We were informed by a well informed janitor that these were fairly
typical years. Another program was written to calculate bi-hourly
average temperature and humidity, average daily temperature and hu-
midity, daily heating and cooling degree days, and total degree days
for whatever period of time calculated. (see first program and
data) Later the program was expanded to plot average bi-hourly
temperature as a function of bi-hourly humidity. (see program and
graph following the first program.)

Much more can be done with this data base, and it can be easily
expanded to include wind, insolation, and cloud cover.

3.) I have developed two methodologies this quarter, both
computerized. The first is a rough sizing methodology, determining
the area of a collector for 100% of the load. It works on monthly
data. Design variables include: design temperature, heat load per
hour, monthly degree days, and monthly insolation. Also; days in
the month, tilt factor, and average collector efficiency. Output
includes area of collector, size of water or rock storage, and size
of water or air pump needed. (see program #3).

The second methodology is quite complex, a daily simulation.
The program has been designed to be as universal as possible and is
described starting on page 4. passive contribution through south
facing glass is considered along with active contributions.
THE HISTORICAL CONTEXT

Since the beginning of time until the industrial revolution housing forms evolved according to man's needs. Form was not based on personal taste, but rather it was based on climatic conditions and limited resources and materials. Today it is relevant to study these indigenous climatic forms and employ their age-old principals in our design work.

Mesa Verda, Colorado (1100-1300 AD) was a mud-walled multi-use village for an agriculturally based community. It was built under a south facing overhang for protection against weather and attack. The thick mud brick walls effectively utilized the concept of thermal time-lag, soaking up and storing the sun's heat in the day and releasing it at night. In addition the cooled bricks then chilled the house during the day. (American Building, Fitch.)
Early American settlers derived the above form, the saltbox, from structural and climatic restraints. Wood was the predominant structural material in the north and east due to its great abundance. The large central fireplace absorbed heat from the flue and radiated it out into the house. The compact house had small windows and rooms, and low ceilings to adapt to the cold winters and warm summers.

The saltbox was easily expanded as shown in the following illustrations of the Baldwin House, Branford, Conn., c. 1645.
The Japanese house is a classical example of climatic design. The characteristic projecting eaves kept the heat of the summer sun out while letting in the winter sun. They also served to keep out the rain, allowing windows to be open during rain storms. The houses were usually built facing south with major living spaces being oriented this direction. Enough openings were made on the north side to permit flow-through ventilation. The Japanese have a great concern for the directional planning in their houses as expressed in the above diagram.
Above is a typical plan for a traditional Japanese house. Its design has much in common with modern prefabricated units due to the universal use of the 3' x 6' tatami mat. Throughout the house the structure is revealed. The interiors make use of both moveable and fixed partitions. Privacy hedges and window grills insure privacy. The entry is one of the most important parts of the Japanese house, and an overall great concern is shown to the visitor of the house. The Japanese garden is a topic which could be the topic of an extensive paper. It is here that the resident finds rest and repose, and a better contact with nature.
With the coming of the industrial revolution many technological devices found their way into the home. The modern bathroom, the laundry tub, and the kitchen sink appeared along with water and sewage systems. With the development of gas, and later electric, lighting the house was freed of its dependence on natural light. 24 hour use was now possible. With the widespread use of steam central heating appeared.

The invention of the balloon framing system in Chicago in 1839 revolutionized the housing industry more than any other single event. It lowered the cost of dwellings by half and helped open the way for westward expansion. However, in our fascination with technology and our belief that resources were unlimited we forgot the tradition that had evolved out of man's basic need for shelter and protection. Why should we try to conquer the climate when it is so much easier to work with it?

Catherine Beecher published a series of books in 1869 which quite accurately described the changing relationship between the family and its house and the house to the new technological context. Her houses were visualized as machines for family life.

Kitchen work centers (see next page left) and movable storage walls (right) show Beecher's concern for organizing tasks along the lines of rationalized work in industry. This functionalism is apparent in the plans on the next page, with classified
THE TWENTIETH CENTURY BUNGALOW

A small one-story house that has an open or enclosed front porch. It is usually sided with wood or non-structural brick veneer. The roof is usually asphalt shingled. There are many regional types of this common style. The California ranch house (which exist all over the country) are one-story ground hugging houses. They usually have double-hung windows, a picture window (which usually views the street); and sliding glass doors which lead to a concrete slab back porch.
storage, central heating, and compartmentalized bathrooms. Rooms were given more exact titles than in the past. The buildings are designed to be constructed with balloon framing.

Important developments in housing since Catherine Beecher's time have mostly been in the technological realm. The following page describes the more or less typical house, the bungalow, which exists in the suburbs, a post World War One development which will be discussed later.
INTERNATIONAL HOUSE STYLE

This design type is very simple, with little or no ornamentation. Windows appear to be continuous rather than holes in the wall. Roofs are flat, walls are smooth and uniform in appearance. Often windows will turn the corners of some walls. This style was started in Europe in the 1920's by Walter Gropius and others in the Bauhaus. It was introduced to America in the 1930's and is the basis for much "modern" architecture. These designs usually neglect the
THE CLUSTER CONCEPT

The cluster development seems to be the most promising idea in residential planning to come along in the past decade. In the cluster concept houses are somewhat closer together in clusters around access courts. The remainder of the tract is left open to be shared by everyone. The result is better use of the land. The planning unit is no longer the individual lot, rather it is an integrated community of homes, apartments, shops, schools, community, and recreational facilities.

In the cluster concept there is private land, the house lots, as well as the common land. The common land may take the form of a lake or woods, often surrounding the cluster, or a community recreational facility. Housing types are mixed to provide for all family types, and to encourage permanence in the community.

If properly planned the cluster development ends up with about the same number of people per acre as the conventional zoning. Planners refer to this as density control as opposed to plain zoning control. The cluster concept is also known as the "planned unit development" and "environmental planning". Whatever the name, the concept provides greater flexibility, imagination, and advantageous use of the site.

The cluster concept cannot be considered to be new. The principle is found in the medieval village, in the colonial villages in New England, and in the Garden Cities of Ebenezer Howard. Howard's cities were to be an integrated foundation for urban life, bringing the best of the city to join with the
best of the country.

In the United States Clarence A. Perry formulated and defined the term "Neighborhood Unit" in 1929 on the basis of rapidly increasing automobile traffic. Perry pointed out that the enormous traffic on main thoroughfares formed absolute barriers dividing the city into many disjointed blocks. He proposed that the busy street encircle the neighborhood, thus freeing pedestrians from crossing busy streets. Perry believed that the school, if properly conceived, could be used to bring the people of a school district together, and generate social consciousness. They were trying to design a social neighborhood, a community.

A typical "cluster" in Radburn, New Jersey. See next page for further details.
SUBURBAN CLUSTER DEVELOPMENT (From Students in the Yale School of Architecture, as published in Community and Privacy, Chermayeff and Alexander.)

Poor visual privacy.

Poor acoustical privacy.

The entire cluster is disrupted by the use of one major servicing activity.

No private outdoor space.

Outdoor spaces are unusable, and very irregular in shape.

No security, or defensible space.

Conflict between pedestrians and auto.

Overall this scheme increases density, but is not much better than the typical subdivision.
TYPICAL SUBURBAN SUBDIVISION

Owners back cars out onto street across pedestrian paths.

Ill-defined outdoor space, not private.

Side yards are unusable for the most part.

Houses do not react to climatic, environmental, or site considerations.

Acoustical privacy is poor.

Constant conflict between car and pedestrian, and children's play and the auto.

Each street tends to look like any other street.

Long and costly utility runs are required.

Shopping and other essential services are often far removed.

Much land is used for streets.

Often require several街 connections to a busy feeder road.
URBAN CLUSTER (Yale School of Architecture Thesis, Kozlnsky, as published in Community and Privacy, Chermayeff and Alexander.)

Private entry to dwelling, with good view of oncoming visitors.
Safe, pleasant, and clear pedestrian circulation.
Garbage collection is centralized to prevent pollution.
Small courtyards might generate annoying noise.
Parking is efficient, service traffic clear.
Cluster is too small to provide rest and play spaces.
Dwelling to car distance is minical.
Small courtyards provide an acoustical barrier.
Pedestrian circulation is well separated from auto traffic and transitions are clear.
RADBURN, NEW JERSY by C.S. Stein and Henery Wright.

Houses are grouped into superblocks, an idea the designers originated, which separate the pedestrian and auto circulation. Dispersal and low density of the project help keep noise down. Generous community space was provided, and commercial facilities close to the site were planned. Elementary schools were located within a one-half mile radius of the residential districts which they served. Auto circulation has a clear hierarchy, and much less land is devoted to streets. A good residential character is obtained by curving of the streets and a high degree of landscaping which gives an overall unity to the community.
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The site is located southeast of Wabash, about one mile from downtown. Development has occurred in all directions outward of downtown except towards the site. The Wabash River divides the site from downtown. The site is heavily wooded. Much of the land is prime farming land and thus should not be developed. A natural drainage system is well pronounced on the site and was not disturbed. A bluff sloping down to the river makes a nice separation of site and river. About 40% of the site was in the 100 year flood plain.

A contour model of the site was constructed and design proceeded on it. Multi-colored stick-on dots, colored paper, wire, and string were employed for flexibility. Photos were taken of each viable concept and recorded on yellow trash. (see photos)

A.) decentralized activity cores (school, shopping, and community center) and B.) centralized activity centers.
thorough (see model photos) method of design was simple and very
were made on a large scale model. The
out and recorded. Component parts at 1:11
structural and assembly details were thought
for future use with the computer. Certain
were designed, developed, and manufactured.
Early in the second quarter the concept of

The site was quite tight for the seven units

The stop was quite tight for the seven units
At this point I left the detailed organization of the 800 units to Larry. I selected an eight acre portion in the northeast section of the site for further development. A detailed analysis of the site was prepared.

Continuing to zoom in on the problem, a one acre site was chosen for further development. Site sections were developed on the plan for use as a base sheet for design.
Basic organizational concepts of units on the site were analyzed and recorded on yellow trash.

Following the same process as was used for the large scale planning, scaled dots, bits of paper, and tape were arranged on a contour model to arrive at different design concepts.
Site plans were drawn showing; A.) typical subdivision planning, B.) loop auto circulation plan, and C.) final cul-de-sac arrangement. Abstract clay units were built or on the contour model according to the finalized site plan.
Basic concepts and conclusions were arrived at early in the process. These thoughts were recorded on yellow trash.

Basic shapes in plan were investigated and analyzed with respect to the site. The design of the housing was studied concurrently with the siting of the units.
Basic configurations in section were also studied. A.) Hillside Ranch, B.) Split-level, C.) Two-story, D.) 1½ story, and E.) One-story.
Early in the design of the unit, the need for a centralized mechanical core was recognized. A 20' x 12' room on the second floor was designated for this purpose. The core contained the electrical and mechanical systems for the building. Its location allowed for easy access to all parts of the building. In addition to the mechanical core, the building incorporated a variety of options in the design, including a larger variety of floor plans and the use of the laundry room.
A program was written and debugged that totaled unit costs (material, labor, contractor and architectural costs, inflation, etc) and calculated the heat loss of the units. This was possible due to the high degree of modularity inherent in the kit of parts.
The following three photos show the first development of the solar systems model operation and the effects of the panels on the building form.

Electricity for the community is produced on site by using the Wabash River to drive generators. Hydraulic rams are used to drive water up to a holding lake without using energy. The water then falls down the steepest part of the site to drive generators with great efficiency. The level of water in the holding lake is held stable by the constant addition of water by the rams in response to the demands of the generators. Rams and generators are set-up in banks to achieve the greatest efficiency by using as little of the machinery as is needed.
In the second quarter the solar system was revised to include an air collector. Storage was placed into a more efficient shape. The building itself was treated more as a collector by turning all clearstories to the south.
The third quarter of design was primarily detail design and presentation oriented. A ½"=1' study model of unit #6 was built to test the panelization. Several problems were identified and solved. One of the greatest problems was the lack of prior planning for the ductwork. After the connections were worked out final drawings began.

Final drawings were done on mylar with pencil and zip-a-tone. The final model is on a cardboard base with striated basswood siding (from a model railroad shop) for walls and Sig 'Lite-Ply' for floors, decks, and roofs. Plastic book-covers were used for windows, clear plastic and black poster board were used to show the collectors.
Several factors caused the jogs seen in the plan. The tightness of the site was a major factor, but the creation of private entries with a one-way view of oncoming visitors was also a major consideration. Small acoustically and visually private outdoor areas were also created. In some cases the dwelling to car distance was reduced. Also the units are better able to react to climatic, environmental, and site considerations.

Each unit was planned to have direct sunlight several hours a day, each room is naturally lit. Every unit has flow through ventilation, a wide variety of enclosures, one room with an indoor-outdoor potential, a large terrace, a private, controlled entry, a wide variety of views, and close proximity to a parking place(s). Utility runs are very efficient and provisions have been made for outdoor storage. An attempt has been made to make the unit identifiable, while maintaining a sense of the ownership of the mass. All units are accessible to the handicapped. Nearby garbage and mail collection points are included.
The use of solar energy in the project began the first day of programming. It was recognized that fall that active systems were beginning to become economically competitive with gas and oil, and the severe winter of 1976-1977 dispelled any doubts in my mind as to short or long-term economic feasibility. The design of the building is clearly related to the climate and site on which it is built.

The use of active solar collection is not the answer to designing an energy conscience building. Choosing a site, siting the building, the outside shell of the building, and finally the mechanical systems were the considerations taken in order of importance. Passive collection and energy conservation are much more important than the design of the active system. Design processes have developed under a blessing of abundant land, materials, and energy. These notions have shaped our culture and our thoughts. We are only beginning to see the error in our thinking, with depletion, waste, and the destruction of our environment. We followed ENERGY-CONSERVATIVE practices rather than ENERGY-INTENSIVE technologies in our design process. The concept of low-technology as opposed to high-technology was practiced...the simpler a solution, the better.

Energy-conscience design and passive solar collection were great influences in establishing form. The entire south facade was treated as a collector. The notion 'the heavier the building, the better' was recognized as having some truth. Mass was added to the center of the units to mediate temperature due to thermal time lag.
The complex consists of seven units, a good number to achieve a sense of being a part of a recognizable group. The complex is porous, allowing for thru-views, better ventilation, and pedestrian circulation. Views of the Wabash river to the north are maximized. Car-related conversation is encouraged by the layout. Visitors are provided with parking on the east edge of the units.

The complex of seven units is envisioned to be sold as condominiums, aiming at the middle class buyer now left out of the market. The new owner was visualized as being young, with or without children, and buying his first home.
As can be seen in the sections, natural landforms, drainage systems, and open space determined the builable zones and the building form.

Centralization of the mechanical equipment reduces installation costs and makes the operation of the equipment much more efficient.
The minimization of space has a great impact on lowering the life costs of the unit, as well as the first costs.
LANDSCAPE
THESIS