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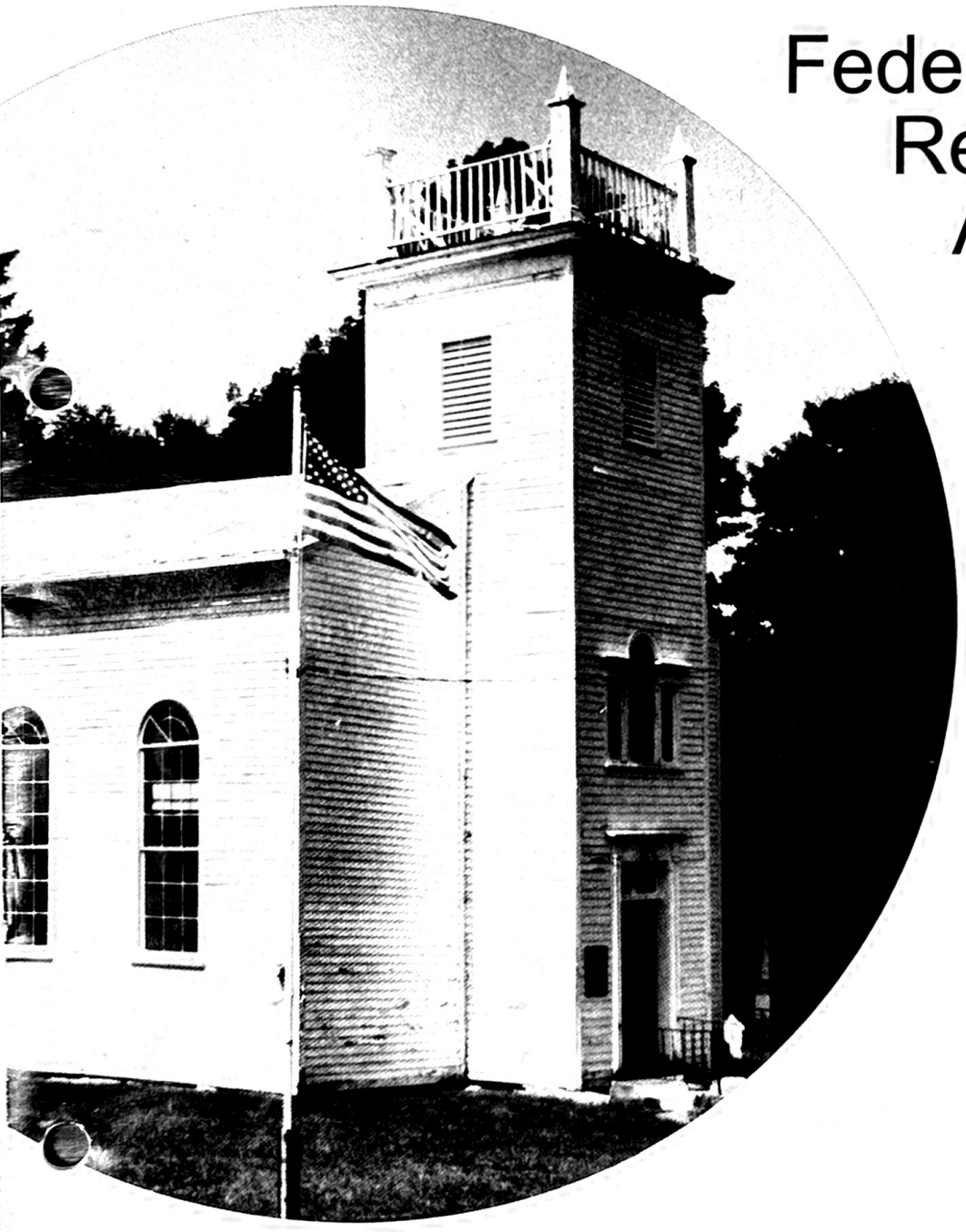

Federal Style Religious Architecture

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Building Systems: To Insulate or Not to Insulate

by Walter Sedovic AIA

The subject of insulating religious properties presents a dilemma: At what cost do we insulate sites that never were? How often are such attempts actually cost effective? When original material and finishes are removed to provide access, what is the real gain and -- most important -- what is the real loss?

Cold winters in New York State may inspire thoughts of tightening up your historic house of worship and filling your rafters with rolls of pink fiberglass. Insulating your historic religious property, however, could prove to be hugely detrimental if the approach is not mindful of your building's site-specific conditions.

The congregation also should be realistic about desired goals, and clear about a reasonable payback period. The intention of this article is to provide insight into proper evaluation of insulation needs and prudent resolution strategies. An objective understanding and identification of the source of the problem, coupled with realistic expectations, are necessary before proceeding.

Evaluating Your Site

As with all major capital projects, it is advisable to consult with a reputable preservation architect or building conservator on the proper methodologies for both evaluation of your needs and implementation of repairs.

To understand the feasibility and the impact insulating your building would have with respect to the structure itself, comfort levels, and cost savings, your consultant should begin by examining the specific characteristics of your site. This process comprises several steps and an array of evaluative techniques – it is in the congregation's best interest to seek as much quantitative information as possible.

1. What is the pattern of usage? The sanctuaries of religious sites are typically used intermittently only one or two days a week. Given the difficulty regulating the temperature in these majestic spaces and the fact that parishioners are less tolerant of the heating standards accepted at the time of their initial design, these are often the first to be considered for insulation despite the fact that the actual cost-effectiveness may be poor. As we will see, there may be less expensive and destructive means to effectively increase the comfort level within the sanctuary.

2. How is the entire building and complex framed and spatially arranged? Is there an accessible attic space? Is there a crawl space or finished undercroft? How is the wall system framed and finished on the interior and exterior? These, and questions like them, set the stage for decision-making regarding the basic type(s), and associated costs, of insulation options.

3. What are the principal materials employed in your building? Stone buildings have an inherent thermal lag -- they absorb the radiant heat of the sun during the day, then release that heat hours later. This is a powerful natural system that may render insulation ineffective. Is the roof wood shingled? Placing insulation within the rafters of a wood shingled roof may lead to accelerated deterioration because the shingles require air flow to keep them dry.

4. Where does most heat loss occur in a building? Buildings are each different with respect to heat transfer and loss, however most heat -- as much as 55-80% -- is lost through the roof; about 5-15% or more is transferred through the foundation; and the balance permeates the wall system. This is good news because it is far simpler to insulate roof structures and foundations than inaccessible cavity-walls. Bear in mind that it is the combination of walls *and* windows *and* doors that represent total heat loss -- often more the result of infiltration via gaps around openings. Sealed gaps, secure siding, and a good coat of paint are the first line of defense.

5. What is the specific level of heat loss? Computer programs can analyze diverse data to calculate heat loss. Each space within a religious complex typically has different needs, indicating that a single remedy can rarely be universally applied to the whole. A valuable supplement to heat loss calculation is an infrared survey. These photographic or video-graphic surveys visually illustrate how much heat your structure loses through a colorful display of heat radiating to the outside from within. Such evaluation procedures demonstrate graphically that a significant improvement in energy efficiency (and a reduction in heat-loss) can be realized by identifying and

correcting areas of air infiltration/loss -- much less destructive and cost effective than full-scale insulation.

6. What is the pattern of costs related to heating the space? Evaluate at least two years of heating (and cooling) costs. Also, examine the heating source and correct inefficiencies and/or upgrade the system. Ask yourself: Are the heating plant, burners, steam traps, and ductwork routinely maintained and cleaned? Are the sanctuary and other autonomous spaces separately zoned for heat? Does conversion to dual fuel (independent connections to both oil and gas, which allow switching with ease during periods of price fluctuations) make economic sense? Is the sexton or heating plant operator fully knowledgeable about the system? (Don't overlook this issue -- gross inefficiencies are often are traced to it.) Addressing the actual heating plant may significantly improve comfort levels and yield substantial savings.

A thorough survey will provide you with a big-picture understanding of your historic house of worship and the information necessary to reduce heat loss and maximize the heating system's performance. Be sure your exam includes:

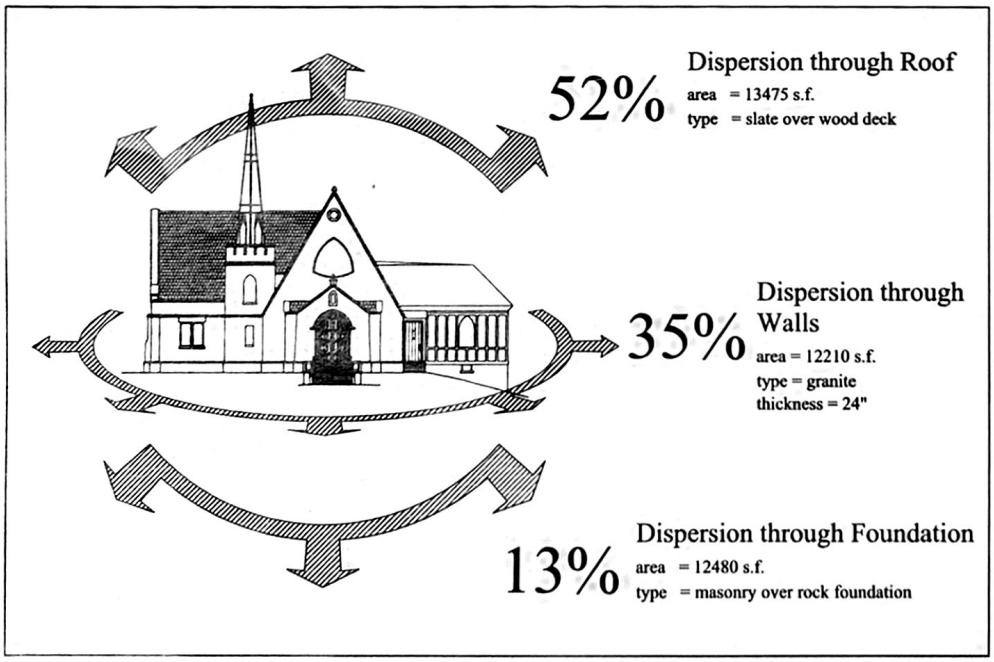
- the structure and materials used in construction;
- where and how much heat is currently being lost and which spaces most acutely require attention; and
- known and projected costs to heat your building and verification of the present system's adequacy and performance.

Based on the survey, your architect can help you determine whether alternatives to insulation would actually prove to be the most economical approach and yield the best results.

Alternatives to Insulation

In addition to sealing areas of air infiltration and maximizing the effectiveness of the heating system, there are several practical options that may obviate the expense of insulating the walls of an historic religious structure. Consider implementing one or more of the following:

- Incorporate timers that would allow the boilers to activate in the middle of the night preceding a service: This would allow more time for the space to become warm.
- Ensure that thermostats are placed in appropriate locations.
- Modify humidity levels within the space by addressing areas of water infiltration or utilizing dehumidifiers in particularly damp locations. Firing up the boilers the night before the service will also help dissipate humidity -- the perception of temperature is affected by the amount of humidity present in the ambient air.
- Use air locks or heated passageways -- through the narthex for example -- to reduce the amount of cold air entering occupied spaces each time a door is opened.
- Maintain window sash and doors, and make repairs that ensure their proper operation and accurate fit when closed. Incorporate weather-stripping systems specifically designed for retrofit applications and, if possible and appropriate, install storm sash. But be careful -- studies have shown that installing vented protective glazing on stained glass will not lead to increased energy savings and may actually damage the glass.



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Thermal Dispersion: Calculations for an 1963 slate and stone parish church in New York City clarify where heat loss occurs globally at the site. This information is crucial as the first step toward establishing an appropriate energy efficiency program, of which insulation is one component. Note: Calculations are based on an average difference in temperature (interior vs. exterior) of 30° F; results will vary from site to site.

A Holistic Approach to Insulation

If the congregation still wants to insulate, then it is necessary for your architect to determine the impact the process will have on the historic fabric, and thoughtfully design the best approach utilizing the survey data in order to determine exactly where insulation would prove most useful. With the projected minimum payback period of ten years in mind, the architect will also calculate the R-value desired (R-value is the standardized measure of a material's resistance to heat transfer. The higher the R-

value, the more effective its insulating properties) and estimate the costs associated with the installation.

Insulation should have a vapor barrier, generally kraft paper, foil, or plastic sheeting. A vapor barrier eliminates the potential for condensation to form when cold air meets warm, and must face the warm side of the space. That means that for ceilings, the vapor barrier faces down; for floors, up; and for walls, inward. This is important because a build-up of moisture could lead to real problems down the line.

Keep in mind that the ceilings/ roofs and foundations/floors, are the most cost-effective and least destructive places to insulate and design your approach accordingly.

- Ceiling/Roof: These locations are generally readily accessible without any kind of demolition or destruction of historic materials. The effectiveness of the insulation here will be greatest if the space is in continuous use. It is usually best to install the insulation within the attic floor or ceiling framing depending on your roofing materials. When the attic is occupied or used for storage, insulating both the floor and the roof may be beneficial. Be sure the attic space is adequately vented to reduce the buildup of moisture and heat during summer months. For open ceilinged spaces, panels of rigid insulation may be incorporated between exposed rafters or -- in some cases -- may be installed beneath the roofing system when the roof is removed for repair or restoration.
- Floor/Foundation: Insulating your foundation will not have a profound effect on cost savings or comfort, but it is a step that is relatively easy to perform and one that will provide some benefit including making it easier to control humidity levels. If mechanical distribution systems are located beneath the floor, insulating between the floor joists will provide a measure of noise abatement as well as reducing the amount of air infiltration (often laden with mold spores and fungi) through the gaps in early wooden floors.

The object lesson is to consider the retrofit of insulation within historic walls as the last resort.

The Last Resort

If all information and efforts thus far lead you to that last resort -- insulating the walls -- consider the following: choosing to insulate the walls will necessitate the removal of irreplaceable historic materials. The cost of such removals, simply from an economic standpoint, often greatly offsets the marginal benefit wall insulation might provide. It is inadvisable unless concurrent restoration work would allow access to the internal wall spaces.

It should also be noted that a typical plaster wall system mounted on a timber frame with wood sheathing and siding, already possesses an R-value of approximately 4.31! While not the highest R-value theoretically possible, it is significant and does represent a considerable capacity of inherent resistance. You have to wonder if insulation will improve conditions appreciably.

The Real Last Resort

For those considering the *real* last resort -- blown-in insulation -- be aware that infrared technology has proven useful in verifying the fact that voids often occur as a result of the technique's inability to negotiate internal framing elements such as wind-bracing and fire-blocking. It also tends to get hung-up on rough lath surfaces and nails. The resultant voids dramatically reduce its insulating ability. It also settles, and depending on what material is used, moisture can be a real problem. If the insulation gets waterlogged it is completely useless as an insulator. It can then soak adjacent materials, and encourage condensation throughout the wall system.

Thus, although blown-in insulation is touted as being easy and effective, it carries with it attendant problems:

- It is tricky to install correctly and must be done by a skilled professional.
- It lacks a vapor barrier, potentially leading to moisture problems, rot, and ineffective insulating ability if the material gets wet.
- It settles, leaving large un-insulated gaps.
- It has difficulty effectively filling voids and negotiating framing elements, which also leaves uninsulated holes.
- Its R-value can be significantly reduced due to all of the above.

Conclusion

To insulate or not to insulate should be determined through a careful and methodical process of analysis, information gathering, and truthful evaluation of the costs and benefits.

Remember that low-tech and relatively low-cost interventions such as sealing voids in the building envelope and maximizing the efficiency of the heating system, can be extremely effective. Should the congregation remain interested in insulating, consider doing the ceiling and foundation first, leaving the walls as a last resort.

Due to the implicitly destructive nature of insulating inaccessible spaces, try to install the insulation when roofing or wall material has been removed for other restoration purposes.