City of Bethlehem, Pennsylvania

Historical Architectural Review Board

Guidelines for Sustainability

Many of Bethlehem's historic buildings are inherently sustainable. Locally quarried stone was used to construct walls, reducing transportation energy and costs. The mass of masonry walls help to regulate interior temperatures and operable double-hung windows provide natural ventilation and illumination.

These *Guidelines* were developed in conjunction with the Historical Architectural Review Board (HARB). The HARB and the Bethlehem Historic Conservation Commission (HCC) review Certificate of Appropriateness (COA) applications for proposed exterior alterations to properties within a Historic District that are visible from a public way. The applicant is responsible for complying with the provisions of the Zoning and Building Codes at the time of application. The applicant must obtain a COA as well as all necessary permits prior to proceeding with any work.

Additional *Guidelines* addressing other historic building topics are available at City Hall and on the City's website at www.bethlehem-pa.gov. Please review this information during the early stages of planning your project. Familiarity with this material can assist in moving a project quickly through the approval process, saving applicants both time and money.

Some of the information presented in the *Guidelines for Sustainability* are "best practices" that are not subject to HARB/HCC review; however, review might be required by other City entities. For more information, to clarify whether a proposed project requires HARB/HCC review, or to obtain applications, please call the **Bureau of Code Enforcement at City Hall at (610) 865-7091.**

PURPOSE

These *Guidelines* were prepared to provide Bethlehem's property owners with information on how sustainability relates to the repair, alteration, or rehabilitation of an existing building. They are not intended to replace consultation with qualified architects, contractors, the Historical Architectural Review Board (HARB), Bethlehem Historic Conservation Commission (HCC) or City Staff.

SUSTAINABILITY

In the most general sense, "sustainability" is the concept of meeting current needs in a way that can be continued in the long-term, without jeopardizing the ability of future generations to also meet their needs. The goals and ideals of sustainable planning and design can be thought of in three major categories:

- **Environmental:** Protecting the natural environment and using resources and energy in a sustainable way
- **Social:** Promoting social equality while enriching and protecting important elements of our culture
- **Economic:** Providing equal economic opportunity and considering the full life-cycle impacts of current decisions

Sustainable recommendations include aspects of environmental, social and economic goals, and addresses a philosophical as well as physical approach to our surroundings.

SUSTAINABILITY & PRESERVATION

Historic buildings have significant inherent advantages when considered in the context of sustainability:

- By reusing an existing structure, the investment of natural resources in the original construction can be reclaimed, a concept known as “embodied energy”
- Buildings constructed prior to WWII were often designed to take advantage of natural sources of heating, cooling, ventilation and lighting
- Historic buildings commonly used more regional materials, with lower transportation and life-cycle costs
- Historic building materials are generally easier to repair when compared with modern materials, which are intended to be replaced frequently rather than repaired
- The preservation of historic buildings and sites plays a key role in the protection of cultural resources and community character, promoting social sustainability

The masonry walls help to regulate temperatures, the awnings shade the rear porch.

ENERGY AUDIT

Property owners should consider an overall approach to energy efficiency before undertaking any work. An energy audit can identify the efficiency of existing assemblies and potential upgrades as a first key step in this process. With an overall plan in place, specific smaller projects can be undertaken in an efficient way, without jeopardizing the desired final outcome or historic integrity of the building or site. Property owners should consult their local utility company regarding energy audits and energy efficiency incentives; many have services and tips for homeowners.

PLANNING YOUR PROJECT

When undertaking measures to increase the energy efficiency of a historic building, or when considering the energy efficiency of planned repairs, careful planning and forethought can prevent unforeseen issues and unintended negative consequences. Bureau of Code Enforcement Staff are available to discuss a planned project, and can provide guidance regarding sustainability issues. Hiring an architect or preservation professional is highly recommended for complex or substantial projects involving multiple building systems or elements. When evaluating a sustainability project at a historic building or site, two important factors should be considered early in the process:

- Its historic fabric and character
- Its inherently sustainable features

When property owners are contemplating how sustainability principles can be incorporated in their historic property, it is recommended that interventions be planned on a whole-building/site basis, even if they will be implemented in phases over time.

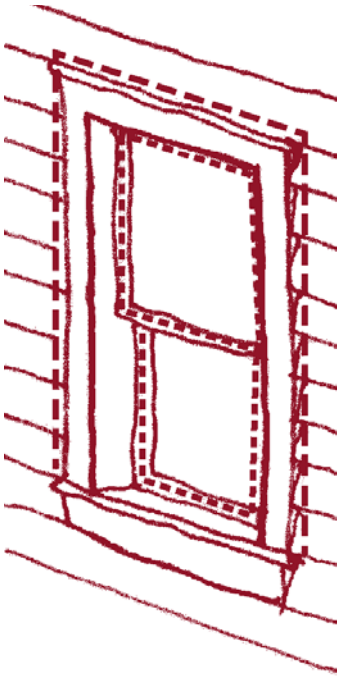
- Upgrades and sustainable features should always be planned with first priority given to the least-impact options and small improvements, such as maintenance and operations improvements, weatherization and insulation, which are generally reversible and can have a big impact at a relatively low cost
- Larger and non-reversible sustainability upgrades to historic buildings and sites should be considered in relation to their impact on the historic fabric and character

MAINTENANCE & OPERATIONS

The principles and approach described in this section can assist in the sustainable design of alterations and repairs. However, the long-term maintenance and operation of a historic building or property can also have a significant impact on the environment.

Although maintenance and operations are not subject to review by the HARB/HCC, they encourage:

- Recycling unused and demolished building materials, as well as everyday products such as paper, plastic and glass
- Using the gentlest effective cleaning methods available for both household use and for exterior building maintenance, rather than harsh chemical cleaners
- Using natural, low-impact materials such as sand for de-icing walkways, paths and driveways, rather than salt or harsh chemical de-icing agents
- Using energy efficient appliances, equipment and lighting
- The use of low-VOC materials, household cleaners, carpeting, adhesives and paint
- Proper lead-safe paint removal and chemical disposal
- Maintaining historic design features - such as glazed transoms - that provide natural light and air circulation



Recommended weather-stripping locations:

- *Behind window sash track*
- *Between window check rails (meeting rails)*
- *At perimeter of doors/ windows*

Recommended caulk locations:

- *Between door/window frame and adjacent wall*
- *Between abutting materials such as corner boards and siding, porch and wall surface*
- *Between dissimilar materials such as masonry and wood, flashing and wall surface*

WEATHERIZATION

One of the most cost-effective and least intrusive ways of increasing the energy efficiency of a historic building is to limit air infiltration and movement ("drafts") through the exterior building envelope. When selecting weather stripping or caulk it is important to choose the material appropriate for each location and follow manufacturer's installation recommendations for the best results.

The HARB/HCC encourage:

- Planning the weatherization of historic assemblies for the overall building before beginning any work
- Addressing air infiltration through a building's historic envelope as one of the first steps in improving a building's energy efficiency

Weather stripping is typically used between the moving parts of windows and doors. As a result, it is highly susceptible to damage and can become loose, bent or torn. It is important to inspect weather stripping on a regular basis, preferably every fall, and replace it as needed. For high use installations such as entrance doors, it may be beneficial to install more durable weather stripping such as spring metal or felt.

The installation of caulk or other sealants should occur throughout the exterior of the building. Locations include where two dissimilar materials meet; where expansion and contraction occur; or where materials are joined together. In some instances caulks and sealants can be sanded and/or painted to minimize their visual appearance. It is important to select the appropriate type for each location and exercise care when removing old caulk that might contain lead.

INSULATION

Given Bethlehem's climate, insufficient insulation in the exterior envelope can be an issue in some historic buildings, particularly in wood-frame construction. In some homes, previous owners may have installed insulation improperly, leading to moisture issues. Properly installed insulation materials can enhance the energy efficiency of a historic home, without causing long-term, moisture-related problems. Moisture problems in buildings can often be worsened by insulation that does not allow moisture to permeate or vapor barriers in inappropriate locations.

The HARB/HCC encourage:

- Understanding a building's materials and actual insulation needs before adding or replacing insulation
- Installing weather stripping and caulk to reduce drafts prior to installing insulation
- Insulating unfinished spaces, such as basements or attics, before finished spaces
- Using the appropriate type of insulation for each specific area of the building (roof, attic, walls, eaves, basements, crawlspaces)
- Understanding if existing building components will need to be removed or altered for insulation installation
- Installing insulation on/from the interior of a historic building, to avoid altering the exterior appearance
- Using reversible materials rather than spray-in insulation
- Controlling moisture at high-humidity locations such as bathrooms, laundry rooms and kitchens

The HARB/HCC discourage:

- Installing insulation in a manner that results in unnecessary damage or loss of historic fabric
- Adding insulation to walls that are susceptible to moisture infiltration
- Installing vapor barriers without evaluating the potential effects of condensation within the building envelope
- Installing insulation that can absorb water and act like a sponge within a wall cavity

DEFINITIONS:

Weather Stripping: A narrow compressible band used between the edge of a window or door and the jambs, sill, head and meeting rail to seal against air and water infiltration; of various materials including spring metal, felt, plastic foam and wood with rubber edging.

Caulk: Flexible sealant material used to close joints between materials; of various materials including tar, oakum, lead, putty, and modern elastomerics such as silicone and polyurethane.

WINDOWS & DOORS

Windows and doors typically comprise at least one quarter of the surface area of exterior walls of most historic buildings. Windows and doors, in addition to their trim, shutters, and associated features, are important character-defining elements of historic buildings. In addition, they can provide natural light and ventilation, reducing the need for supplemental illumination, heating and cooling.

Windows and doors can:

- Define the character of each individual building and provide a visual features along the streetscape
- Provide natural light and ventilation
- Help define the building type, use and architectural style
- Help identify the age of construction
- Act as a transition from the exterior to the interior

DEFINITIONS:

Check Rail/Meeting Rail: Typically the bottom rail of the upper sash and top rail of the lower sash.

Mullion: The vertical element separating two window or door frames.

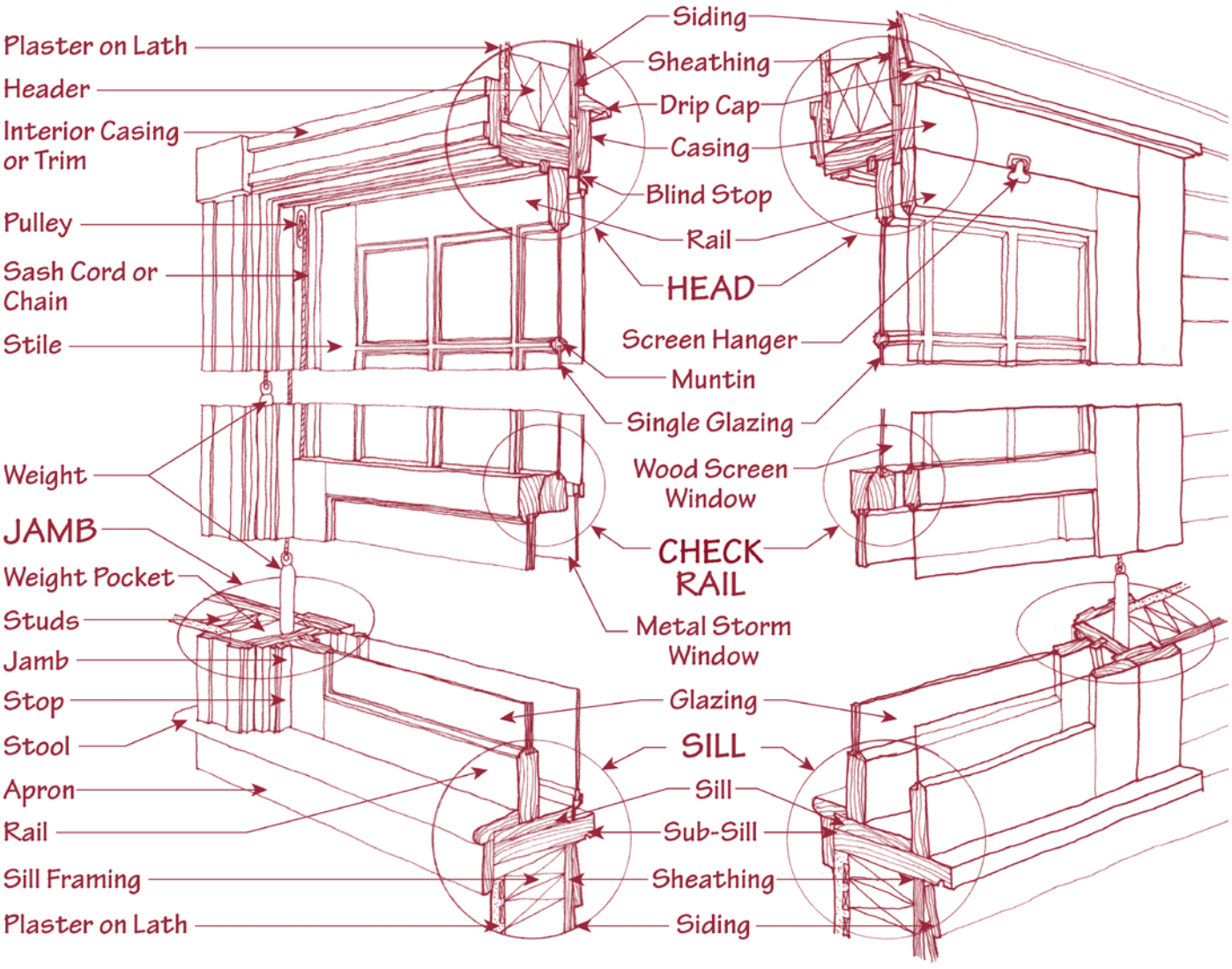
Muntin: The narrow molding separating individual panes of glass in a multi-paned true divided light sash, or applied in a simulated divided light sash.

Sash: The part of the window frame that holds the glazing, especially when movable.

Simulated Divided Light (SDL): A window or door in which muntins are applied to the glass at the exterior, interior and between layers of insulated glass.

True Divided Light: A window or door in which the glass is divided by muntins into several small panes.

DOUBLE-HUNG WINDOW COMPONENTS

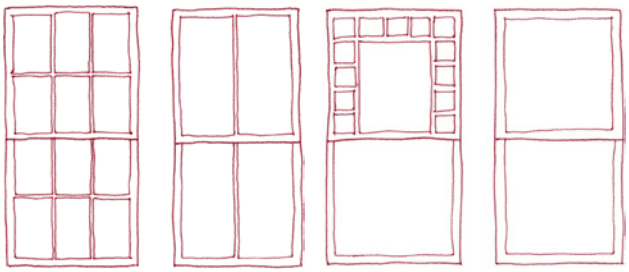


(Viewed from Interior) *(Viewed from Exterior)*

WINDOW STYLES

Window patterns and configurations are linked to a building's period of construction and style. Windows at buildings dating from the 18th and early 19th centuries were typically constructed with small individual pieces of glass within an operable sash. As technology developed at the end of the 19th century, smaller pieces of glazing were replaced with larger pieces of glass allowing for more expansive views. This coincided with the beginning of the Victorian period, which encouraged varied shapes of windows and more elaborate frames, casings, applied ornament and trim. When the Colonial Revival style was popularized beginning in the 20th century, the use of multi-paned windows with simpler frames and casings became more prevalent.

Since all of the components and details of a window are essential to defining the construction period and style, the pattern and configuration of proposed replacement windows should be historically appropriate for each building. Altering the window type, style, shape, material, size, component dimension, muntin pattern or location can dramatically alter the appearance of the building.



1770-1870 | 1855-1920 | 1855-1900 | 1855-1930

WINDOW MATERIALS

Wood windows were historically manufactured from durable, close, straight-grain hardwood of a quality uncommon in today's market. The quality of the historic materials and relative ease for repairs allows many well-maintained old windows to survive from the 18th century or earlier.

Replacement windows and their components tend to have significantly shorter life spans than historic wood windows. Selecting replacement windows is further complicated by manufacturers who tend to offer various grades of windows, with varying types and qualities of materials and warranties. Today, lower cost wood windows are typically made from new growth timber, which is much softer and more susceptible to deterioration than hardwoods of the past. Vinyl and PVC materials, now common for replacement windows, break down in ultraviolet light, and generally have a life expectancy of less than 20 years. Because of the great variety of finishes for aluminum windows, they continue to be tested to determine projected life spans.

HISTORIC WINDOW & DOOR PROBLEM SOLVING

Property owners do not pay attention to their windows or doors until a problem occurs. Typical concerns include operation, reducing air infiltration, maintenance and improving appearance.

Generally, the appearance of a window or door that has not been properly maintained can seem significantly worse than its actual condition. Replacement of an entire wood window or door because of a deteriorated component, typically the sill or bottom rail, is rarely necessary. In many instances, selective repair or replacement of damaged parts and the implementation of a regular maintenance program is all that is required. It is generally possible to repair windows and doors in fair or good condition relatively economically.

To improve operation

- Verify that hardware including sash cords, chains, weights, hinges and locks are functional
- Remove built-up paint, particularly at jambs, taking care to use proper removal techniques for lead-based paint
- Repair or replace deteriorated components such as parting beads that separate window sash, window sills and lower door rails - often repairs can be made with epoxy fillers or Dutchmen, where wood piece are installed of the same size, profile and character as the historic wood element

To reduce air infiltration

- Install weather-stripping snugly between moving parts (quality metal weather-stripping can last 20 years)
- Replace broken glass (glazing)
- Re-caulk perimeter joints
- Remove and replace missing or cracked glazing putty
- Add sash locks to tighten windows and verify that the window or door closes tightly within its frame
- Add an interior or exterior storm window (a storm window can achieve similar R-values to a new thermal window)
- Add an interior or exterior storm door and door sweep
- Insulate window weight pockets if no longer in use

To reduce solar heat gain or heat loss

- Utilize operable exterior shutters, blinds and awnings where historically appropriate
- Install interior shades or curtains
- Plant deciduous trees at south and west elevations to block summer sun and allow in winter sun,
- Plant coniferous trees at north elevation to reduce effect of winter winds
- Install UV window shades or film

Maintenance

- Regularly review, repair and repaint windows and doors

SHUTTERS & BLINDS

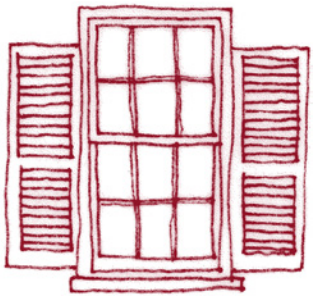
Historically, exterior shutters and blinds (louvered shutters) were used as shielding devices. Paneled shutters were typically installed at the first floor to provide a solid barrier when closed and blinds at upper floors where they could be adjusted to regulate light and air. Shutters and blinds were not used on all historic building styles, types or locations. It is often possible to determine if shutters previously existed by looking for hardware such as hinges or tie-backs or evidence of their attachment such as former screw holes in the window casing. Towards the end of the 18th century, Bethlehem's paneled shutters were often painted a light color to match the window trim while blinds at upper floors were often painted a dark color such as deep green.

The HARB/HCC encourage:

- Maintaining historic shutters
- Installing new shutters where they existed historically
- Operable shutters with a smooth, paintable finish
- Shutters and operable shutter hardware of the appropriate style for the building and location
- Appropriately sized and shaped shutters for the window opening, fitted to cover the window when closed

Six-over-six double-hung window with paneled shutters

Appropriate



The blinds are too short and narrow for the window

Inappropriate

STORM WINDOWS & DOORS

Storm windows and doors should conceal as little of the historic window or door as possible and should be selected to complement each window or door type. This generally means selecting a screen or storm window that has rails that coincide with the rails and glazing pattern and overall configuration of the associated window or door.

The HARB/HCC encourage:

- Maintaining wood storm windows and doors
- Storm windows and doors appropriately sized and shaped to fit within openings
- Aligning rails of storm windows with window rails
- Interior storm windows on primary elevations
- Large glazed openings at storm doors that do not conceal glazed or interrupt glazed openings
- Finishing or painting exterior storm windows or doors to match associated window sash or door

WINDOW & DOOR REPLACEMENT GUIDE

Historic wood windows and doors are often the first building elements targeted when homeowners are planning to increase the energy efficiency of their property. Despite marketing literature published by new window and door manufacturers, historic wood windows and doors - if properly weatherized - can meet or exceed the energy efficiency of modern replacements.

The HARB/HCC encourage:

- Maintaining existing windows and doors to ensure that they remain operable as a source of natural ventilation
- Weather stripping and caulking historic windows and doors to improve energy efficiency (Refer to *Page 3*)
- Using reversible methods/products such as transparent UV films, where appropriate, before resorting to severe interventions such as replacement glazing
- Maintaining and utilizing historic operable shutters, blinds and awnings, or installing new historically-appropriate shutters, blinds or awnings to improve energy-efficiency
- Installing interior or exterior storm windows or doors, compatible with the appearance of the historic windows

If replacement windows or doors within existing openings are warranted, the HARB/HCC encourage:

- Locating replacement windows in less visible areas
- Installing quality wood replacement windows in existing openings with an exterior painted wood finish, matching the historic window appearance and design (Wood windows typically required in HARB and HCC districts)
- Installing historically appropriate wood doors

The HARB/HCC discourage:

- Replacing repairable historic windows or doors in the name of improved energy efficiency
- Removing, covering or altering surrounding trim

HARB/HCC REVIEW

Properties within locally designated historic districts must comply with all HARB or HCC requirements. Contact the Bureau of Code Enforcement at (610) 865-7091 prior to starting work to confirm review requirements.

REPLACEMENT WINDOW COSTS

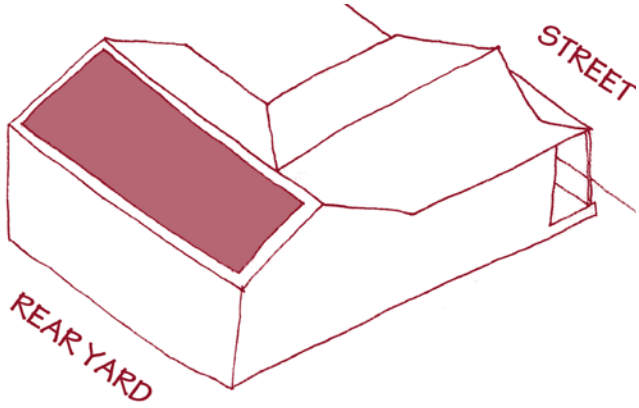
The costs that should be anticipated if considering the installation of new windows in existing openings include:

- Labor to remove old windows and environmental costs of disposal including transportation and landfill fees
- Purchase price and delivery of new windows
- Environmental costs of manufacturing and transporting new window from the factory
- Labor and materials to modify existing frames for new windows and their installation
- Life-cycle costs associated with more frequent replacement of new windows as they deteriorate

ROOF SUSTAINABILITY OPTIONS

Property owners are more frequently looking towards their roofs when considering sustainable improvements to their buildings. Roof sustainability options can generally fall into the following categories:

- **Reducing Solar Heat Gain:** Because a roof surface is typically exposed to the sun for large portions of the day, the temperature of the roof surface, and often the attic below, can easily exceed 120 degrees Fahrenheit. Although the added warmth may be appreciated in the winter, it can result in higher cooling needs in the summer. Possible ways to reduce solar heat gain include planting deciduous trees to block the summer sun's rays, installing an attic fan or vent, or installing attic insulation to limit effect of heat gain in habitable portions of building. Another potential option is to install lighter colored, more reflective roofing if historically appropriate or the roof surface is not visible from the public way.
- **Capturing Solar Energy:** Solar collectors provide a renewable energy source. The City of Bethlehem encourages solar collectors for space heating, hot water and electricity. However, property owners are encouraged to locate solar collectors where they are hidden or minimally visible from public view. The proximity and seasonal shading characteristics of adjacent and neighboring trees and structures should also be considered to ensure sufficient year-round solar exposure to justify the expense of installation.
- **Improving Natural Lighting:** Skylights, although found in commercial or industrial buildings historically, were rarely found in residences. The installation of new skylights should minimize alteration of the roof structure with the long dimension oriented down the roof slope. Skylights should be hidden or minimally visible from the public view, and should not disturb historic roof materials such as slate or terra cotta.
- **Managing Storm Water Run-Off:** Much of the rain that falls on a roof surface is typically diverted to a gutter, then a downspout, and from there, discharged at the perimeter of a building or into a storm sewer. By either reducing the amount of water that reaches the gutter or collecting the water as it is discharged from the downspout, the soil around a building does not become saturated, and the sewer system is less likely to become overwhelmed in a significant storm. One of the means of controlling the quantity of water diverted to a gutter system is to install a green roof in a manner that the planted material is not visible from the public way. An option for flat and sloped roofs is to install rain barrels at the bottoms of downspouts. Rain barrels collect storm water discharged from downspouts. They typically include a spigot near the bottom for a hose hook-up, allowing the collected storm water to be used for future watering of gardens and lawns.



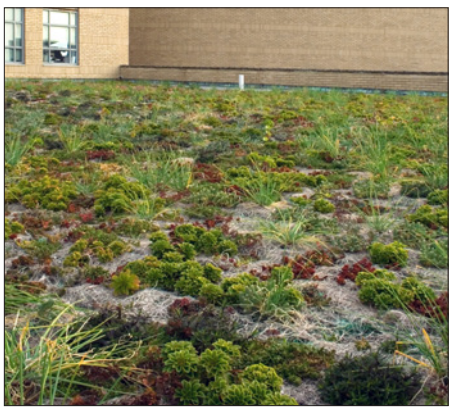
Placement of solar collectors, skylights and roof mounted equipment is encouraged facing a rear yard wherever possible. If it is not possible, placement as far back on a side slope as possible is preferred.

ROOF SUSTAINABILITY RECOMMENDATIONS

Installation of cool (i.e., reflective) roofing and green roofs are becoming increasingly common as an energy-efficiency measure. However, for historic buildings, the selection of a new roof system must take into account the historic character of the building.

The HARB/HCC encourage:

- Installing historically appropriate roofing, including material and color, at all visible roof surfaces
- Placement of all roof mounted equipment (including mechanical equipment, vents, television dishes, solar collectors and skylights) in a manner that is as visually unobtrusive as possible
- Installing skylights and solar collectors so that they are parallel to and do not extend more than 8 inches above the roof surface
- Using cool-roof and green-roof technologies, when appropriate, in areas that are not visible from the public right-of-way and do not adversely impact the appearance, structure, or moisture-performance of a historic structure
- Installing dark colored rain barrels and shielding them from public view with evergreen shrubs



Green roofs are becoming increasingly common in new construction, providing both an insulating layer of soil and reduced storm water runoff. They may be an energy-upgrade option for buildings with flat roofs and sufficient structural capacity.

HEATING, VENTILATION & AIR CONDITIONING (HVAC)

Installation or improvement of a building's HVAC systems can provide significant upgrades in energy efficiency, but they must be carefully designed and planned. An improperly designed HVAC system installed in a historic building can damage significant historic fabric, cause moisture-infiltration issues and be uneconomical.

The HARB/HCC encourage:

- Maintaining existing HVAC systems to ensure proper operation and efficient operation
- Incorporating incremental measures such as programmable thermostats, ceiling fans and properly located vents into existing HVAC systems
- Using a "zoned" HVAC system to reduce energy costs
- Taking into account whole-building performance when designing a replacement or upgrade to an HVAC system
- Upgrading obsolete HVAC equipment with more efficient systems, in a way that is sensitive to the historic building
- Considering HVAC systems specifically designed for existing buildings, such as high-velocity systems with small ducts, to minimize the impact on historic fabric
- Locating HVAC equipment to the rear of a property to minimize impacts on the historic character of the building and/or streetscape and screen it from public view

ALTERNATIVE ENERGY SOURCES

In exploring alternative energy technologies in historic buildings, including solar power and geothermal heating/cooling, it is important to consider how proper installation and selection of systems can improve energy-efficiency without adversely affecting a building's historic character.

The HARB/HCC encourage:

- Minimizing impacts on the historic fabric and appearance of a building when installing modern equipment such as solar panels (Refer to Page 7)
- Investigating whether a geothermal system can improve the energy-efficiency of a building's HVAC system while not to disturbing archeological remains or tree roots

T*he HARB/HCC discourage:*

- Installing modern equipment in a manner that is not reversible or adversely affects the historic building

Rain barrels can collect storm water for future use in the garden, reducing run-off into the River. Property owners are encouraged to select neutral colors and shield rain barrels from public view with plantings to the extent possible.

SITE FEATURES

In addition to upgrades to the historic building itself, proper design of the site can contribute to a property owner's energy-efficiency and water conservation goals.

The HARB/HCC encourage:

- Considering the historic character and landscape of a site before installing any new site features
- Utilizing existing site features - such as shade trees, cisterns and topography - to maximize energy efficiency and conserve water
- When compatible with a historic property, installing sustainable features such as bioswales, rain barrels and cisterns
- Minimizing new site features with adverse impacts, such as impervious paving

T*he HARB/HCC discourage:*

- Introducing non-native plant species to a site, resulting in increased water-use or requiring pesticides
- Installing new trees or plantings where they may damage the historic building

DEFINITIONS:

Geothermal Heating/Cooling: General term for HVAC systems that use the thermal energy generated and stored in the Earth to heat/cool a building

VOC: Volatile Organic Compounds, which are generally harmful to human health when introduced into the air

Bioswale: A landscape element designed to remove particles from storm water and slow storm water runoff

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