Light & Space
Maintaining the sanctity of space within the parameters of passive solar design

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Introduction

This project explores the relationships between light and space through the design of a CoHousing development in Indianapolis, IN. The work was done by myself with assistance from my thesis advisor Professor Robert Koester as well as my thesis studio Professor, Jack Wyman.

The possibilities of passive solar design adapting and helping to maintain the qualities of space that make that space habitable are explored in some detail. The majority of my efforts were focused on the design of the community house, but I also focused on the larger scale of the entire community.

Things such as light, temperature, view, materials, colors, and pathways were studied.
Can a space be comfortable and inhabitable if it is designed in a passive solar manner?

When one thinks of a traditional passively solar heated space, things such as thermal mass and direct gain come to mind. These things are usually associated with a large sloped area of glazing. Why is this? These systems, while technically competent usually also prove to be less inviting than what might be considered a more traditional housing type. Overheating and glare are huge problems when it comes to traditional passive solar design. The purpose of this project is to explore new ways of dealing with a passively solar heated space while not compromising the inhabitable qualities that make spaces comfortable to be in. Maintaining microclimates provides a range of spaces with different temperature and light qualities that might be better suited to specific tasks.

It is my opinion that a space will be more
comfortable as a result of natural conditioning, whether it be heating/cooling, lighting or ventilation, than it would be otherwise. Who wouldn't like to sit in a room lit by the sun on a cold winter's day with natural heat radiating from the floor rather than a room lit with conventional incandescent lights and a vent in the floor? It is for this reason that I intend to explore the possibilities in passive solar heating.

The area that I chose as a site for my project lies on the northeast side of Indianapolis. A site, which is currently undeveloped on the east side of Geist Reservoir, provides many opportunities to investigate the incorporation of passive solar design into a real world application. The site presents problems and conflicts as well as possibilities that were dealt with at great length. The site lies on the east side of the reservoir, which begs for the spaces to be oriented to the west, but a true passive solar design requires as much southern exposure as
possible.

Another conflict is the size of the site. It is quite large for a community this size. The first instinct might be to spread out on the site to take advantage of its size, but a more sustainable approach might be to limit the size of the community, thus not only keeping it more intimate, but also allowing the open land to be utilized for growing crops or for general recreation. As time passes, this will also allow for expansion of the community or possibly for a new community of similar interests and ideals.

A CoHousing project was chosen as the means of exploration because it provides many opportunities to investigate spaces and their relationships using light. There is a wonderful array of spaces ranging from a wholly public recreation area in a main community house all the way to the most private bedrooms in the private residences.
Background

The residential units are standardized. All have at least two bedrooms, fully equipped kitchen, dining room, living room and at least two baths. There is a two-story unit type as well as a single story type for handicap accessibility.

The community house is a conglomeration of many different spaces. It functions as a place for residents to hold meetings, engage in recreational activities, serve lunches and dinners, as well as a place from which to manage the property, provide daycare, accommodate guests and house laundry facilities. This structure is connected to the outdoor community pavilion via a pathway that winds through the community.

The major contextual elements of this area are high-end residential neighborhoods. Most of the homes in this area are clad with brick or stone and wood siding. They range from large, spread-out, single-story ranch homes to somewhat compact
three story structures. This type of physical context is characteristic of today's society, which is moving ever more towards privacy and individualism. One goal of this community is to work against this individualism that is inherent in today's society.

As a basis for beginning design, I did some research into existing CoHousing developments to see what makes them successful and what can be improved upon. I chose four communities across the United States, each one has a decidedly different focus. One, in Arizona, was focused on natural systems including water collection and reclamation. One in California was focused on maximizing the community feeling. Another in Colorado focuses on the reduction of material consumption through cooperation in the tasks of daily living. The last, in Michigan, focuses on sharing resources and lives in a manner which respects the earth.
Passive solar design is something that we, as a society, will need to start using as our nonrenewable resources are used up. Solar energy is free, and inexhaustible. The possibilities that solar energy present to us are simply amazing. We can create electricity, heat our homes, heat the water we use and even power our cars. This source of energy will become the most widely used out of necessity. I believe that it is time that we start looking seriously at how to incorporate it in the design of our spaces.

This has been going on for quite some time now. There are solar homes that date back to the Sixties, but due to their greater expense and the relatively low prices of fossil fuels at the present time, this type of design is not garnering the type of attention it deserves. There are two type of solar design, active and passive. Active design requires much more equipment and is achieved at a greater expense than passive design. Because of this, I believe that passive solar design is going to be quite
Proposal

important in the not too distant future. However, there are some problems inherent in today's methods of passive solar design. The main principle used is direct gain, where a space that has significant thermal mass usually has an expansive southern exposure to allow for sunlight to heat the mass, the mass retains the solar energy in the form of heat and slowly releases it long after the sun's rays have diminished. The problems with this approach are heat and glare. Direct gain spaces often become overheated during peak hours due to the intense sunlight, which also causes glare. This thesis project will deal with solving these problems and looking at alternative means and methods of passive solar design. The project used to explore this will be a multifamily residential unit.

The other aspect of this project deals with the understanding and interpretation of space and its qualities. We need to understand what it is about a space that makes it enjoyable or unpleasant. Searching for these answers will be part of the
design process. Aspects such as color, texture, light quality and intensity, sound and smell are all part of what makes spaces. The qualities that are most affected by this passive solar design are obviously light quality and intensity, and therefore, temperature. But this is not to say that the others will not be considered. It is very important to study and understand the impact of colors and textures on the sanctity of space, both of which will be affected by the choice of materials used in the passive solar design. Typical thermal mass materials such as concrete and brick may impose a colder, less inviting feel that would a room with an abundance of wood, a material with a low thermal mass. Also, color plays a large role in the creation of space because of the emotions it invokes in the users as well as the heat absorbing qualities that it possesses. It is very doubtful that anyone would enjoy being in a space that was nearly all black or very dark, but such a space would be efficient in collecting solar energy on a cold winter's day.
Research

Upon researching the aforementioned case studies, it became apparent that there needed to be a focus of the design of this facility in order for it to function successfully. I chose as a design tool to focus on light. This requires, above all else, a careful placement of spaces on the site based upon solar patterns. Take for instance the placement of the daycare space. It will most likely be occupied for the bulk of the day, from about eight in the morning till around five in the evening. This timespan sees the sun move from the east in the morning across the southern sky and into the west by the time the children are picked up in the evening. As a result, it seems logical that this room have exposure on the east, south and west sides. Its placement within the overall design accommodates for this.

The same design methods were used for all other spaces as well. The recreation room, for instance, is oriented toward the west, allowing for
an expansive view of the reservoir. This space also would require southern exposure for use during the day, but there should be a variation in the amount of light provided because of the diverse activities that will be taking place there. The daylit area could be used for arts and crafts or some other activity which would require a high footcandle rating, whereas another activity might be watching movies on a large screen. This would obviously be best suited in a darker area with more control over the lighting and therefore there is a southern exposure on only have of the space.

The living space, which will be more passive in nature, would require a less intense and diverse lighting atmosphere. It, therefore, has a minimum western exposure with patio doors and a strip of ribbon windows up high on the north wall.

These are the primary reasons for placement of spaces, the secondary is their relationship to
The recreation room and living room need to have an intimate, but highly controllable relationship in order to limit noise from the recreation room in the event of both spaces being simultaneously occupied and having opposite functions. The daycare space should be separated from the main spaces to limit access (both in and out) and it should have an easy drop-off and pick-up point.

Another priority for the organization of spaces was the concept of arranging all of the spaces around the large and versatile dining space. It acts as a sort of hub for interior traffic patterns. And as a result of all the importance placed upon it in such an arrangement, it is larger in scale, both in plan and section, than the rest of the spaces. It acts as an anchor to which the rest of the spaces are attached.

The design process then moved from
investigations into the arrangement of spaces on the building scale to site scale. Pathways were a major consideration in the site design. The main access to the site will not only have a major impact on the site circulation but also on the first impression one gets when entering the CoHousing development. This is possible by controlling views with vegetation and earthforms.
Program

This program is a primary step in the development of this CoHousing community. It provides a means of recording the desired spaces of the residents in the design of their community house within their future CoHousing development.

HISTORY:

CoHousing began in the 1960's in Denmark and has spread slowly since then. There are less than one hundred of these in the United States today, but all are successful. They allow the residents to live in a community unlike any other. A community that is closely knit and everyone is a close friend. This seems a logical step in a world that seems confined by a constant need for privacy. Large yards and privacy fences are what destroy neighborhoods. CoHousing is a step in the opposite direction, in the direction of a true community spirit.

SCOPE:

This program represents the spatial needs of
Program

the residents in their common house. Each space is described in detail including users, activities, furniture and furnishings and environmental conditions. It also provides net square footage calculations for each space and a total gross square footage for construction. A cost estimate is provided to establish a project cost for the community house.

A common exterior space is also described and included in the programmed spaces.

Organization:

The organization of people within this facility is simple. All residents are equally involved and are required to work at least ten hours per month in general maintenance, using storage areas within the common house. The house will be used by all residents in a combination of recreational and relaxational ways. They will have two offices in the community house in which to organize meetings, and perform routine facility maintenance functions.
Design Criteria:

Indianapolis, and in particular the area around Geist Reservoir is expanding rapidly. The growth is mainly residential and is taking a turn away from a community focused design. There is an uncomfortable feeling in the area with many large homes on small lots. This project will attempt to counteract these issues and provide the Indianapolis area with its first CoHousing development.

There is a distinct palette of materials used in the immediate area. These materials will be carried through in the design of this CoHousing development to promote a feeling of unity.

As with all CoHousing units, there exists the possibility to engage the facility in an energy efficient design. With a number of housing units clustered together, many resources can be shared, and energy
saved. Also in CoHousing developments, the issue of public and private space is of utmost importance. The traditional relationship between these spaces is challenged and a new arrangement is often adopted. In the process of evaluating the public and private spaces it is important to maintain a distinction, but not a hard separation.

One way of defining spaces is to use light, specifically, daylight. By using daylighting as a technique to define spaces the opportunity to use the sun’s energy also comes into play. By correctly organizing spaces and using the correct materials, a passive solar heating design may by implemented.

The design of this community house will be driven by the passive solar and daylighting concepts described above. The material palette that exists in the area lends itself well to the ideals put forth in these design arenas.
The Presentation

Common House

Graphic Program

Living Space - 800 s.f.
Kitchen - 250 s.f.
Dining - 500 s.f.
Recreational - 1000 s.f.
Restrooms - 4 @ 30 s.f.
Storage - 250 s.f.
Mechanical - 200 s.f.
Office - 2 @ 200 s.f.
Childcare - 150 s.f.
Total = 5180 s.f.

Support spaces to be dispersed as necessary throughout facility.

Community

Graphic Program

Community House - 5180 s.f.
Housing - 24 @ 1200 s.f. (average) ea.
Parking - 78 spaces @ 300 s.f.
Total = 57,700 s.f.

Parking will most likely be grouped up into at least two parts, one for guests and elders near the community house and the other for residents.

Housing units are grouped into six buildings of four units each. Sizes of units vary from 800 s.f. to 1500 s.f.

These graphic programs were used at the interim presentation to convey a sense of scale. Each of the spaces are represented in boxes that are proportional in size to one another.
This plan of the community house shows careful placement of spaces with respect to sun paths as well as space relationships. As mentioned earlier, the daycare space is positioned to receive sunlight all day while the recreation and living rooms will receive sunlight from mid afternoon to evening. The spaces on the north also provide a thermal block from the northern winter winds.
This section shows light penetration into the dining space. The raked overhang blocks the sun in the summer while allowing it to enter in the winter.
This rendering shows the southern entrance to the community house as well as the covered patio that allows for overflow seating of the dining room in the summer. The great expanse of glazing on the southern facade allows for passive solar heating. The planters provide a visual barrier and help to define the exterior spaces while allowing a place for the residents to do some gardening, either purely aesthetic or for food.
This rendering of the recreation space shows how the room is very versatile in its arrangement of furniture. All the chairs, seats, tables and lamps are moveable so that the room can accommodate any number of different functions. Also, the large amount of glazing on the west, and to a lesser extent, the south side offer a range of lighting conditions for tasks which may require either a large amount or small amount of light.
This rendering of the living room demonstrates a calmer atmosphere, with clerestory windows on the north to offer a more constant and comfortable level of daylight. The doors on the west side open onto a patio that is separated from other outdoor spaces. This room has a close, but highly controllable relationship to the recreation space.
This plan represents a single story housing unit. These units are designed for accessibility and offer an ample amount of space for starting a family or for single occupants. These units are located on the southern end of the housing clusters and are designed to take advantage of sunlight.
This rendering shows the master bedroom in the single story housing unit. The windows are positioned so that they allow eastern sun in the morning to awaken the occupants and southern windows, which allow sunlight in throughout the day to warm the space for occupation in the evening.
These plans illustrate a typical two story housing unit. The amenities are standard and are representative of most of the single family housing throughout the area. These units utilize sunlight from the east and west for passive solar and are supplemented by a roof system that preheats intake air for a conventional forced air system.
This is the entry space of a two story unit. The two story space on the west side will help to draw heat out of the lower level living area during the hot summer months.
Again, this photo shows the two story space that helps to draw heat into the upstairs where it will be exhausted by a fan. The spaces in these units are also designed to help foster the community feeling. Spaces are not separated by walls, but rather flow into one another. Differences in elevation are used to help define space as well.
Another rendering of the two story to help demonstrate the openness of the spaces. The stairs provide a partial separation while still allowing views into the living room.
The community is positioned on the east side of Geist reservoir. This image shows the arrangement of spaces on a community scale. The community house is located at the north end of the development while a community pavilion is located at the south end. This structure will be used for outdoor summer activities. A small playground will be available for children and a beach area will provide a place to cool off.
This photo shows how the site design can allow for future expansion.
Reflection

Light and space are really at the heart of every good design. If enough thought and consideration are put into these two areas the results will be well worth the effort. This project has proven to be very informative and has gotten me to think about what a space really is, and what makes that space pleasant or unpleasant. Natural systems are far underused. They have been used for centuries in indigenous architecture, but were tossed aside when the industrial revolution hit the world. Today people rely on fossil fuels for climate control in their homes. Some even because they don’t know any better. They have never known anything but these systems and are not aware of the possibilities that nature provides for us. This project helps to show how simple it is to incorporate natural systems and respond to the sun and wind to increase the comfortability of a space. The project type also helps people to realize that there are other ways in which to live that can also help to increase their quality of live. Long ago native americans lived in similar communities with shared resources; they were happy and healthy. If we as a society can start to embrace these design ideals, then I think we are taking a step in the right direction. We need to get to the basics. Spaces need to be analyzed before they can be designed, and one main aspect that needs to be analyzed is light, and its implications and impact on the quality of space.
Bibliography


