Park Forest Green Village
A demonstration sustainable community
Jon Wetmore

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A Bachelor of Architecture Thesis Design Study

May 1998

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College of Architecture and Planning
Ball State University

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Park Forest Green Village
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Bachelor of Architecture Degree Spring 1998 Thesis Design Study

Thesis Design Committee

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"What is the use of a house if you haven’t got a tolerable planet to put it on?"

-Henry David Thoreau
This book is dedicated to my parents, French and Mary Lu Wetmore, who have selflessly invested time, money, and love in my education. Now that I have reached this milestone, I take the time to look back at all of the support you have shown me throughout the years. I give you my thanks and my love.
There have been many people throughout this past year who have assisted the development of this thesis exploration. I would like to take the time to acknowledge each of them for their contributions. Here are their names in alphabetical order:

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Park Forest Green Village
A Demonstration Sustainable Community
“You cannot escape the responsibility of tomorrow by evading it today.”

- Abraham Lincoln

Who takes responsibility?

Living in the world today one cannot help but notice the broad impact that human population growth and industrial activity have on the environment. From creating a "hole" in the ozone layer to causing the extinction of plant and animal species, humanity is changing the environment of the Earth. With the realization of the critical state of the world we are left with the question of responsibility. What facet of society has had the greatest impact on the state of the environment?

The built environment is one clear example of the impact of human activity on the earth and its resources. Approximately 40% of the U.S. annual resource expenditure is consumed by the construction industry. This represents the nations largest manufacturing activity. Buildings account for one-sixth of the world’s freshwater withdrawals, one-quarter of its wood harvest, and two-fifths of its material and energy flows. Beyond such resources structures also effect watersheds, air quality, and transportation patterns of communities.

It becomes clear that the responsibility lies with the construction industry and ultimately in the hands of the architect. One may say that architects are on the front line of this battle. Not only are they responsible for such environmental degradation, but they have the greatest potential to make a positive impact on the world.

The focus of this thesis is to study how an architect can best minimize man’s impact on the environment while providing the services expected of the designer. To accomplish this architects must understand the concept of sustainability.

Sustainability was first defined in 1987 by the United nations’ World Commission on Environment and Development in a report known as "Our Common Future": “Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs.”

In order to take on the responsibility required by the very nature of the profession, architects must have an understanding of these principles. The concept of sustainability must be the foundation of every decision made by an architect. This way of thinking will bring us closer to a more environmentally responsible means of living.
How?

A hurdle for sustainability:

The concept of sustainability will find difficulty becoming mainstream unless it is proven that it can be applied without disrupting the intent of the given project. That is to say that we can live in a "green" world without altering our lifestyle, giving up the comforts we have come to expect, or increasing the complications or cost of the project.

Therefore, this thesis will apply these theories to a project which was never intended to be green. This will be a study of how to bestow a sustainable way of living onto a project without disrupting its original intention or imposing a drastically altered way of life.
“By changing the house, we inevitably change society.”
-Sean Wellesley-Miller, Toward a Symbiotic Architecture

With these principles in mind the question of what type of project to apply them soon arose. So far I had established that the project will ingrain a sense of environmental responsibility into a project which had never intended to ingrain a sense of environmental responsibility. The question which remained was: what type of project could reach a large amount of people and effect their daily lives?

This investigation led to housing design. Residential architecture offers the architect an opportunity to effect the users on many levels. This is due to the influence it has on so many aspects of daily life. A sustainable home may lead to a sustainable way of living.

The area of housing design, however, is limited. The influence of a home can rarely reach past its own visual range. Sustainability must reach out and effect the interaction between groups of homes, and between groups of people. This is where the answer to a sustainable way of life lies. Therefore this thesis will focus on the design of an entire sustainable community.

Alongside the broad focus of this project came a broad area of study. I found that in order to accomplish that which I had set out to do it was necessary to branch into many other areas. These areas included urban planning, and landscape architecture.

Because this community would confront so many environmental issues, it is uncertain whether it would accomplish fully each and every goal. Hence its objective would be to serve as a demonstration community which explores alternative development methods with the intention of influencing other developments.

In the end what I hoped to accomplish was a design for a demonstration sustainable community. This community will be referred to as the Park Forest Green Village.
Site

Criteria for Site Selection

“Leave the site in better condition than when you found it”

-A boy scout camping principle

One of the more destructive impacts that mankind has on the environment is the use of land itself. It may be worth reminding that land is a precious resource and can be used responsibly or irresponsibly. All too often we see the impacts of lost natural habitat because developments are unable to use this resource responsibly.

There are even examples of developments constructed on a virgin site which claim to be sustainable. How does a development hope to benefit the environment when by its very presence it is helping to destroy it?

That is why a guiding principle of this project was to reuse land which had already been developed. In a sense it is recycling a precious resource rather than using virgin material. The project thus also has the potential to take an area of damaged land to an improved level of natural quality.

The criteria for the selection of this site were as follows:

1. An area of previously used land.
2. An area who’s natural features and ecosystems could be improved by the construction of this project.
3. A site on which a residential area would be appropriate and viable.
4. A site which would accept a somewhat dense housing development.
5. A site on which a residential development could become a reality.

The site chosen was an area in downtown Park Forest slated to be developed as residential. It is currently a large parking lot and a development will certainly improve its natural features.
The Village of Park Forest was built immediately after World War II for veterans and upwardly-mobile young families. Designed by Chicago developer Phillip Klutznick, it became famous as one of the first totally planned communities. Its location of approximately 30 miles south of downtown Chicago and its access to commuter rail lines made it an ideal commuting community. Since its founding it has been twice named an All-America City and was a winner of the National Planning Landmark designation in 1992.

Park Forest is home to 2,000 acres of parks, recreation facilities and open land, a full equity theatre, a professional symphony orchestra, a fine arts gallery and a community operated cultural center.
Residential:

There are two types of residential. The first type is composed of simple single family houses on individual lots. The original Park Forest plan included a handful of house designs which are repeated in a "cookie cutter" method. The manner by which homes stand out from each other include: color choice, additions, landscaping, and garage design (since the original plan did not include garages).

The second type are what are known as Co-ops, or denser townhouses. The Co-ops are arranged in clusters which surround a central parking lot on one side and open up to a public yard on the other side. These homes offer fewer options for individual expression.
In the center of Park Forest lies the central business district. Included in the original 1950’s master plan was a regional shopping center. This shopping center was contrived in the form of an open air pedestrian mall known as the Park Forest Plaza. The Plaza was the first planned regional shopping mall in the Midwest and became a model of suburban retailing. It was not long before the success of this shopping area was impaired by the development of a larger mall located in a neighboring community. In the 1980’s due to its failure to compete with such opposition, the Plaza was given a face lift and redeveloped into the Park Forest Centre.

The success of the Center, however, was limited and did not result in a stable retail area. In 1995 the Village of Park Forest purchased the shopping center and embarked on a master plan to create “Downtown Park Forest.”

The concept of the new Downtown Park Forest was to no longer compete with regional shopping centers, but to create a traditional downtown which would serve the needs of the Park Forest community. This plan includes the construction of two streets through the pedestrian mall opening up the retail area to an interconnected street system while creating a new main street. Another development is the introduction of two residential areas in the downtown.
The site chosen was an area in the north west corner of the downtown area right off of the New Main Street. This is one of two areas designated for future residential. The site is approximately 8.84 acres and currently consists mainly of parking lots. The site is bordered by the downtown to the East and South, by residential to the North, and by retail to the West. The residential on the north side includes co-ops and a new townhouse development.

The current parking lots around the site which serve the shopping area are vastly oversized. More area is devoted to parking than should ever be needed. The commercial area is essentially surrounded by a sea of asphalt. The current situation is extremely uninviting to pedestrians, and isolates the commercial area from the residential.

The creation of this development will assist in eliminating some of the parking area and creating a more human-friendly environment.
Perhaps the greatest advantage of the site is its location. As mentioned earlier Park Forest has been known as a commuting community. This is due to its proximity to Chicago and its access to transportation.

The site itself is located in the center of town therefore a wealth of opportunities are located within walking distance. Almost all of the necessities for daily life are within a 4 minute walking range.

Park Forest Transportation:
- Served by 2 freight rail lines
- 3 Metra commuter rail stations with continuous service to and from Chicago's Loop
- A nearby Amtrak station
- Several local bus routes
- Easy access to 3 interstate highways
- Old Plank Road bike trail

The proximity of nearby shopping, recreation, etc... in walking minutes
As mentioned earlier the goal of this project was to create a design for a demonstration sustainable community. The field of sustainability, however, represents a broad spectrum of issues. The specific problems which this thesis would face had to be determined. This was decided by identifying the most severe impacts that building construction burdens the environment with and identifying which of these impacts the project had the ability to assist in solving.

The following 5 goals for the project were chosen:

1. Create Community
2. Save Energy
3. Enhance Site/ Restore Ecosystems
4. Select low-impact materials
5. Save Water

The development of a sustainable world must begin with the interactions of people. More than just a collection of homes, a community is concerned with the way in which people and spaces relate with one another. All too often homes are designed which actually hinder the sense of community.

A sustainable community must be designed to reduce our dependence on the automobile, and foster interaction between residences.

Methods:
- Encourage pedestrian travel
- Provide access to public transit
- Create a high density development
- Dominance of public over private space
- Encourage interaction

Energy use in a building is probably its single greatest environmental impact. Approximately 50% of the energy use in buildings is devoted to heating, cooling, ventilation, and lighting. A typical building’s energy bill constitutes approximately 25% of the building’s total operating costs. Estimates indicate that climate-sensitive design using available technologies could cut heating and cooling energy consumption by 60% and lighting energy requirements by at least 50% in U.S. buildings.

Returns on investment for energy-efficient measures can be higher than rates of return on conventional and even high-yielding investments.

Methods:
- Passive solar heating
- Daylighting
- Minimize the use of the automobile
Design Proposal

Enhance Site/
Restore Ecosystems

If a development is intent upon helping the environment, it can begin with the very land on which it rests. Construction in any form should result in an enhanced site.

Methods:
- Reintroduce native species
- Xeriscaping
- On-site waste water treatment
- Use of Porous paving materials

Select low Impact Materials

Every product has an embodied energy. This can be described as the amount of energy and raw materials which were used in the production of that product. A building must utilize materials which have a low impact on the environment.

Methods:
- Select materials that have recycled content
- Consider disposal as resource

Save Water

In many regions water has become a precious resource in danger of becoming scarce. Though water resources have not yet reached that extreme in this region, it is important to treat every resource as if it were limited. If resources are always treated in this manner, a situation resembling that mentioned above should never happen.

Water conservation and efficiency programs have begun to lead to substantial decreases in the use of water within buildings. Water-efficient appliances and fixtures, and changes in irrigation methods can reduce consumption by up to 30% or more. Investment in such measures can yield payback in 1 to 3 years.

Methods:
- Efficient fixtures
- collect rainwater for landscape irrigation
- Xeriscaping
- Solar-aquatic wastewater treatment
In support of higher density

One aspect that sets this development apart from neighboring residential areas is its density. As mentioned earlier land is a precious resource. Consequently, any development which can accomplish with a small amount of land what another development can accomplish with a larger amount of land is being resource efficient. Put simply, the more we can consolidate human habitat the more natural land that is preserved.

Aside from these obvious advantages, there are many other rewards to a higher density community. It is generally more affordable to consolidate in a smaller area. Shorter distance to travel means shorter roads and utility lines. Shorter utility lines consume less energy than longer ones. It also allows transportation to become more sustainable by reducing the use of the automobile. Doubling a city’s residential density reduces its annual per capita auto mileage by 25-30%. At this scale transportation can be oriented to pedestrian travel. Closer living may also lead to a more social way of life.

Somewhere along the line a belief was fostered that more land equals better living. This is not necessarily true. A house amid a vast area of land is the equivalent to a house surrounded by stacks of money. Money like land is useless unless invested properly. A properly designed dense housing area can be more rewarding than a simple display of wealth.

In support of mixed occupancy

A myth has been fabricated by our society’s current love for the suburbs and nourished by developers who embrace it. The myth recount the tale that that everyone needs a single family detached house. This is a fallacy in our society today. Households are increasingly composed of single persons, single parents, working couples, retired couples, or friends.

One of the many advantages to mixed occupancy is the issue of security. In a traditional monoculture suburban area the majority of the population works at the same time leaving ample opportunity for theft. On the other hand, if the occupancy includes working residents and retired citizens the situation has changed. Retired people are most active during the day and can watch over the area, while working people are most active later when the retired people are asleep.

The design of this community accommodates these realities by offering various housing types.

81 homes

45 (55%) clustered 3 bedroom
12 (15%) individual 3 bedroom
12 (15%) 2 bedroom 2nd floor
12 (15%) 2 bedroom accessible
Co-Housing (demonstration)

There are two types of 3 bedroom townhouses (clustered and individual) the details of these will be discussed later. There are also 2 bedroom apartments for those households which do not fit the suburban myth. The first floor apartments are entirely accessible for the elderly or handicapped. Situated above the accessible apartments are another layer of 2 bedroom apartments.

A co-housing demonstration project is included in the plan. Co-housing is a semi-communal way of life which is growing in popularity. It provides for compact individual apartments as well as shared space. The shared spaces are comprised of social areas, workrooms, laundries, guest rooms, and child care and play areas. The unique feature is a common kitchen and dining room, where dinners are prepared and eaten communally several days a week.

The general advantage of co-housing is that shared resources and expensed will save money, time, and natural resources. There may not be a huge market for this type of living in the area, but a model of co-housing is included as a demonstration.
Density comparison of six units

Traditional Single Family

Co-ops

Clustered Homes

Green Village Homes

Park Forest Green Village
A Demonstration Sustainable Community
"Americans have been living car-centered lives for so long now that the collective memory of what used to make a landscape or a townscape, or even a suburb, humanly rewarding has nearly been erased."

-Jane Jacobs

Most of today’s sustainable planners believe that reducing automobile dependence to be the most important urban design consideration. A prime objective of this community design involves encouraging pedestrian and alternative forms of transportation.

A transportation strategy was devised to determine how one can gain access to everyday needs. As discussed in the Transportation Analysis section, a tremendous advantage to this site is its close proximity to so many of the necessities for daily life, most of which are within a 4 minute walking range. This proximity coupled with other forms of transportation enables a way of life almost completely free from the automobile.

<table>
<thead>
<tr>
<th>Use</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commuting downtown</td>
<td>carpool/ bike/ bus to train station</td>
</tr>
<tr>
<td>Grocery</td>
<td>walk/ bike</td>
</tr>
<tr>
<td>Park/ Pool</td>
<td>walk/ bike</td>
</tr>
<tr>
<td>Cinema</td>
<td>walk/ bike</td>
</tr>
<tr>
<td>Bank/ Post Office</td>
<td>walk/ bike</td>
</tr>
<tr>
<td>Mall/ Wal-mart</td>
<td>car</td>
</tr>
</tbody>
</table>

To Encourage pedestrian travel from the site to each of these areas, a traffic study was assembled. (see following page) Pedestrian paths to and from the site were analyzed and connected to pedestrian corridors throughout the area. Major street crossings were identified. Where these paths connected to the site became a critical aspect of the design.
"Communities are planned for people and technologies are to be supportive not dominant”

-principle of Dewees Island conservation development

Encouraging pedestrian travel within the site began with the idea that a community should be designed around the person rather than the automobile. The arteries of the neighborhood are not for automobiles (as is usually the case) but for people. Cars are kept at the perimeter of the site and the main streets become pedestrian paths. Removing the cars from visual range assists in removing them from everyday life without dampening their convenience.

Whenever a pedestrian and automobile route cross pedestrian paths are clearly given dominance.

The pedestrian paths which access the homes are also capable of accommodating temporary vehicular traffic for emergency vehicles, garbage pickup, and moving trucks. A 12 foot service area outside the 6 foot walking path is composed of Grasspave³, a load bearing trafficable grass porous paving system. Grasspave³ is made from recycled plastic and can withstand heavy car loads while allowing grass to prosper.

The parking areas provide for only 1.5 spaces per home. This is intended to discouraged the typical 2 car per household situation. The parking areas are not only minimal and visually reserved but are constructed from porous asphalt. Impervious paving surfaces add dramatically to stormwater runoff problems: erosion, downstream flooding, and pollution of surface waters.

Bicycle travel is encouraged by community bike storage areas.
One of the most influential principles in the design of the community layout was passive solar design. Effective passive solar design does not begin and end with the design of the unit itself, but requires appropriate site planning.

In order to take maximum advantage of the sun’s energy, it is crucial to orient the building’s widest face to due south. This strict orientation is particularly meaningful to this community because of the way it helps to generate an awareness of natural systems. Regardless of street arrangements or other factors southern orientation is the overriding principle.

In addition to orientation, the solar envelope must be considered. The solar envelope is the three dimensional space in which an object can have access to sunlight throughout all seasons. Any space can be shadowed by other buildings. That is why homes must be arranged with their solar envelope in mind.

Knowing the solar angles at all seasons and the height of each home, the proper distance apart to place them could be calculated.
What helps in creating a community?

A community is not just a collection of houses, it is the orchestration of the interaction between those houses. In this orchestration, other characters come into play such as streetscapes, public open space, and pedestrian corridors.

As mentioned earlier parking was kept to the perimeter, leaving the interior of the site solely pedestrian. These pedestrian paths are therefore ideal locations for social interaction. The community is thus designed to encourage interaction on these streets. The paths are anchored on either end by the parking lots and the village green. This should lead to maximum traffic along the paths. Every path leads to somewhere and no one lives in a cul-de-sac or any type of dead end. The paths and the proximity of the houses generate a streetscape which the homes can engage with by the use of front porches.

Community buildings/ areas
- The community center is a multi-purpose building for holding events and social gatherings.
- Community bicycle storage adds convenience while encouraging alternative modes of transportation.
- Community recycling/composting centers uses "waste" to generate revenue for the community and produces fertilizer from yard and kitchen scraps.
- The community solar oven replaces the conventional grill with something more sustainable.
- Community pavilions provide accidental meeting places.
- A playground provides recreation opportunities for children where they can be easily watched.
- Solar aquatic waste water treatment facility produces flowers and fertilizer as a by-product.

The village green then becomes the central spine which all homes relate to and have access to. The green is the common ground which gives identity to the community.
"In wildness is the preservation of the world.”

-Henry David Thoreau, Walking (1862)

Traditional landscaping has become dependent upon foreign plants which are high-maintenance and of high cost to the environment as well as the patron. The cost of such landscaping has been calculated as $3,500 to $10,000 per acre annually.

Environmental costs of traditional landscaping:
- Herbicides and insecticides contain toxic and hazardous substances
- Fertilizers often accumulate in surface waters and disrupt the balance of aquatic life
- Irrigation contributes to the depletion of water resources and uses electricity
- Mowing of lawns and trimming of trees is requires energy and causes air pollution
- Causes the loss of biodiversity

Xeriscaping is the process of using native plant species in a landscape plan. There are many reasons for implementing this type of strategy. Using native plants aids in the restoration of natural habitat and Native species are well-adapted to their region, and therefore require less water and fertilizer. This important due to the fact that landscape irrigation accounts for roughly 35% of residential water use. Each of these benefits help to reduce the cost of landscaping.

Conventional turfgrass for example is actually a foreign species and requires massive amounts of water and upkeep in the form of fertilizing and mowing. Turfgrass, however, has become commonplace and can be perceived as the ideal representation of residential lawns.

The landscaping plan for this community calls for the use of native species almost exclusively. It is important that what is perceived as beautiful is also natural.

Natural prairie grasses are an effective and extremely rustic method of xeriscaping. At one time this area was over 90% prairie. The implementation of such a natural system will help to increase biodiversity. Prairie grasses also require no herbicides, insecticides, fertilizers, mowing, or irrigation. And its cost of installation and maintenance are far less than traditional landscaping.

The extensive root systems of native prairie plants are the reasons for its ability to stabilize the soil, contribute to infiltration of surface water, and act as a long-term carbon sink.

The plan of this community replaces turfed areas with prairie grasses wherever possible.
There is, however, something to be said about turfgrass. It is one of the most enduring to heavy traffic among landscape materials. Therefore this plan maintains areas of turfgrass for heavy recreation and sports. Areas of lesser traffic are comprised of Buffalo Grass (a native grass species which grow to about 3" in height) and wildflower patches. And areas of little traffic are composed of native prairie plants.

The village green plan for example is divided into smaller areas of turfgrass intermixed with prairie grasses and treed areas.

Pavilion
Turfed Areas
Playground
Amphitheater
Community solar oven

Trees  Prairie Grasses  Buff Grass  Turf & wildflowers
The higher density which was a goal for this project could not be justified unless the composition of spaces were designed for optimum use.

Here the public areas are given priority over private areas. Rather than chopping the space up into less than useful personal parcels, the space is compiled to form such areas as the village green which everyone can make use of.

Coupled with its proximity to Central Park this community offers a variety of outdoor areas. The activities which would occur in outdoor areas were analyzed in order to make available the necessary space.

<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front yard/ Street</td>
<td>socializing/ cycling</td>
<td>socializing/ sitting out/ watching children</td>
</tr>
<tr>
<td>Back yard</td>
<td>ball games/ incidental play</td>
<td>barbecues/ watching children</td>
</tr>
<tr>
<td>Village Green</td>
<td>Frisbee/ larger scale ball games/ fixed playground equipment/ cycling</td>
<td>Socializing/ sitting areas/ cook outs</td>
</tr>
<tr>
<td>Central Park</td>
<td>baseball/ tennis/ large playground</td>
<td>cookouts</td>
</tr>
</tbody>
</table>

In order to maintain effective public and private space it is crucial that the areas be properly defined. Edge defining features were studied in order to make clear each transition.

Fence  
Hedge border  
Hedge and level change  
Hedge and wall
This notion of compiling space into public areas is also addressed at the scale of the yards. The clustered houses have their own private front yard, while sharing a common backyard.
An alternative to the more communal space arrangements are individual yards for each home.

Community storage and bike storage
An essential part of creating a community is the realization that buildings must work as one composition rather than individual units. Using a consistent setback from the street is one way of accomplishing this.

The streetscape is further enhanced by the use of level changes which help to define the separation between personal and private space. This manipulation of the ground plane also becomes useful for thermal insulation (as will be described later).
With many of the tasks which the built environment must accomplish, there is usually much to be learned from natural systems. Often by imitating environmental systems a method can be devised which is healthier for the environment.

The Living Machine solar aquatic wastewater treatment system is one such example.

A solar aquatic system purifies municipal sewage using aquatic plants, fish, algae, and microorganisms. It uses large translucent tanks linked together in a greenhouse enclosed gravity-feed system through which the sewage circulates. As the wastewater moves from tank to tank, aquatic plants use up the excess nutrients, break down the toxic chemicals, and sequester heavy metals. These living machines make unnecessary the use of toxic chemicals or large amounts of energy to provide cost effective and reliable sewage treatment.

These natural processes produce flowers as a byproduct which can be sold at a community flower shop. Fertilizer is also produced to supply the landscaping around the community.

Wastewater treatment centers are generally the type of facilities which are undesirable as neighbors. In contrast, due to its lack of any odors or offensive appearance, and its yield of flowers and other plants, the Living Machine is a facility which people would enjoy living next to.

Advantages:
1. Uses no chemicals
2. Capable of meeting tough sewage outflow standards
3. Relatively inexpensive
4. Produces flowers as byproduct which can generate revenue
5. Its appearance is visually appealing, and completely odorless
Before we get too involved in the housing design, it is important to mention that the plan for this community calls for several different unit plans. No community exists which is comprised of exactly the same inhabitants, therefore none should exist which are comprised of exactly the same homes. However, due to the time allotted for this thesis only one unit will be fully designed.

Nevertheless, even within the same design there is room for individualism. Methods for individual expression include color, window treatments, door treatments, and landscaping within private yards. Each home is also equipped with a solar powered porch light which includes the house number and the family names. The intention of this is to create awareness of the sustainable systems being used and to create an awareness of community.

"Live simply that all may simply live!"

-Jan Juffermans

The size of the homes are somewhat modest. The earlier studies on density and land use have shown us that we can live in smaller spaces. A modest and simpler means of living is better for the environment by reducing strain on resources. One may notice the absence of a master bathroom in or a full bathroom on the first floor.

Program

3 Bedroom homes
1568 sq. ft.
3 bedroom
1 ½ bathrooms
kitchen
living/ dining area

2 Bedroom 2nd floor and 2 Bedroom Accessible homes
962 sq. ft.
2 bedrooms
bathroom
kitchen
living/ dining area

A note on porches:

Front porches have become a lost feature of suburban life. But they are essential for socializing or what is known as "sitting out" in a residential context. There are many examples of modern day suburban homes which had no front porch consequently the owners resorted to putting chairs in their attached garages to facilitate the function of a porch.

Residing within the modest front yards, each home in this community has a porch oriented to the pedestrian path. Homes also have second floor balconies from which they can observe the happenings on the street.
To add flexibility to the house layout, movable partitions were placed that enable the resident to shift from an open plan to a more subdivided one. The partitions are made from a translucent material which allows light to penetrate when closed.
Design Proposal

Unit Design

Privacy

Day Lighting

Ventilation

Section

Solar Collector
Solar Water Heater
Waste House Fan

Park Forest Green Village
A Demonstration Sustainable Community
Passive Solar design

Just as passive solar heating was a key design influence on the community plan, it is also a primary influence of the design of the home.

There are two ways to produce heat with the sun's energy: passively and actively. Of the two passive is the most affordable and easiest to maintain. The basic idea of passive solar design is to allow daylight, heat, and airflow into a building when beneficial. The U.S. Department of Energy has shown that passive solar buildings use 47% less energy than conventional new buildings and 60% less than comparable older buildings. The beauty of passive solar is that it requires no additional equipment thus the construction cost is raised only slightly. An effective passive solar strategy requires little more than encouraging solar gain from the south while preventing heat loss from the north.

Advantages of passive solar design:
- Energy performance
- Investment return
- Comfort
- Low maintenance

To determine the amount of solar collecting window area to apply to each wall the Mazria index was consulted. The Mazria index is a method of calculating glazing area for maximum passive solar heating.

<table>
<thead>
<tr>
<th>Results from the Mazria study</th>
<th>Ext. wall Area in sq.ft.</th>
<th>Estimated Window area</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Wall</td>
<td>532</td>
<td>171</td>
</tr>
<tr>
<td>North Wall</td>
<td>532</td>
<td>57</td>
</tr>
<tr>
<td>East Ext. Wall</td>
<td>228</td>
<td>8</td>
</tr>
<tr>
<td>East Party Wall</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>West Ext. Wall</td>
<td>228</td>
<td>24</td>
</tr>
<tr>
<td>West Party Wall</td>
<td>0</td>
<td>0</td>
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<td>Overall Bldg. Area</td>
<td>1520</td>
<td>260</td>
</tr>
</tbody>
</table>

These figures were applied to a model to study the required necessary area.

An important concept of passive solar design is to match the time when the sun can provide heat to a building with those when the building needs heat. Low winter sun should be collected, while high summer sun must be avoided.

The heating season for the region was determined to begin in early October. The local solar angles at this time of the year were then calculated. Shading devices could then be applied which would allow full solar access beginning in October while blocking the summer sun. The shading requirements were incorporated into the design of the roof overhangs and the balconies.
Design Proposal
Passive Solar Design

Thermal mass is the method by which heat is stored. Solar energy enters the home via the southern windows, and heats up the thermal mass. The heat then radiates evenly throughout the day which makes heat available even when the sun is not out.

The house design calls for three masonry piers on the south side which absorb the sun's heat. They also serve to divert the direct sunlight. Additional solar mass is provided by the east and west walls and the ceiling.

It is crucial in passive solar heating to maintain a tight thermal envelope, otherwise the sun's heat would be lost as quickly as it were gained. The following are features which the house design employs to maintain its thermal envelope:

- Townhouses were chosen as the form of this development because they share common walls. The shared walls reduce the amount of heat loss on the east and west sides.

- The compact shape of the homes means less surface area and consequently less heat loss. Compactness and the need for solar exposure were the two influences on the building shape.

- The walls are framed with 2x6 studs instead of 2x4's. The larger studs allow for more insulation space (90% of wall left for insulation).

- To ensure there is no heat leakage due to breaches in the insulation from electrical outlets, no outlets are placed on exterior walls. All outlets will be accommodated on interior and party walls.

- The landscaping is also adapted to thermal control. Trees placed on the north side are coniferous which will assist in blocking winter winds, however the trees on the south side are deciduous which block sunlight in the summer, but allow sunlight to pass in winter.

- To ensure the greatest possible insulative value on the north side, the earth itself is used. Earth berms are built halfway up the first floor of the north side of the house. To accommodate this the areas of the home which required less windows (such as kitchens and bathrooms) were placed on the north side. While areas which benefited greatly from large windows (such as living rooms and bedrooms) were placed on the south.

Solar Exposure

Compactness

The main doors are configured as airlock entries. This cuts back on direct heat loss.
Backup Heater

Though the building is passively solar heated, it is possible that the sun will not provide all of the heating requirements. That is why a direct vent, sealed combustion furnace is used as a backup heater. Placed in the basement, its vertical heating ducts are extruded directly through the center of the house. This arrangement is to ensure that all heat which may radiate from the ducts is used to its fullest. The vertical ducts pass vertically in conjunction with the fireplace and its flue which together represent the central hearth of the home.

Passive Cooling

The sun’s energy can also help to passively cool a building with a solar chimney.

Solar chimneys are stack-effect ventilators that use passive solar heat to boost their performance. A solar chimney is essentially a passive solar collector with its inlet drawing air from the building interior and its outlet discharging to the outdoors. A glazed surface allows solar energy to heat the interior of the chamber. As the temperature of the air inside the solar chimney increases, it becomes less dense and rises leaving the chimney and drawing more air through the inlet. As hot air leaves the solar chimney, air is drawn from the interior of the building, and outdoor air flows into the building through open doors and windows.

The configuration of the house is designed so that the stairwell with its operable windows becomes a vertical shaft for ventilation. The inlet of the solar chimney is placed at the top of the stairwell which assists in acting as a heat stack. A solar chimney however, will not work to its fullest potential at all times of the year, that is why it is supplemented by a whole house fan also placed at the top of the stairwell.

Solar chimney detail
Daylighting

Daylighting is yet another advantage of the sun’s energy. Natural daylight is the highest quality light available, yet all to often we seem to be trapped in boxes illuminated by artificial light. Daylighting strategies bring the maximum amount of natural light into the house reducing dependence on electric lighting saving money and energy. A house designed for daylighting may use as little as 2% of standard lighting consumption.

The highly placed windows of the units bring daylight deeper into the rooms. This places the entire house in daylighting zone 1 (or fully daylit). The vertical stairwell also functions as a lightshaft bringing daylight down into the north half of the house. Sunlight enters through its top windows and is reflected about its lightly colored walls.

When electric lighting is necessary energy efficient compact fluorescent light bulbs are used. Task lighting is also provided in necessary areas allowing the overall light use to be reduced.

Solar water heating

The average home uses 21 million Btu’s per year for water heating. Solar hot water heating is a way of eliminating that energy use.

The Copper Cricket geyser pumping solar collector can heat water even in cold-cloudy conditions with no moving parts, no maintenance, and no additional energy. Heat from the sun is absorbed by a solar collector mounted on the roof. The heat is transported by a methanol-water solution which passes from the solar collector to a heat exchanger. The heat exchanger transfers the heat to a water storage tank located in the basement. The methanol-water solution is transported through the tubes via the geyser pumping action which requires no energy or moving parts.

The water heating system costs about $2,000 installed which can be completely paid back by energy savings in less than 3 years.

Energy Efficient Appliances

Appliances account for about 14% of the entire home energy use. By using energy efficient appliances the entire energy consumption can be greatly reduced.

An example is the energy efficient refrigerator. It uses 535 kWh per year as opposed to a standard refrigerator which uses 767 kWh per year. This type of refrigerator costs about $80 more than a standard one but saves about $20 per year in electricity. The upgrade would pay for itself in 4 years.
Water saving features

The average person uses 70 gallons of fresh water per day. Consequently residential architecture has the potential to reduce the nation's use of water.

- Low flow faucets use 38% less water than standard faucets.
- The Envirovac toilet uses only 1.5 quarts of water per flush.
- Water saving dishwashers use less than half the water used by a standard dishwasher.
- The Amana horizontally loaded clothes washer uses 19.9 gallons per cycle, as opposed to 36.4 gallons.

Another measure taken to reduce overall water consumption was to recycle the greywater produced from bathing and use it for toilet flushing. In standard homes fresh drinking water is used for the simple task of toilet flushing. However, greywater from bathing can be used after a minimal filtration process. Thus saving 46,080 gallons of water per year.

Rainwater harvesting

Rainwater collecting is an issue of a supply rather than demand. To allow a resource such as rainwater to go unused would be wasteful. That is why rainwater is collected communally for landscape irrigation.

Rain falls onto the metal roofs of each of the houses (asphalt shingled roofs could lead to obstructions) and is drained through the gutters community cistern. Some of the homes will incorporate ponds at ground level which the water will splash into before draining underground. The purpose of this is to create an awareness of the natural systems being used, and remind us that beauty lies in the processes of nature.

The water collected in this cistern is then used for landscape irrigation.
Each of the materials chosen for the construction of the homes were weighed for their embodied energy and resource depletion. The materials chosen are as follows:

Roofing- standing seam metal shingles
made from 60% recycled steel

Foundation- concrete containing 25% flyash
uses an industrial byproduct to lower embodied energy of concrete

Sub floor- Oriented Strand Board
made of strandlike particles from smaller faster growing trees or lumber by products

Floor joists- Trus Joists
an engineered wood I-joist made from Microllam flanges and OSB web
it is made from smaller, faster growing trees that are harvested on a sustain able basis
with its I-shape it is stronger than dimensional lumber
can be ordered at exact lengths to avoid cut-offs

Studs- finger jointed 2x6's placed at 24" o.c.
finger jointed studs are produced from sections of smaller faster growing trees which are joined together
finger jointed wood is produced stronger and straighter than conventional lumber
studs placed at 24" o.c. uses less material without altering structural stability
2x6 stud walls allow for more insulation space (90% of wall left for insula-

Sill plates- Oriented Strand Board

Insulation- cotton insulation
made from recycled material
easier to work with
has same thermal qualities as fiberglass

Gypsum board- made from recycled newspaper

Siding- Wenzlitz Cladding
siding made from recycled wood chips

Interior walls- Stramit compressed straw panels
replaces both drywall and framing with a renewable, fast growing resource

Trim- finger jointed wood trim

Carpentry- made from recycled plastic

Carpet pad- made from used tires

Floor tiles- made from recycled glass
Bibliography


