SECTION D

MARIETTA'S "GREEN PAGES"

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7.1. Understanding Systems & Your Environment

Marietta's "Green Pages" Introduction

On one hand we have a building, its systems, and the desire to be energy efficient and comfortable at a reasonable cost. On the other hand we have Mother Nature knocking at the door. The balancing act is a dynamic one that is constant and continuous. We recognize its effects, cold air rushing in when the door's opened in the winter, water evaporation on a hot day, but maybe do not exactly understand why it happens and how it relates to energy efficiency.

The first thing to do is know what you're working with and where you want to get. In other words, you need to understand your local climate, its recommended design efficiencies, and make an assessment of your building systems, which also includes understanding your individual energy costs.

The U.S. Department of Energy's (DOE's) "Building America Program" is also an industry-driven research program that promotes the accelerated development and adoption of advanced building energy technologies in new and existing homes. The program gives home builders and remodelers access to the nation's leading building science developments to build high-performance homes that use less energy, are more comfortable, healthier to live in and long lasting. This includes traditional, existing homes for owners who want to improve the energy efficiency while protecting potential historic character. Much of the information found in this section of Marietta's "Historic Homeowner's Handbook" was researched (and more can be found through the DOE) at: www.buildingamerica.gov.

"Although older buildings require attention and maintenance, they repay the effort as assets that gain value over time. More and more, homeowners value historic houses for their appealing aesthetic character, lifestyle advantages and quality of life. Depending on the circumstances, these advantages may include beautiful ornamentation, spacious room proportions, natural lighting, outdoor spaces and - not least of all - a feeling of history, tradition and permanence. Furthermore, time has shown that even the most unappreciated historic styles eventually become popular; so, even if you have mixed feelings about the appearance and design of a "historic" house, bear in mind before doing anything to diminish its historic character, that the next occupants may love that style - and that [changes you make] may affect the selling price."

- *U.S. DOE, Energy Performance Techniques and Technologies: Preserving Historic Homes, Building America Best Series, Vol 13 (2011)*

SEARS,

NOW IS THE TIME TO ORDER YOUR STORM SASH

DON'T WAIT UNTIL THE LAST MINUTE, when the snow flies and the wind whistles in around your windows, when it keeps you busy running up and down the cellar steps filling coal scuttles in order to keep warm.

In one season storm sash will more than pay for themselves through the saving in your fuel bill. They will last indefinitely and after the first season you will save one-half of what you paid for fuel bills. Think of the your investment.

QUALITY GUARANTEED

TWO-LIGHT STORM S

Two-Light Storm Sash.

ca. 1910 Sears Roebuck catalog advertisement. See full reproduction page ad on Pg. D.15.

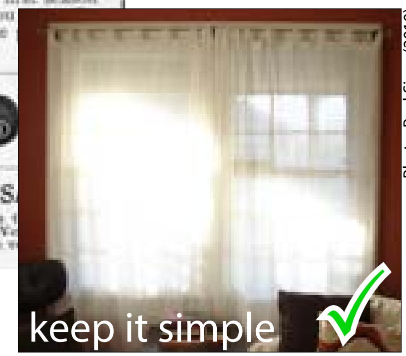


Photo: Paul Simo (2010)

Sheer curtains hung and drawn closed during the day allow bright sun to warm and light a room while still minimizing any drafts in winter and help shade in summer. Added heavyweight curtains (not shown) can be hung on a double curtain rod for winter nights.

Special energy-retrofitting challenges include preserving the home's historic features, being aware of and adhering to regulations related to "historic" designations, and balancing these concerns with health and safety issues. Building America's research provides field-tested approaches to help address these challenges.

Please note: Retrofitting homes that are designated as "historic" does not require a formal review process, but all homes deserve a thoughtful approach to maintaining their character. If you are a home owner, please share this Section with contractors and, in turn, with their subs so they can understand how to make your homes more comfortable, durable and energy efficient, while respecting the homes' historic qualities.

7.2. "Green Glossary"

To start the discussion of energy efficiency, we need to establish, define and understand what is actually being dealt with. Below is a list of common energy terminology to help you stay more informed when talking to industry professionals about your home and future home projects. Some of these terms may show up in specifications, advertising and other discussions:

The "Building Structure:" roof, walls, windows and doors – this is considered the building "envelope"

The "Mechanical System:" consisting of furnace, air conditioner, duct work.

Energy Users (which are in addition to the mechanical system): including water heater, dish washer, clothes washer, dryer, refrigerator, lighting, and other appliances.

R-Values and U-values. These are scientific calculations that measure thermal resistance (R) and thermal conductance (U), or in simpler terms, how slowly or quickly heat flows through a material. These values are related, in that they are the inverse of each other (U=1/R). They show up on labels for insulation and windows, but the important things to remember are the larger the R-Value or the lower the U-value the better the insulating capability.

Conduction, convection, and radiation. These are the different ways of heat (energy) transference. Conduction is through solid objects, convection is by air movement, and radiation is heat transfer from a surface to the surrounding air without a transfer medium.

Vapor Diffusion. This is the movement of moisture in the vapor state through a material because of vapor pressure and temperature differences. Moisture moves from areas of greater to lesser concentration and from warm to cool sides of materials. The measurement of moisture movement is by units of permeability, also known as "perms." Any material with a perm rating of less than 1.0 is a Vapor Diffusion Retarder (aka Vapor Barriers).

Climate Zones. These have been established for the United States by the National Oceanic and Atmospheric Administration (NOAA) and set into the International Energy Conservation Code (IECC) to come up with a map to show regions with relatively homogenous climates. Data is based on 30-year averages for heating degree-days (HDD) and cooling degree-days (CDD) calculations. Georgia falls in Climate Zones 4 (northern) and 3 (southern) - see map and definitions on Pg. D.6.

Insulation Zones. The U.S. is also divided into Insulation Zones, which, in Georgia at least, roughly parallel the Climate Zones. Insulation Zones are used for design purposes to determine recommended insulation levels. Georgia falls for the most part in Insulation Zones 2 (northern) and 1 (southern) - see map and definitions on Pg. D.5.

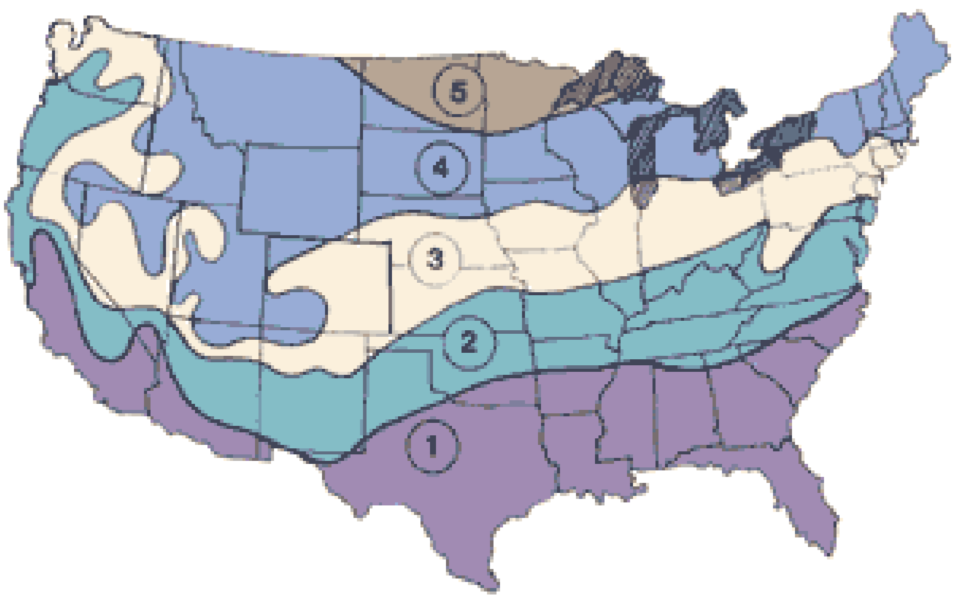
(Note that climate zones and insulation zones provide important basic guidance for design purposes and characterize our environmental adversary. However, be aware that the various places you find this information use the data to define the zones somewhat differently. So depending on where you look, be it the internet, code books, or other sources, the maps and zone designations are probably going to vary. Nonetheless, the basic information is pretty consistent. (See next section, 7.3 "Marietta's Climate Environment" for the zone maps at the time of this handbook production.))

7.3. Shelter Designed for Its Environment

It used to be that people built according to their environments. Entire civilizations developed an architectural language uniquely developed for the rigors of their particular climate. Over time, these unique languages became clearly identified with their original civilization. These architectural languages didn't develop by accident. They were thoughtfully and deliberately developed over a course of years, as the people experimented to find a design that was well adapted to their climate. People in cold climates strove to keep out the cold, while those in hot climates tried to minimize the heat. Dry climate civilizations captured rainwater and rainy climate civilizations repelled it. Forested regions made lumber an easy building supply, while brick and clay were used extensively in deserts. For each climate there are a myriad of different variables which led to the development of a specific type of architecture. Temperature, humidity, snowfall, rainfall, water supply, building materials, terrain, prevailing winds, sunshine and cloudiness all played a part in determining how civilizations built. Each civilization understood the unique dynamics of their environment, and built accordingly.

The southeastern United States has one of the most difficult climates to design for: hot and humid in the summer, but still somewhat cold and humid in the winter. The southern home needs to be designed for both climates, but with a greater emphasis on controlling heat. To combat this particular combination, southern architecture relies heavily on controllable shade and ventilation. Shade helps protect the building from the hot sun, and ventilation allows breezes to cool a building. (See Chapter 9 in this Section.)

US Insulation Zones map



The effectiveness of insulation is measured in R-values. The higher the R-number, the more insulation value you get and the more money you eventually save. Imprinted on every batt or blanket of insulation or on every bag of loose insulation is its R-number.

Find your home-heating zone on the map of Climate Zones and Insulation Requirements (at left) and check chart (below) for the R-value you need in your attic floor, exterior wall and other house areas. How much insulation should you buy? You can figure out how many square feet of insulation you'll need by measuring in feet the length and width of the area to be covered, and multiplying the two dimensions. The answer will be the square footage of insulation material necessary.

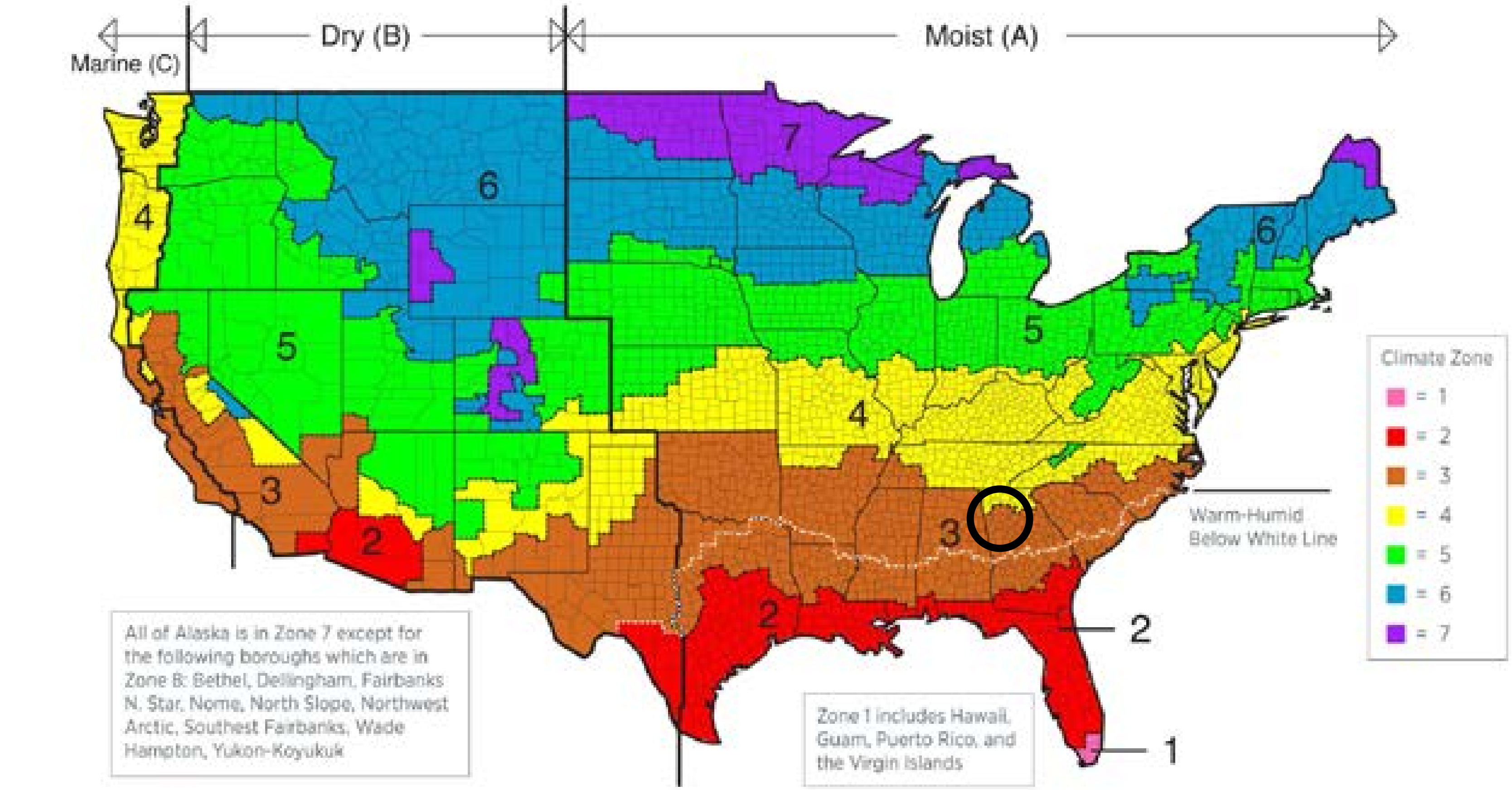
Heating Zone	Crawlspace or Basement Ceiling	Attic Floors	Exterior Walls
1	R-11	R-26	R-Value of full wall insulation, which is 3 1/2" thick, will depend on material used. Range is R-11 to R-13
2	R-13	R-26	
3	R-19	R-30	
4	R-22	R-33	
5	R-22	R-38	

map & R information found at: www.accuratebuilding.com

US Climate Map

US Climate Zones are based on International Energy Conservation Code (IECC) climate regions, which will help you know what kind of weather to prepare your home for. Note that Cobb County, Georgia is in Zone 3 which is known as a "hot-dry climate." This is defined by the IECC as a region that receives less than 20 inches (50 cm) of annual precipitation and where the monthly average outdoor temperature remains above 45°F (7°C) throughout the year.

However, the US DOE "Building America" program also puts a line through Zone 3 where areas above the line also share data as a region that receives more than 20 inches (50 cm) of annual precipitation, has approximately 5,400 heating degree days (65°F basis) or fewer, and where the average monthly outdoor temperature drops below 45°F (7°C) during the winter months. (Note: Marietta, Georgia has been circled.)



International Energy Conservation Code (IECC) climate regions

map information found at: http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/ba_climateguide_7_1.pdf

The degree-day measurement is the difference in temperature between the mean (average) outdoor temperature over a 24-hour period and a given base temperature for a building space, typically 65°F (25°C in Canada). For example, if the mean temperature at a given location for January 3 is 35°F, then the heating degree days measurement for that day is 30 (65 - 35 = 30).

Marietta Average Annual Weather Data

Marietta shares US Weather Data with the Atlanta region.

Atlanta

The tables below display average monthly climate and weather indicators in Atlanta Georgia.

Temperature by: Fahrenheit / Centigrade

Atlanta Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Temperature	41.0	44.8	53.5	61.5	69.2	76.0	78.8	78.1	72.7	62.3	53.1	44.5	61.3
Avg. Max Temperature	50.4	55.0	64.3	72.7	79.6	85.8	88.0	87.1	81.8	72.7	63.4	54.0	71.2
Avg. Min Temperature	31.5	34.5	42.5	50.2	58.7	66.2	69.5	69.0	63.5	51.9	42.8	35.0	51.3
Days with Max Temp of 90 F or Higher	0.0	0.0	0.0	< 0.5	1.0	8.0	13.0	10.0	3.0	0.0	0.0	0.0	36.0
Days with Min Temp Below Freezing	16.0	12.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	< 0.5	5.0	12.0	49.0

Atlanta Heating and Cooling	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Heating Degree Days	744	566	365	138	27.0	0.0	0.0	0.0	10.0	138	367	636	2991
Cooling Degree Days	0.0	0.0	8.0	33.0	157	330	428	406	241	54.0	10.0	0.0	1667

Atlanta Precipitation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation (inches)	4.8	4.8	5.8	4.3	4.3	3.6	5.0	3.7	3.4	3.0	3.9	4.3	50.8
Days with Precipitation 0.01 inch or More	12.0	10.0	11.0	9.0	9.0	10.0	12.0	10.0	8.0	7.0	9.0	10.0	116
Monthly Snowfall (inches)	0.9	0.5	0.4	< 0.05	0.0	0.0	0.0	0.0	0.0	< 0.05	0.0	0.2	2.0

Other Atlanta Weather Indicators	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Wind Speed	10.4	10.7	10.9	10.1	8.7	8.1	7.7	7.3	8.0	8.5	9.1	9.8	9.1
Clear Days	8.0	8.0	9.0	10.0	9.0	8.0	6.0	7.0	10.0	14.0	12.0	9.0	110
Partly Cloudy Days	6.0	6.0	8.0	8.0	11.0	12.0	13.0	13.0	10.0	7.0	6.0	6.0	107
Cloudy Days	16.0	14.0	15.0	12.0	11.0	10.0	12.0	10.0	10.0	10.0	12.0	15.0	149
Percent of Possible Sunshine	49.0	54.0	58.0	66.0	68.0	67.0	63.0	64.0	62.0	66.0	58.0	50.0	60.0
Avg. Relative Humidity	58.5	68.0	66.0	64.5	65.5	68.5	72.0	74.0	74.0	71.5	68.0	68.0	70.5

January 2012, source: http://www.climate-zone.com/climate/united-states/georgia/atlanta/

Residential Features Inherent to Marietta's Climate

Understanding your local climate and design efficiencies is relatively easy. Please look at maps and tables on pages D.5 & D.6.

Other Insulation Zone maps and tables of Insulation Groups are also available on the U.S. Department of Energy website.

The tables provide recommended levels of insulation for various parts of your house. For instance, most of Georgia falls into Heating/Insulation Zone 1 (if you have gas heat) and recommends the following amounts of insulation for Marietta (northern Georgia):

- R-26 for Attics, which equals about 13"
- R-13 for Ceilings in crawlspaces or unconditioned Basements (3 1/2")
- R-11-13 for floors over unconditioned space and for walls, which equals about 3-1⁄2"

An alternate source for similar information is the International Energy Conservation Code (be aware it will look different than the DOE maps and tables). These numbers give you a baseline for comparison when you assess your building systems. But besides looking at how much or little insulation you have, you need to look at and evaluate other things, too. In no particular order, you should inspect the building envelope for leakage points, which includes around windows, doors, fireplaces, and pipe and wire penetrations; check floors, walls, and attics for insulation levels; check your furnace and air-conditioning unit to determine if they are approaching an age where they might need replacement; check your duct work for joint seals and insulation; finally, check your major appliances, including water heater, to determine if they are getting to the point of replacement.

Concurrent with any building systems assessment, you also need to look at past energy costs and usage, since without this information, you really can't quantify any improvements. Of these two numbers, the one for usage will likely be more useful as an indicator of improved efficiency.

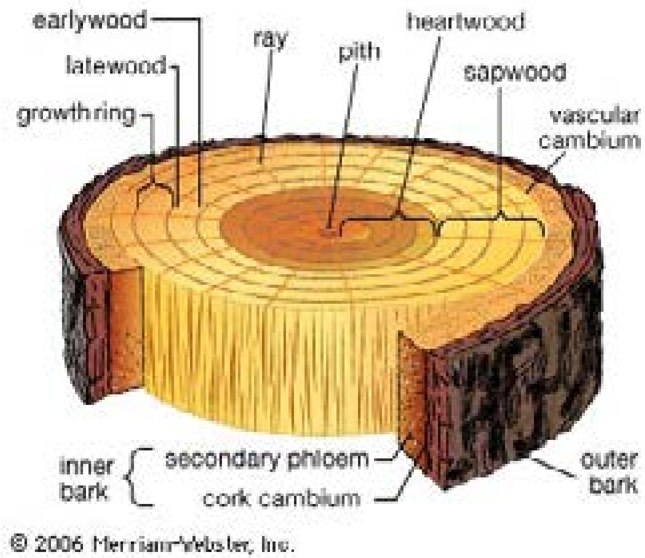
8.1. Building Materials in the South

Landfills Should Not Be for Buildings

A building represents an investment in time, materials, money, manpower and energy. When a building is demolished, all of the waste goes to the landfill. Across the United States, the demolition of existing represents a tremendous waste of materials. While there are occasions when the removal of an entire building is desirable or necessary, all too often historic buildings are demolished when they could just as easily be repaired to a working condition, or expanded to fit new needs.

In the south, this waste is exacerbated since most buildings built before 1930 are constructed of heart pine, a virtually extinct material from the south's depleted old-growth pine forests. Ideally suited to the southern climate, heart pine is extremely dense, very strong, is naturally termite resistant and rot resistant, and takes literally hundreds of years to reach maturity. The disposal of this far superior wood is a great problem in a time when the quality of our lumber supply is getting poorer and poorer.

To a lesser degree, individual pieces of a building represent the same investment. An individual window embodies time, craftsmanship, and energy. If it is removed and sent to a landfill, all of that goes literally in the dump.



Atlanta, Dowskins Bldg. Demolition
Photo: Brandy Morrison

The "Embodied Energy" of Buildings

Excerpt From: "Preserving Buildings Helps Preserve the Planet":

Author: Richard Moe (2008 The National Trust for Historic Preservation)

"Retention and reuse of older buildings is an effective tool for responsible, sustainable stewardship of natural resources, including those that have already been expended. Consider the idea of 'embodied energy.'"

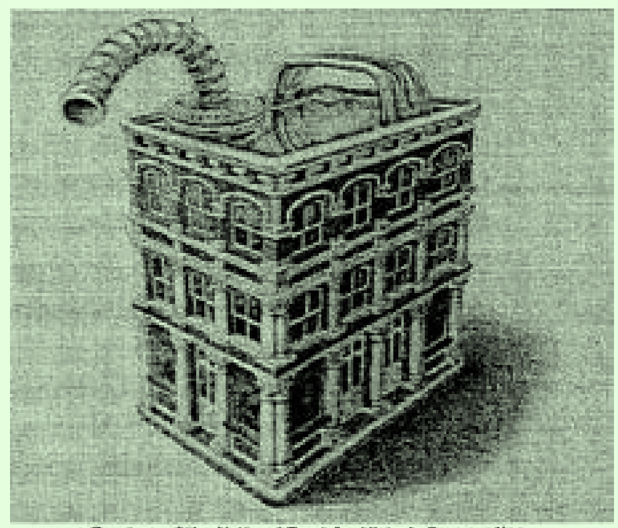
Buildings are vast repositories of energy. It takes energy to manufacture or extract building materials, more energy to transport them to a construction site, still more energy to assemble them into a building. All of that energy is embodied in the finished structure, and if the structure is demolished and landfilled the energy locked up in it is totally wasted. What's more, demolition uses still more energy, and, of course, the construction of a new building in its place uses even more.

The use of all of that energy releases tremendous amounts of carbon into the atmosphere. For example, it is estimated that building a new 50,000 square-foot commercial building releases about the same amount of carbon into the atmosphere as driving a car 2.8 million miles.

Don't assume that the energy efficient operation of that new 'green building' will offset the environmental costs associated with demolishing and replacing an existing building. A recent study from the United Kingdom finds that it can take between 35-50 years for a new, energy efficient home to recover the carbon expended during the construction of the house.

Also, don't assume that historic buildings are not energy efficient. Many have thick walls and other features that enhance efficiency. Their durability allows for renewal that underscores recognizing them as genuinely sustainable resources, and sustainability, after all, is the ultimate objective of a nation and a society that values its future.

Combating climate change will require us to elevate sustainability as a priority in all facets of our lives. For too long we have assumed that natural resources would always be readily available and our environment would be resilient and support life. We now understand that this is not true. Today we are challenged to find a way of living that will ensure the longevity and health of our environmental, economic, and social resources. I am confident we will create and make available new sources of energy. We will learn to be better stewards of our communities and our planet. Our buildings and our homes will reflect that understanding and stewardship.



Courtesy of the National Trust for Historic Preservation.

Originally published on: Planetizen: Urban Planning, Design and Development Network www.planetizen.com

Does "Maintenance Free" Exist?

A common selling point used in sales pitches for new materials, windows, etc., is that they are "maintenance free". However, as Mr. Bill Hover, Architectural Reviewer at Georgia's Historic Preservation Division, aptly points out "if something isn't designed for maintenance, by default it's designed for replacement." Historic materials, by comparison, were built to last for multiple generations and to be maintained so replacement would not be necessary.

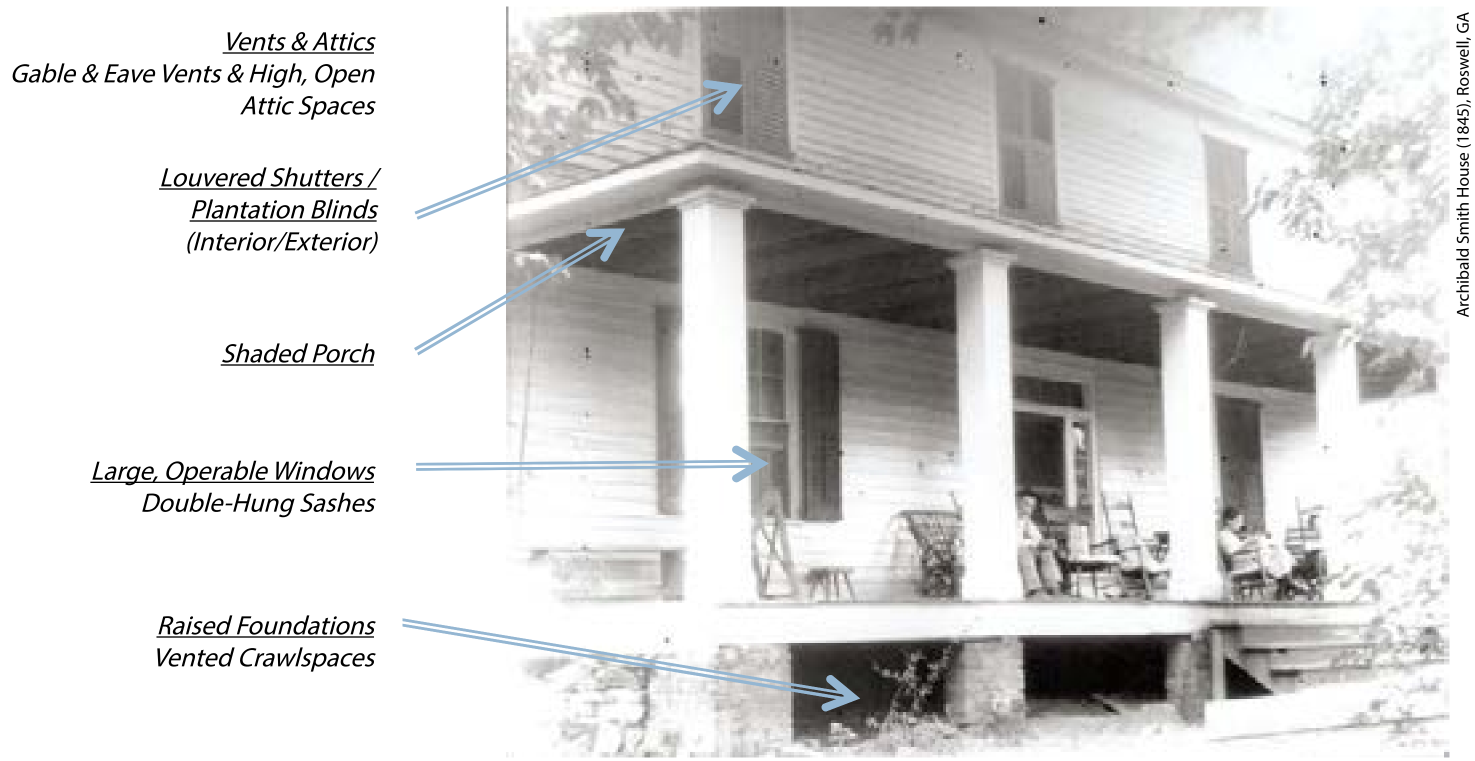
8.3. Traditional Home Features Designed for Energy Efficiency

Parts of the Traditional Home Ventilation System

As stated earlier in this Section, the southeastern United States has one of the most difficult climates to design for: hot and humid in the summer, but still somewhat cold and humid in the winter. The southern home needs to be designed for both climates, but with a greater emphasis on controlling heat. To combat this particular combination, southern architecture relies heavily on controllable shade and ventilation. Shade helps protect the building from the hot sun, and ventilation allows breezes to cool a building. By making these features controllable, the occupant can adjust them to fit the outside temperature: more ventilation when it is hot, less when it is cold. Some of the most common southern housing types include the plantation house and the shotgun house.

Today, with interior HVAC ("climate control") systems many older homes, for example, have had their windows painted and/or nailed shut. Home expansion and renovations have installed second levels up into attic spaces and therefore have lost the mechanical drawing feature of the space to pull hot air up and out of homes. (These additions are engineered to attempt to insulate walls directly against hot roof rafters and the spaces use more energy to cool.) Occupants do not USE the features of their homes for their intended energy efficiency, rather we rely on expending more energy to keep us warm, cool or in well-lit environments. The features to do all of this are built right in to our older, traditional homes!

Fig. 4.1: Common "Built-In" Traditional Ventilation Features

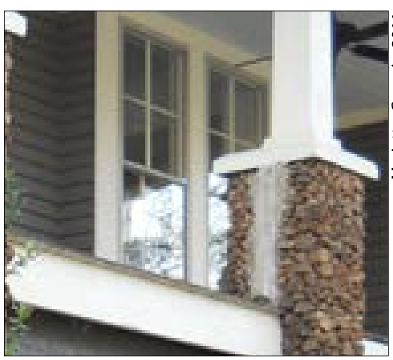


The Function and Use of Operable Windows

Windows are a classic example of how southern buildings use nature to heat and cool buildings. Large glass windows are a hallmark of southern architecture. These windows allow hot and cold air to pass freely in and out of the building, which is too often considered a detriment to modern mechanical air conditioning, and so it is. What most people don't understand is that those giant windows represent natural air conditioning.

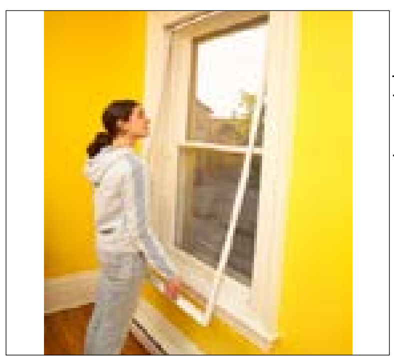
On a hot, summer day, these windows could be thrown open and breezes allowed to pass through the building. Curtains, different weights for different seasons, once had a function beyond mere decoration. Lightweight sheers billowed to let breeze in yet helped keep bugs out. By the 1880s the installation of wire mesh screens became common. Opening lower sashes gives breeze to people in a room, while upper sashes, lowered at later times of the day, can draw heat out of the high ceiling rooms. Windows closed during the heat of the day, room transoms opened and either upper sashes cracked open or a house fan turned on could draw cool air out of lower areas and earthen crawlspaces of a home. This process cooled hot southern buildings and kept interior spaces dry more efficiently than many modern-day air conditioning units - the only energy involved is that used to open the windows.

Fig. 4.2: Traditional Window Treatments and Features



Marietta, Georgia 2011

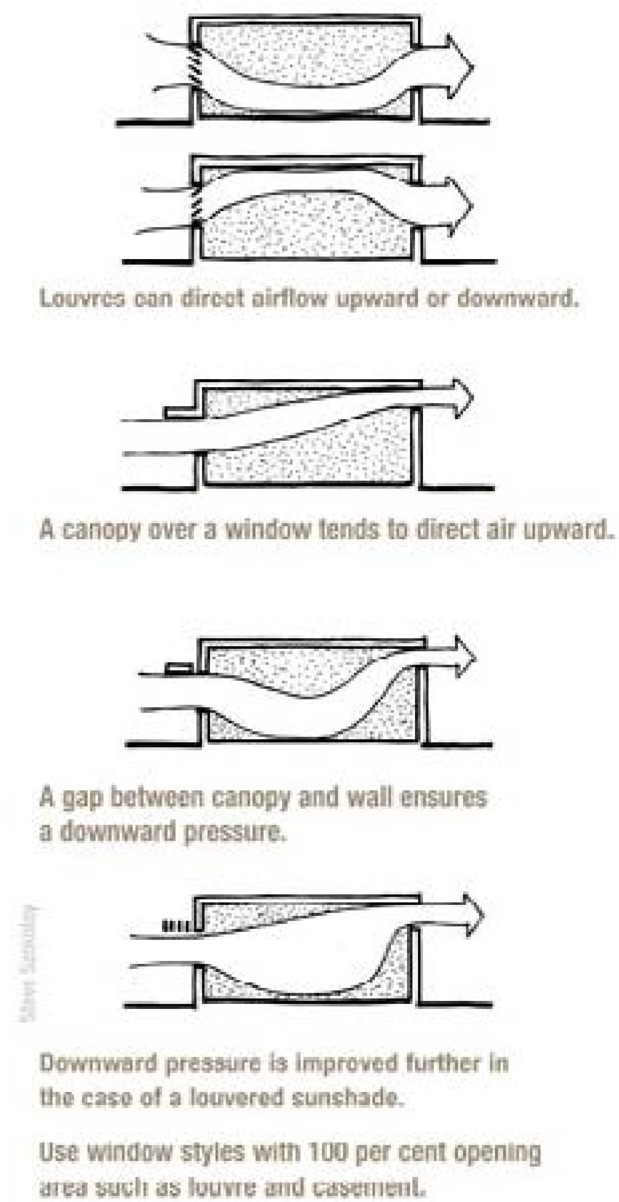
This Church-Cherokee neighborhood home makes use of full aluminum exterior storms (low profile, low visible impact) with horizontal stabilizing frame aligned with meeting rails. Original profile of wood windows can still be viewed.



www.innergywindows.com

Interior (magnetic seal) storm windows may also be a solution to snap in place (low profile and not seen from exterior) where windows are difficult to reach. Kits can be mail ordered.

Fig. 4.3: Air Movement with Operable Shutter Louvres & Canopies



By Bill Hover, Architectural Reviewer
Georgia Department of Natural Resources – Historic Preservation Division.

(Excerpted from a presentation given at the Tax Incentive Workshop for Energy Efficient Buildings sponsored by the Chatham County-Savannah Metropolitan Planning Commission on August 23, 2006)

Somehow old windows have become the poster-child for energy inefficiency, while new windows are touted as the miracle cure - - "cut your energy bills up to 25%!"

However, such numbers don't appear to stand up under closer examination. If, using DOE figures, windows account for 10% of energy loss (air leakage), stopping all of that loss only calculates into energy savings of just under 5% (.45x.10=.045). Additionally, this best-case scenario is unlikely in that a typical single-glazed wood window should have a U-value of about .98, which converting to R-value is about 1. A comparable double-glazed window with a low-e treatment has a U-value of about .34 or R-3. Logic would indicate the values available aren't great enough to achieve such a remarkable improvement in overall energy usage.

The point here is that windows are, by their very nature, not very energy efficient. However, they also provide a multitude of functions; among them are light, ventilation (sometimes) and stylistic character. Light and ventilation come at a cost to energy efficiency that we all seem willing to pay. And, from casual observation and judging from the selection of windows used in new construction, it appears that the costs of style are readily accepted, too.

From a preservationist perspective, old windows are very significant to the stylistic character of old buildings; in fact, they go further, because they also help define their physical historic character. As such, retaining old windows as part of a rehabilitation, renovation, or maintenance project really is a reasonable and desirable expectation. And, old windows don't need to be replaced for the sake of energy efficiency. Some independent studies indicate that adding a storm window to single-glazed windows will provide similar efficiencies as new double-glazed windows.

But this isn't to say you should keep the old windows in their current condition, which in many cases probably is pretty sad. It's kind of ironic that old windows have proven durability because they've withstood neglect, little or no maintenance for years and years, yet can often be repaired to function as they did originally and continue to last indefinitely, with a little care.

The reasons for this are that the material these windows are made from generally is of a higher quality than what is readily available and typically used today, and their assembly techniques make them quite repairable. Of course, that doesn't mean that working on old windows is necessarily cheap, but, then again, neither are replacement windows.

But you might be thinking about maintenance and its associated costs. The answer to that is twofold.

First, maintenance is a good thing. Stuff lasts longer if you take care of it. And, if you are doing regular maintenance, you get to know your building and systems pretty well and have a greater chance of catching problems when they're small and easily taken care of. Windows that are candidates for replacement probably got that way because they were neglected. If they had been taken care of regularly, their maintenance costs should have been relatively low. The alternative to maintenance is a big window project, either repair or replacement - - both expensive. And, actually, what are your choices? Repair a window that may last as long or longer than it already has (60-80-100 years?) or put new ones in that tout low or no maintenance and a warranty that ends at 20 years.

Second, if something isn't designed for maintenance, by default it's designed for replacement. Which in the long run costs more?

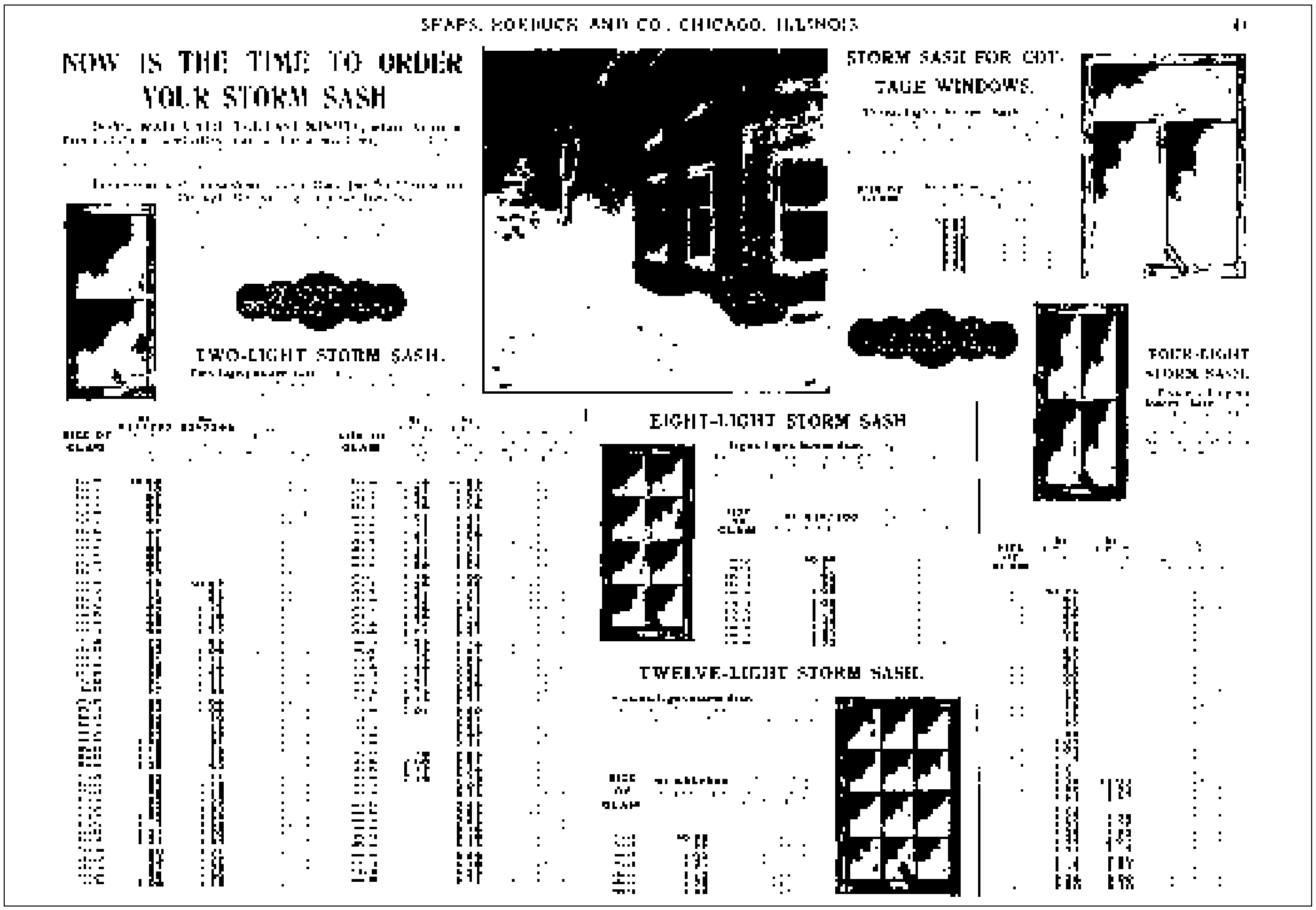
So, while it makes sense to replace a window that has deteriorated to the point that it can't be repaired, replacing repairable windows doesn't appear quite as logical when you factor in these considerations.

While windows have been the main point of this retention versus replacement discussion, the same basic concepts apply to other historic features as well. Some energy efficiency improvement projects can be done with little or no impact on historic features and materials, like adding attic insulation; others could constitute a historically detrimental impact, like removing plaster to insulate walls.

A good source for energy efficiency guidance can be found at: www.eere.energy.gov/buildings/info

In the wintertime, heavy curtains drawn at night prevent heat loss and lightweight, sheer curtains closed in the day still allow for bright light while minimizing any drafts. (Of course all of these were expected to be installed, along with storm windows set in place, almost always included with the original home.) This process cooled a hot southern building more efficiently than any air conditioning unit - the only energy involved is that used to open the window.

Fig. 4.4: Example Catalog Page for Storm Windows (ca. 1910)



1910 Sears Roebuck & Co. Catalog Page, Storm Windows (Reprint by Dover Publications, NY)

Built-In Energy Efficient Features to the Older Home

- SHUTTERS AND AWNINGS used in both hot and cold climates, with adjustable louvers allow for air circulation and block solar gain on hot days. Operable shutters reduce drafts on colder days and block solar gain on hot days. Post-Katrina construction in New Orleans and on the Gulf Coast is seeing the re-institution of more historic louver shutters that admit air, while providing shade. Removable or permanently attached awnings protect the windows from solar gain on hot days, allowing for winter solar gain.

- OVERHANGS, EAVES, AND COVERED PORCHES provide shaded outdoor living space and protect the walls from the hot summer sun and precipitation. If siding is being replaced, an overhang could allow for the addition of exterior rigid foam to help insulate the walls.

- SEASONALLY SHADED INTERIOR COURTYARDS provide outdoor living space for hot summer days and warm protected areas on cooler days.

- BRICK AND ADOBE provide thermal mass to moderate the temperature swings, releasing heat gained during the day into the cooler night.

- CROSS VENTILATION is encouraged with the use of double-hung windows both upstairs and downstairs, creating an air flow through the house and exhausting hot air from the upper story.

- VEGETATION is used to provide windbreaks and provide shade for the hot summer days. Evergreen trees provide year-round wind protection while deciduous trees provide seasonal shade, allowing for winter solar gain.

Taking advantage of retaining these features will benefit the home by preserving its historic integrity, increasing the comfort of the homeowners, and reducing the need for additional energy efficiency features.

Information found at:
http://apps1.eere.energy.gov/buildings/publications/pdfs/building_america/historic_homes_guide.pdf

Marietta, Church-Cherokee Neighborhood (2011)
Operable Exterior Shutters

Marietta, Church-Cherokee Neighborhood (2012)
Deep Exterior Porches, large double-hung windows

Marietta, Church-Cherokee Neighborhood (2011)
Mature landscapes shade older homes

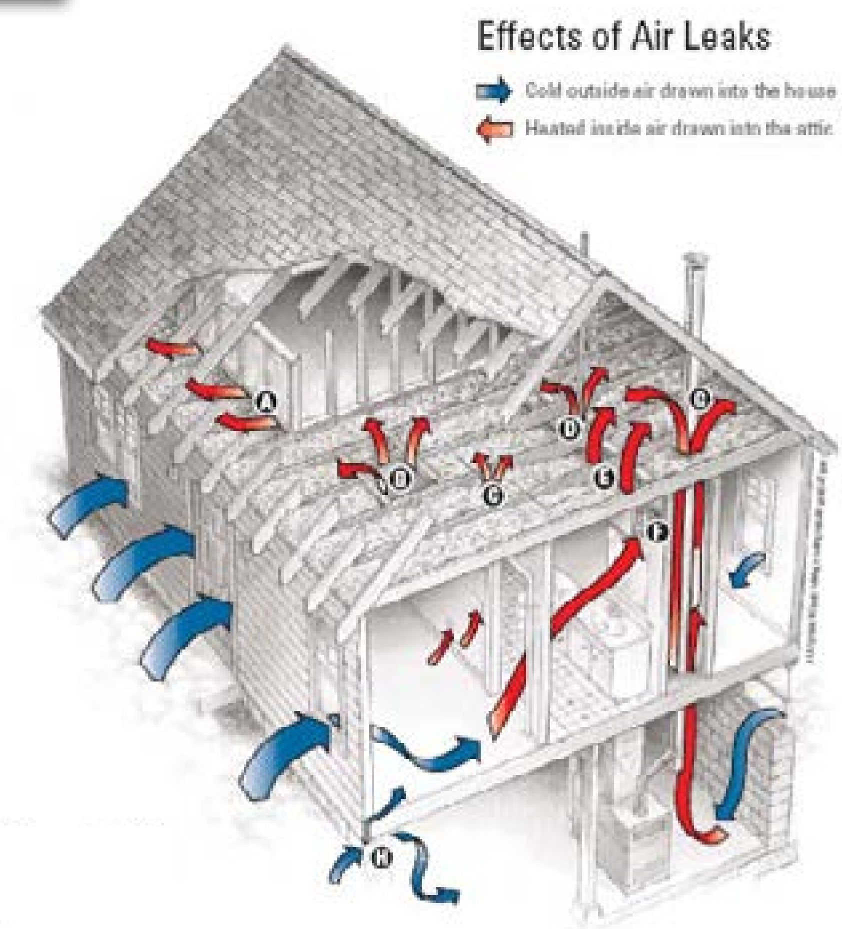
Recognizing Air-Leaks and Needed Air-flow for Building Health

There is a definite balance in the older, traditional historic home between "air leaks" and needed "air movement" throughout the structure. All too often people go right for replacing valuable, irreplaceable historic windows because they are "drafty" when the reasons for the air being pulled in through the windows (see Pg. A.5) is usually due to the rest of the home having poor insulation or many common household air leaks. Proper exterior or interior storm sash installation, generally in the winter, will greatly minimize window air infiltration and taken off during summer months for the use of screens and some air passage to help draw fresh air through the more humid environment. Thus, simply adding some attic and crawlspace insulation and doing basic maintenance like sealing cracks at window casings and adding switch cover insulated pads, will allow you to save your historic sashes without paying for full, usually inferior quality, window replacement.

To fix your windows you may need to first look at your ceilings, floors and walls! Conduct an air leak, home energy audit and then find the solutions to the problems that are the simplest AND the most "reversible" to the historic material.

Complete encapsulation of the older home, sealing eave and attic vents and closing up all ability for air movement throughout often results in mold and rotting building components. Additions of rooms into large attic spaces of historic homes can also greatly offset the balance of needed air flow. Ensure eave cavities and space between ceilings and rafters is allowed. Use of reversible, rigid foam reflective insulation set between roof rafters has proved extremely successful in home build-in projects.

Fig. 4.5: Sources of Air Leaks in Your Home



Information and Illustration found at "Energy Star"™ Website:
http://www.hpwes.net/HowItWorks/CommonAirLeaksHouseDiagram.html

19th and 20th Century "Historic" Mechanical Systems

Older homes in Marietta may still retain their original (sometime inefficient) systems. Each home is an individual case study and home construction had much to do with the mechanical systems that were available to be installed. National Park Service Preservation Brief #24 describes:

Nineteenth-Century Building Technology:

The industrial revolution provided the technological means for controlling the environment for the first time. The dual developments of steam energy from coal and industrial mass production made possible early central heating systems with distribution of heated air or steam using metal ducts or pipes. Improvements were made to early wrought iron boilers and by late century, steam and low pressure hot water radiator systems were in common use, both in offices and residences. Some large institutional buildings heated air in furnaces and distributed it throughout the building in brick flues with a network of metal pipes delivering heated air to individual rooms. Residential designs of the period often used gravity hot air systems utilizing decorative floor and ceiling grilles.

Ventilation became more scientific and the introduction of fresh air into buildings became an important component of heating and cooling. Improved forced air ventilation became possible in mid-century with the introduction of power-driven fans. Architectural features such as porches, awnings, window and door transoms, large openwork iron roof trusses, roof monitors, cupolas, skylights and clerestory windows helped to dissipate heat and provide healthy ventilation.

Cavity wall construction, popular in masonry structures, improved the insulating qualities of a building and also provided a natural cavity for the dissipation of moisture produced on the interior of the building. In some buildings, cinder chips and broken masonry filler between structural iron beams and jack arch floor vaults provided thermal insulation as well as fireproofing. Mineral wool and cork were new sources of lightweight insulation and were forerunners of contemporary batt and blanket insulation.

The technology of the age, however, was not sufficient to produce "tight" buildings. There was still only a moderate difference between internal and external temperatures. This was due, in part, to the limitations of early insulation, the almost exclusive use of single glazed windows, and the absence of airtight construction. The presence of ventilating fans and the reliance on architectural features, such as operable windows, cupolas and transoms, allowed sufficient air movement to keep buildings well ventilated. Building materials could behave in a fairly traditional way, expanding and contracting with the seasons.

Twentieth-Century Building Technology:

The twentieth century saw intensive development of new technologies and the notion of fully integrating mechanical systems. Oil and gas furnaces developed in the nineteenth century were improved and made more efficient, with electricity becoming the critical source of power for building systems in the latter half of the century. Forced air heating systems with ducts and registers became popular for all types of buildings and allowed architects to experiment with architectural forms free from mechanical encumbrances.

In the 1920s large-scale theaters and auditoriums introduced central air conditioning, and by mid-century forced air systems which combined heating and air conditioning in the same duct work set a new standard for comfort and convenience. The combination and coordination of a variety of systems came together in the post-World War II high-rise buildings; complex heating and air conditioning plants, electric elevators, mechanical towers, ventilation fans, and full service electric lighting were integrated into the building's design.

The insulating qualities of building materials improved. Synthetic materials, such as spun fiberglass batt insulation, were fully developed by mid-century. Prototypes of insulated thermal glazing and integral storm window systems were promoted in construction journals. Caulking to seal out perimeter air around window and door openings became a standard construction detail.

The last quarter of the twentieth century has seen making HVAC systems more energy efficient and better integrated. The use of vapor barriers to control moisture migration, thermally efficient windows, caulking and gaskets, compressed thin wall insulation, has become standard practice. New integrated systems now combine interior climate control with fire suppression, lighting, air filtration, temperature and humidity control, and security detection. Computers regulate the performance of these integrated systems based on the time of day, day of the week, occupancy, and outside ambient temperature.

9.1. Targeted Contemporary Interventions

As we have made advances in controlling our interior environment to counter the exterior environment, our relatively simple systems have become complex ones. Yet we are still dealing with two principal challenges.

First, we have exterior environmental encroachment, which involves Nature's need to equalize everything, or to put it another way "Nature abhors a vacuum." This balancing act is dynamic, constant, and continuous. We recognize its effects, cold air rushing in when the door's opened in the winter, water evaporation on a hot day, but maybe do not exactly understand why it happens and how it relates to energy efficiency.

Second are the inherent weaknesses in our building systems. These boil down to the need to have openings in our buildings and, also, by the very nature of the way they are put together, creation of air leakage points.

Checklist: When to Use New Technology as a "Fix"

When should you use contemporary measures and materials? Use this checklist to determine if it is a good solution.

USE CONTEMPORARY MATERIALS (IN GENERAL) IF:

- ☐ ... it is on original construction and the original materials are TRULY damaged and cannot be replaced,
- ☐ ... it is to be used on a new addition,
- ☐ ... an original feature is missing or nonexistent in the original building
- ☐ ... a new measure is minimally intrusive, affordable, a proven product and will measurably improve the energy efficiency of your home.

Example: Insulation – Attic and crawlspace insulation is one of the most cost-effective, unobtrusive ways to improve the energy efficiency of a historic home. Insulation is cheap and cheaply installed. Because it exists on the interior structure of your home, it is not seen from the outside, so has no impact on the appearance of your home. Georgia Power states that "Sealing and insulating the 'envelope' or 'shell' of your home - its outer walls, ceiling, and floors is often the most cost effective way to improve energy efficiency and comfort, and should be the first energy efficiency improvement made to any home."

(Source: http://www.georgiapower.com/earthcents/residential/home.asp, emphasis supplied)

What You CAN DO to Gain Energy Efficiency in Your Older Home

Now that we understand how historic homes work, what are some good ways to improve their energy efficiency, while capitalizing on their inherent value?

- Seal pipes and duct work. "In a typical house, however, 20-30 percent of the air that moves through the duct system is lost due to leaks and poorly sealed connections." (Source: Georgia Power) (see below)
- Install tankless or energy efficient water heaters
- Install compatible double-pane windows on a new addition
- Install a programmable thermostat
- Install rain barrels to catch rainwater for irrigation
- Install interior or exterior storm windows (either seasonally or permanent) ensuring product-recommended air flow to avoid heat and moisture build up behind storms (see Pg. D.13).
- Purchase energy-efficient-rated appliances (install tankless water heat)
- Install solar tubes for lighting interior spaces (See below)
- Install curtains and blinds to control sunlight and prevent drafts
- Install attic and crawlspace insulation – Don't over insulate as this can trap moisture in the historic house, causing rot and other structural issues (see below).
- Weatherstrip your windows and doors (see below)
- Installing wall cavity insulation using the "drill and fill" method. Drill a small hole in the wall and blow in insulation through the hole. This avoids the removal of historic material and saves you the hassle of a house that is a construction site while insulation is being installed.
- Install solar panels unobtrusively (on rear roof)

Fig. 4.6: Simple vs. Over-done Solutions for Energy Efficiency


Photo: Brandy Morrison (2011)

Well-wrapped HVAC ducts (attics or crawl spaces) will minimize energy loss of air leaving cracks. Note, this is rigid duct work. The lowest amount of blown insulation layer is shown at the floor (only) of the unconditioned, high attic space.


Solar Tubes - product information

"Solar Tubes" are new products that are low profile, low impact to the roof/form of a historic home and can bring light down into a small or dark interior space without a skylight that has more surface to leak.


jB+a Photo Archives

Over-insulating this attic space off-set the intended vapor transmission of heat and moisture. Hard-to-reverse, closed-cell foam with full coverage caused undue moisture build up rising from the ground into the home and bloomed mold within months of the project.


Photo Archives

It is unnecessary to remove all interior (or exterior) wall covering to full-fill the walls with foam (or most other) insulation. Wall cavities in most older homes were built for the materials to "breathe" more than new engineered materials.

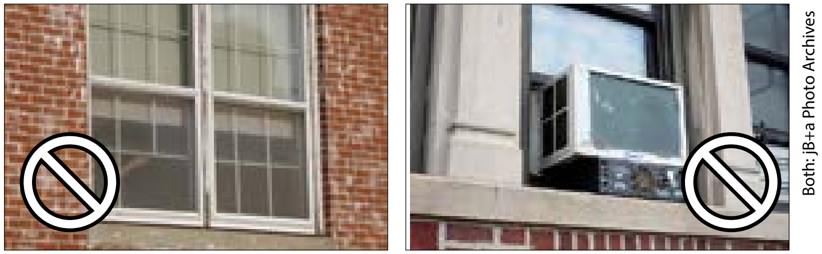
Checklist: When New Technology is NOT a good "Fix"

When should you not use contemporary measures and materials? This checklist can help you to determine if it is not a good solution.

CONTEMPORARY MATERIALS (IN GENERAL) ARE NOT SUGGESTED AS A SOLUTION WHEN:

- [ ] ...Original construction or features CAN be repaired and is still considered as able to perform its original function (windows, shutters, duct work, some insulation (even though it may look bad) and unseen areas such as attics or crawlspaces),
- [ ] ... The change will cause a dramatic change in the appearance (or form) of your house,
- [ ] ... The new material is of a lower quality than the original or rated to last significantly less time than the original rated materials,
- [ ] ...The change will damage historic material, features, or the mechanics (movement, expansion, reaction, etc.) of your historic home and is different from the old,
- [ ] ... The added materials mask the ability to easily inspect the original, underlying surface or a change is not "reversible" to the original.

Example: Window replacement - Increasingly frequently, new double-pane windows are being sold as energy efficient, cost-saving replacements for historic building components. But do the numbers really add up? Let's take a closer look. On average, replacing windows will cost between $7,000-$20,000 for a typical residence according to the Window Replacement Center, a for-profit website geared toward encouraging homeowners to replace their windows (http://www.windowreplacementic.com/articles/replacement-windows-costs/). This same website claims those windows will save you an average of 10-25% off your home heating bill each year. They tout this as a big reason to get new windows, and it does, indeed, sound like a big chunk of savings on your energy bills. Let's do the math to see if this is accurate: Say your average energy bill is $200/month (sounds reasonable). At 10% cost savings, you'd save $20/month, and at 25% savings you would save $50/month. How long would it take you to recoup your investment? At the low, $7,000 rate, it would take 140-350 months (12-30 YEARS) to recoup that money! If you spent $20,000, it would take between 33-83 years to make it worthwhile. Meanwhile, a study cosponsored by the National Association of Home Builders and Bank of America found that "for windows and skylights, aluminum windows are expected to last between 15 and 20 years while wooden windows should last upwards of 30 years..." (http://www.housingzone.com/housingzone/article/study-reveals-life-expectancy-windows-and-doors). So, with that in mind, it is extremely likely that you will be replacing your new windows before they pay for themselves.



(right) Window AC units cause a visual impact, put weight on window units and often drip condensation on sills. (Left) Modern vinyl replacement windows (when installed rated higher than the existing 50-year wood windows they replaced). Only 15 years later the "grid-be-tween-glass" mullions are dropping, parts have shrunk and visual character does not match.

9.2. Cautionary Notes & Unintended Consequences

In historic buildings energy efficiency improvements could also have unintended consequences, which for the most part generally involve moisture-related problems, including mold, rot, condensation, and peeling paint. When sealing and insulating and otherwise making a building snug and tight, you might also be creating situations where moisture is being trapped and will lead to these problems.

How could this happen?

One circumstance could be installing a "vapor barrier" incorrectly. The general rule of thumb is to put a Vapor Diffusion Retarder on the warm side of the building envelope. But, you might be thinking, "the warm side varies, in winter it's the inside, in summer, it's the outside." Well, what's really recommended is based on what Climate Zone you're in and more specifically its number of Heating Degree Days. For Georgia, generally, in the northern half of the state, the Vapor Diffusion Retarder should be put on the interior side, while in the southern portion of the state one shouldn't be used.

Another situation could be the inadvertent use of a paint, which because of its perm rating, acts as a Vapor Diffusion Retarder. If you're having paint peeling problems, that could be a reason why your paint is not sticking.

Other moisture problems might have to be dealt with by adding exhaust vents in bathrooms and kitchens and/or by installing a basic dehumidifier.

Fig. 4.7: Unintended Consequences to Materials from Home Projects

www.calfinder.com/magazine/light-construction/common-causes-dry-rot

Rot is a form of living fungal spore that begins to form on natural building components (mainly wood) when moisture becomes present. There are hundreds of forms. Some will form in sunlight but generally dark, dank and cool conditions such as crawlspaces and joists between floors (or where plumbing, HVAC evaporator lines or appliances provide moisture). Some rot enjoys hot, seemingly dry conditions and spores turn wood powdery, but always requires a source of water or a leak.

Source: ReliableRemodler.com (blog)

Black mold can be the worst type of mold spore outbreak that will spread through your home and on building components if the moisture levels are high. This is an extremely bad condition shown. Black mold can also cause rash and respiratory problems (especially in children). Best to never let it start by keeping moisture levels low, use of exhaust fans and avoid over-insulating your home.

jB+a Photo Archives

This floor register was installed at the base of full length wood porch windows and the combination of condensation forming, causing rot, and dry heat in the winter, cracking the material, has damaged the bottom window rail (repairable). NOTE: a clear plastic air diverter was added to attempt to re-direct some of the air.

9.3. Cost Effective Energy Improvement

Building Feature	(minimum, less than $100)	$ ($100 - $500)	$$ ($1,000 - $5,000)	$$$ ($5,000 +)	Notes:
Windows	Weather-stripping, curtain rods and window sheers	Heavy drapes, interior blinds & treatments, scrape out & replace exterior muntin putty approx. every 30 - 40 yrs.	Window repairs (rout window insulating strips onto all sash edges, whole house storm window package)	Window replacement (ONLY IF sashes are extremely rotted) or hire professional to spot-repair broken elements & recondition.	Full window replacement of any original or "old growth" hard-wood sashes NOT recommended
Insulation	Foam back-pads for light switch plates and outlet covers	Caulk for sealing holes and cracks (pay attention to underside of window aprons and around casings) ea. yr.	Spot installation of extra attic and / or crawlspace insulation	New wall insulation including loose blown-in cellulose from small penetrations in wall (only if needed and sealing all other areas does not stop air infiltration)	It's easy to over-insulate with spray-on (especially closed cell) foams, often trap-ping water that might infiltrate against material. Seeing material is difficult
HVAC	Clean AC condenser coils (NOTE: do not void warranty in doing so - ask professional)	Inspect/tape ducts at seams, programmable 7-day thermo-stat with at least 4 time slots	Wrapping ducts	New energy efficient HVAC system or installation of a geothermal system	Ensure forced air does not blow directly onto windows or glass and that humidity levels do not dry interior and crack woodwork
Water	Rainwater barrel, soaker hose, new shower head, 1.28 GPF high-efficiency toilet (ea. less then $100)	Tankless hot water heater for 1 bath or addition, water heater tank cover (if needed)	Tankless hot water heater for a full home (2 + baths)		
Electricity	Fluorescent bulbs, dimmer switch on most-used lights, turn off lights in rooms not in use, set refrigerator temp up	1 dimmer switch per room, Install ceiling fan (to cut down on HVAC running)	Solar panel installation (limited use) and micro wind turbines (not readily seen from public street)	Solar panel installation (whole house use) - (installed as to not glare on neighbors or completely obscure roof)	Limited use would be for a single service or appliance such as heat-ing your hot water heater

Make an Energy Improvement Plan

Improving the energy efficiency of historic buildings can be a beneficial objective. Doing so makes the buildings more desirable and agreeable as places in which to live and work, allowing for their continued use, which also helps stabilize communities and neighborhoods. Often these improvements can be accomplished economically and with minimal physical impact on the historic fabric of the buildings. However, the means by which the improvements are made and the level of improvement expected should be carefully considered so that the historic character of the buildings is not compromised and so that money will be spent for those improvements which will provide the best results.

To plan an energy efficiency improvement project, remember to:

- Recognize your building as an assembly of systems – framing, including wall/ceiling/roof finishes; mechanical system, including furnace, A/C, and duct work; and energy users, including water heater, appliances, and lighting.
- Identify weaknesses in the systems and where they might be failing or need improvement. Understand that changes in one system may impact the others, e.g., sealing the house up too tight may result in conditions where existing ventilation and humidity control are no longer adequate, resulting in mold growth and other moisture-related problems.
- Fix or improve the easy and less expensive items first.
- Avoid treatments that require wholesale removal or loss of historic material or finishes.