HOW OLD BUILDINGS
WERE DESIGNED TO WORK

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As I work with and train historic preservation commissions I find that many, if not most, are unintentionally buying into the replacement product industry's mantra that the only way to be energy efficient is to replace the old systems. I call this the big lie. Remember, they call them replacement products because you have to keep replacing them over and over again.

Contrary to what most folks believe about energy efficiency, most old houses and buildings were designed to take advantage of the weather.

Eaves

From the early Victorian era Italianate and Second Empire styles through the Arts & Crafts era (1900 to 1930), wide overhanging eaves were the norm. This feature even continued into the recent past with California ranches. While this element is attractive and allowed for brackets, corbels and later, exposed rafter tails, the original idea was strictly to manage the sun. In the winter, when the sun is lower in the horizon, sunlight bypasses the wide eaves and comes in through the windows. In the summer, when the sun is high in the sky, the wide eaves help keep the blazing sun from directly bearing down on the inside of the structure. Brilliant? Well, not really. For thousands of years enlightened builders have understood this concept.

Above: *Wide eaves and deep porches were designed to manage the sun in both the summer and winter.*

Below: *The moveable upper and low sash in traditional double-hung windows draw heat out of the house and let cool breezes in.*
NAPC file photos

Windows

Early builders and architects knew that creating good ventilation was critical to the success of any building. Without cross-ventilation these early structures would have been unbearable to live or work in. Air conditioning as we know it was not available or affordable in this country until the late 1950s and early 1960s. In a way, this introduction was the beginning of the end for our collective knowledge about how our homes were intended to be used.

Double hung windows (one window sash on top and one on the bottom) are the most popular type in the United States and it appears they started showing up in Europe in the late 1400s, primarily as an early air conditioning system. Vintage double hungs have two window sashes that move up and down utilizing a counter balance system with a cast iron weight, and a pulley and rope to connect the weight to the side of the window sash. If you lower the top window sash three inches and raise the lower sash three inches a very interesting thing happens. The heat and humidity leaves the house through the top gap and cooler breezes enter the house through the lower gap.

Now, most of us wouldn't give up our air conditioning, but in most climates when we use our windows in this fashion, we really don't have to turn on the air conditioning until July and it goes off in mid-August. Most property owners can save between 10% and 25% on summer electricity bills without sacrificing much comfort to do so.

In most pre-1960 homes with wood windows, there is also a storm window that protects them. Part of the reason we don't use our windows as air conditioning systems is that we replaced the original wooden storm windows with aluminum, self-storing storms. Folks just got tired of climbing up and down ladders in the spring and fall to switch out glass storms with screen storms. Whoever invented these aluminum storms did so because of this fact.

The problem with this design is that there is only a screen on the bottom and so everyone painted their top window sashes shut. Not only did this stop people from using their double-hung windows as air conditioning, the windows got much less use and people didn't pay much attention to maintenance issues.

One of the primary problems I have with new double paned (insulated glass) windows—wood or vinyl—is they have no storms. Your interior double hung units, old or new, were never intended to take a direct hit from the weather. From the 1400s until around the 1870s most windows had wooden storm shutters. Then wooden storms windows and screens were invented in favor of shutters. These were more practical than hassling with closing the shutters every time a storm was coming.

The good news is that there are now combination wooden storms that are either self-storing or have glass that can be taken out of the wood frame from inside the house. No more trudging up and down the ladder to change storms and screens twice a year. These storms also have full screens so your windows can be used as they were intended.

It will take a consumer 20 to 50 years to get any payback (saving enough energy to pay for the new windows) from replacement windows with double paned glass. A restored and weather-stripped original wood window with a wood or aluminum storm will be more energy efficient than a replacement double hung with double paned (insulated) glass. Considering the following statements in the window industries trade magazine, *Glass Magazine,* they make the case for restoration.

July 2001, *Glass Magazine,* By Editor, Charles Cumpstom:

> "The consumer's perception of glass is significantly different from the industry's. While some in the industry think a 15-year life is adequate, it is the rare homeowner who envisions replacing all his windows in 15 years."

Another *Glass Magazine* article from 1995 by Ted Hart states:

> "Remember our industry, with rare exception, has chosen to hide the fact that insulating glass does have a life expectancy. It is a crime that with full knowledge and total capability to build a superior unit, most of the industry chooses to manufacture an inferior single-seal unit."

Single seal units are still the norm in plastic/vinyl and most stock wood windows with an average seal life of two to six years according to accelerated testing by the flat glass manufacturer, IG Cardinal. About 12 million replaced window sashes end up in our landfills every year. While most of these are original old growth wood sashes, more and more are windows less than 15 years old.

Consider that heat and air conditioning loss through windows accounts for only 12% to 15% of energy loss in a structure. This is a small percentage when you understand

Storm Windows: Wood versus Metal

Even though wood storm windows are more historically accurate for buildings constructed before the advent of aluminum storm windows, and even though they may provide greater energy efficiency because of wood's greater insulating properties, it may not always be realistic to require property owners to use them instead of aluminum models. Wood storm windows usually have to be custom-made, putting them outside of many property owners' budgets. Additionally, even if removable glass and screen inserts are used, wood storm windows require more maintenance than readily available aluminum models and some property owners may not be physically capable of doing it themselves and unable to afford to hire someone to do it for them.

Property owners who see wood storm windows as a long term investment, but are unable to make the financial commitment without taking out a second mortgage have some options. Local high school or community college vocational education programs may have woodworking classes whose instructors are willing to have them make the windows for a lower price than a craftsperson in order to give their student valuable experience. Property owners with sufficient spare time and skills can make the windows themselves, thus greatly reducing the cost. The investment can also be spread out over several years, replacing two or three aluminum storm windows a year until all of them have been changed gets the job done, but avoids a major hit to the wallet all at once.

Making the Most of Aluminum

If aluminum storm windows are used, they should be sealed with caulk, with care being given to not closing the ventilation points that prevent moisture condensation between it and the sash. Aluminum storm windows can also be painted a compatible color to make them less obtrusive. Property owners should be advised to keep them in good operating condition with regular cleaning and lubricating moving parts.

how air moves in a house. For most homes and buildings, you will never find a simpler, more cost effective and energy efficient window unit than an original weatherized, single paned, double hung window with a traditional or combination wood storm.

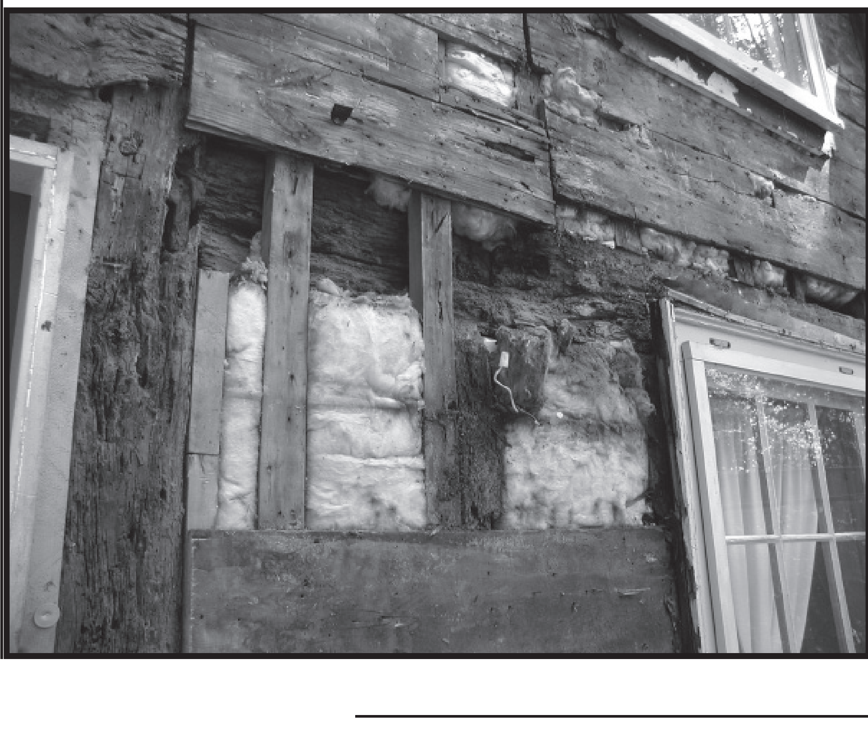
Walls

If your goal is to continue loving your old house or building and make it energy efficient while keeping your costs down, then you absolutely ***don't*** want to blow insulation into the sidewalls.

One of the top reasons for exterior paint failure, mortar deterioration, termites, mold, and structural damage to old buildings is cellulose insulation blown into the sidewalls. "Hey, wait a minute Bob, if we can't insulate the sidewalls, how can we afford to heat our old house?" That's a valid question, but you need to think of air movement in your house as if the house were a chimney. Heat loss happens primarily in an upward movement, like a chimney. So, I want you to insulate your attic space to the highest R-value for your region and be sure to allow eave ventilation. You should also friction fit craft-faced (paper faced) fiberglass batting—insulation or foam board into the box sills in your basement (the area where the beams or floor joists rest on top of the foundation). The craft face acts as a vapor barrier and should face the inside.

Building codes today require that when a new house or addition is built, it must have a vapor barrier. When a new house is going up, they frame the sidewalls and install exterior sheathing. Typically, the next step is to go inside and install fiberglass, batting insulation between the 2" x 4" or 6" studs. Before the drywall can be installed over this wall, 4 mm thick plastic sheeting must be laid over the insulation on the entire wall. That plastic sheeting acts as the vapor barrier. (Note: In most of the deep south, the vapor barrier generally goes on the outside of the house because of extreme exterior humidity.)

Below: *Improper insulation techniques can trap moisture and act as an air filter, reducing the effectiveness of insulation.*
Photo courtesy of Robert Cagnetta



We create warm, moist air in our homes by cooking, taking showers, having plants, breathing, etc. That warm, moist vapor is attracted to the exterior walls. This vapor enters the wall through hairline cracks, outlets, switches, and window trim. In an un-insulated wall cavity, the moisture may condensate when it hits the cold surfaces in the wall. However, there is nothing to hold the moisture and there's enough airflow to dry it out quickly. In new construction, the plastic vapor barrier under the drywall stops the wet air from getting to the insulation and condensating.

In old buildings with plaster walls, there is no vapor barrier under the plaster so the wet interior air hits the insulation and condensates. This moistens the blown-in insulation making it a wet mass at the bottom of the wall cavity, and creating an inviting place for termites, mold, and dry rot. The moisture enters the exterior sheathing and wood siding causing permanent exterior paint failure. Since the homeowner, for some "unexplained" reason, can't keep paint on the house anymore, they call the vinyl siding salesman. This makes the problem even worse as you now have a vapor barrier on the outside of the wall that stops the free exchange of air, trapping the moisture.

The other factor that must be examined is payback. Let's say you spend $6,000 to have your old house walls insulated. In my experience you would probably save about $200 per year on heating and air conditioning costs. So, it would take 30 years to recoup the money you spent on the insulation. Results and pricing can vary and this doesn't take into account the termites, dry rot, mold, mortar, or paint failure.

Foam insulation, whether closed cell, open cell, soy based, etc. is unproven. They claim "it won't shrink" but I have witnessed shrinkage in all of them after opening the walls a year after installation. The foam industries claims just aren't credible. Much of the formaldehyde-based foam that was installed in houses during the 1970s is now dust at the bottom of the wall when we open them today. The risk of foam expanding in the walls during and right after installation is real. This can cause the plaster walls and siding to bow and potentially cause structural damage. I've inspected thousands of old houses with blown-in insulation and over 80% of them have a wet insulation problem.

If your house is drafty then tighten it up. Weather-strip your windows and doors, keep the house painted and caulked well, insulate the attic and box sills. This will stop the air infiltration, make you more comfortable and ***really*** save money on utilities.

Again, the primary issue for energy efficiency is stopping air infiltration. There is no reasonable payback to blowing insulation into your sidewalls. This practice has truly been the ruination of many of our historic central city homes and buildings.

For more information go to the National Park Service website *www.nps.gov* and check Preservation Briefs No. 3 Conserving Energy in Historic Buildings and No. 24, *Heating, Ventilating, and Cooling Historic Buildings: Problems and Recommended Approaches*

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