Green Building Design for Friendly House Worcester, Massachusetts

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Abstract

A green building is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. Friendly House is a social services building located in the city of Worcester, MA. Friendly House needs an upgraded facility to better serve the community, and a "green" building can both serve the environment and allow them access to funding that would otherwise be inaccessible. This study provides Friendly House with appropriate, well-informed decisions about their new building that will allow them to build the most environmentally friendly facility they can given their specific needs and budget.

Table of Contents

Executive Summary

A green building is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. Friendly House is a social services building located in the city of Worcester, MA. Friendly House is an invaluable asset to the community, providing services such as outreach programs, and food, health, and social services to the city. This study was conducted for the purpose of redesigning Friendly House's 31-year-old facility using "green" ideas. Their building has far exceeded its life span and their spatial needs have eclipsed what it can provide them. Friendly House wishes to construct a new building in an environmentally friendly manner for three reasons: to give them access to multiple sources of funding that would not be available otherwise, to illustrate the message of energy conservation to their clientele and neighbors, and to build responsibly and enjoy the benefits of occupying an environmentally sound facility.

To accomplish our goal of providing Friendly House with appropriate, well-informed decisions for their new building, we utilized archival research and case studies to gather data. We interviewed other owners of green buildings and architects who have designed them. We also interviewed the staff of Friendly House to see what aspects of the new building were most important to them. We identified and evaluated those "green" techniques that promised to have the best cost-to-benefit ratio, and to meet other selection criteria related to maintainability, durability, and energy efficiency. The United States Green Building Council has developed an official standard for Green Building Design, called LEED certification, and we used this as a guide to determine what techniques will impact the "greenness" of Friendly House the most. We recommended specific green building design products, technologies, and approaches in each of four general categories: materials and recycling, water efficiency, energy efficiency, and indoor air quality.

The materials and recycling category includes building products that incorporate recycled substances, and general ideas for incorporating "green" materials into Friendly House's new building. Specific recommendations include:

- Durisol: An insulated concrete form that incorporates recycled wood and cement with integrated insulation, and is comparable in price to traditional concrete blocks and insulation.

In the water efficiency category, we list products that will help Friendly House save a large amount of money on their water bills, as well as conserve fresh water. Recommendations include:

- Waterless Urinals: These fixtures use absolutely no water and require little maintenance – the traps must be changed periodically, but this is a small price to pay for the benefit of using no water whatsoever.
- Low-flow fixtures: Low-flow pluming and showerheads can save a great deal of water, with only minimally greater startup costs.
- Vegetation: Choosing indoor and outdoor vegetation carefully, such as using only native plants and minimal lawn can save money by requiring less water to keep

the plants alive. Rain barrels can also be incorporated into the outdoor building design to catch rainwater for use in watering vegetation.

The category of energy efficiency details cutting energy costs through more efficient lighting, renewable power sources, and heating and insulation. Recommendations in this area include:

- Compact Fluorescent Light bulbs: These bulbs consume ¼ the energy of regular light bulbs, and run at far cooler temperatures as well.
- Solar Panels by Power light: We determined that solar panels are probably the method that would best suit Friendly House if a renewable power source is needed for their new building, and Power light is a company that can provide them with good quality solutions.
- Burnham Boilers: Burnham is a company that makes outstandingly energy efficient boiler systems that are Energy Star approved.
- Nu-wool: A spray-on insulation solution that is made up of 100% recycled fibers and covers walls better with fewer air pockets, resulting in far better insulation than traditional solutions.

Finally, the indoor air quality category includes options for heating and cooling using advanced ventilation systems. One of the biggest concerns for the new building was proper air management and cooling, and these recommendations can aid in that area:

- Fantech: Fantech is a company that produces energy star approved advanced ventilation systems for large scale uses such as Friendly House.
- Rheem: Rheem manufactures environmentally friendly central heating and cooling units. Their units are also Energy Star approved.

We also recommend a number of ways that Friendly House can communicate the message of energy awareness to their neighbors, by placing clearly marked recycling bins and informative signage about the various "green" techniques in the building in highly trafficked areas. We have described techniques that will have the greatest potential impact on Friendly House's "greenness," and in using these techniques, Friendly House will be able to become a LEED certified building. This document will allow them to make decisions for their new building that best suit their needs and budget.

1. Introduction

"Green" buildings have recently come into mainstream use as an excellent method of conserving energy and reducing a building's overall impact on the environment. A green building is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner (USGBC, 2003).

The social services organization, Friendly House, located in Worcester, MA, helps families in need with basic services like food, clothing, and shelter. Friendly House's current facility was originally designed for a 20-year lifespan. That was thirty-one years ago. It was repainted and endured numerous renovations, but it is far too small for Friendly House's purposes.

Building "green" is something that Friendly House wants to do to encourage grants from organizations that fund green buildings, and promote the critical need for energy conservation to their neighbors. However, Friendly House needs a compilation of the green building options available to them, and that is a main objective of this project.

2. Background and Literature Review

The main goal of the project was to provide examples of the most effective technologies and methods for the new Friendly House building. The following sub-sections of the background chapter briefly describe the direction of the project, what Friendly House is all about, key aspects of green building designs, and applicable technologies.

2.1 Friendly House

"Friendly House helps people to help themselves, generate self-reliance and increase their quality of life. The strengthening of the finest family standards and the highest American ideals is the underlying educational purpose of Friendly House. Friendly House provides opportunities for individuals to realize his or her potential for a full life through self-direction and growth."

2.1.2 Past

Friendly House opened its doors to serve the public in 1920 with funding and support from the Worcester Civic League (Friendly House, 2002). Friendly House's intent was to promote neighborhood health and welfare for the betterment of Worcester. The main focus was to further the interests of Worcester's immigrants by introducing them to customs and traditions of their new home and helping them to become an integral part of civic life.

In the early 1920's Friendly House was forced to relocate due to spatial needs and shortly after, in 1928, the Junior League assumed control of Friendly House and once again moved to a bigger and better facility in order to meet its needs. The 1930's were a decade of growth and constant challenge for Friendly House. The coming of the 1940's brought World War II, and as a result, settlement houses were faced with severe staffing shortages. At that time Friendly House focused their attention on programs for school-aged children. After the wars years, the primary focus of Friendly House continued to be the school age recreational programs (Friendly House, 2002).

The turbulent 60s presented a radical challenge for Friendly House. The rediscovery of poverty in neighborhoods throughout the country, the Vietnam War, and the Civil Rights movement made this decade particularly challenging to settlement houses. In 1966, Friendly House received its first major federal grant from the Office of Economic Opportunity. This was the turning point in the kind of services Friendly House provided. The once small, single purpose agency was being transformed into a multi-service community center. Then in 1972 ground was broken for their new and current building (Friendly House, 2002).

2.1.3 Present

Today, Friendly House survives solely on donations and funding from members of the community. They are staffed with many qualified social service agents and volunteers, who are a key to their success. Their philosophy remains the same as in the past, but with newly added programs such as childcare, housing services, and emergency services.

2.1.4 Future Outlook

With the increasing poverty in the Worcester area and the necessity for social services on the rise, Friendly House has come to a crossroad. The Friendly House is at a point where their current facility has seen its last days of use. Thus, the necessity for a larger and more user-friendly facility is in great need, but the funding is scarce. With the constant competition for funding among the many non-profit organizations in Worcester, the Friendly House needed a new edge for their funding. As a result, Friendly House intends to utilize green building design to construct a building on the same location that is environmentally friendly and energy efficient.

2.2 Green Building Design; Technologies and Approaches

Sustainable design or building "green" is a way to use natural resources efficiently while creating healthier buildings (USGBC, 2003). It provides cost savings to all through improved human health and productivity, lower cost building operations, and resource efficiency. It also moves us closer to a sustainable future.

2.2.1 Reduction of Environmental Impact

The impact of buildings on the environment is staggering. Every year building construction (CEPA, 2000):

- consumes 25% of global wood harvest,
- consumes 40% of the materials entering the global economy,
- consumes 3 billion tons of raw materials, for foundations, walls, pipes, and panels,
- consumes 50% of the copper used in the USA, and
- generates 50% of the global output of greenhouse gases and the agents of acid rain.

2.2.2 Energy Efficiency

Energy efficiency is one way to help lessen negative impacts on a society. By using less energy or implementing a new, more cost effective, and environmentally friendly technique, new buildings are more likely to be welcomed into neighborhoods.

2.2.2.1 Passive Solar Design

A passive solar building provides cooling and heating to keep the building comfortable without the use of mechanical equipment. This style of construction results in buildings that respond to the environment. For passive heating and cooling, the plan of the building, careful site selection, construction materials, building features and other aspects are designed to collect, store, and distribute the sun's heat in winter and to block the sun's rays in summer.

2.2.2.2 Geothermal Systems

Geothermal systems, also known as geoexchange systems, use the energy stored within the earth to heat and cool buildings, as well as provide hot water. The earth absorbs about 47% of the sun's energy, which is more than 500 times more energy than man needs every year. These systems are designed to take advantage of the buildup of energy and use this energy to heat buildings in the colder months and return it during the warmer times (Geothermal Heat Pump Consortium, Inc., 2002).

2.2.2.3 Power Sources

Solar energy, also known as sunlight, can be used for many purposes including generating electricity and providing hot water. Other purposes for sunlight include heating, cooling, and providing light for buildings (US Department of Energy, 2003). Solar cells are typically combined into modules that hold about 40 cells. These modules are then typically arranged in a group of about 10, into what is called a PV (Photovoltaic) array. PV arrays can be used to produce electricity for a single building (US Department of Energy, 2003). These arrays are usually placed facing south.

2.2.3 Green Building Materials

Materials used in buildings are one of the main causes of negative environmental impacts of buildings. The removal of raw materials damages ecosystems and degrades water quality. These raw materials, through the manufacturing process, are transformed into finished materials, and the manufacturing process generates waste and pollution. After these finished materials are installed in the building, they require maintenance. Thus, the cleaning of them can produce toxic waste and health hazards. The materials themselves can release toxic gases as well. Because of the need to replace them, the process of gathering raw materials, manufacturing them into a product, and then providing maintenance begins all over again. "Green materials" are now being produced keeping these harmful results in mind and, in turn, trying to minimize their effects as well as providing longer lasting products (California Integrated Waste Management Board, 2003).

2.2.3.1 Materials Containing Recycled Content

Many materials that are produced are made partially or fully out of recycled content. Materials that are made of post-consumer waste or recovered materials are available. These materials allow the greatest benefit on the environment due to the fact that landfills are not being filled and a greater amount of raw materials is not being used unnecessarily.

2.2.3.2 Barriers Involved With Recycled Materials

The use of recycled materials has not, as of yet, become a widespread practice. Therefore, availability, options, and knowledge about such products are not readily available or well understood.

2.2.3.3 Reuse and Recycling of Materials

One of the most effective ways of limiting new material use is through the salvage of parts that remain in an already existing structure. This accomplishes two tasks. First, it cuts down on the waste and disposal of materials from the old building. This cuts down on the overall cost of the project. Secondly, harmful effects can result from the manufacturing of a product.

2.2.4 Recycling

Integrated waste management encompasses prevention of waste whenever possible, reuse or recycling whenever practical, disposal only of what is left, and buying products made out of materials people recycle (CEPA, 2000). Materials reuse and recycling boasts these benefits (CEPA, 2000):

- Prevents pollution and waste generation
- Saves money through prevention
- Creates new recycling industries
- Reduces landfill disposal and expansion, and where it is used for disposal, waste incineration and its associated air pollution.

2.2.5 Water Efficiency

There are three main approaches to water efficiency in a green building: water efficient landscaping, wastewater and storm water management, and overall water use reduction (USGBC LEED rating document, 2002, 16). Water efficient landscaping can be achieved by using high-efficiency irrigation techniques to water the surrounding plants, or by using rainwater or recycled water from on-site, to reduce the overall potable water consumption. Using native plants that require little water and minimizing lawn space will contribute as well (EPA Laboratory Brochure, 2001).

2.2.6 Indoor Air Quality

Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems in buildings. Inadequate ventilation can increase indoor pollutant levels by not bringing in enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutants out of the building. High temperature and humidity levels can also increase concentrations of some pollutants (EPA Website, 2003).

2.3 Integrating Green Building Design into Friendly House

2.3.1 Costs of Green Buildings

Technologies and materials used for green buildings can be costly. Some green buildings cost more up-front but save money through lower operating costs over the life of the building. The

green building approach applies a project life cycle cost analysis for determining the appropriate up-front cost. Some benefits, such as improving occupant health, comfort, productivity, and reducing pollution and landfill waste are not easily measured. Careful planning and well thought-out additions can aid in developing a reasonable budget.

2.3.2 Standards for Green Buildings

It is useful to examine what the accepted "standards" are for green building design. There exist many official standards developed by cities, states, and organizations in the field of green building design that concisely define what experts in the field believe makes up a truly "green" building.

Perhaps the most widely known and respected standard is the Leadership in Energy & Environmental Design (LEED) Green Building Rating System. This rating system represents the U.S. Green Building Council's national standard for what constitutes a "green building." The rating system aims to improve occupant well being, environmental performance, and economic returns of buildings using established and innovative practices, standards, and technologies. To receive LEED certification, an applicant must fill out an extensive form and submit multiple documents about the project. Projects then receive points from each section that add up to a final total. Depending on the total, one of four levels of certification is awarded. Sections include:

- Sustainable sites (i.e., erosion and sediment control, choice of building site, storm water management, heat and light pollution)
- Water efficiency (i.e., water efficient landscaping, wastewater innovations, water use reduction)
- Energy and atmosphere (i.e., energy performance, renewable energy sources, CFC reduction, green power)
- Materials and resources (i.e., recycling, building and resource reuse, construction waste management, use of local materials)
- Indoor environmental quality (i.e., tobacco smoke, CO_2 control, ventilation, emission and pollutant control, use of daylight, aesthetic appeal of layout)
- Innovation & design process.

2.3.3 How Green Building Design Relates to Friendly House

It is clear that Friendly House needs a new facility. They have far outgrown their needs and their current building is falling down around them. Green building design is an excellent choice for them. Their new building will not only benefit the environment, but it gives them a great opportunity to raise much needed funds for construction, and it also communicates to their employees, clientele, and neighbors the desperate need for energy conservation.

3. Research Methods

3.1 Introduction

The main goal of this project is to suggest to Friendly House methods and technologies that will be the most appropriate methods and techniques of green building design. "Appropriate" methods and techniques for Friendly House are ones that can be easily maintained, are energy efficient, durable, and cost effective. Using these four characteristics as our main qualifiers, we

have been able to judge what green building techniques should and may not work for Friendly House.

3.2 Case Studies

Case studies allow researchers the opportunity to see how theoretical concepts are applied to real life situations. These concepts can then be analyzed and compared to find the most useful applications for our project (WPI IQP Handbook, 2001, ch. 9). In green building design, different materials and practices may appear very beneficial, but they may not be economical or feasible due to such factors as location or availability. Location was the primary basis for choosing the case studies we did. By looking at these different case studies, many questions have been answered.

3.3 Interviews

In order to determine the proper interviewees we first had to take a look at the goals of this project and the major objectives that were to be researched. The goals of Friendly House and green building design have been mentioned in chapters prior to this. The primary concerns were environmentally friendly materials, energy efficiency, indoor air quality, water efficiency, lighting, and of course costs. One particular purpose of our interviews was to obtain specific information that could be analyzed for the general population, not simply applicable to a single respondent. By doing so we gained an understanding of the general consensus of the Friendly House staff and their clientele, and not just what one particular individual wants or needs in the new building.

3.4 Archival Research

Perhaps the most important method we utilized was archival research. A great deal of information is available about green building design from Internet sources, electronic journals, research publications, and books. Since we did not develop our own specific green techniques, but merely suggested existing options to Friendly House, we needed to analyze the previous research of others to compile the list of possibilities.

3.5 Cost Benefit Analysis

Building an environmentally friendly and energy-efficient building will help Friendly House to interest environmentally cautious people and organizations, such as the Massachusetts Technology Collaborative, in donating money. Budget is always a concern when designing a new building and therefore building “green” is something the Friendly House is using not only to reap all the environmental and energy-saving benefits but also to gain an angle in fund-raising. The environmentally friendly and energy efficient methods and techniques we have suggested to Friendly House will not only raise money for the construction of the building but also save money through lower operating costs when the new green building is in utilized. Friendly House has made it clear that money has been and continues to be the biggest problem they face in their endeavor to build a new facility.

4.0 Results

4.1 Basis for Analysis and Evaluation

A green building cannot be built using only one technology or material. A green building needs a combination of different methods and ideas to really work in an energy efficient and environmentally friendly manner. The following chapter details different green materials, technologies, methods and personal practices that together will provide Friendly House with a green building that meets the standards for LEED certification. Implementing only a few of the following technologies would still result in a more energy efficient and environmentally friendly building than would be attainable with traditional materials and technologies. However, to meet Friendly House's goal of building the greenest building possible for them, each of the materials and technologies in this chapter should be considered.

The standard rating system, or rubric, we established for each of the four qualifiers is as follows (see Table 1):

TABLE 1.

MAINTAINABILTY
1=POOR A score of 1 indicates that this material or technology, while it may be environmentally friendly in some manner, has extremely high upkeep costs or a low overall lifetime. Because Friendly House is seeking materials that will last a long time and provide them with an easily maintainable building, these materials will not be recommended.
2=ACCEPTABLE A score of 2 indicates that this material or technology could be used, but the drawbacks outweigh the benefits. These technologies are similar to traditional technologies and could be maintained, but require time and effort for Friendly House.
3=AVERAGE A score of 3 indicates that this material or technology has equal maintainability as traditional materials and technologies. Friendly House would have to spend no extra time maintaining these materials and technologies than traditional ones.
4=GOOD A score of 4 indicates that this material or technology's maintenance benefits outweigh its drawbacks. This material or technology can be maintained more easily than traditional materials and will be recommended to Friendly House.
5=EXCELLENT A score of 5 indicates that this material or technology is exceptional in the category of maintainability. It has a longer than normal lifespan, is easily maintained, and its startup costs are not prohibitive. As far as maintainability is concerned, these products definitely fit Friendly House's needs.

ENERGY EFFICIENCY

1=POOR

A score of 1 in the energy efficiency category indicates that a material or technology uses more energy than traditional material or technology. Because energy efficiency is a large part of what Friendly House is looking for in a new building, materials and technologies that receive a 1 in this category will not be considered.

2=ACCEPTABLE

A score of 2 for energy efficiency indicates that the material or technology conserves the same amount of energy as traditional materials. Although these may be relatively feasible, Friendly House is looking to reduce costs and conserve energy, so a score of 2 would not be advisable.

3=AVERAGE

A score of 3 indicates that the material or technology is more energy efficient than similar, traditional materials and technologies. Although there are benefits to using these materials, drawbacks exist as well. These materials would be recommended over traditional technologies, but only if their other scores are favorable as well.

4=GOOD

A score of 4 in the category of energy efficiency means that the material or technology is more energy efficient than traditional techniques, and has few drawbacks. These materials are very likely to be recommended to Friendly House, because of the importance they place on energy efficiency.

5=EXCELLENT

A score of 5 in the energy efficiency category indicates a material or technology that conserves a significant amount of energy compared to traditional materials or technologies. Products and technologies with a rating of 5 in this category will most likely be recommended to Friendly House.

COST EFFECTIVENESS

1=POOR

A score of 1 in the cost effectiveness category indicates a material or technology that is not cost effective at all and in some cases could be relatively expensive. Since Friendly House is a non-profit organization cost is a major aspect of this project and a score of 1 would not be feasible.

2=ACCEPTABLE

A score of 2 indicates that a material or technology has relatively expensive startup costs compared to traditional materials or technologies, or takes an extremely long time to pay itself off. Items with scores of 2 would not be recommended for the Friendly House because of the emphasis placed on cost in this project.

3=AVERAGE

A material or technology that receives a score of 3 in cost effectiveness is more cost effective than traditional, non-green techniques. It may have drawbacks in other areas, but it pays its initial costs off within a reasonable time span. These materials would probably be recommended as long as their other scores reflect quality as well.

4=GOOD

A material or technology that receives a score of 4 in this category shows financial benefits over time through energy efficiency and has a relatively small start-up cost. The materials or technologies in the "good" category have similar start-up costs to traditional ones. These materials and technologies will most likely be recommended to Friendly House providing they have high scores in the other qualifying categories.

5=EXCELLENT

A material or technology that receives a score of 5 in this category is either cheaper than regular materials and is environmentally friendly or it is extremely "green" and has a pay off over time.

DURABILITY

1=POOR

A score of 1 in the durability category indicates a material or technology that is fragile and can be worn with relatively little use. These materials and technologies would need to be replaced every year. A material or technology of this nature would be not advisable for the Friendly House due to the heavy use of their facility.

2=ACCEPTABLE

A score of 2 in the category of durability indicates that a material or technology is no more durable than regular, non-green techniques and lasts approximately 10 years. These materials would only be recommended for Friendly House if their other merits were numerous, because durability is very important for such a heavily trafficked facility.

3=AVERAGE

A score of 3 in the durability category indicates a material or technology that is "green" and durable. An "average" product would not need to be replaced for a significant amount of time (15 years) and would most likely have an average score in the maintainability category.

4=GOOD

A score of 4 in the category of durability indicates a material or technology would not need to be replaced for 25 years. These materials and technologies would be appropriate for Friendly House due to the heavy use of the building.

5=EXCELLENT

A score of 5 in the category of durability indicates that the given material or technology has a life span 30 years or more and can withstand heavy traffic and continual usage. Materials and technologies listed as excellent would be perfect for Friendly House, since their building receives thousands of people in and out each day.

4.2 Assessment of Green Building Technologies

4.2.1 Materials and Recycling

Materials and recycling are both important aspects of green building design. The following templates illustrate some of the various approaches and techniques that are available and effective for Friendly House.

4.2.1.1 Use of Locally Produced Building Materials

Buying materials and utilizing the services of local construction companies is recommended because the closer the materials originate from, the less smog-forming pollutants are allowed to enter the air from transportation vehicles. Materials from local companies will probably be more cost effective as well overall, because shipping costs will be lower.

4.2.2 Energy Efficiency

Energy efficiency is the largest section in our assessment of green building technologies for Friendly House. This is because the most outstanding characteristic of the ideas, methods, and technologies we researched was that they were energy efficient.

4.2.2.1 Passive Solar Design

One way that virtually any building project can save on energy costs is to employ passive solar design.

4.2.2.2 Passive-Solar-Friendly Building Materials

Any internal material that is able to absorb light energy and convert it to heat is considered passive-solar-friendly.

Good insulation is extremely important for effective passive solar design. Without proper building insulation, heat gained by solar radiation can be lost extremely quickly.

4.2.2.3 Southern Building Orientation

An essential part of passive solar design is that the building faces the south. A building receives the most sun if it faces the southern sky. Most of a building's windows should be on the south side to take advantage of the sun's rays. Windows should be designed with overhangs or awnings such that they allow less light to come in during the summer, therefore keeping out unwanted heat and lowering cooling costs; during the winter, windows will then allow more light to penetrate when the sun is lower in the sky, allowing more heat to enter, and saving overall heating costs.

4.2.2.4 Windows and Skylights/Light Tunnels

Passive solar design can be much more effective with the right type of windows. All windows should be coated with a special glazing material made of transparent or translucent glass. Windows should be double layered and operable. Double-layered windows insulate far better than single pane windows. Skylights and or light tunnels are an excellent way of lighting rooms

during the day. Natural sunlight is vastly preferable to any other type of light, and it is of course provided free of charge by the sun.

4.2.2.5 Electrical Lighting

The use of compact fluorescent light bulbs, or CFLs, can greatly benefit any building. They use one quarter the amount of energy that regular light bulbs use and run at only 100F compared to 300-500F for regular light bulbs, reducing unwanted heat generation. Dimmers, timers, and sensors should also be used.

4.2.2.6 Kitchen and Cooking Ideas

The kitchen is an area in a building that usually uses a great deal of energy. Stoves, microwaves, and ovens can consume a great deal of electricity if energy efficient models are not chosen. Because the south side of the building will get the most sunlight, therefore becoming warmer than the north side, the kitchen should be located in the north side of the building. This will generate heat in the winter and keep the southern side cooler in the summer.

By utilizing the following procedures, Friendly House can further increase energy efficiency in the kitchen:

- Self cleaning ovens have higher insulation levels which result in lower energy use
- Gas ovens with new electronic pilot less ignitions reduce gas usage by 30% as compared with a constantly burning pilot light
- Preheat oven only when necessary
- Do not lay foils on the rack
- Use glass or ceramic pans in the oven
- Keep range-top burners and reflectors clean
- Match the size of the pan to the heating element
- Use smaller kitchen appliances instead of oven/range when appropriate
- When boiling water in a pan, always use a cover

4.2.3 Water Efficiency

Although water is the world's most abundant resource it is still important to protect it. Being smart about water use takes little effort and offers energy and water saving benefits.

4.2.3.1 Water Conservation

An extremely important issue in green building design and LEED certification is the water efficiency of a building. Many points are available towards certification for buildings that manage their water effectively. The following list of water-conscious ideas can help Friendly House score these points.

- Install ultra-low flow toilets that require only 1.6 gallons per flush and waterless urinals
- Consider a pressurized model for optimal performance when installing low-flow toilets
- Check toilets periodically and repair them promptly
- Reduce tank capacity by placing a one gallon plastic jug of water or gravel, or two one-quart bottles in the tank
- Install a "dam" that partitions off a section of the tank so that it can't fill with water
- Do not use the toilet as a trash can

Friendly House plans to make showers available to their employees and clientele. When choosing new showerheads, take these suggestions into consideration to save money.

- Choose showerheads that comply with the new 2.5 gallon flow rate
- Since public water from an older municipal system is available for Friendly House, select a brand specifically designed to maximize satisfaction with low-pressure water output
- Signs can be posted to encourage people to take quick showers, this can save an average of 20 gallons of water per day
- Do not drain the hot water heater completely with each shower, or energy savings gained through the new efficient showerhead are wasted
- Replace showerheads that fill a one-gallon bucket with water in 20 seconds or less
- Install aerators on kitchen and bathroom faucets
- Repair leaky faucets and showerheads promptly

4.2.3.2 Indoor/Outdoor Vegetation

An element of green building design that should not be overlooked is the vegetation used in and around the building. Being selective with the plants used can increase the LEED ranking of the building by making the indoor air quality better and conserving water.

4.2.4 Indoor Air Quality

Indoor air quality is an important issue these days, especially with increases in energy efficient methods and technologies. Energy efficiency improvements sometimes make houses relatively airtight, reducing ventilation and raising indoor pollutant levels.

4.2.4.1 General Heating and Cooling

Heating and cooling are an important part of designing a building. The climate in Worcester varies quite a bit throughout the seasons, from extremely hot to bitter cold. To manage these climate changes without excessive costs, the actual heating and cooling systems must work efficiently.

4.3 Recommendations for Energy Conservation Awareness

Placing recycling bins in easily accessible places in and around Friendly House will encourage its occupants to recycle. Items such as cardboard, paper and newspaper, plastic bottles, glass, and tin and aluminum cans can be recycled. Interesting statistics about how different materials can be broken down and reused will encourage occupants to turn their trash into recyclable material. Some possible statistics for the signs include:

- Twenty years ago it took 19 aluminum cans to make one pound, but today, aluminum beverage cans are lighter and it takes 29 cans to make a pound.
- Americans throw away enough aluminum every three months to rebuild our entire commercial air fleet.
- Every minute of every day, an average of 123,097 aluminum cans are recycled. Today, the national average of aluminum can recycling is two out of every three cans.
- Tossing away an aluminum can wastes as much energy as pouring out half of that can's volume of gasoline.

- Making new aluminum cans from used cans takes 95 percent less energy and 20 recycled cans can be made with the energy needed to produce one can using virgin ore.
- Recycling one aluminum can saves enough energy to keep a 100-watt bulb burning for almost four hours or run your television for three hours.
- While recycling has grown in general, recycling of specific materials has grown even more drastically: 42 percent of all paper, 40 percent of all plastic soft drink bottles, 55 percent of all aluminum beer and soft drink cans, 57 percent of all steel packaging, and 52 percent of all major appliances are now recycled.
- 1% of America's current waste stream is equal to about 2 million tons of trash each year.
- There are 3,091 landfills in America. 75% of these landfills have less than ten years left before they are filled to capacity.
- The average office worker generates about a pound of recyclable paper each day.
- Recycling one aluminum can saves enough energy to run a television for three hours.

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