMIdU.

E. Heating, Ventilation, and Air Conditioning (HVAC)
How do I know if I need a new heating and cooling HVAC system?
If your HVAC system is over ten years old or is not performing properly, have it inspected by an HVAC contractor. HVAC systems can be costly, so be sure to address air leaks before investing in a new system. Air leaks are often the true source of problems rather than the heating and cooling equipment.[69]

Can I figure out what size HVAC system I need for my building myself?
A contractor should be consulted to determine what equipment is best for your building. Determining the proper size of equipment requires engineering calculations, which, if done incorrectly, may result in the purchasing of improperly sized equipment. The wrong sized HVAC system can be inefficient and lead to uncomfortable spaces as well as higher energy bills.[70]

Additional Resources:
National Park Service's Preservation Brief 24: Heating, Ventilating, and Cooling Historic Buildings
https://www.nps.gov/tps/how-to-preserve/briefs/24-heat-vent-cool.htm

U.S. Department of Energy: Heat and Cooling
https://www.energy.gov/energysaver/heating-and-cooling

F. Renewable Energy
What weather conditions do solar panels work in?
Solar panels need sunlight to create electricity, but they do not necessarily need direct sunlight. Solar panels can still create electricity on cloudy, snowy, and rainy days. Solar panels generate the most electricity on clear, sunny days under direct sunlight.[71]

How durable are solar panels?
The average life span of solar panels range from 25 to 30 years. This long lifespan is beneficial as the electricity produced and its resulted savings cover the initial installment costs. Also, because solar panels do not have any moving parts, they do not break often and are easy to maintain. Panels only need to be cleaned and free of debris.[72]

How much do solar panels cost up front?
There are different payment structures depending on what type of solar panels are installed and the company they are being purchased from. Solar panels can be purchased outright or in some instances can be leased depending on what the companies' purchasing options are.[73]

Additional Resources:
National Renewable Energy Lab
http://nrel.gov/

National Park Service's Preservation Brief 3: Improving Energy Efficiency in Historic Buildings
https://www.nps.gov/tps/how-to-preserve/briefs/3-improve-energy-efficiency.htm#moisture.

U.S. Department of Energy: Planning for Home Renewable Energy Systems
https://www.energy.gov/energysaver/planning-home-renewable-energy-systems

Figure 23: Prospect and East Ninth Streets, from Park Avenue around 1918

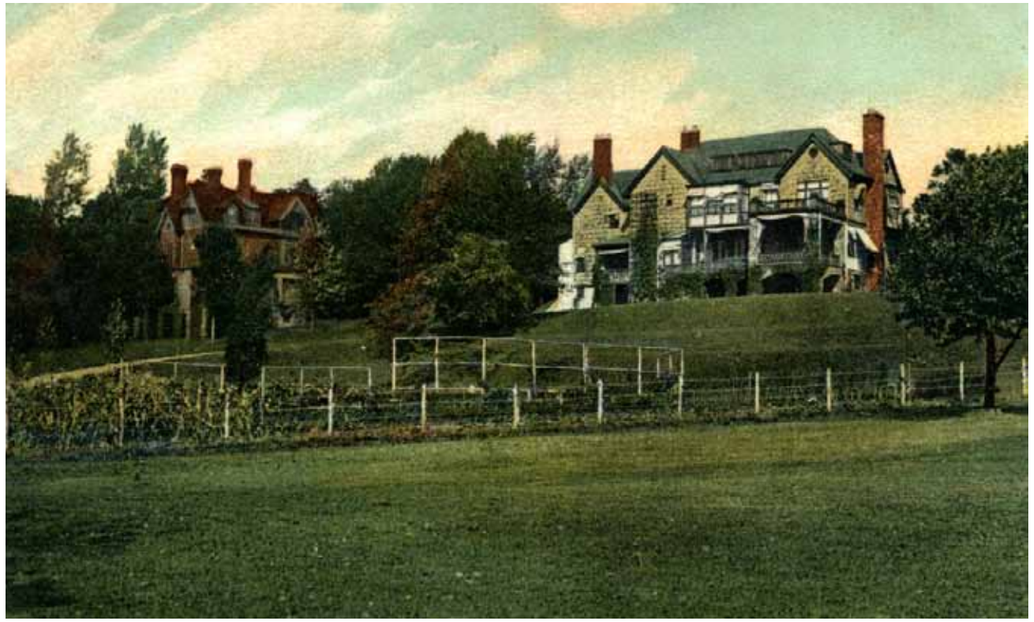

Figure 24: Woodland Avenue residences around 1910

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VII. APPENDICIES

City of Plainfield’s Historic Preservaion Ordinance

Article IV: Historic Preservation Commission
https://cms9files.revize.com/plainfield/Document_Center/Resident/Art,%20History,%20and%20Culture/Historic%20Preservation%20Commission/Land%20Use%20Ordinance/Article%20IV-%20Historic%20Preservation%20Commission.pdf

Article X: Historic Preservation Controls
https://cms9files.revize.com/plainfield/Document_Center/Resident/Art,%20History,%20and%20Culture/Historic%20Preservation%20Commission/Land%20Use%20Ordinance/Article%20X%20Historic%20Preservation%20Controls.pdf

City of Plainfield’s Design Guidelines for Historic Districts and Sites
https://cms9files.revize.com/plainfield/Document_Center/Resident/Art,%20History,%20and%20Culture/Historic%20Preservation%20Commission/Design%20Guidelines/Plainfield%20Design%20Guidelines%20rev%202-09.pdf

National Park Service

Technical Preservation Services - Sustainability
https://www.nps.gov/tps/sustainability.htm

Preservation Briefs
https://www.nps.gov/tps/how-to-preserve/briefs.htm

Preservation Tech Notes
https://www.nps.gov/tps/how-to-preserve/tech-notes.htm

The Secretary of the Interior’s Standards for Rehabilitation & Illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings.
https://www.nps.gov/tps/standards/rehabilitation/sustainability-guidelines.pdf

The Secretary of the Interior’s Standards for Rehabilitation
http://www.cr.nps.gov/tps/standards/four-treatments/treatment-rehabilitation.htm

Preservation Trades Network
http://ptn.org/

Window Preservation Alliance
https://windowpreservationalliance.org/

Advisory Council on Historic Preservation Energy Conservation & Weatherization
https://www.achp.gov/initiatives/sustainability-climate-resilience/energy-conservation-weatherization

National Trust for Historic Preservation
8 Ways to Green Your Historic House
https://savingplaces.org/stories/8-ways-to-green-your-historic-house#.YxD3bHbMJPY

Preservation & Sustainability
https://forum.savingplaces.org/learn/issues/sustainability

U.S. Environmental Protection Agency
Energy Advice for Owners of Older and Historic Homes
https://archive.epa.gov/region5/sustainable/web/html/energyadvice.html

A Field Guide to American Houses Virginia and Lee MacAlester
For information about character-defining features of buildings