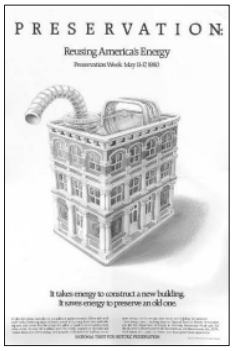
Historical Buildings
A Holistic Approach to “Green”

The Issue

- How to maintain a building which may have been built prior to the installation of mechanical heat and air conditioning?
- Will the alterations do more harm than good?
- Energy is expensive – what is the best use of available funding?

The Solution

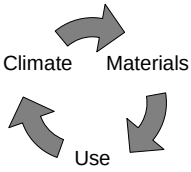


Historic buildings were *designed and built to be sustainable*

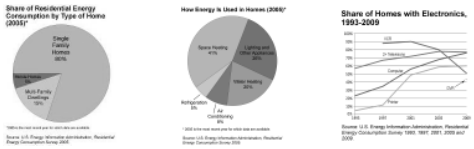
- **Climate driven design**
- **Passive solar**
- **Day lighting**
- **Natural ventilation**
- **Built to last**
- **Durable & natural materials**
- **Ability to be maintained**

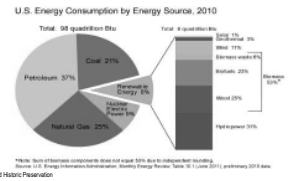
Preservation Week Poster from 1980

Decision Making & Building Science



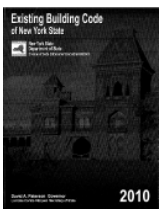
Residential Energy Usage





New York State Codes

Existing Building Code of New York State



HISTORIC BUILDING. Any building or structure that is listed in the State or National Register of Historic Places; designated as a historic property under local or state designation law or survey; certified as a contributing resource within a National Register listed or locally designated historic district; or with an opinion or certification that the property is eligible to be listed on the National or State Register of Historic Places either individually or as a contributing building to a historic district by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places.

New York State Codes

New York City Energy Conservation Code

NYCECC 2010 – NYC

New York City Local Law 85 of 2009, which became effective July 1, 2010, established the New York City Energy Conservation Code (ECC) and ensured that the NYCECC was at least as stringent as the New York State ECC (2007 edition). When the 2010 NYSECC was released, Local Law 66 0f 2010 was enacted to incorporate the new state code and became effective December 28, 2010.

101.4.3 Historic buildings. The following exceptions shall apply:

- 1. Any building or structure that is listed in the State or National Register of Historic Places; designated as an historic property under state designation law or survey; certified as a contributing resource within a National Register listed historic district; or with an opinion or certification that the property is eligible to be listed on the National or State Registers of Historic Places, either individually or as a contributing building to a historic district by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, is exempt from this code.
- 2. Any building or structure that is designated by the Landmarks Preservation Commission, either as an individual landmark or as within an historic district and is not listed, designated or certified as provided in subdivision one of this section; or that is calendared by the Landmarks Preservation Commission for consideration as an individual landmark or part of an historic district and is not certified to be eligible to be listed as provided in subdivision one of this section, is exempt from the envelope and exterior lighting requirements of this code. Any interior that is designated as a New York city landmark and is not listed, designated or certified as provided in subdivision one of this section; or that is calendared for consideration by the Landmarks Preservation Commission for designation as an interior landmark and is not certified to be eligible to be listed as provided in subdivision one of this subsection, is exempt from this code.

New York State Codes

Energy Conservation Construction Code of New York State

The 2010 ECCCNYS has an effective date of December 28, 2010, and is based on the 2009 International Energy Conservation Code (IECC). In compliance with the American Recovery and Reinvestment Act (ARRA) of 2009, the 2010 ECCCNYS equals or exceeds the 2009 IECC for residential buildings, and equals or exceeds ASHRAE 90.1-2007 for commercial buildings. If property is eligible or listed on the State or National Register, the work is ***Exempt*** from the Code.

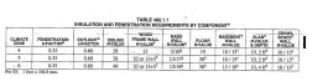
101.4.2 Historic buildings. An alteration or renovation to an existing building or structure that (1) is listed in the New York State Register of Historic Places, either individually or as a contributing building to a historic district, or (2) is listed in the National Register of Historic Places, either individually or as a contributing building to a historic district, or (3) has been determined to be eligible for listing in either the New York State or National Register of Historic Places, either individually or as a contributing building to a historic district, by the New York State Commissioner of Parks, Recreation and Historic Preservation, or (4) has been determined to be eligible for listing in the National Register of Historic Places, either individually or as a contributing building to a historic district, by the U.S. Secretary of the Interior, need not comply with this code.

New York State Codes

Energy Conservation Construction Code of New York State

TABLE 301.1
CLIMATE ZONES BY COUNTY, ALL ZONES ARE CATEGORY "A" OR, MOIST DESIGNATIONS

Climate Zone 4			
Bronx	Nassau	Queens	Suffolk
Kings	New York	Richmond	Westchester
Climate Zone 5			
Albany	Erie	Ontario	Saratoga
Cayuga	Genesee	Orange	Schenectady
Chautauqua	Greene	Orleans	Seneca
Chemung	Livingston	Oswego	Tioga
Columbia	Monroe	Putnam	Washington
Cortland	Niagara	Rensselaer	Wayne
Dutchess	Onondaga	Rockland	Yates
Climate Zone 6			
Allegany	Franklin	Montgomery	Sullivan
Broome	Fulton	Oneida	Tompkins
Cattaraugus	Hamilton	Otsego	Ulster
Chenango	Herkimer	Schoharie	Warren
Clinton	Jefferson	Schuyler	Wyoming
Delaware	Lewis	St. Lawrence	
Essex	Madison	Steuben	

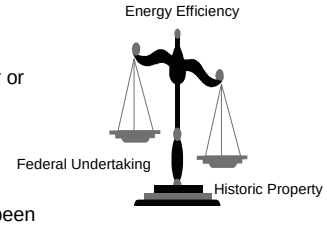


A Holistic Approach to Weatherization

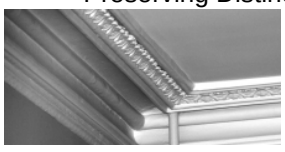
Where one size doesn't fit all

How Does Weatherization Fit into the Goals of the Project?

- What are the goals of the Housing Agency?
- Will weatherization procedures adversely impact/effect the exterior or interior of the building?
- Are we able to find a balance with both preservation and weatherization in mind?
- Have original elements been covered up? Have they been removed?



Achieving Weatherization Goals While Preserving Distinctive Features



Historic building features can:

Save Energy

Save the Earth

Save Money

Refining those features will:

Improve Property Values

Improve Health

Add Local Jobs

New York State Office of Parks, Recreation and Historic Preservation

Sustainability

Historic buildings are often highly adaptable for new uses

New York State Office of Parks, Recreation and Historic Preservation

Waste & Demolition

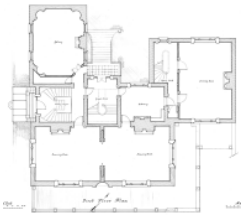
New York State Office of Parks, Recreation and Historic Preservation

Inherently Sustainable Features

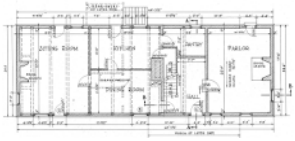
- Floor Plan
- Exterior materials
- Roof overhangs
- Fireplace locations
- Window sizes
- Shutters
- Orientation

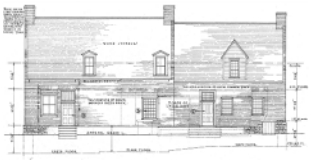
New England Climate

Southern Climate



New York State Climate
Humid Continental

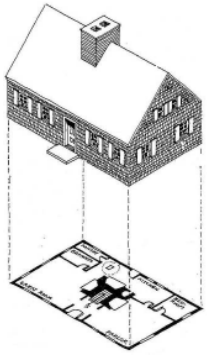




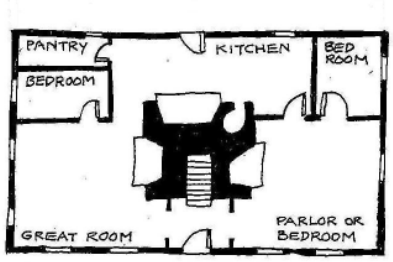
Neighborhood Developments

A Short Story of 200 Years

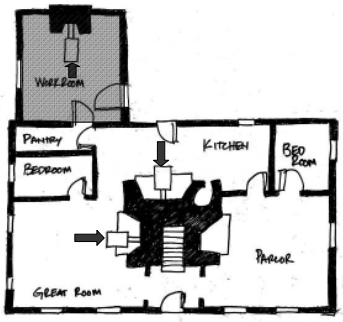
1804, Jefferson County, NY



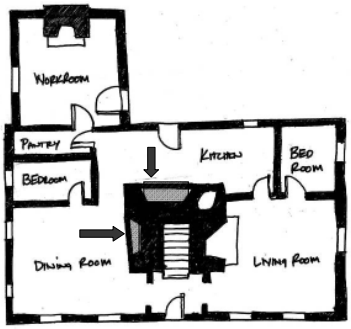
1804



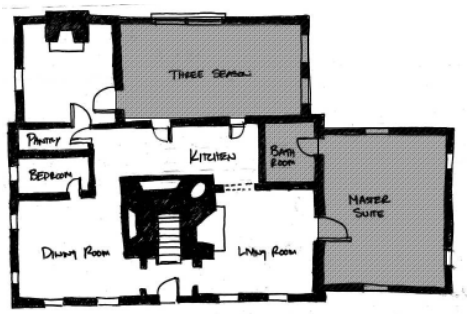
1848



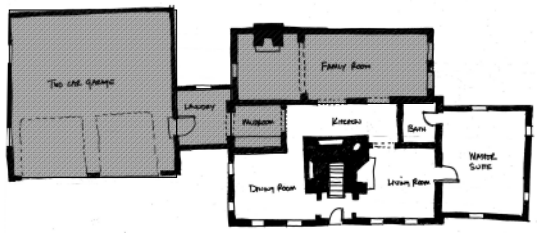
1940



1960



1986-2012

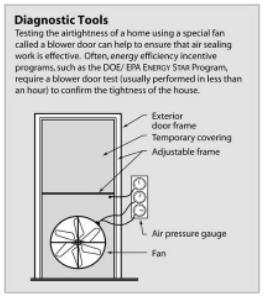


Energy Audit

- Identify the location of air infiltration
- Review past energy bills – 1-2 years
- Determine baseline for current use of home.
- Blower door test & infrared thermography
- Determine Inherently Sustainable Features

Blower Door Test

- A fan that mounts into the frame of an exterior door
- Fan pulls air out of the house, lowering the air pressure inside
- The higher outside air pressure then flows in through all unsealed cracks and openings.



US Department of Energy

Audit Results

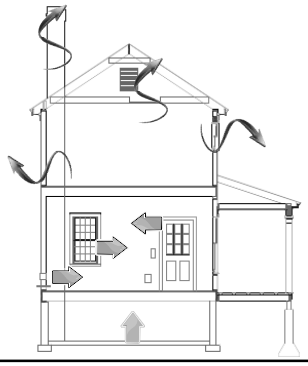
- Implement improvements that will provide the most payback and the least compromise to the historic character of the building.

Minimal Alterations to Historic Buildings

- Chimneys
- Attic Insulation
- Seal ducts & pipes
- Weather-strip doors
- Add storm windows & doors
- Seal locations of air infiltration

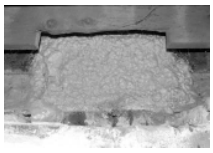
Common Air Leaks – Stack Effect

- CHIMNEY
- ATTIC HATCH
- WINDOWS
- OUTLETS
- UTILITY ENTRANCES
- DOORS/WINDOWS
- DRAINS
- CRACKS



Air Infiltration

- Seal ducts
- Pipe and electrical penetrations.
- Foam inserts at electrical outlets
- Leaks around doors and windows



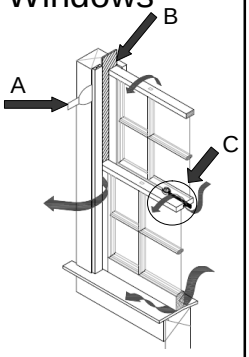
Air Infiltration - Doors

Air Infiltration at Windows

A Weather-stripping should be installed at the jambs, the sill, the head and at the meeting rails. Use a thin putty knife to slip behind the stop and lightly pry off.

B Spring bronze is a good choice for the jambs. The strip is nailed to the jamb channel along the interior side at the stop or parting bead.

C An interlocking strip is best for the meeting rails. When the window is closed, the strips close off any air gaps. The sash lock pulls the meeting rails tight.

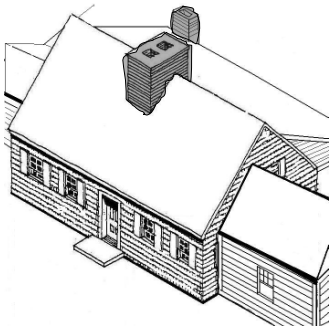


Air Infiltration at Windows

Indoor Air Quality

- Homeowners are spending more time indoors.
- Tightening the envelope too much could lead to poor air quality and mold issues.
- Addition of a whole house air exchanger will aid in air quality issues, but is an additional use of energy.

Chimney



Closing the Damper

Insulation

Heat loss at Attic - Over 30%

Codes & Building Science

- Onondaga and Erie County: Climate Zone 5
- The ECC2010 requires an R-38 for ceilings with attic spaces (NYSHCR: R-49)
- Thermal insulation (excluding foam insulation), must fill cavity in walls, floors, ceilings, attics in a manner that does not harm or damage historic fabric and ensures free air movement.
- Understand the inherent thermal properties of existing materials and the insulating needs for the specific climate and building type.

Types of Insulation

Insulation - R-Value Per Inch Chart

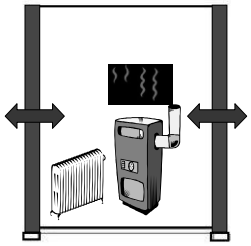
Insulation Type	R-value per Inch	R-Value	Appearance	Typical Application	Historial Application
Cellulose, Loose Fill	3.2		Grey. Chopped up newspaper with a fire retardant.	Walls, Enclosed Cavities, Attics	YES
Extruded Polystyrene	5		Pink or blue rigid board	Exterior sealing of basement walls. Waterproof	YES
Fiberglass, Batts	3	3x8=R-11 2x8=R-19 2x10=R-30	Pink or Yellow Blankets. Unfaced or paper faced. The Kraft face moisture barrier should be placed on the warm side of the thermal envelope. .	Install in open wall, floor or ceiling cavities and attic floors	YES
Fiberglass, Loose Fill	2.8		Pink, yellow, or white. Comes in compressed bags.	Attic Floor, and Walls (existing) A moisture barrier should be added to the warm side of the thermal envelope.	YES
Low Density Urethane, Spray Foam	5.8		Yellow/white foam which is sprayed vast and expands as it dries.	Attics, Walls (new construction), Sill Plate, Rim Joist, and Framing Transitions	NO
Poly-isocyanurate, Rigid Board	6.5		Foam boards with Foil facing	Foundation Walls, and Doors	YES
Polystyrene, Expanded Rigid Board	4		White	Foundation Walls, Sill Plate, and Rim Joist	YES
Rockwool	3	2x4=R-13 2x6=R-22 2x10=R-38	Dark grey or black batts with paper facing	Attic Floor, Walls, and Basement Ceiling (may be loose or batts) Used during the 1950-1960s.	NO
Urethane, Spray Foam	6.5		Yellow/white foam which is sprayed vast and expands as it dries.	Attics, Walls (new construction), Sill Plate, Rim Joist, and Framing Transitions	NO
Vermiculite Loose Fill	2.4		Looks like very small mica flakes	Attics. May contain asbestos	NO

Solid Masonry Walls

- 18th & 19th C brick walls were multiple wythes thick and plaster was often applied directly over the brick.
- 20th century buildings added an air space with furring and painted gypsum plaster.
- Thermal properties include a thermal lag - slows the transfer of heat down until night when the air is cooler

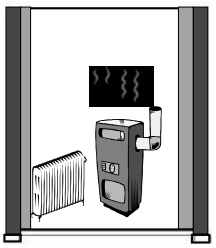
Building Science of Masonry Walls

- Historic bricks were fired at different temperatures, were made of different mixtures, and have different porosity levels.
- Buildings heated during the winter protect the exterior face of the masonry wall by reducing the possibility if water freezing in the outer layers of the wall.



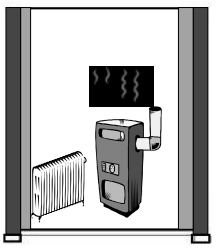
Building Science of Masonry Walls

- Adding insulation to masonry walls prolongs the drying rate.
- The wall will stay cold
- Increased freeze/thaw cycles
- Damage may occur to the brick – future $$ for repairs & repointing
- Look at the brick at non heated locations – if you see deterioration, the brick may act in a similar fashion if insulated.



Building Science of Masonry Walls

- Exterior masonry walls can absorb water when it rains and insulation may slow the drying period.
- Such changes may damage the historic masonry, may damage the interior finishes, and cause deterioration to wood or steel structure within the wall.

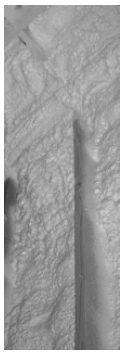


Insulating Solid Masonry Walls

- Should be avoided when it involves the removal of important finishes or features or when the additional thickness alters the historic character of the interior.
- Use rigid insulation at basements.

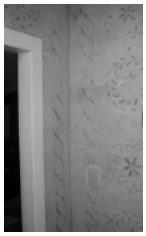
Spray Foam Insulation

- Since liquid foam insulation (closed & open cell) will adhere permanently to wood and masonry fabric, its use is not advised for listed or eligible buildings. (Not reversable)
- Pressure used for installation could cause damage to historic material including plaster keys & details
- Hides the condition of the structure. A leak in the roof will go undetected
- Doesn't allow for accessible locations for repairing or running new electrical, plumbing, or HVAC lines
- May trap moisture
- Long term effects of adding spray foam to historic masonry walls have not been adequately documented.



Insulating Wood Framed Walls

- Blow in wall insulation where no decorative plaster or stenciling is damaged.



Wall Insulation Concerns

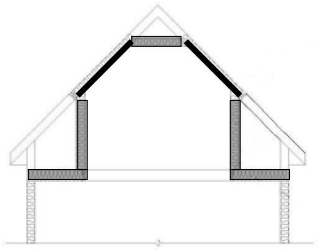
- Does wall sheathing exist? Is exterior siding nailed directly to the studs? Platfrom or Ballon framed?
- If holes are drilled through exterior siding, holes must be filled with wooden plugs, sanded smooth, and primed and painted to match surrounding siding finish
- Recommended use of *borate only* grade of cellulose insulation. Cellulose treated with sulfates will react with moisture in the air and will form sulfuric acid which corrodes metal.

Insulation Concerns

Attic & Wall Insulation Concerns

- Installation of a moisture barrier is difficult without removing historic fabric
- Inspect for safety and moisture related issues, and address accordingly
- All kitchen and bath fans venting into attic must be vented outdoors through roof fittings
- Walls and attics may contain knob and tube wiring. If this still exists, it must be removed/updated prior to adding insulation.
- Existing insulation, such as vermiculite, may contain asbestos – Contractor Safety

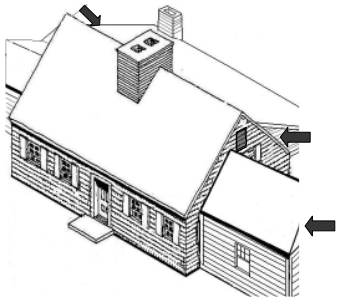
Eaves and Finished Spaces



Unfinished Attic Spaces

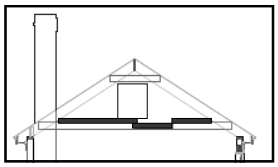
At eaves, install baffles, dams or other blocking devices

Attic Venting



Attic Insulation

- Install insulation over the attic floor and over the attic hatch. Rigid insulation should be placed over the attic hatch
- Attic vents need to be clear for proper air movement and drying.
- If you must install new attic vents in the gable end, consider how this will alter the historic appearance of your building and avoid irreversible changes.



Attic Venting at Gables

Attic Venting at Gables

Deep Energy Retrofits

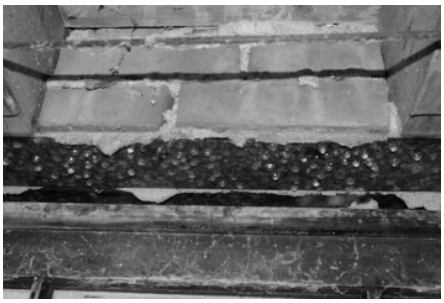



Never an appropriate treatment for historic buildings.

Moisture Migration & Mold




Basement Moisture

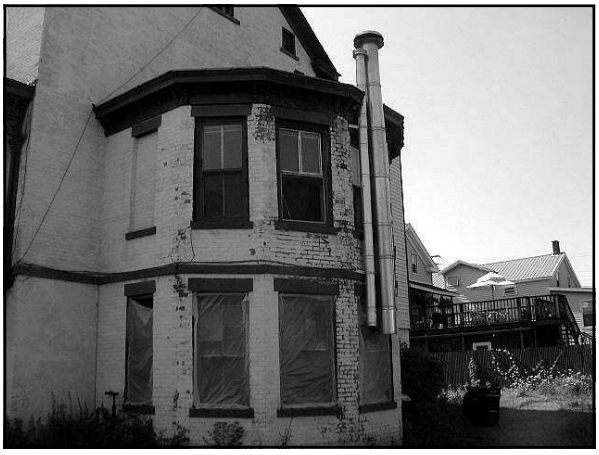


Heating & Cooling Systems

- The energy audit will determine the age of your system, its efficiency, and if it is properly sized for your building and your lifestyle

Heating & Cooling Systems

- Will new pipes need to be installed?
- New exhaust or fresh air piping at the roof or exterior wall?
- Use of a wood stove or insert?



Unconditioned Basements

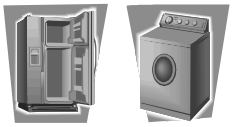
- Install a moisture barrier over exposed dirt floors to prevent ground moisture from entering conditioned spaces.
- Seal ducts for heating and AC

Thermostats

- Installation and usage of a programmable thermostat
- Reduce building's heating costs by approximately 25%.

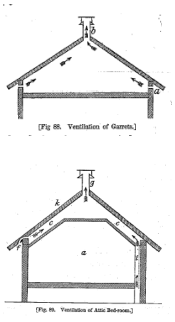
Energy Star Appliance Upgrades

- Refrigerators, washing machines and dishwashers.
- Available rebates at www.energystar.gov



Cross Ventilation & Vegetation

Cupolas & Ventilation

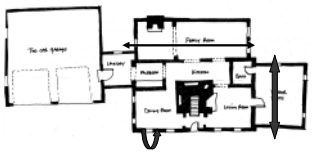


[Fig 88. Ventilation of Garrets.]

[Fig. 89. Ventilation of Attic Bed-room.]

Summer Cooling

- Window & door screens
- Close windows and curtains to reduce solar gain during the day
- Open windows overnight to draw in cooler air
- Open both the bottom and top sashes to increase the cycle of cool and warm air.



Insulated Shades & Awnings

- Awnings should only installed when compatible with the character of the building
- Interior shades are an cost effective alternative to controlling heat gain and loss
- Pleated shades provide air spaces which add insulation value. Lower at night during the winter season

Exterior & Interior Shutters

Exterior Storm Windows

- Salvaged storm windows can be repaired and reused as they are often the correct size and the cost is minimal.
- Some new storm windows offer clear, non tinted, low-e glass.
- Studies show that the use of an exterior storm window can equal the performance of a new double glazed replacement window.
- Use solves the issue of insulated glass seal failure found in new replacements.

Exterior Storm Windows

- Storm windows must be tight fighting to the existing opening – reduce the formation of condensation on the existing primary window
- Align with the meeting rail of the existing sash
- Match the color of the existing sash
- Caulked around the frame without closing off weep holes

Interior Storm Windows

- As long as a proposed measure does not diminish the historic character of a building or endanger historic materials, then it will meet the Standards.
- Gaskets must be used to ensure a tight fighting to the existing opening – reduce the formation of condensation on the inside of the existing primary window

Windows

Windows come in all shapes, sizes, and types, and are some of the most important character defining features on historic buildings.

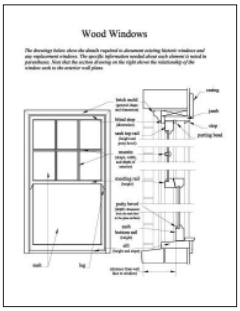
Historic Windows

- Originally built of old growth and dense wood.
- Glass was individual panes.
- Easily repaired
- Easily adapted to receive energy enhancements

Common Issues:

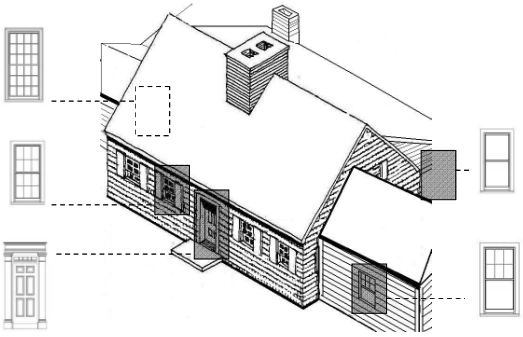
- Sticky Windows / Loose Windows
- Replacing Glazing and Putty
- Sash Cords and Weights
- Cracked Paint

Window Survey



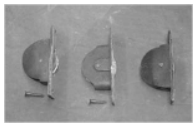
- Window Survey
- Photographs
- Comparative drawings and manufacturer's cut sheets

Window Types - Survey

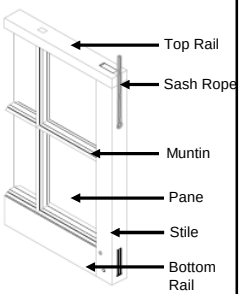


Window Repair

- Glass Repair
- Caulk
- Rope Repair
- Weights
- Salvaged items



Sash Repair



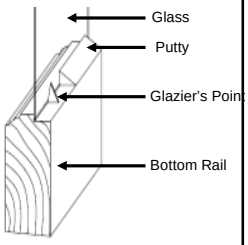
Pane Replacement

Pane Replacement:

- Remove existing damaged pane.
- Insert pane into existing sash, secure with glazing points
- Seal perimeter of pane with latex or oil based glazing compound, or vinyl glazing strips.

Re-glazing:

- Lead paint and asbestos hazards



Lead Paint

EPA RRP

- Built prior to 1978
- Lead compounds were used as they had excellent adhesion, drying, and covering abilities for such elements as window sash, window frames, trim, and siding.
- Disruption of more than 6 square feet by any contractor performing renovation, repair, and painting projects in homes, child care centers, and schools triggers RRP
- Preservation Brief 37 - A preferred approach, consistent with *The Secretary of the Interior's Standards*

Lead Hazard Control in Historic Buildings

- If Federal funds are involved in the project and it is eligible or listed on the National Register, treatment must comply with the Secretary of Interior's Standards.
- See Chapter 18: Lead Hazard Control and Historic Preservation

- Consult with the SHPO on different levels of treatment.

1. Stabilization & removal of lead based paint
2. Extensive repair with in kind or closely matching materials
3. Replacement and Removal - Extensive review by SHPO and ACHP

www.hud.gov/offices/lead/lbp/hudguidelines/Ch18.pdf

Asbestos

- Used since the late 1800's as a ingredient for caulking and putties.
- Asbestos increases the viscosity of caulks, reduces the sag, and reinforces the matrix.
- Ranges from 5-25% of caulking, glazing, and patching compounds.

Asbestos & NYS Department of Labor

- Part 56 of Title 12 of the Official Compilation of Codes, Rules and Regulations of the State of New York (Cited as 12 NYCRR Part 56)

Historic Doors

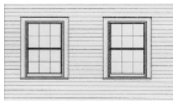
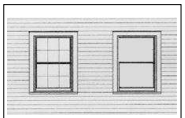
When is Replacement an Option?

- Severely deteriorated
- Lead paint & children
- Non-historic windows that have failed

Replacement Windows

- Proportions of the frame to sash
- Configuration of windowpanes and muntin profiles
- Material, including type of wood or metal and glass characteristics.

Replacement

DO	DON'T	DON'T
		
Replacement of 6 over 6 in kind, keeping muntin pattern and size.	Replacement with 1 over 1: Poor selection, no muntins change the design substantially and reduce the overall character of original windows and building.	Replacement with smaller opening: Poor selection, wrong size and proportion to overall wall

Character Defining Features

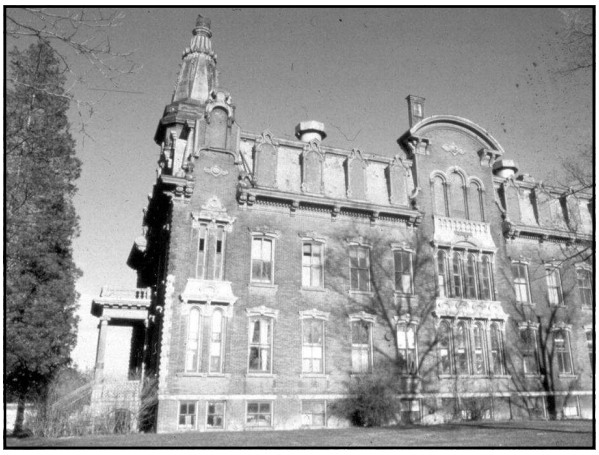
Character Defining Doors & Windows

New York State Office of Parks, Recreation and Historic Preservation

New York State Office of Parks, Recreation and Historic Preservation

Acton Civill Polytechnic Academy

New York State Office of Parks, Recreation and Historic Preservation



Electrical

- Fluorescent bulbs use 2/3 less energy than standard incandescent bulbs.
- Strip Fluorescent Fixtures: Garages, laundry rooms, closets and utility rooms.
- Use less electricity than traditional incandescent bulbs
- ENERGY STAR-qualified CFLs use about 2/3 the energy and last ten times longer than a comparable incandescent bulb
- Can fit into existing lighting fixtures

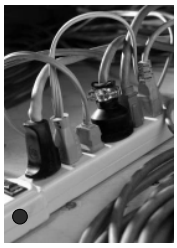
Lighting

- Turning off unnecessary lighting will save energy and money.
- Lighting Occupancy Sensors: Convenience of turning lights on automatically when someone enters the room

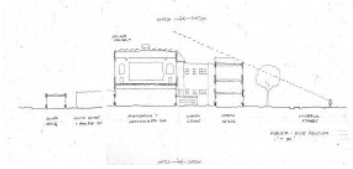
The Little Red Light

Phantom loads:

- Computers, cable boxes, DVR, TV and other similar devices, even when turned off, consume energy.
- Chargers plugged into walls when not in use are still using energy.
- Consider plugging these devices into a power strip and using the power strip switch to turn off devices.



Solar Panels



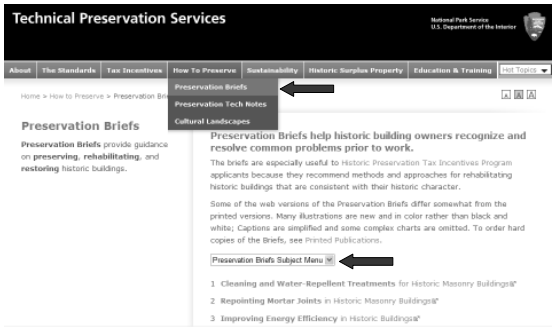
- Visibility from public right-of-ways must be limited
- Orientation of panels can have a significant impact on visibility
- Best accommodated on buildings with flat roofs and parapets

SHPO Web Resources

www.nysparks.com/shpo/

NPS Web Resources

www.nps.gov/tps/



NPS Web Resources

Preservation Briefs

3. Improving Energy Efficiency in Historic Buildings
9. The Repair of Historic Wooden Windows
16. The Use of Substitute Materials on Historic Building Exteriors
37. Appropriate Methods for Reducing Lead-Paint Hazards in Historic Housing
39. Controlling Unwanted Moisture in Historic Buildings

Case Studies

Exterior Conditions

Exterior Conditions

Exterior Conditions

Windows

Existing Conditions

Audit Phase

- Determine Inherently Sustainable Features
- What can be refined or repaired?
- Audit

Findings

- Original Interior Storms
- Second Empire style with highly ornate porch (shading)
- Large windows – operable
- Tall ceilings
- Paint can be removed
- Wall insulation installed

Measures

- Install interior and exterior storm windows
- Install exterior storm doors while retaining original doors. Weather-strip doors & windows
- Remove lead paint
- Insulate attic
- Repair cornice – water issues

Rehabilitation & Lead Abatement

Storm Doors

Cornice Repair

Henry Street Settlement
MAS Demonstration Project

- National Historic Landmark
- Landmark Preservation Commission
- Circa 1830 Federal Row house

Existing Conditions

Windows

Existing Conditions

Air Infiltration

Process - Brainstorming

Audit Phase

Issues:

- Top floors very warm
- High electrical bills
- High heating & cooling costs
- Lack of thermostats
- Old steam boiler system
- Windows are not operable
- Staff have personal refrigerators, fans, printers, etc
- Too much light, too little light

Inherently Sustainable Features & Goals

- Masonry walls
- Large windows
- Tall ceilings
- Nearly flat roof – Solar?
- Rainwater collection?
- Natural shading at street

Short Term Goals

- Costs to change from oil to gas/boiler
- Window Survey
- Passive shading options
- Efficient Lighting
- Weather-stripping
- Staff education

Shading Options

Energy Efficiency Manual

MAS and the LPC are producing a manual, "Greening New York City's Landmarks: A Guide for Property Owners."

"…improve the energy efficiency and sustainability of the city's landmark buildings while meeting preservation standards."

New York State Office of Parks

OFFICE OF PARKS • RECREATION • HISTORIC PRESERVATION
NEW YORK STATE