Environmental Movement and Buildings
A Brief History of Environmentalism

The environmentalists of our country have accomplished many things in the improvement of our natural environment. Environmentalists began at the end of the nineteenth century with two interest groups: one of conservationists wanting to stop the squandering of our natural resources and a smaller group wanting to preserve the environment for its own sake. The institution of this movement matured in April of the year 1970 with the first Earth Day. Over the next several years, interest levels varied as the novelty wore off for those who jump from cause to cause. But, in 1990, the twentieth Earth Day showed the true success of this movement. Record numbers of people came out to rally for the only planet on which the human race can survive. Today, the environmentalists seem here to stay. They come from all different backgrounds and have many different interests leading them to save our natural environment. Some of the most recognized activities include helping species survive, pollution control, and forest preservation. One area of more recent concern and involvement is the sustainability of the built environment.

...it is the "American way of life" that is one of the greatest threats to sustainability. We are setting all the records for consumption, waste, and pollution. Our designs are causing stress, illness, and reduction in productivity, in addition to excessive consumption and pollution. Our community designs are contributing to the isolation, separation, and fear that grips and debilitates our society. Ironically, just as we are becoming aware of the flaws in these existing designs, the developing world is rushing to duplicate the American way of life.2

Many things are being done in the construction industry to help further develop the knowledge and information available to the average architect, builder, or developer. For instance, The World Fair planned for the year 2000 will contain an exhibit of environmentally conscious architectural technology. The exhibit will be based on "Hanover Principles" which define living as "part of the earth." Also, the American Institute of
Architects' Committee on the Environment is working to educate architects on green architecture. A part of their efforts was publishing the Environmental Resource Guide for architects which contains environmental information about many materials.
Relevant Issues

Three issues were selected from the environmental research examined to use as a basis for the information in this report. They are

- energy conservation,
- indoor air quality,
- indirect environmental impacts.

Energy Conservation

The United States is very good at using energy. The energy crisis in the seven-
ties brought to reality that natural resources used to produce energy will not last very long if we continue use at even today's rate. This, plus the depletion of the ozone through burning natural resources and the fact that we still want air conditioning, automobiles, and television, means we need to make as efficient use of our resources as possible. Buildings are one area where improvements can still be made. The following statement was made by Amory Lovins:

Buildings are rarely built to use energy efficiently, despite the sizable costs that inefficient designs impose on building owners, occupants, and the utility companies that serve them. The reasons for this massive market failure have to do with the institutional framework within which buildings are financed, designed, constructed, and operated: many of the roughly two dozen actors who play a role in this process have perverse incentives that reward inefficient practice. Fragmented and commoditized design, false price signals, and substitution of obsolete rules-of-thumb for true engineering optimization have yielded buildings that cost more to build, are less comfortable, and use more energy than they should.4

When a building is demolished and buried in a landfill, not just the materials are wasted, but the energy to produce the materials and construct the building are also wasted. This is referred to as embodied energy. By keeping a building, all of this energy is saved. By using the materials of the building the energy used to construct the building is wasted, but the energy used to produce the materials is saved. In an environmentally ideal situation, we do not waste any of this energy and use buildings as
they are, maintaining them in good working order.

Not only can energy be saved through using existing buildings, but also through the systems used in those buildings. Many strategies have been developed to aid in the reduction of the use of energy. The following systems have been investigated for this research:

- lighting;
- HVAC;
- thermal envelope.

**Lighting**

Lighting is one system that can greatly reduce energy use by incorporating a few, relatively simple ideas. First, lamps and ballasts are now on the market which are much more energy efficient. Electronic ballasts, for instance, use less energy than the often installed magnetic ballasts. A second application is to include sensors. Occupancy sensors installed in a room that is not continuously occupied will ensure the lights are not on while no one is in the room. Also, there are dimming sensors for daylight. If enough light is being supplied naturally, the lights will dim or turn off completely.

There are also many design ideas that can maximize the use of natural light. Things such as interior windows, situating the most used spaces closest to the windows, and open floor plans can all be helpful to reduce the amount of artificial light needed, thus reducing the use of energy.

**HVAC and Thermal Shell**

Heating, ventilation, and cooling systems have come a long way in the past twenty years in particular in energy conservation. Many engineers know the need to give a client the most energy efficient system. Many different types of systems, composed of several parts, have been designed, each working well for a particular situation.
Computer programs have been developed that design systems and demonstrate their efficiency in different types of buildings. One important issue with HVAC, particularly when an existing building is concerned, is to look at each case and design looking at the climate, building use, types of spaces, and especially the building's shell.

Together the shell of the building and the HVAC system maintain the environment inside the building. If they are not considered together, one system could make the other fail. The walls, windows, and roof make up the thermal shell, holding in and letting out certain amounts of warmth. Milton Meckler, an engineer, CEO and president of the Meckler Group, gives steps to follow for energy efficient HVAC/thermal shell design:

1. select initial system from real-life experience according to clients needs
2. use a computer program to optimize the shell
3. next optimize and alter the HVAC system to achieve overall optimization
4. if the HVAC system changes too much, examine the shell more closely for changes that could be made there

Thus, in order to design the most efficient HVAC system or thermal shell, both systems must be studied together and ultimately work together.

**Indoor Air Quality**

Just as the air outside is polluted, our indoor air can become polluted as well. People can suffer from minor respiratory problems to serious illnesses from being in a building with polluted air. The importance of the air quality to people's health was apparent long ago. Hypocrites recognized in his treatise, "On Air, Water and Places," the significant affects of the quality of the air, water, food, overall living conditions, and climatic elements. Benjamin Franklin wrote, "no common air from without is so unwholesome as the air within a closed room that has been often breathed and not changed." Today, with technology allowing practically air tight buildings to be constructed and the increase in the amount of time spent in buildings, the quality of air
maintained inside has proved to be an important question. Problems resulting from indoor air pollution have been designated with terms such as: problem building, building related illness, sick-building syndrome, tight-building syndrome, and crisis building.⁸

One well publicized case resulting in twenty-nine deaths was the American Legion convention in Philadelphia in 1976. The illness came from air borne pathogens growing in and being circulated by the HVAC system in the hotel where the convention was held. Not only did many people who attended the convention become ill, but even some people who passed by the hotel on the street. This form of pneumonia became commonly termed as Legionnaire's Disease.⁹

Until recently, all the problems of indoor air pollution were not fully realized. It has finally come to the forefront, however, in the concerns for creating a healthy indoor environment. The 1995 November/December issue of "Environmental Building News" listed "indoor air pollution" as the top priority in the category of "Major human health problems" for building designers to consider.¹⁰

Products which contain volatile organic compounds (VOC's), or materials which contain toxins which evaporate into the air, for instance formaldehyde, are air polluters. Eliminating such materials and ventilating together can maintain a healthy indoor environment. A general base for ventilation levels is the cubic feet of outside air coming into the building per minute per person occupying the building (cfm/person). Through human response, it has been estimated that the air is comfortable when there are less than 1000 parts per million of carbon dioxide in the air. To achieve this in an office situation as studied here, it has been determined that 20 cfm/person needs to be supplied while the building is being used.¹¹

One source of indoor air pollution can be avoided through managing the sequence materials are put into the building. Absorbent materials such as carpet are considered "sinks." The absorbent material has the potential to soak up any toxins
emitted by wet products installed after them. Thus, installing in the correct order will eliminate sinks.

Another scheduling solution involves an appropriate airing-out of the building. The occupants should not plan on using the building until a sufficient amount of clean air has passed through it to flush out a large percentage of the toxins produced by the installation of some products. This ventilation should be done with the return air vents closed to ensure that no toxins get into the duct system, which could cause problems after the building is occupied. Generally, the return air ducts send the air back to the HVAC system to be filtered, conditioned, and blown through the building again. Even if the filter was able to remove the toxins from the air, this would unnecessarily fill up the filter.

An 1991 issue of "Indoor Air BULLETIN," presented several ideas that could help reduce toxins in a building project. These suggestions serve as a good summary of common ideas for improving indoor air quality. They are:

- **Isolate Construction** - Fully isolate construction zones in partially occupied buildings. Keep these areas under negative pressure relative to the adjacent spaces.

- **Select the Right Building Materials** - Carefully select building materials to avoid using unnecessarily strong emitters or those that contain known irritants and toxins. Require manufacturers to provide data on their products' contents and chemical emissions (if tested) and evidence that they have addressed IAQ concerns.

- **Schedule Activities Appropriately** - Schedule construction/installation to minimize the build-up of high levels of contaminants that can't be removed before occupants enter or return to the space.

- **Plan Adequate Airing-out Periods** - From the beginning, plan adequate time for the installation and move-in process. Airing-out a construction area with 100% outside air and no recirculation before occupancy is essential. A sufficiently long airing-out period (weeks instead of days) can drastically reduce airborne concentrations of most contaminants.

- **Maximize Ventilation** - Maximize ventilation during installation. Seal return-air ducts and use direct exhaust to the outdoors either through openable windows or through temporary openings — possibly with fan-powered assistance.
• **Avoid Creating Sinks** - Whenever possible, avoid installing adsorptive surfaces such as textiles, insulations, and carpets, adhesives, paints, sealants, etc.

• **Ventilate Wet Products** - Never install any "wet" product without maximum outside air ventilation — preferably at least five air changes per hour.

• **Commission the HVAC System** - Commission the HVAC system thoroughly to avoid problems for occupants in buildings with newly constructed ventilation. This is much more than the routine "testing, adjusting, and balancing" that is normally required for new HVAC systems. It means defining the performance criteria for the system and measuring that performance to demonstrate system acceptability.¹²

Creating airtight buildings for energy efficiency is often blamed as a cause of indoor air problems. While a building allowing less uncontrolled infiltration indirectly relates to these types of problems, it is not the cause. The cause is what pollutes the building. The first step to stopping indoor air problems before they begin involves use of nontoxic materials and proper maintenance of not only the traditional surfaces on the interior, but also the systems, particularly the HVAC system.

**Indirect Environmental Impacts**

The last issue studied here encompasses many things which can be looked at together as the indirect impacts on the environment. There are many different ways in which a building project indirectly impacts the environment including things such as:

- waste from the production of products used to construct the building
- pollution and energy used to transport materials
- recycled content or recyclability of the materials
- disposal of demolition debris

When considering materials for the building, not only should those materials which occupants will be exposed to be examined, but all the materials being used. For instance, the insulation or ducts should be examined. The designer needs to ask the manufacturers for information about the manufacturing of their products to best determine the impacts it has on the environment. For instance, when polyvinyl chloride plastic (PVC) burns, toxins are emitted. This then should not be used. Whatever the
advantages are to using PVC, they are greatly outweighed by the potential toxic production as an after use affect. In an article in a 1991 issue of Progressive Architecture, the following list of questions to ask product manufacturers was given:

- Are any components of the product installation method responsible for long term off-gassing?
- What chemicals are used to install your product?
- Can you provide an antimicrobial agent as an integral part of your product?
- What materials do you recommend to maintain the product?
- What chemicals are required to remove repair your project in case of repair or renovation?
- Do you provide written life safety test results?
- Do you provide written toxicity test results?
- Do you have any recommended program recycling your product? 13

A product ideally would produce no toxins through waste or otherwise; it would be produced within the local region, be made from recycled materials and be able to be completely recycled after use, along with performing well for a good price. Realizing this is a tall order considering today's market, this study examined if the designers considered these ideas when selecting materials rather than simply if they fulfilled them.

The basic reasons for asking about products in such a way is to ensure the manufacturing of a product does not pollute the air or water; or, after a product is used, it does not simply become part of a landfill.

- In 1991, a whopping 280 million tons of waste was generated, of which 75 percent ended up in landfills, 10 percent was incinerated, and only 14 percent was recycled. 14
- The construction industry uses 54 percent of the energy we expend as a nation, not just in heating and cooling but in "embodied energy"
- It has been estimated that by the year 2020, all natural area in the U.S., besides the national reservations and parks, will be developed. 15
- Approximately 10-20% of landfills is construction and demolition materials. 16

One key issue brought out by environmentalists is the amount of waste in this country. We waste energy, natural resources, and just about anything else we can find. The main solution for solid waste problems at this point is to put garbage in landfills
and let a future generation deal with the problem. Even these landfills, which no one wants to live near, are becoming full, and there is no place for new ones. New England, having the least vacant land and been populated for the longest time, is feeling the garbage crunch particularly hard. So, something must be done about the materials which are being put into landfills. Recycling debris from construction and demolition is part of a solution to this problem.

Summary

If these three issues were properly addressed in rehabilitation projects, the natural environment would be in a better state. One example of this will be discussed in Chapter 5.
Government Regulations

The regulations on the issues discussed previously generally come from building codes. These codes are established by the government to ensure that buildings are safe for their occupants. Relative regulations include a minimum amount of ventilation which must be supplied, a minimum thermal rating which must be met, and regulations for materials determined to be hazardous to our health. There are also standards established by ASHRAE which are typically more stringent than the local building code. These guidelines are often what is used by engineers to design systems rather than the building codes because practitioners consider the development of ASHRAE guidelines to be ahead of that of the codes. For instance the Wisconsin Administrative Code requires only 5 cubic feet per minute per person of fresh air while the ASHRAE guidelines suggest 20 cubic feet per minute per person of fresh air, four times the amount. Building codes are required by law; therefore, unlike preservation which is somewhat voluntary, all buildings must comply to the locally accepted codes.17

Summary

This chapter began with the overall ideas which made the environmental movement and went on to examine three specific issues which relate directly to rehabilitating buildings. These three issues, energy conservation, indoor air quality, and indirect environmental impacts, will appear again in Chapter 5 as a basis for analyzing the two case studies presented. The next chapter examines the regulating historic preservation and environmental information for overlaps. The same three issues were considered when examining those documents.
Notes

11. ASHRAE-Contaminant and Ventilation Control for Indoor Air Quality and Energy Efficiency
17. Meckler, p. 146.