Remodeling to Save Energy: Is It Always Cost-effective for a Public Library?

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The most energy efficient building is one where energy efficiency was part of the building program. The ideal would be completion of the building program before site selection since building shape, orientation, location of windows and entry area all greatly contribute to heat loss or heat gain—often with no additional cost to the project. In a country filled with articles on energy costs, many architects still place a building's aesthetics far above energy efficiency, operational efficiency and operational costs. Although many people differ on what is attractive, few can justify unreasonable utility bills.

If energy conservation is so important why do we see all the wild and wasteful solutions to hotels, office buildings and other commercial structures? The key is the word commercial. The commercial owner writes off 50 percent of his utility bills at tax time as operational expense. The other 50 percent is passed on to the customer. A public building is tax supported and all operations including utility bills come from that yearly limited budget where we must balance services offered against operational costs.

Most energy articles have been written about the single family residence where utility bills are a large part of the yearly budget. The average home is occupied 24 hours a day by adults, children, dogs, birds, fish, etc. Generally the greatest number of people occupy the home when there is the most demand for heating, hot water, and lighting. A 40-hour work week permits 70 percent of the week in one's home if desired.

A public library occupancy rate is the exact opposite of a residence. Many Indiana public libraries are open from 40 to 60 hours a week. The 1979 state statistics indicated hours open per week of each of the 237 Indiana Public Library systems; the hours ranged from 73 hours per week down to 3 hours a week, with a great number listing less than 40 hours a week.

Remodeling for energy conservation must prove cost effective. Planning and building properly from the start is far less expensive than altering, rebuilding, revamping, replacing or adding materials to an existing structure or system. Many alterations have been greatly over-promoted for profit reasons rather than saving our nation's fuel reserve or our monthly utility bills. Once more, compare occupied hours of a library versus a residence. Is the library actually open when there is the greatest demand for heating or lighting?

There is no single solution to remodeling public libraries for energy conservation. The existing 1900-1916 buildings have a different set of problems than the 1940-1975 public libraries. Many of the older libraries have minimal lighting, far below the light level tables demanded after World War II. They were built before building codes required exhaust fans, continuous outside air into a heating system, additional stairways, additional doors as fire exits and public toilets. Many of these libraries do not have hot water, and I have been told some are without any telephone. Of course, many of these are the ones open from 3 to 35 hours a week.

I will address the old Carnegies and similar buildings first, since they differ so much from later buildings or, at least, they should. First get the heating system working as well as possible without replacement. Burners and controls that are out of adjustment are some of the greatest wastes in the building. Have a *trusted* heating man checkout your entire system and give you a total breakdown of various costs and options to making your system more efficient. Get a second opinion if you wish. Pay for the checkout and ask for a listing of items as they would relate to fuel savings and comfort. For more money a consulting engineer, if available, could give you a report without a conflict of interest. Avoid the many new Sunday magazine widgets until you get the basic system at its best for its design and age.

Consider a night set-back on your heating system. This pays off

for any set-back over 6 hours in length. And let the temperature drop nights and weekends. Each building has its own thermal behavior or fly-wheel action. In most buildings heat or cooling can be shut down 1 to 3 hours before a temperature change is noticed. Obviously the more efficient systems need less lead-time in the morning before building occupancy. Set-back timers can cover 24 hours or 7 days with each day different. All have an override switch. If your hours differ in the summer, be sure to change your timer settings. A high-low thermometer will let you know the results. Human bodies give off heat when occupying the building. The more active the body, the more heat is provided. Remind the staff of that condition.

If the decision is a new boiler or furnace remember bigger is not better. The most efficient heating or cooling unit is the one closest to the demand. Starting and stopping is less efficient. The coldest outdoor temperature will normally be when the building is unoccupied and does not need to be 70^{o} inside.

Often you can add an outside air temperature controller that anticipates a temperature drop and regulates boiler temperature before the internal need is noticed. With this system, your boiler temperature varies with the need and can cut fuel costs.

Where ceiling heights are over 15 feet slow moving ceiling fans can break up the heat stratification at the ceiling.

With your system working at its best, then consider the building envelope—walls, roof, floors, windows and doors. Much heat is lost through the ceiling and roof. Add attic insulation with a total of about 12 inches as long as insulation is separated from any recessed lighting fixtures and the attic has fresh air vents as per latest codes. A vapor barrier is desired for all insulated spaces, but not always possible. Make sure any skylights or stained glass domes are tight. If major remodeling is done to the building requiring plan review by the Administrative Building Council, be prepared for possibly covering a ceiling dome opening or adding a sprinkler system as the dome is considered a fire hazard creating a natural chimney action during a fire. Make sure any old fireplaces are thoroughly sealed as they can leak much warm air.

New wall insulation is difficult to justify. Walls lined with books are partially insulated. Vapor barrier is critical to wall insulation. Carpet samples can add comfort to children sitting on basement children's room floors.

A leaky window can cause heat loss, but a permanently sealed window can prevent natural ventilation when air conditioning is not needed. In most public libraries air conditioning costs are similar to heating costs. The tall double hung window is a great natural ventilation device for a high ceiling Carnegie. If the window is opened from both the top and the bottom, the high hot air escapes and is

replaced by lower cooler air. The real problem with an open window is outside noise, insects and a job description covering window operation at closing time. Many old Carnegie buildings had storm vestibules (an inner set of doors). If the inner doors were removed consider re-installing them, but make sure they swing toward the outside doors. This air lock helps indoor comfort and direct heat loss.

Lighting cut back is seldom the problem with the old Carnegies unless remodeled after World War II. From the war until 1975, the required light level standards required increasing foot candle levels every year the standards were published. Most of the standards committee members represented the utilities, fixture manufacturers, and light bulb manufacturers, and although very knowledgeable about lighting, they might not always have been totally objective about eye injury from maximum or minimum light. Quality of light is more important than quantity. Until recently most lighting was an all-on or all-off system for an entire room or an entire floor. Present lighting systems can be split into zoned systems especially light rows next to windows. The every other row system gives bright and dark areas. In a two-tube or four-tube light fixture, a tube removed will also cut out another tube. If you desire to cut down lighting by reducing tubes, investigate buying phantom tubes, a non-lighting, almost noenergy substitute tube that can keep the desired tubes working but reduce light levels and power consumption. Any change in lighting should be done after an accurate estimate in cost is made and an estimate of electrical power savings considered.

At the present time, new electrical controls are appearing on the market. These systems have a remote module or receiver fastened on an individual light fixture or the supply line to two or more fixtures. This receiver is controlled by a transmitter plugged into any wall convenience outlet in the building. Sears, Radio Shack and others have systems on the market. More advanced transmitters can be programmed with hours, sequences, dimming, controlling exhaust fans, heating, cooling and the coffee pot.

Before making any alterations to an old Carnegie, at any price, have at least a five-year plan indicating your future program to remain in the building as is, to expand and do major remodeling, or to build a new building. This is the process used by business corporations even though remodeling is a business tax deduction.

Perhaps some of the biggest savings in energy use can be found in changes to buildings built from 1940 to 1975. The buildings designed in the cheap energy era were typically engineered by the 'play-it-safe' method. If the lighting standards called for 60 foot candles, the system might be engineered for 70 to 80, and for good reason. One northwest Indiana public library system was ready to sue its Architect/Engineering Firm for producing a lighting system

that provided a couple foot candles under the lighting standards of that year. Board members bragged about the personal expense to the Architect to add more fixtures. Now in the 1980's fixtures are being unused.

Building codes for years have required large amounts of outside air to be added to the building. If one air change per hour was required, it could be engineered for three changes to play it safe. Various toilets, storage rooms and work areas have to have exhaust fans by code. Normally these are powered to run continuously even in a library closed 60 percent of the time. The air going out the exhaust fan has been either heated or cooled by the buildings' systems at some expense. These fans can be controlled by a timer.

As with the old Carnegie, consider the same process of getting all heating-cooling systems and the control systems working at maximum efficiency. This includes having systems balanced to provide all areas with required tempered air. Also consider time clocks, night set-backs, outside temperature anticipater, ceiling fans, special lighting circuit controls, remote controllers, phantom light tubes, and task light at higher levels only where needed. Many of the architects locate and design window areas for aesthetic reasons rather than for function or ventilation. Do not expect much natural air ventilation from non-operating windows. The air conditioning cost savings from natural ventilation more than off-set any heat loss through infiltration of a good quality window.

The more recent air handling units can be made to circulate 100 percent outside air during spring and fall periods not requiring heating or cooling.

Many things can be done in the effort to cut down utility bills, but are they actually cost effective? Is the pay-back period less than 20 years or the life of the system? These questions all must be answered before money from your limited budget is spent for a change. Alternative energy sources seldom can be cost effective for an existing structure used during normal library hours.