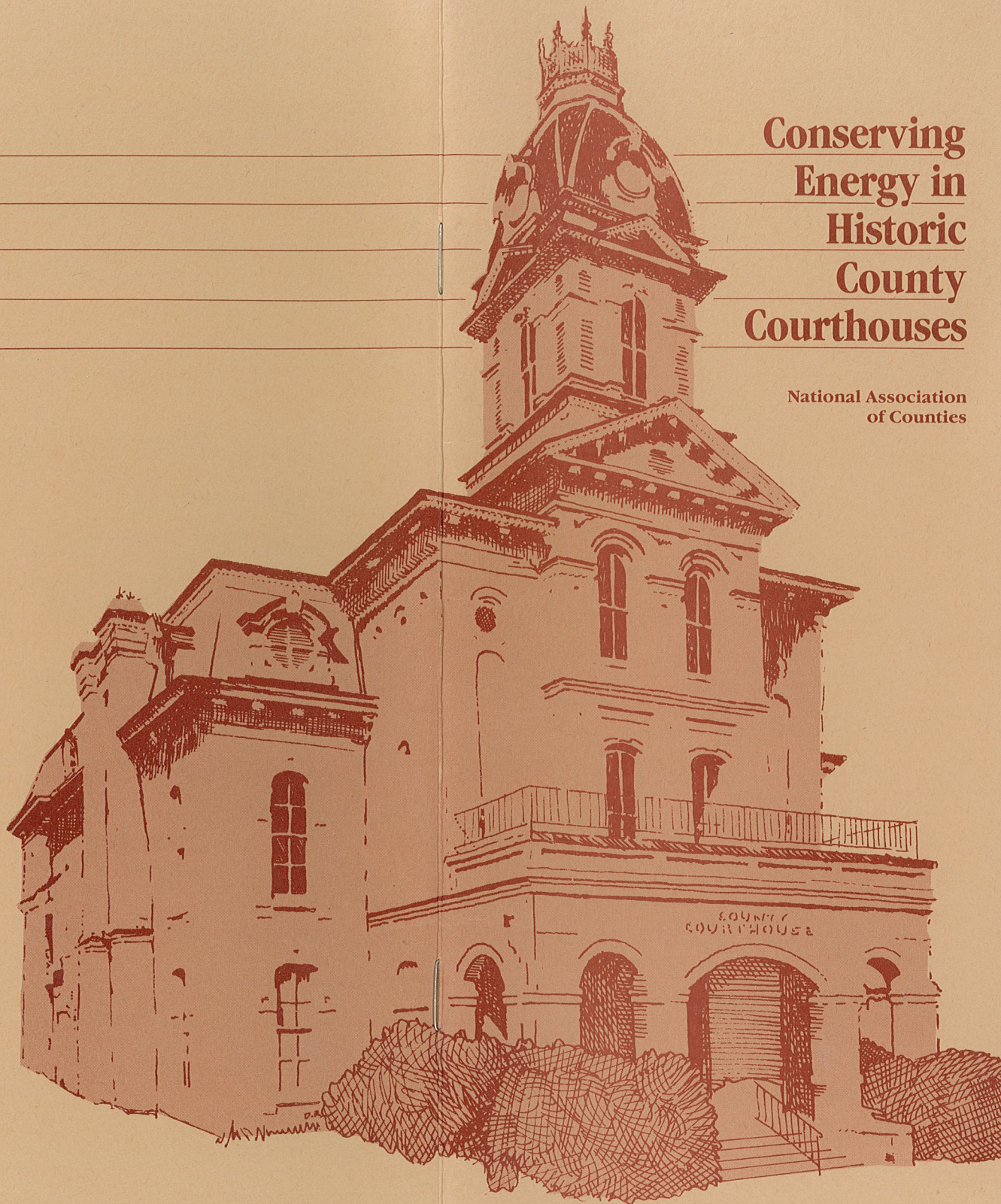


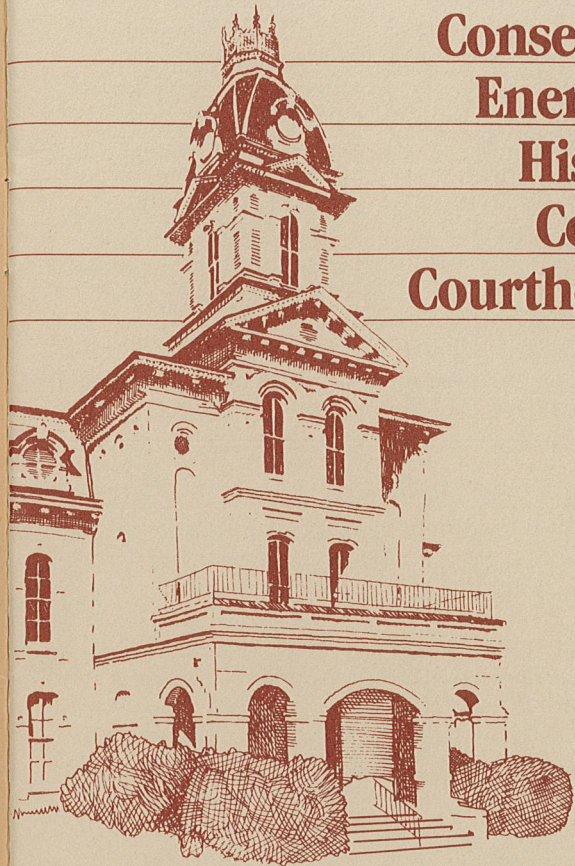
Conserving Energy in Historic County Courthouses

National Association
of Counties



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By
Gerri Hill



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Introduction

In an era of escalating energy costs, dwindling energy supplies and new thermal-efficiency demands placed on existing buildings, counties are anxious to conserve energy and save taxpayer money.

In many counties, the courthouse remains the focal point of daily government business, and is one of the largest items in the county energy budget. However, a retrofit of or weatherizing the courthouse for energy conservation may be delayed because of the fear of unduly altering the building's historic character.

This booklet, prepared by the Energy Project of the National Association of Counties Research, Inc. (NACoR), provides county building managers with techniques to improve thermal efficiency in the four major energy-consuming systems of the historic courthouse: heating, ventilation, air conditioning, and lighting.

Many building managers are unaware of the inherent energy-saving characteristics of most historic courthouses. These are identified in this booklet, along with conservation, solar energy, weatherization, and retrofit techniques.

While some well-known weatherization and retrofit measures are highly recommended for historic courthouses, others are less beneficial and can result in the inappropriate alteration of important architectural features, or even worse, cause serious damage to the courthouse's historic building materials. These measures are also discussed.

We recommend that building managers of historic courthouses read this booklet prior to initiating energy-conservation measures, and seek advice from professional consultants before applying any of these measures.

Case studies of four counties that have curbed excessive energy use in their historic courthouses are presented. Their experiences illustrate that energy costs can be reduced in historic buildings without sacrificing the building's character.

NACoR will continue to collect examples of historic courthouses which have been weatherized and/or retrofitted for improved energy conservation. We are interested in any figures which indicate monetary savings, reduced energy consumption, and cost of the retrofit. Please contact the NACoR energy staff if your county has this information available.

A Brief Architectural History of the County Courthouse and its Inherent Energy-saving Features

In the early history of this country, most public buildings were solidly built wooden structures. Wood was readily available in most parts of the United States, and a wooden building was more quickly built than one of masonry. As county government activities increased and the economic base of the community stabilized, wooden buildings were often replaced with larger, more impressive structures. Although stylistic elements and building materials varied in different parts of the country, stone and brick predominated. The level of community affluence was a determining factor in the building's size, quality of materials, and ornateness of architectural details. With the exception of the Southwest and California, which had an early history of adobe construction, this building pattern for county courthouses was repeated as settlements moved westward.

With the economic expansion and growth of population during the mid-nineteenth century, the county role in providing leadership and community services increased. As a result, the large courthouses we know of today became common. The courthouse was often the most impressive building in the community, reflecting the commercial vitality and important functions of the county government.

Today, county budgets do not permit replicating the grandeur of these original courthouses. In recent years, material and labor costs have escalated to a point where few, if any, counties can afford to build a structure using extensive amounts of carved stone, fine wood, and metals. The nineteenth-century courthouse was built with pride in quality work and to last a long time.

The historic courthouse building is also a remarkable energy-saver. Nineteenth-century architects built in energy-saving physical features and devices to provide good thermal performance. The courthouse's *thick masonry walls* conserve heat and dramatically reduce the need for summer cooling. The large mass and weight of its thick brick and stone walls have the advantage of high thermal inertia (inertia modifies the thermal resistance of the wall by delaying heat transfer into the building). By late afternoon, when the sun's heat has penetrated the building, office workers have generally gone home. High thermal inertia is the reason many older masonry buildings are cool throughout the summer, even without air conditioning.

The use of *operable windows* tends to take maximum advantage of natural light and ventilation, making them

inherent energy-savers. In addition, roofs topped with a *cupola* and *skylight* provide light for central hallways, and when opened, a natural draft for the hot summer air to rise and pass through the cupola windows. These features, which provide fresh air and light, assure that energy-consuming mechanical devices may be needed only to supplement natural energy sources. Any time the mechanical heating and air conditioning equipment can be turned off and the windows opened, energy will be saved.

In the warmer climates of the United States, buildings were often built to minimize the problem of summer heat gain. This was accomplished by introducing *awnings*, *exterior balconies*, and wide *roof overhangs*.

Another physical characteristic that enables historic buildings to be energy efficient is the front *portico*. Many historic courthouses, formal and elegant in appearance, feature a front portico supported by widely placed columns. Many courthouses have porticoes on four sides. The portico keeps sun from penetrating the main doorway in the summer, and keeps wind and cold air out in the winter. In addition, *vestibules* create a secondary air space at a doorway, reducing air infiltration while the primary door is open.

Most *historic wooden doors* are very thick and have good thermal properties. Some interior doors feature *glass transoms*, which allow air from the hallways to circulate within the offices.

Not all of these energy-saving physical features may be found in older buildings. However, studies by the Energy Research and Development Administration show that the buildings with the poorest energy efficiency are actually those built between 1940 and 1975. Older buildings were found to use less energy for heating and cooling and hence probably require fewer weatherization improvements. They use less energy because they were built with a well-developed sense of physical comfort and used maximum natural sources of heating, lighting, and ventilation.

One should understand these inherent energy-saving qualities before planning to retrofit or weatherize a historic courthouse.

Subsequent sections specify ways to decrease heating, ventilating, and cooling consumption by installing insulation, weatherstripping, and caulking. These measures yield impressive savings and can further improve the energy efficiency of the historic courthouse.

The Energy Audit

Since energy consumption varies according to building design, age, use, and location, the only way to determine the energy consumption pattern for the historic courthouse is to conduct an energy audit.

An energy audit is the initial step in understanding how to minimize usage of energy-consuming equipment. The audit determines how much energy is being used in a particular building and provides a procedure to develop an energy base.

Ideally, an audit monitors the building's energy consumption on a continual basis; forecasts energy costs for the coming year by taking the amount of energy used in the previous year and applying any new rates; establishes an energy conservation goal; and determines whether the building is paying the lowest utility rates. (Electric utilities often have multifactor rate schedules. Changes in the schedules or the building's energy consumption patterns may make the original rate inconsistent with current operations.)

The local utility company should be consulted to determine whether it can provide a functional breakdown of the building's energy use. For example, knowing how much electricity is used for lighting, air conditioning, and similar functions will be helpful in assessing the results of various conservation measures.

Once the audit is completed, the data can be used to identify areas of potential energy conservation. Particular measures could include lowering the thermostat to 68° F in the winter and raising it to 78° F in the summer; controlling the temperature in only those rooms actually used; reducing the level of illumination and number of lights (maximize use of natural light); and using operable windows, awnings and vents, as originally intended, to control the interior environment (maximize fresh air).

Other energy-saving measures include maintaining mechanical equipment at maximum efficiency with regular checkups; cleaning radiators and forced air registers to ensure proper operation; and setting the water heater down from 145° F to 120° F.

These measures should be the first steps taken to save energy in any existing building. They are particularly appropriate for historic buildings because they do not necessitate building alterations or the introduction of new materials that may alter the historic character of the building.

Weatherization and Retrofit Measures

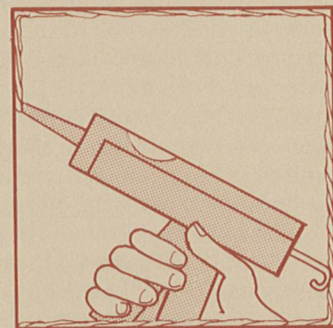
Building managers *can* undertake many weatherization and retrofit measures that will not jeopardize the historic character of the courthouse. Prior to these measures, however, the building manager should investigate the physical condition of the building.

The building manager should inspect the attic, roof, wall, and basement to determine methods of construction, types of building materials, and the presence of insulation. Doors, windows, and where the floor and ceiling systems meet the walls should also be inspected to determine sources of air infiltration. Existing caulking and weatherstripping must also be checked to determine if it needs to be replaced, or if more is needed.

Also inspect the condition of exterior wall materials (wood siding, brick, or stone) and the roof to determine sources of air infiltration and to assure that rain and snow are kept out of the building, where they can damage insulation. Existing insulation should be checked for full coverage and presence of a vapor barrier. If the insulation is wet, it will need to be replaced. If more insulation is needed, what type (batt, blown-in, or poured) and where to install it must be determined.

Caulking and Weatherstripping

The first priority is reducing air infiltration. Cold, outside air can infiltrate the building through open and loose doors, windows, and cracks in the outside shell of the building. This infiltration places an additional load on the heating and cooling



system. Installing weatherstripping around doors and windows and caulking the open cracks and joints are necessary to reduce air leaks. Very little skill is required in caulking and weatherstripping and the cost is minimal. Use good quality, long-lasting materials, such as polysulfide caulking and wood or metal weatherstripping with a felt or rubber bead edge. Make sure that weatherstripping is not installed so that windows are inoperable.

Insulation

Of all the standard techniques for reducing energy consumption in buildings, adding insulation is generally the most effective and widely applicable. A well-insulated historic courthouse resists heat gains in the summer and heat losses in the winter, and has significantly lower fuel bills than a poorly insulated building.

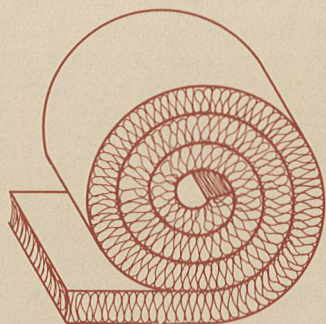
Insulation which is not installed properly will not function. Always follow the manufacturer's instructions when installing insulation and use insulation specifically developed for the surface it will cover. Always place the vapor barrier against the warm surface to prevent moisture from penetrating the insulation. Wet insulation does not function as a thermal barrier and can eventually rot wooden framing members, or corrode metal ones, and cause peeling of paint surfaces.

Warm air rising to the attic and roof from heated working areas is a major source of heat loss during the winter. In the summer, the sun "baking" the roof can cause air conditioning to run all day. Because of these seasonal conditions, the roof and attic area should be the first to receive extra insulation. Attics with floors should have insulation placed between the roof's framing members, with the vapor barrier facing the installer. Unfloored attics should have insulation placed between the floor joists, with the vapor barrier down.

Substantial heat loss also occurs through cold basements and crawl spaces. However, building managers must be conscious of the moisture often present in these spaces. If there is excessive moisture, consider installing a power extract fan. In crawl spaces and certain unheated basements, the insulation is generally placed between the floor joists (the ceiling of the basement), with the vapor barrier facing up. Avoid stapling the insulation in place, because staples often rust. Special anchors developed for insulation in moist areas should be used.

In heated basements, or where the basement contains the heating furnace, or where there are exposed water and sewer pipes, insulation should be installed against interior foundation walls, with the vapor barrier facing the installer.

In addition, heating and cooling ducts and pipes and hot water pipes should be wrapped with insulation.



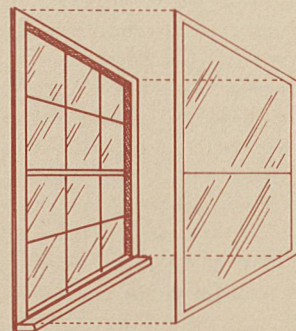
Note that air conditioning ducts and pipes will be cold in the summer, causing moisture to condense there. The vapor barrier should face out to prevent moisture from entering the insulation.

Storm Windows

Windows are a poor thermal barrier and a source of air infiltration and heat loss. Installing storm windows greatly improves the thermal performance of existing windows. They should be installed carefully, so as not to damage the historic window frames. If the metal frames impair the appearance of the building, it may be necessary to paint them to match the color of the historic frames. Many new storm windows are available in factory-applied colors.

Existing storm windows should be retained. However, make sure they are in good working condition and properly fitted.

When the exterior appearance of a building would be unduly impaired by exterior storm windows, interior storm windows may be preferable. Interior storm windows are as thermally effective as exterior ones, but they can cause problems. With interior storms, the outer sash will be cold in the winter, and moist air may be trapped between the storm and historic windows. Condensation often collects on the flat surface of the cold, outer sash, or sills, causing paint to blister and the wood to deteriorate. On metal windows, corrosion and staining may occur. These problems can be overcome by using interior storms that are operable; they should be opened to allow outside air to enter the building during mild weather and to allow condensation to evaporate during the winter months.



Solar Energy Measures

County building managers should always consider more traditional retrofitting measures before considering solar. However, in communities where energy costs are high, solar can be cost effective. Solar retrofits rarely supply *all* energy needs, but they can contribute a significant proportion of a building's hot water or heating needs. Solar hot water systems were introduced in Florida and California and have since been installed in many public and private buildings across the country.

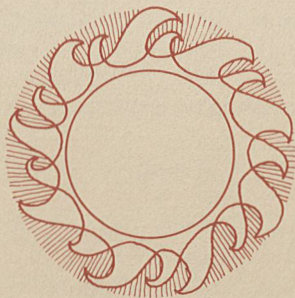
Data gathered in an energy audit will be useful in evaluating the possibilities of solar energy use. The auditor should note the amount of southern exposure on the building surface, windows, and roof; the amount of solar radiation received by the south-facing sections of the building; the amount of shading; and the amount of additional weight the roof would support for solar equipment.

The state climatologist or local weather bureau should have information on solar radiation available in any particular area to assist this assessment.

Solar technologies are generally categorized as either active or passive systems. Many of the inherent energy-conserving features of historic courthouses are actually passive solar techniques. Two popular modern passive solar systems are trombe walls and solar greenhouses. Both these systems collect and store the sun's heat and radiate it into a building's interior. A trombe wall is an addition of double-glazed material attached to the existing masonry wall, which has been painted black to maximize heat absorption from the sunlight passing through the glass. The solar greenhouse is a glass room, free-standing or attached to the building, which captures heat from the sun and stores it in a thermal mass, such as an adjoining masonry wall.

Since trombe walls and greenhouses can be quite intrusive, they should be considered only for the rear or sides of historic courthouses. They should not be visible from well-traveled areas. Once the system is in place, upkeep is minimal and does not require the use of mechanical or electrical components. Since a passive system usually provides radiant heat, rather than warmed air, building occupants will often feel comfortable at temperatures lower than those provided in a space heated by conventional means.

In addition, passive solar energy technology can be



utilized by opening the drapes on the sunny side of the courthouse during cold months to let the sun add its warmth. More technologically sophisticated and expensive measures include metallic film window coatings and window solar screens that reflect the sun's rays and the unwanted heat. Use of solar screens and coatings for windows should be conditioned by their impact on the character and appearance of the building.

Awnings and trees can also be used to shield the building from the sun, keeping it cooler in the summer. If awnings and trees are in place, keep them in good condition. Building managers may consider adding awnings or planting trees if the summer cooling load is substantial. Awnings should be compatible with the architectural character of the courthouse. If trees are planted, select deciduous ones that provide shade in the summer and, after dropping their leaves, allow the sun to warm the building in the winter. When planting trees, make sure they are no closer than 10 feet to the building, in order to avoid damage to the foundations. Adding either awnings or shade trees may be expensive, but in hot climates, the benefits can justify the costs.

Active solar systems are an alternative or supplement to passive solar systems. They are typified by the well-known solar collector mounted on the roof. Active systems use mechanical aids, such as pumps and fans, to circulate and store air or water heated by the collector.

Active systems can be easily added to existing buildings and can achieve higher temperatures with less collector area than passive systems. However, installing an active system in a historic courthouse can create problems with roof weight loads. Also, active systems are expensive, and the proper sizing of collector and storage systems is critical. As with passive systems, active solar systems should be attached with a minimum of damage to and visual impact on the architectural character of the courthouse.

Measures Not Recommended

There are some energy-saving treatments and techniques which building managers erroneously believe would benefit historic buildings. Unfortunately, some common weatherization measures intended to improve thermal performance and reduce long-term maintenance costs actually have just the opposite effects. Other measures can damage or destroy the character and building materials of the historic courthouse.

Vestibules

As mentioned earlier, vestibules create a secondary air

space at a doorway to reduce air infiltration while the primary door is open. If a vestibule is in place, retain it. If not, adding a vestibule, either on the exterior or interior, should be carefully considered to determine the possible visual impact on the character of the building. The energy savings would be small compared to construction costs. Adding a vestibule should be considered in very cold climates, or where door use is very frequent. But in either case, the question of visual intrusion must be resolved. For most historic buildings, adding a vestibule is not recommended.

Wall Insulation

In many historic buildings, adding wall insulation is a complex issue. Since the building is already in place, wall insulation must either be placed on the inner or outer wall surfaces, or placed into the wall cavity. With any of these alternatives, the costs are high and the chances for moisture damage to the building materials and health problems for building occupants are great. Generally, therefore, adding wall insulation should be a low-priority retrofitting measure, undertaken only after considerable study of the technical and aesthetic problems which could be encountered.

However, if the following two conditions are present in a given building, then wall insulation should be considered. First, is there great need for the wall insulation? This is determined by knowledge of the area's climate and an understanding of the degree to which the walls contribute to the heat loss of a given building. For example, the need for wall insulation in a multistory building in the far northern United States is great because there is a large amount of wall area and a cold climate.

Second, is it practical or feasible to add wall insulation? If the building is frame, and either the exterior or interior wall surface materials are being removed for some other reason (i.e., severe deterioration requiring replacement), then fiberglass batt insulation can be installed easily, along with a proper vapor barrier inside the wall cavity. Or, if the interior walls (either frame or brick) are not decorated with historic wooden or plaster moldings, paneling, or wall coverings such as murals or wallpaper, then it may be a relatively simple matter to add one or two inches of rigid insulation on the inside.

These may be the only two cases where adding wall insulation is practical. Thus, when considering wall insulation, give it a very long, hard look, since there are few cases when it can be justified.

Replacement of Historic Windows

Windows are an important aspect of the architectural

character of the historic courthouse. Their design and craftsmanship alone make them worthy of preservation. Unfortunately, modern, double-paned windows are commonly used to replace historic windows. However, adding exterior storm windows is a viable alternative to replacing historic ones. If historic windows are beyond repair, replacement windows should closely match the historic ones in size, number of panes, frame color, and reflective glass quality.

Waterproofing Masonry Walls

Many have been led to believe that waterproof coatings on masonry would improve the thermal performance of the wall by keeping it dry. However, application of waterproof coatings is not recommended because the coatings actually trap moisture within the masonry, and can cause severe deterioration during a freezing cycle. In addition, their contribution to energy conservation is doubtful.

Dropped Ceilings

Dropped acoustical ceilings have often been installed to conserve energy or hide mechanical equipment. This destroys or, at the very least, alters the architectural character and proportions of the courtrooms. This common alteration can obscure vaulted ceilings, murals, coffers, medallions and other decorative elements often found on historic courthouse ceilings. Therefore, dropped ceilings should not be considered.

Mechanical Equipment

Every effort should be made to salvage all existing mechanical equipment. Also, concealing such mechanical equipment as piping and ductwork within wall and floor systems may not always be appropriate for historic buildings because of the damage that often results.

The best advice concerning mechanical equipment in historic buildings is to assure that the existing equipment works at maximum efficiency. Building managers should determine how to keep and utilize old mechanical systems, such as plumbing and early lighting fixtures, whenever possible. If existing equipment must be replaced, new equipment should be installed in areas and spaces that will require the least possible alteration to the structural integrity and physical appearance of the building. The case studies in this booklet give examples of how county building managers have improved the energy efficiency of their mechanical equipment.

Conclusion

When considering retrofitting measures, building managers should keep in mind that there are no permanent solutions. One can only meet current standards with current materials and techniques. In the future, it is likely that the standards and the technologies will change, possibly necessitating a whole new retrofitting plan. Thus, historic building managers should limit retrofitting measures to those that achieve reasonable energy savings, at reasonable costs, with the least intrusion or impact on the character of the building. Overzealous retrofitting, which introduces the risk of damage to historic building materials, should not be undertaken.

Case Studies

Counties are increasingly aware of the impact escalating energy prices are placing on their government buildings. Their primary goal is to implement measures to reduce fuel consumption and improve upon the energy efficiency of these buildings, particularly the older ones. Examples of county energy conservation measures to improve thermal performance in their historic courthouses follow.

Mecklenburg County Courthouse

The Mecklenburg County Courthouse in Charlotte, North Carolina, is an architecturally plain but imposing structure constructed in 1926. The three-story building features widely spaced Corinthian columns on its front and rear porticoes and broad steps leading to a raised first floor entrance.



Mecklenburg County Courthouse

Mecklenburg County has incorporated energy-conservation measures in the restoration of its courthouse. Solar screens cover approximately 98 percent of the exterior windows. These very fine venetian blinds of anodized aluminum have the appearance of copper and are compatible with the architectural character of the building. The louvers allow the low-lying winter sun to enter, providing supplementary heat. In the summer, when the sun is relatively high, these louvers block the sun's rays, reducing the air conditioning load.

Other initiatives include insulating exposed ducts in the basement corridor and steam piping in the return air chase. As part of the HVAC renovation, the dual duct system was converted to a variable air volume system. This new system allows the boilers to be turned off

during the summer and the chillers to be turned off during the winter. In the past, boilers and chillers operated year-round.

Overall energy consumption in the county's government complex, of which the historic courthouse is a part, was reduced by 30 percent to 40 percent because of changes such as these.

Jefferson County Courthouse

The Jefferson County Courthouse—a Boulder, Montana, landmark—stands today much as it did when built in 1889. Designed in Gothic revival style, this five-story building features red brick masonry with gray stone quoins and a gable roof.

The Jefferson County Courthouse is functioning as it was intended. Energy-conserving features such as heavy masonry walls, operable windows, and roof-top ventilators provide a reasonably comfortable working atmosphere, without the use of mechanical air conditioning. Storm windows have been installed, improving the thermal performance of existing windows during the winter. The county has also installed insulation in the floor of the attic. And recently, an engineering firm inspected the heating system to ensure its efficiency.

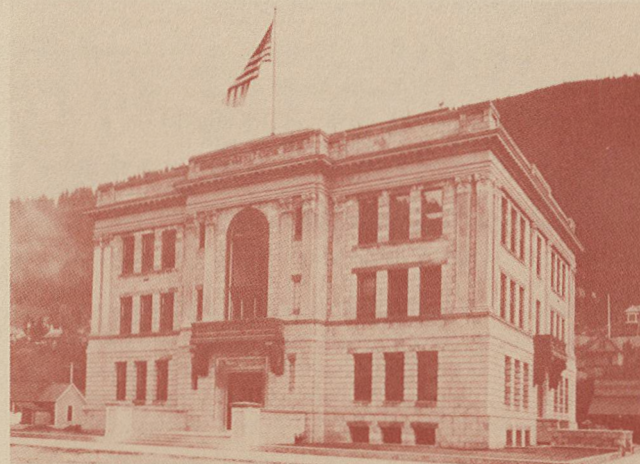


Courtesy of Boulder Monitor

Jefferson County Courthouse

Shoshone County Courthouse

The Shoshone County Courthouse was built in 1906 in the neoclassical revival style. Located in Wallace, Idaho, the courthouse is a three-story building, on a raised foundation. Constructed of painted block concrete, it features a facade decorated with fluted pilasters, rusticated stone on the first floor, and a central projecting pavilion with a two-story arched window. The building has a flat roof camouflaged by a high parapet.



Courtesy of Shoshone County

Shoshone County Courthouse

Shoshone County has improved the energy efficiency of its courthouse by installing a forced air furnace. The furnace can burn gas for primary purposes and oil for auxiliary purposes. The oil is kept on reserve for the courthouse to use during the curtailment of gas. The system operates by a calendar-timed thermostat. During the night and other times the building is vacant, the temperature is reduced and air-handling equipment operates without the introduction of outdoor air or the use of air conditioning.

The county's retrofit project also included insulating heating and cooling ducts and hot water pipes, and replacing incandescent lights with fluorescent ones.

Washington County Courthouse

The Washington County Courthouse, Washington, Pennsylvania, was completed in November 1900, and designed in Italian renaissance style. The four-story building is constructed of sandstone; its magnificent dome, decorated with glass and frescos, sets the courthouse on a scale with many famous capitol buildings. Lamps adorn the columns at the entrance, and a grand stairway leads to the courtroom floor.



Courtesy of Washington County Planning Commission

Washington County Courthouse

Washington County's courthouse retrofit project began with new thermal pane windows. The double-hung windows are made operable by an anodized aluminum frame sash of bronze, which blends with the sandstone color of the building. The new windows have a minimal impact on the appearance of the building. The original windows were severely deteriorated which warranted replacement. Rigid insulation was later installed under a new clay tile roof. In July, 1981, the county conducted an energy audit to identify other retrofit opportunities. The county has already begun to convert the courthouse from oil to gas.

For further information on the retrofitting projects described in this booklet, contact the individuals listed below.

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