THE USE OF ALTERNATIVE ENERGY SYSTEMS IN HOUSING DESIGN

by

Donna K. Emerson

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APPROVED:

Warren R. Kank, Chairman

Homer Hurst

Dennis Kilper

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ACKNOWLEDGMENTS

I would like to thank the members of my committee, Warren Kark, Homer Hurst, and Dennis Kilper for their assistance in the completion of this thesis. I would also like to thank those others of the faculty, staff, and students of the College of Architecture for their influence on my thinking processes over the years.

I would like to thank my family for their support.

To the friends I had and the friends I have made, I offer special thanks because only you have made it bearable.

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PART 1 PROBLEM

The Problem: Energy-Efficient Housing

It is the goal of this design problem to provide an energy efficient housing alternative for low-income families. Many families, with limited or fixed incomes, live in sub-standard housing which is difficult to heat efficiently. In addition, energy costs, which are predicted to rise approximately 10% over the next decade, will take an ever-increasing share of low incomes.

Goals: Esthetic and Habitable Environments

In response to the needs of those living on low or fixed incomes, it is the primary aim of this study to use alternative energy systems and energy conservative construction systems to design housing units which offer an improved living environment with relative freedom from worry over rising energy costs.

The creation of flexible living environments that will fulfill the housing needs and aspirations of low-income families of varying ages and sizes is also considered a primary goal. It is hoped that through response to a given site, and manipulation of energy conservation devices, not only the goal of low cost operation will be met but also a secondary goal of the creation of an esthetic and habitable environ will be achieved.

Within the context of and in response to the housing and site development criteria (Appendix A), the following objectives of this study have been developed:

Specific Objectives

1. Selection/manipulation of industrialized building units on a given site to create a cluster of housing units suitable for use by families of two to four members.
2. In-depth exploration of interior space planning and design in terms of the needs of:
    a) a family with children (ages 1-18);
    b) an elderly family;
    c) the handicapped.
3. Selection/adaptation of a marketed solar energy system to an industrialized building system.
4. Evaluation of the performance of the final design in terms of:
    a) energy efficiency;
    b) functional adaptability, i.e., the aged, the handicapped;
    c) site adaptability.

Justification

As an aftermath of the recent energy crises, much research has been done concerning both energy conservative building construction and solar energy. The former is a means of taking those things that are familiar and proven conservation devices and using them to conserve that which is once again a precious commodity--energy. The latter is a step into the world of the future--the utilization of that which is intangible--the sun's energy--to replace our rapidly depleting natural resources.

In many instances the design of structures making use of the energy conservative building construction result in structures reminiscent of the early 1900's, boxy and rather dark. The structures making use of solar energy, in most instances, are open and airy, reflecting the accepted lifestyle in most of the United States.

The two need not contradict one another. The goals of this design study will be fulfilled if housing units making use of both concepts, and creating esthetically pleasing and flexible living environments, is successfully concluded.

Background: The Energy Crisis

Since man first discovered fire his use of natural energy resources has grown phenomenally. First wood and then coal were used to produce the fire that was so essential to man's well-being, for warmth and later for cooking.

As man became more advanced, he learned how to extract the oil and natural gas from the ground and turn them into energy. As more energy was available, more and more uses were found for it. Things that our grandparents did by hand are done for us by electricity, natural gas, or nuclear power.

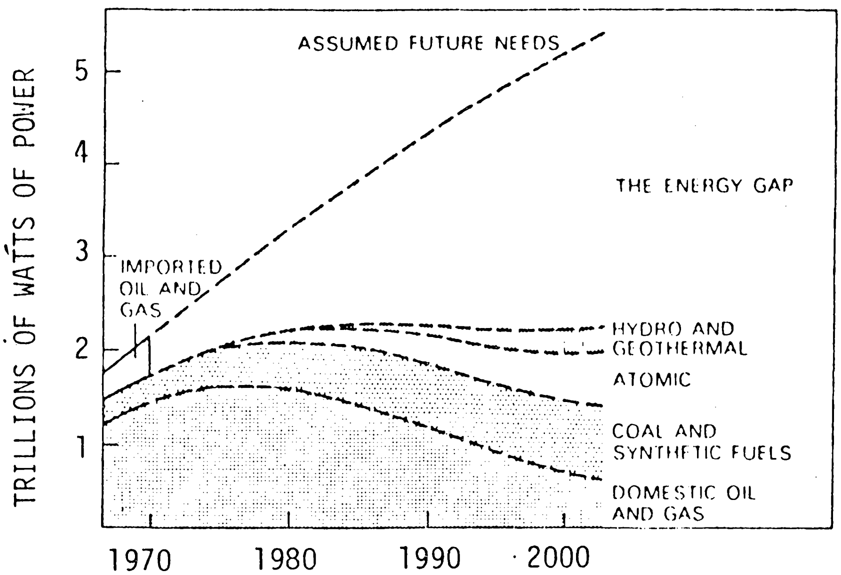
The consumption of natural resources has been a problem concerning ecologists for several years. In October, 1973, the problem became a public concern when the Arab Oil Embargo cut off supplies of crude oil to the United States.

Various methods were used to stretch our supplies of automotive and heating fuel. The "American way of life" was threatened by Sunday closings of gas stations, odd-even days of gasoline buying, and heating bills that soared even as thermostats were lowered. Speed limits were lowered nationally to 55 mph, year-round daylight savings time was instituted and the long delayed Alaskan pipeline was approved by Congress.

With the ending of the embargo in March, 1974, many of these hardships were forgotten by the average American, as a period of plenty once again was prevalent. Only warnings of caution by national leaders that we must strive for energy independence before our whole way of living was threatened, rising gasoline prices, and ever-increasing heating bills remained with us as warnings of future problems.

Today, 5 billion barrels of oil later, walking away from the worst winters the nation has suffered in many years, the United States is more dependent on Middle Eastern oil than it was in 1973-74. (1) Prices have risen sharply, causing economists to fear that by 1980 Americans will have spent as much as $600 billion in the Middle East for crude oil. (2) Inflation has increased and people in industries dependent on oil have been laid off their jobs. (Figure 1)

Presidents Nixon and Ford attempted to deal with the problems. Nixon established the Federal Energy Administration and Ford followed this by creating the Energy Research and Development Administration (ERDA). Energy policies established attempted to control prices on



Projected U.S. Energy Gap

FIGURE 1

domestic oil, gave the President emergency powers and set mandatory fuel economy standards beginning in 1977. (3)

During the winter of 1976-77, the American public was once again confronted with the fact of an energy crisis. In the face of record low temperatures, snow and ice storms, the country was also faced with a shortage of natural gas heating fuel and home heating oil products. Everyone rallied to insure that homes had sufficient fuel to stay warm.

Schools closed by the inclement weather remained closed to conserve fuel. Businesses of a non-necessary nature were urged to curtail working hours or close completely for the duration of the problem. In Ohio, schools beseiged by bad weather and fuel shortages closed their doors for several months and gave lessons over local television. Factories closed and went on maintenance-level heating. Thousands of out-of-work people applied for emergency welfare payments.

As heating bills soared higher and higher, newspapers began to give more attention to stories about elderly persons and welfare recipients found frozen to death because of lack of heat or because their gas had been turned off.

Census figures show that in 1973, in the United States there were 68,886,000 houses being heated, of which 7,213,000 were using electricity for heating, 61,422,000 were using fossil fuels such as gas, coal, or wood, 151,000 were using other fuels such as solar or geothermal energy, and 480,000 were not heated at all. (4) Although it should be considered that some of those homes without heating may be located in areas where little or no heat is necessary, it is probably more true that they are simply unheated homes.

1974 HUD statistics show that there are 1,641,300 low-rent public housing units in the United States. (5) Statistics also show that in 1973 there were 22,973,000 persons living on incomes below the low income level. (6) If one assumes that these families live in the public housing units and the unheated housing, one finds that, in the United States in 1974, there were 22,973,000 persons, of all ages, living in 2,121,300 housing units. These people, living on low or fixed incomes, are among the hardest hit by the rising costs of food, shelter, and energy.

Studies show that low income Americans spend a larger portion of their income on housing expenditures than do those with higher incomes. (7) Those with lower incomes generally tend to live in less sound housing, leading to higher fuel costs. These higher costs are difficult to meet on incomes already lower than the national standard, and result in gas shut-offs or an inability to purchase other fuels.

State of the Art

Vernacular architecture is the term given to building style developed over the years in response to the climatological and socio-cultural problems of a region. These styles solved, without a high degree of technological advancement, many of the energy problems man is faced with today. Available materials (or lack of materials, as in the underground caves of China and Tunisia) were considered, along with the climatological problems: high temperatures, excessive humidity, torrential rains, etc., in creating built environments easily adaptive to the seasonal problems of climate control.

With the industrialization of the American lifestyle, these vernacular solutions to regional climatic problems have become simply building styles that can be constructed in any climate. Until the arrival of the energy crisis of 1973-74, the wonders of central heating and air conditioning made possible the row upon row of "ticky-tack" houses with fixed windows and little vegetation around them. But with the arrival of that crisis, a second look has been taken at vernacular American architecture. No longer is warmth simply a matter of adjusting the thermostat.

A study of architectural styles in America can range from the sod huts of the early colonists, and the pueblos of the indians of the Southwest, to the igloos of the Eskimos. Each makes use of thick walls constructed of various regionally available materials, earth, stone, clay, ice. Much as the conical thatched roofs of houses in Tanzania shed water from torrential rains, the shed roof of the New England saltbox was developed to prevent heavy build-up of winter snows. (8)

Before the days of woolglass insulation, thick walls were used to insulate homes. The thick adobe walls of the pueblos of the indians of the Southwest blocked the heat of the sun during the daylight hours and, according to a study by architect Ralph Knowles, stored as much as fifty percent of the sun's heat during the winter for use at night. (9)

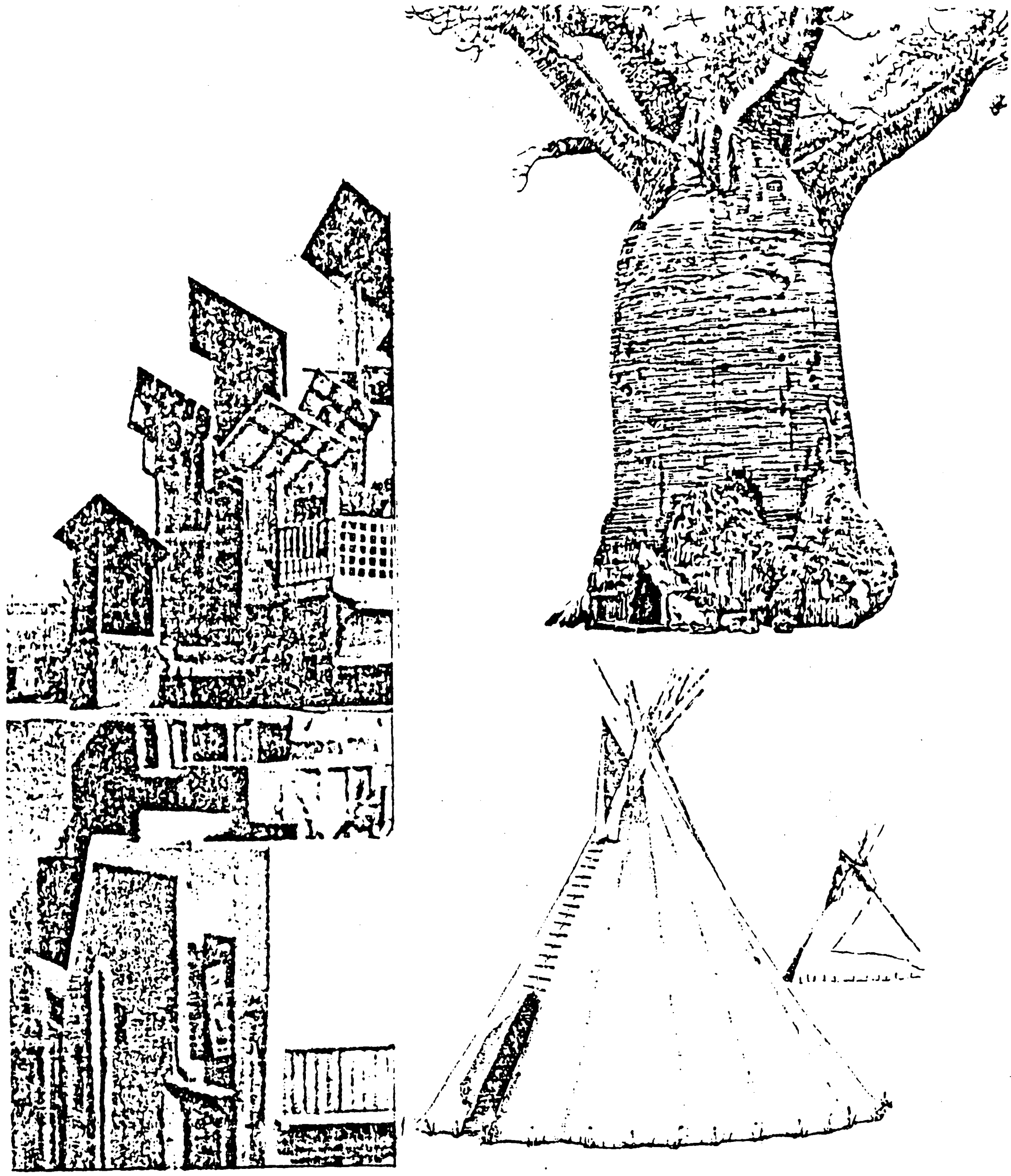
In studying the buildings at the Shaker village at Pleasant Hill, Kentucky, several energy conserving features are observed. Thick walls of limestone blocks and stone rubble, with plasterwork on the interiors, hold the heat of the winter sun yet maintain cool interior spaces in warmer weather. Windows are deeply recessed as are exterior entrances. Rooms are heated in the winter by small, free-standing, trapezoidal iron stoves. (Figure 2)

In recent years, interest has been regenerated in the building techniques of the past. Studies by various groups, such as the Arkansas Power and Light Company, the Department of Housing and Urban Development, and the Tennessee Valley Authority have caused the development of several legislative acts and standards.

The Energy Conservation in Buildings Act will provide up to $55 million a year in federal funds to insulate existing low-income buildings, particularly for the elderly and the handicapped. Figures indicate that approximately 1.5 million units can be weatherproofed, thus saving the equivalent of 35,000 barrels of oil or a total of $200 million a year. (11)

The ASHRAE Design and Evaluation Criteria for Energy Conservation in New Buildings, Standard 90-75, will go a long way toward encouraging the architect and engineer to design buildings with lower energy consumption. Standard 90-75 contains the following basic energy-conscious standards:

1. Maximum heat flow (i.e., minimum thermal resistance values), depending on climate, for roof-ceiling assemblies, walls and floors. (This deals with required amounts of insulation to be used in the various parts of the country.)



VERNACULAR CLIMATIC DESIGN ADAPTATIONS

FIGURE 2

2. Maximum air leakage rates through wall, doors, windows, and ducts. (This deals with the selection of and insulation of building materials with low U factors.)

3. Minimum efficiencies for heating, cooling, and ventilating equipment.

4. Mandatory cooling with outdoor air (i.e., the so-called economy cycle) for ventilating equipment. (This deals with the use of more efficient equipment for ventilating with outdoor air except in such instances as high pollution content.)

5. Minimum electric (power-factor) and lamp efficiencies. (12)

In addition to these standards, it recognizes the use of solar and wind energy by allowing certain of the items listed above to be lowered or ignored if these systems are used.

In addition to federal and industry attempts to lower energy requirements while maintaining comfort, many states and cities are revising their code requirements to meet energy conservation standards. Both California and New York state already have passed laws, effective in 1975, the former dealing with office and commercial buildings, in addition to an already-in-effect residential standard, and the latter dealing with residential standards. In Davis, California, a building code has been passed for city-wide energy conservation. (13) It governs such things as window area, roof color, and quality of insulation. In other areas of the country tax credits are being given to housing newly built or renovated to the use of solar or wind energy.

The Arkansas Plan, which is a landmark in energy conservative building construction, was developed by the Arkansas Power and Light Company, with the assistance of the Department of Housing and Urban

Development. Basically, the plan deals with construction detailing related to placement of vapor barriers, use of 2" by 6" studs placed 24" on center, amounts of insulation in walls and ceilings, and the allowable square footage of window area. (14) Originally developed in response to complaints by homeowners with heat pumps, the Arkansas Plan has been monitored to show energy savings of up to sixty-three percent. (15)(Drawing #1)

The "Super Saver" Program has been developed by the Tennessee Valley Authority for use in homes which heat with electricity, a product which they produce. It has basically the same components as does the Arkansas Plan. The two vary in that the TVA program discusses and recommends additional energy savers such as the use of fluorescent lighting where possible, site orientation to take advantage of climatic factors and the use of heat exchangers or outside entry for combustible air for fireplaces. (16)

If maximum insulation and site orientation are important factors in energy conservation building programs, they are major factors in the successful use of such alternative systems as solar and wind energy.

The heat of the sun and the chill of the wind are probably the oldest comfort factors known to man. Almost all of his vernacular architecture capitalizes on one or both to make his shelter comfortable. Orientation of structure on a site to take advantage of seasonal sun and wind factors was automatic as recently as the early 1900's.

It is possible that much of what man once knew regarding the use of the sun and the wind has been lost, as much of his early history and development has been lost. The current energy crisis has strengthened an already growing interest in the past use of these and other systems. In the 1960's there were nine buildings in the world dependent, to some degree, on solar technology; today there are several hundred, with that many or more under construction. (17) Currently the most viable of the "new" energy systems, the sun can be harnessed in four basic systems, ranging from highly technical and extremely expensive "active" systems, to simple, low cost "passive" systems.

According to an Arizona State University study, the four basic types of solar systems are:

1. the direct heating of space by the sun's rays;
2. the direct heating of a mass (generally water or rock) which radiates heat to the space;
3. the heating of the collector by the sun's rays, which in turn transmits its heat via water or air to a material, such as water or rock, to be stored until needed to heat the space;
4. the storing of the sun's rays in solar cells or immediate conversion to electrical power to operate the mechanical equipment necessary to condition the space. (Appendix C)

Each system has certain implications relating to design site orientation, and selection of construction materials.

One fallacy regarding solar power is that it operates only in warm, sunny climates. Harry Thomason's installations, in Washington, D.C., are located almost on the perimeter of the "solar belt." (18) An inventor-engineer, Thomason's installation used part of the roof as a heat collector through which water is circulated. This water is then stored in a tank in the basement which is "insulated" with rocks which also hold heat. A blower fan circulates the warm air to the house. Although heat may be stored for several days, a standby heating system is also available. The use of a standby system is standard in northern climates where heating solely by solar energy would require an enormous collector-storage system.

Although solar energy is currently used almost exclusively in single-family housing, President Carter's proposed tax incentives for use in industry will, if passed by Congress, increase the number of businesses using solar power as an energy source. Current installations include a school in Colorado, office buildings in New Mexico and a community center in Alabama. These are not experimental laboratories as are many solar installations, but structures whose owners are convinced of the future of solar energy. In the near future the Federal Energy Research and Development Administration will begin construction of a plant in California which will convert solar energy into electricity.

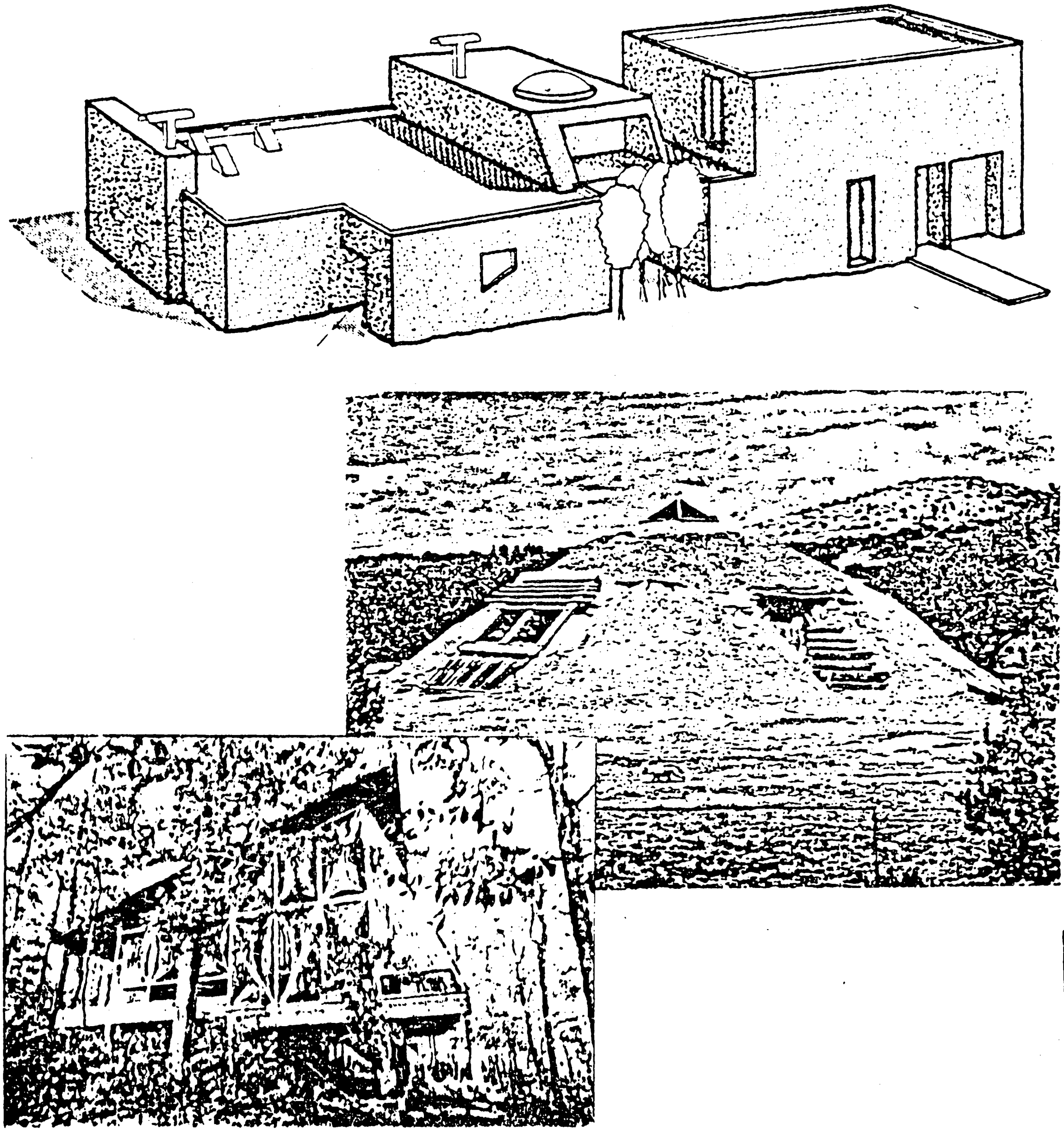
An installation which has interesting implications for the use of solar energy in multi-family housing was designed and built by Lee Porter Butler. Located in a densely wooded area of West Tennessee, the house, which is 70 feet square and 40 feet high, has twenty-six rooms, and a greenhouse garden with pools, all located on four levels. (19) Mid-winter battles with zero degree temperatures have proved the workability of the passive system incorporated into the design of the house, as interior temperatures fell only to an average level of 68 degrees. (20)

In all of these installations, whether house, school, or community center, construction details play an important part in the viability of the structure. Maximum insulation in walls, floors, and ceilings, double-glazed windows or storm windows on retrofitted installations, vestibules at exterior entrances, caulking and weatherstripping, all increase the comfort of the structure.

Although solar collectors can be retrofitted onto existing structures or added to traditionally-designed new housing, the majority of installations are on new housing of contemporary design. In many instances a comparison of individual design points show a high degree of adaptation of vernacular architectural ideas. (Figure 3) Richard Crowther's recessed doorway reflects the entrance of a Masai hut, Sydell and Steve Lipson's greenhouse reminds one of the thatched huts in many humid regions, and Daniel Newman's hogan is . . . a hogan.

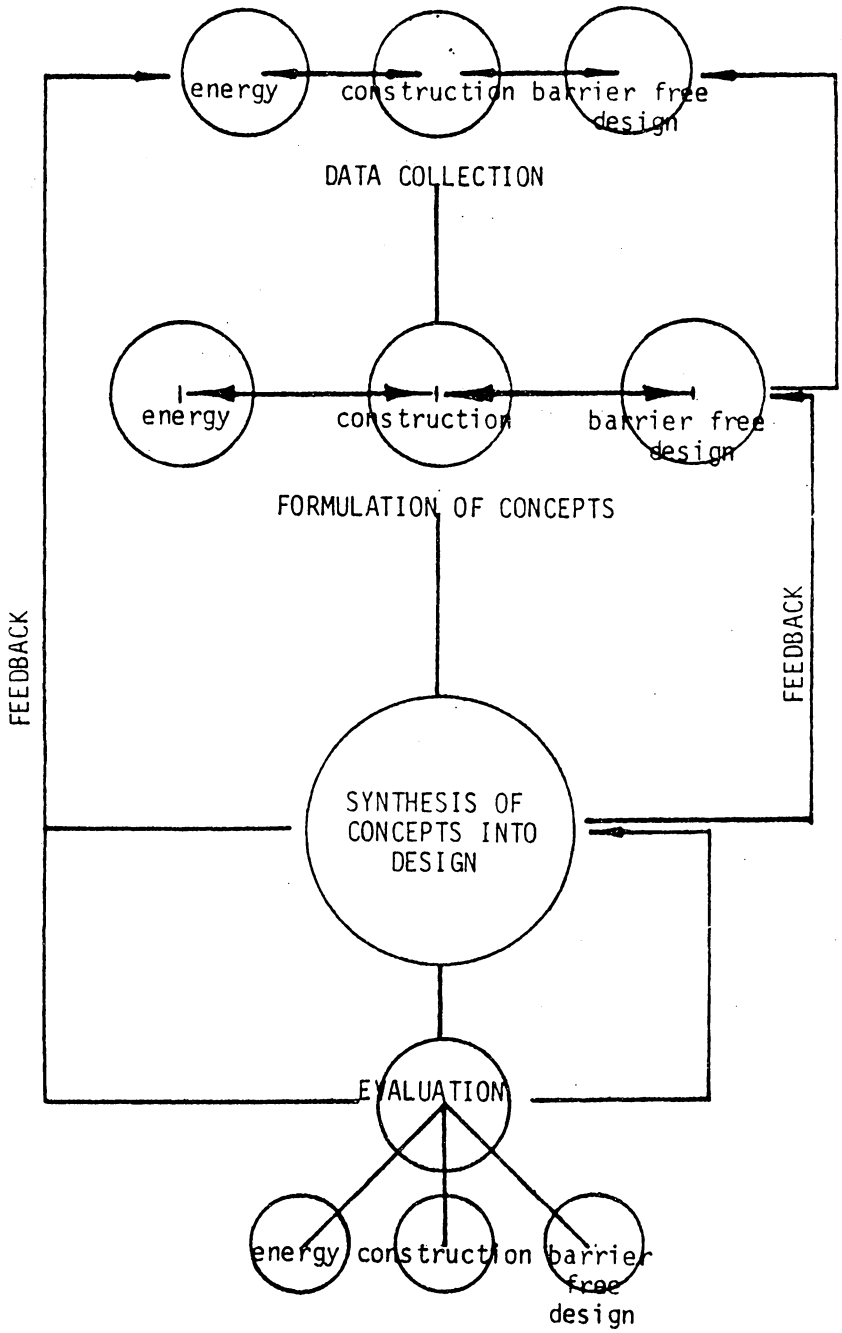
John McGinty, of the American Institute of Architects, reflects that dramatic changes in architectural design will be and, in fact, already are being made. These changes, he feels, will reflect a return to regionalism in design, back toward the vernacular design that maximizes climatic factors and, McGinty continues:

> I think it's going to be exciting. More beautiful, more humane. We're going to think more about natural comfort instead of resorting to mechanical solutions. I don't think we are going to have any suffering--I think we're just going to burn less oil. (21)



CONTEMPORARY VERNACULAR ARCHITECTURE

FIGURE 8



DESIGN METHODOLOGY

FIGURE 4

PART 2

ANALYSIS

Site Selection

Increased awareness of and interest in nature has caused many Americans to seek homes in previously rural areas. Reverse-migration statistics indicate that an influx of people has caused the countryside to take on an increasingly urban/suburban appearance. Houses built in areas that once were farm land have created a need for extensive support facilities, such as electrical power, waste water disposal, and shopping facilities. As these facilities have evolved, the rural landscape has taken on a cluttered look.

National concern has caused citizens' groups to take action in various ways. In one New England state a citizens' group has given to local farmers the price of their lands in return for a document that states that the land will remain agricultural in perpetuity.

In Tennessee and Alabama the concern of citizens' groups has caused the creation of the Elk River Development Associations. The goal of the associations is to create an alternative to "rural sprawl." With the assistance of the Division of Navigation Development and Regional Studies of the Tennessee Valley Authority the Lower Elk Concept was developed.

As proposed by the Associations and TVA, 1000 square miles in the three counties of Lincoln and Giles, Tennessee, and Limestone, Alabama, will be developed into a national demonstration of ways to provide necessary services to make the rural areas attractive for living while preserving the rural setting and environment. (22) The development of services and amenities should attract residents into well-planned rural villages. Although some industrial development is anticipated, most of this would occur in the existing service towns of Athens, Alabama, and Pulaski and Fayetteville, Tennessee.

The following objectives for the rural villages were identified after several months of discussion by the citizens' groups and TVA:

1. Provide a range of choices in living conditions by developing a series of new rural neighborhood villages.

2. Maintain the natural beauty and openness of the three-county area.

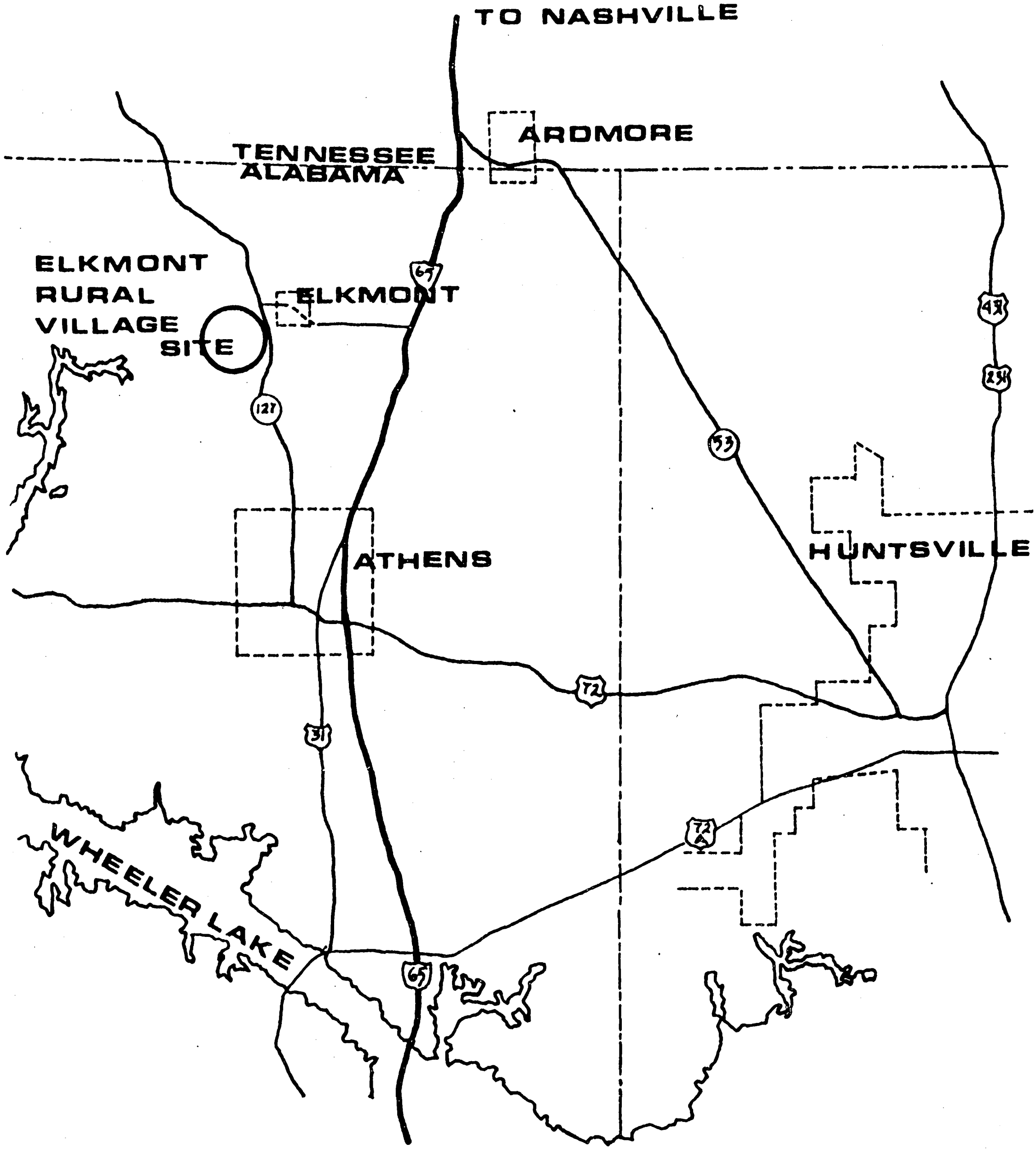
3. Improve job opportunities in existing towns and provide for ready access to jobs outside the area.

4. Provide housing for a full range of social, economic, and racial groups. (23)

Location: Elkmont, Alabama

The location selected for the first village is adjacent to the west side of State Highway 127, near Elkmont, Alabama, ten miles north of Athens, and three miles west of Interstate 65. (Figure 5) The 1500 acre site is essentially an elongated plateau surrounded on three sides by a series of steep ravines that open to flood plains cut by creeks flowing into the Elk River. (24) Much of the site is relatively flat or undulating although there are moderate to severe slopes in places.

Elkmont Rural Village will consist of approximately 900 acres of developed land and 600 acres of open space, primarily on the periphery of the village. (25) Slope areas will be retained in their



LOCATION: ELKMONT, ALABAMA

FIGURE 5

natural state and flood plains will be reserved for common open space. All utilities in the village, including electrical and telephone lines, will be underground.

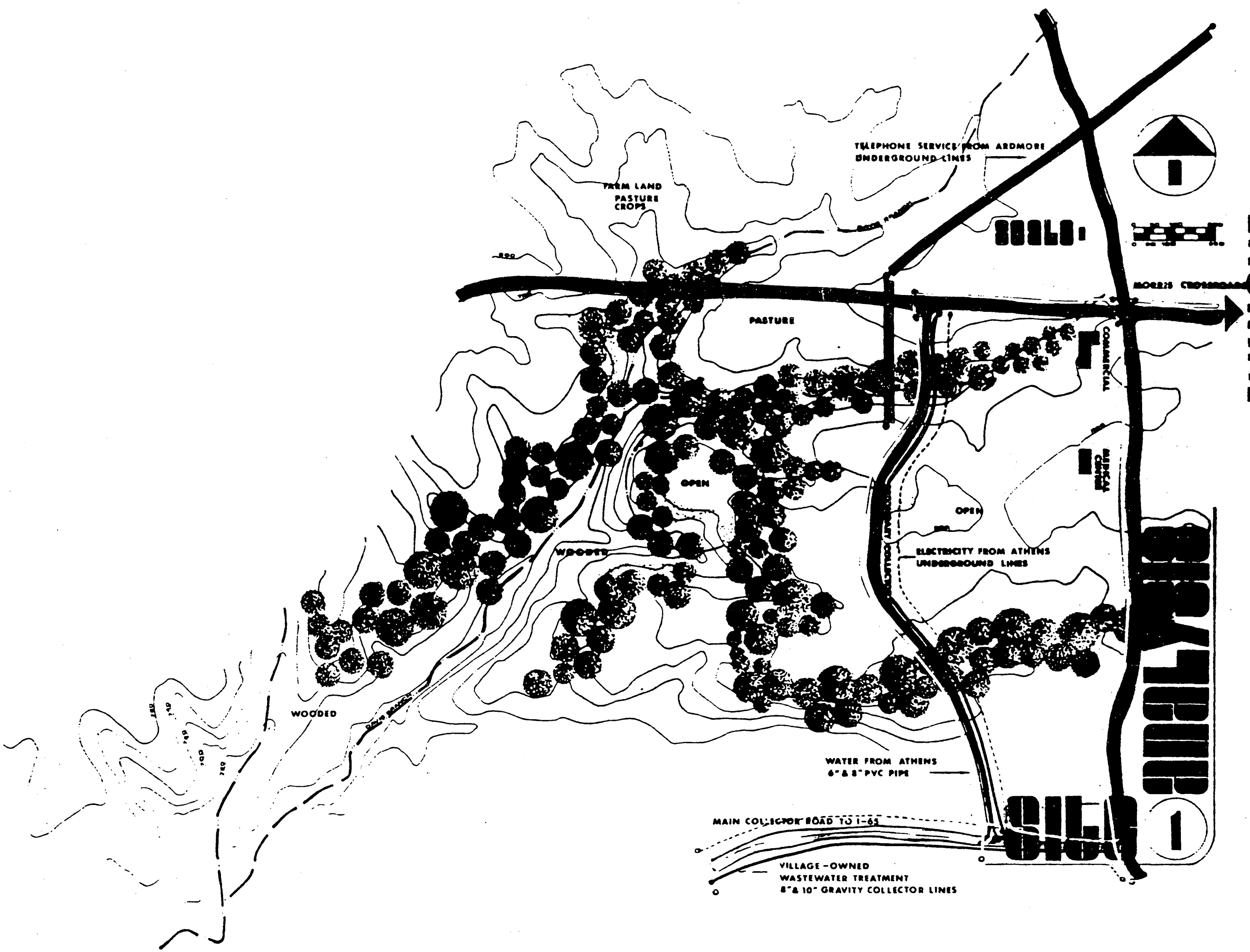
The village will contain housing for approximately 1,000 families, ninety percent of which will be single family units. The remaining ten percent will be in multi-family units. (26) Available public incentive programs to provide for the housing needs of families of low and moderate income will be utilized in the development of the village.

Elkmont Rural Village, along with the yet-to-be-established villages in Tennessee are to serve as research vehicles for the Tennessee Valley Authority. As each village is to be developed in stages, it is felt that any and all new waste water treatment systems, energy systems, and conservation devices can easily be built into the housing of any new stage.

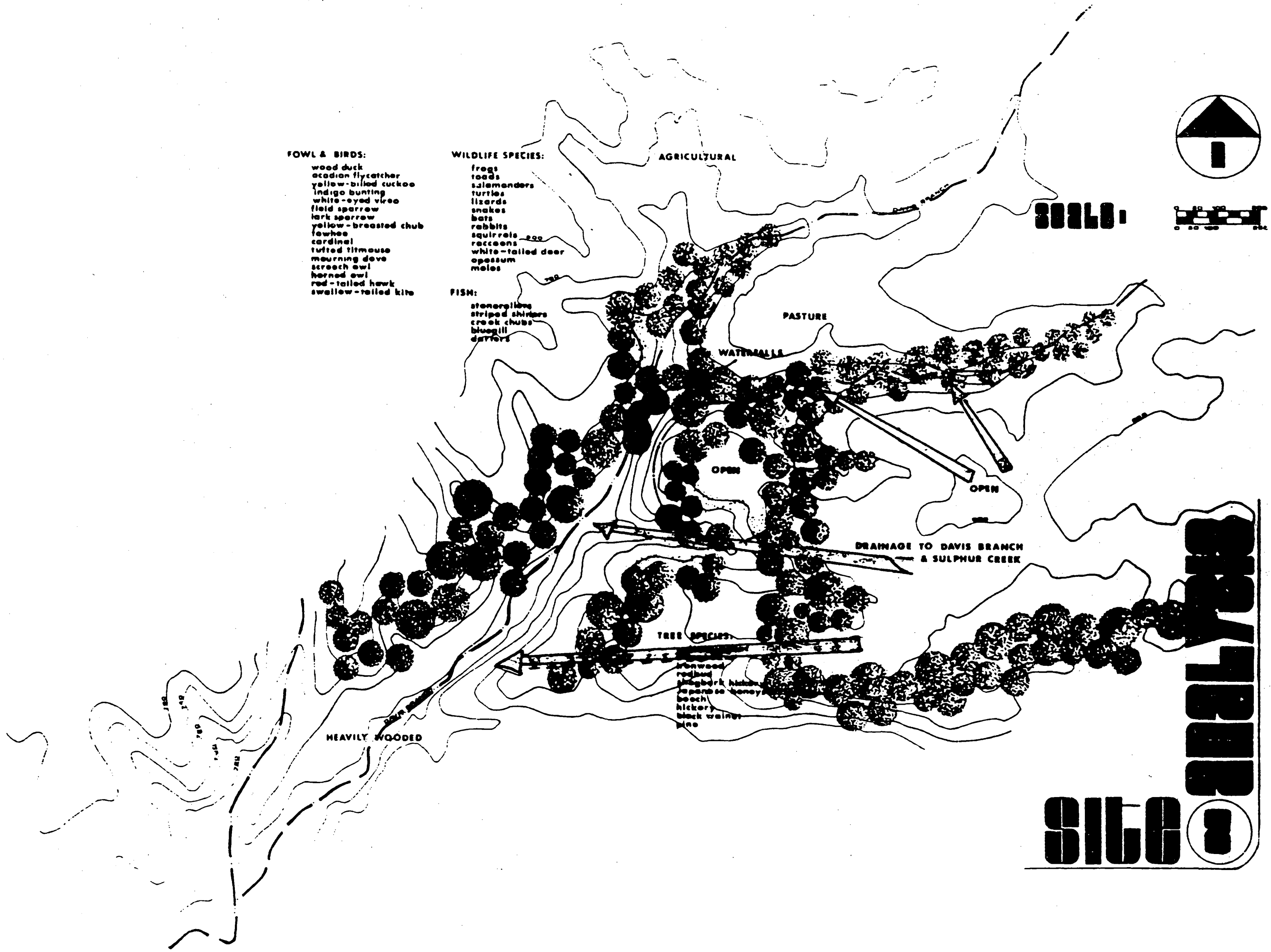
Current restrictions relate to the use of solar energy, the "Super Saver" construction program, and restricted use of open wood-burning fireplaces.

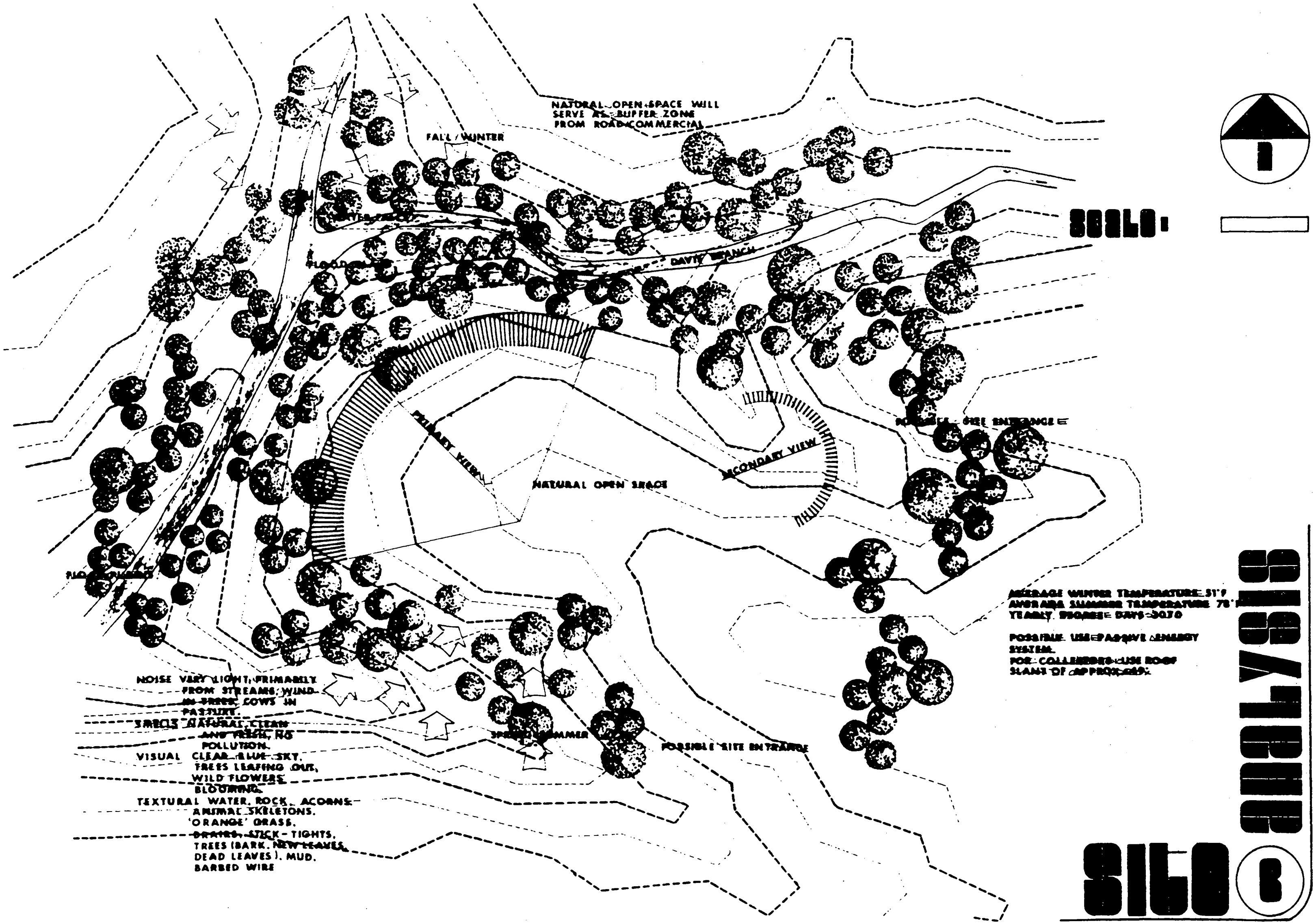
Building Site Location

The site selected for the location of the housing to be designed is located below the junction of Sulphur Creek and Davis Branch, in an area designated for multi-family housing. Surrounded by trees on all sides, the site itself is free of vegetation other than grasses and small bushes.



TELEPHONE SERVICE FROM ARDMORE
UNDERGROUND LINES
FARM LAND
PASTURE
CROPS
SCALE
MORRIS CROSSROADS
ELKMONT
PASTURE
COMMERCIAL
OPEN
OPEN
WOODED
WOODED
ELECTRICITY FROM ATHENS
UNDERGROUND LINES
WATER FROM ATHENS
6" & 8" PVC PIPE
MAIN COLLECTOR ROAD TO I-65
VILLAGE-OWNED
WASTEWATER TREATMENT
8" & 10" GRAVITY COLLECTOR LINES
SITE
ANALYSIS
1


FOWL & BIRDS:
wood duck
acadian flycatcher
yellow-billed cuckoo
indigo bunting
white-eyed vireo
field sparrow
lark sparrow
yellow-breasted chub
towhee
cardinal
tufted titmouse
mourning dove
screech owl
horned owl
red-tailed hawk
swallow-tailed kite
WILDLIFE SPECIES:
frogs
toads
salamanders
turtles
lizards
snakes
bats
rabbits
squirrels
raccoons
white-tailed deer
opossum
moles
FISH:
striped shiners
creek chubs
bluegill
darters
AGRICULTURAL
PASTURE
WATERFALLS
OPEN
OPEN
DRAINAGE TO DAVIS BRANCH
& SULPHUR CREEK
TREE SPECIES:
beech
hickory
black walnut
pine
HEAVILY WOODED
SCALE:
SITE 3 ANALYSIS


NATURAL OPEN SPACE WILL
SERVE AS BUFFER ZONE
FROM ROAD COMMERCIAL
FALL / WINTER
DAVIS BRANCH
PRIMARY VIEW
SECONDARY VIEW
NATURAL OPEN SPACE
POSSIBLE SITE ENTRANCE
NOISE VERY LIGHT, PRIMARILY
FROM STREAMS, WIND
IN TREES, COWS IN
PASTURE.
SMELLS NATURAL, CLEAN
AND FRESH, NO
POLLUTION.
VISUAL CLEAR BLUE SKY,
TREES LEAFING OUT,
WILD FLOWERS
BLOOMING.
TEXTURAL WATER, ROCK, ACORNS,
ANIMAL SKELETONS,
'ORANGE' GRASS,
STICK - TIGHTS,
TREES (BARK, NEW LEAVES,
DEAD LEAVES), MUD,
BARBED WIRE
SPRING / SUMMER
SCALE:
SITE ANALYSIS

The site is relatively isolated, as it will be accessible only via a secondary collector road. At least one portion of the boundary line runs along a buffer zone which consists of several acres of pasture land. This effectively isolates the site from the noises and odors created by traffic along a major traffic area.

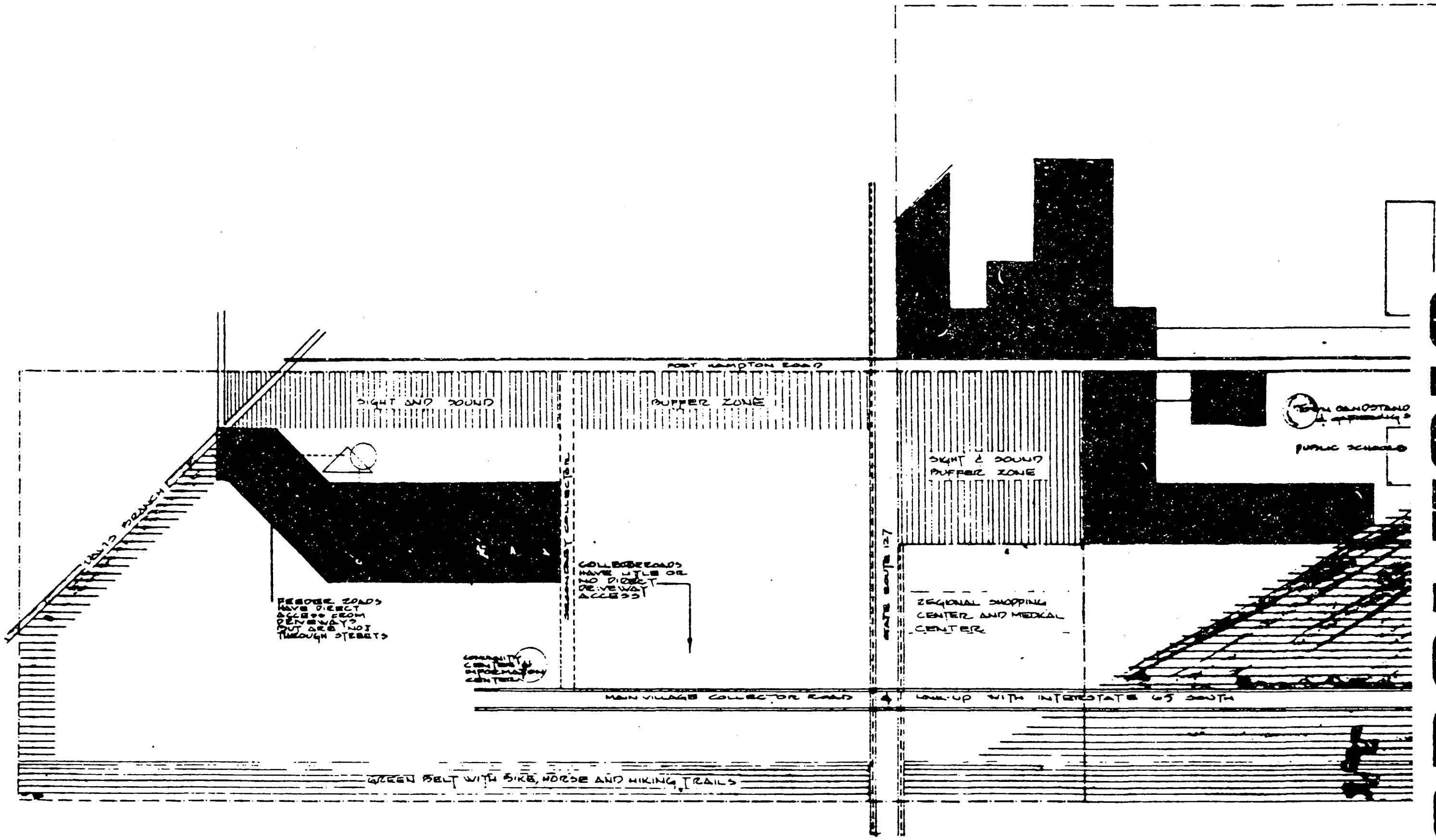
Utilities and other basic needs such as trash collection, police protection, and medical care will be supplied by surrounding communities until such time that the rural village is annexed by Elkmont or becomes an incorporated town.

Building Program

The housing requirements for the cluster of family housing (Appendix A) is strongly based on the needs and desires of low-income southern families. A strong relationship to the out-of-doors is considered important as these people traditionally are farmers or farm workers.

In contrast to many low-income families, the family size in Limestone County is relatively small (3-4 family members) and rarely is housing shared by more than two generations. Older persons continue to maintain independent homes for the most part.

As Elkmont is the nearest market area the village must be considered in relation to it. Not only will friends and family be located there, but also the educational facilities to be used by the villagers will be located in Elkmont.

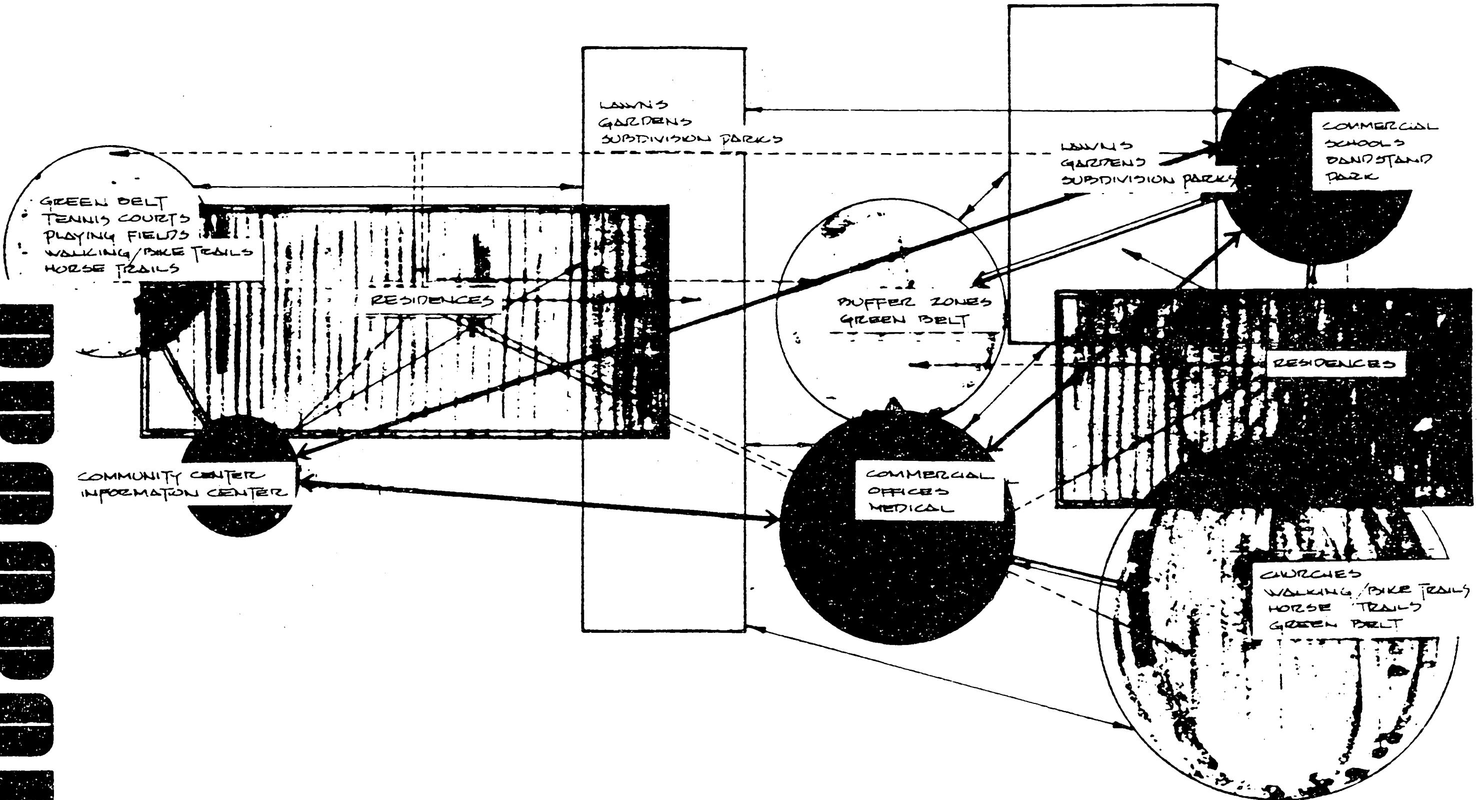


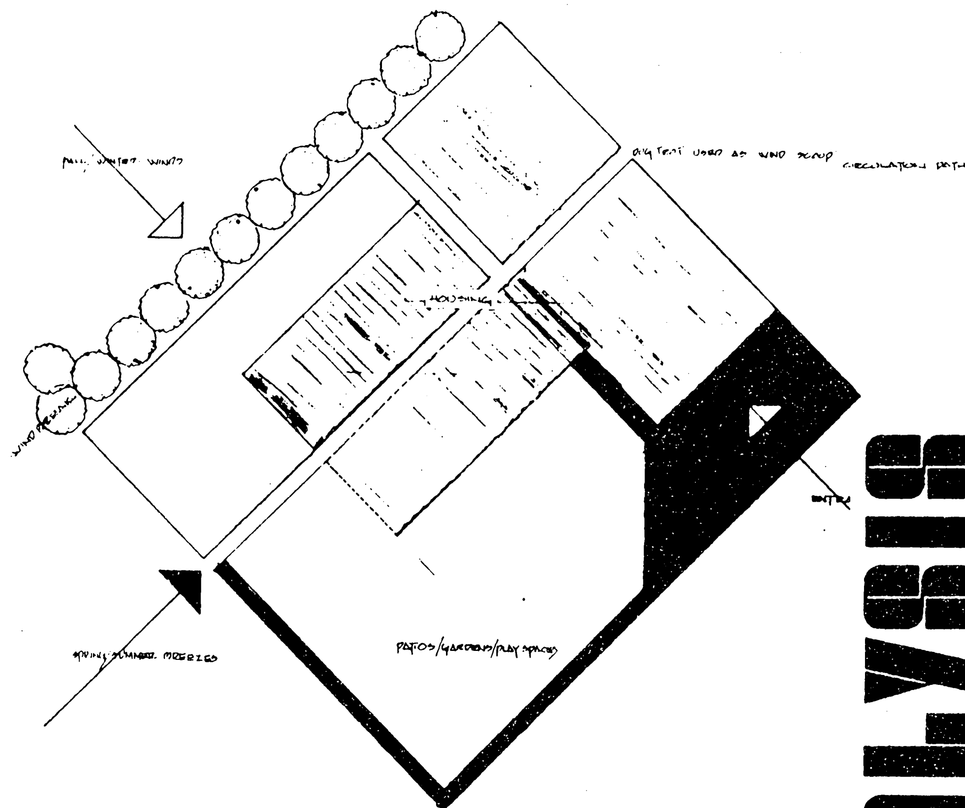
PROGRAM 1

SYNTHESIS

PROGRAM

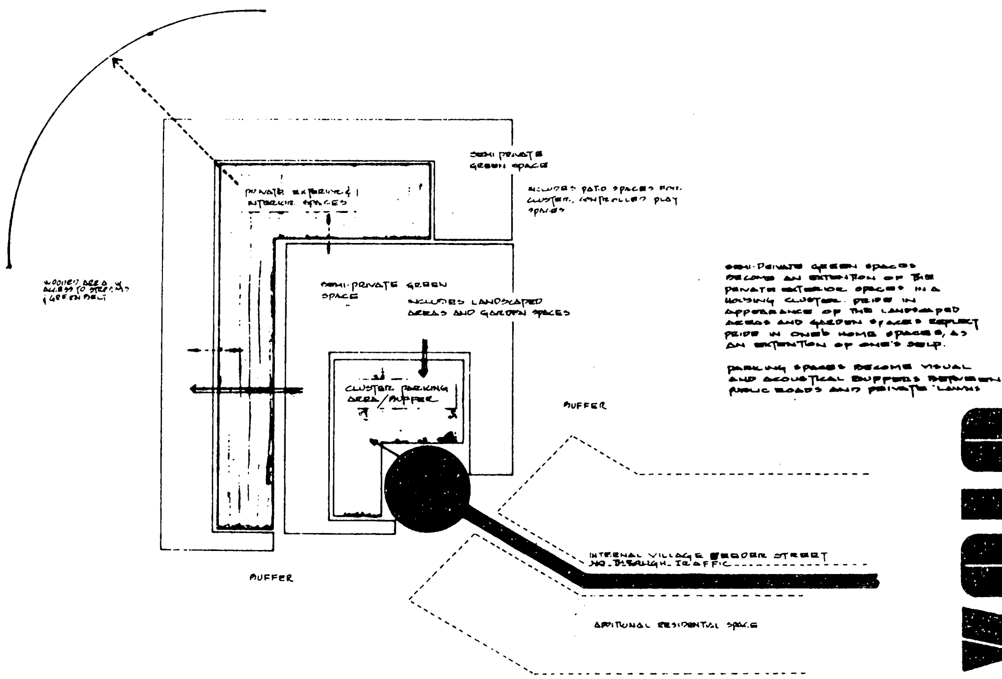
analysis



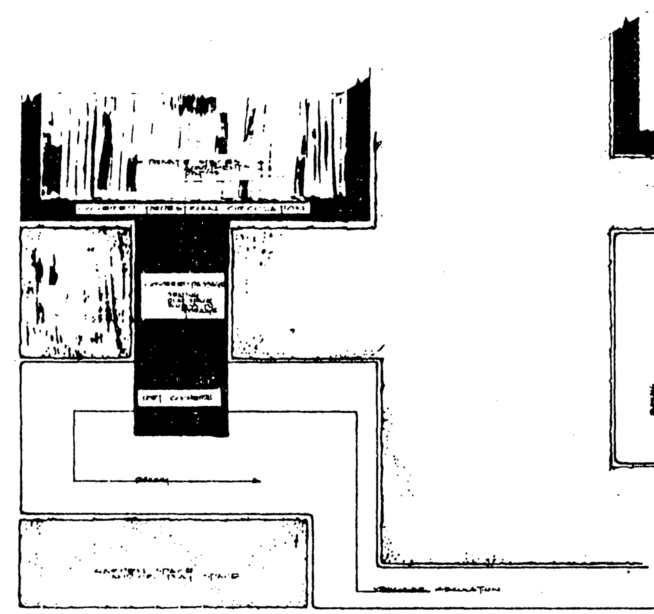


PROGRAM ANALYSIS

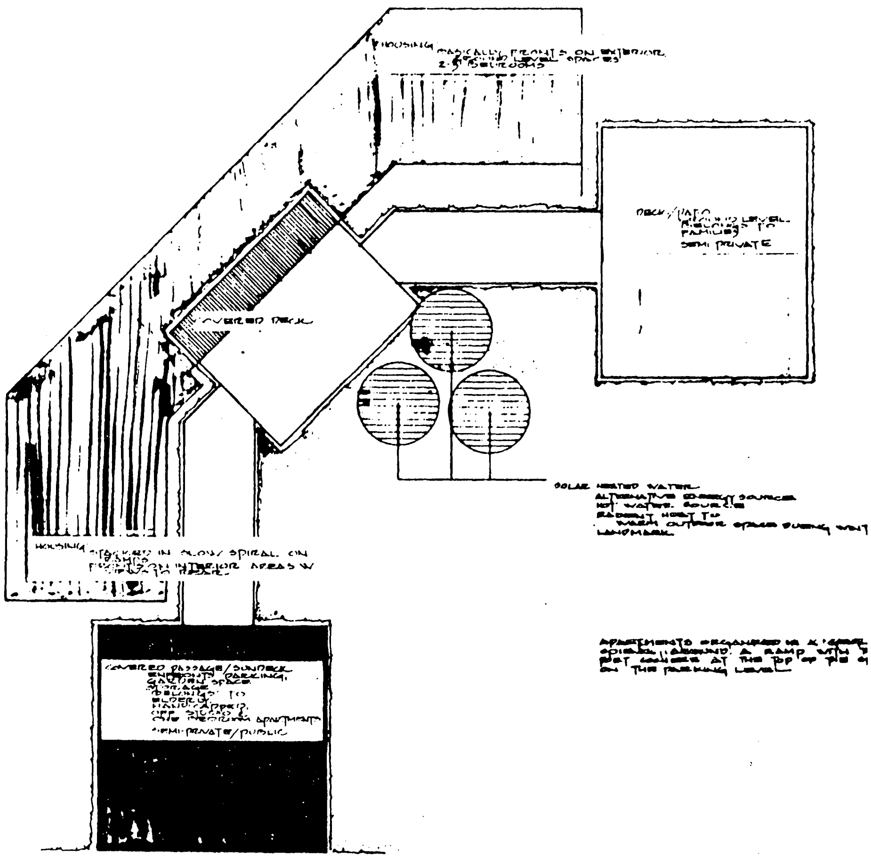
3



PROGRAM 4 ANALYSIS

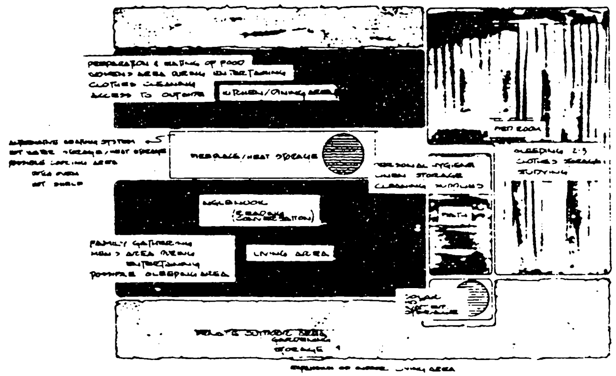


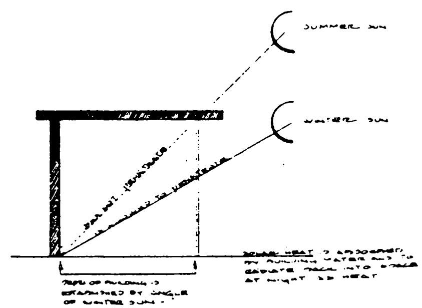
PROGRAM 5 ANALYSIS

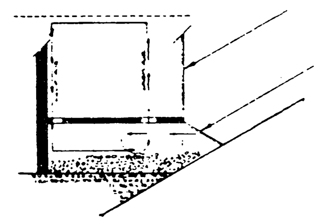


PROGRAM ANALYSIS 6

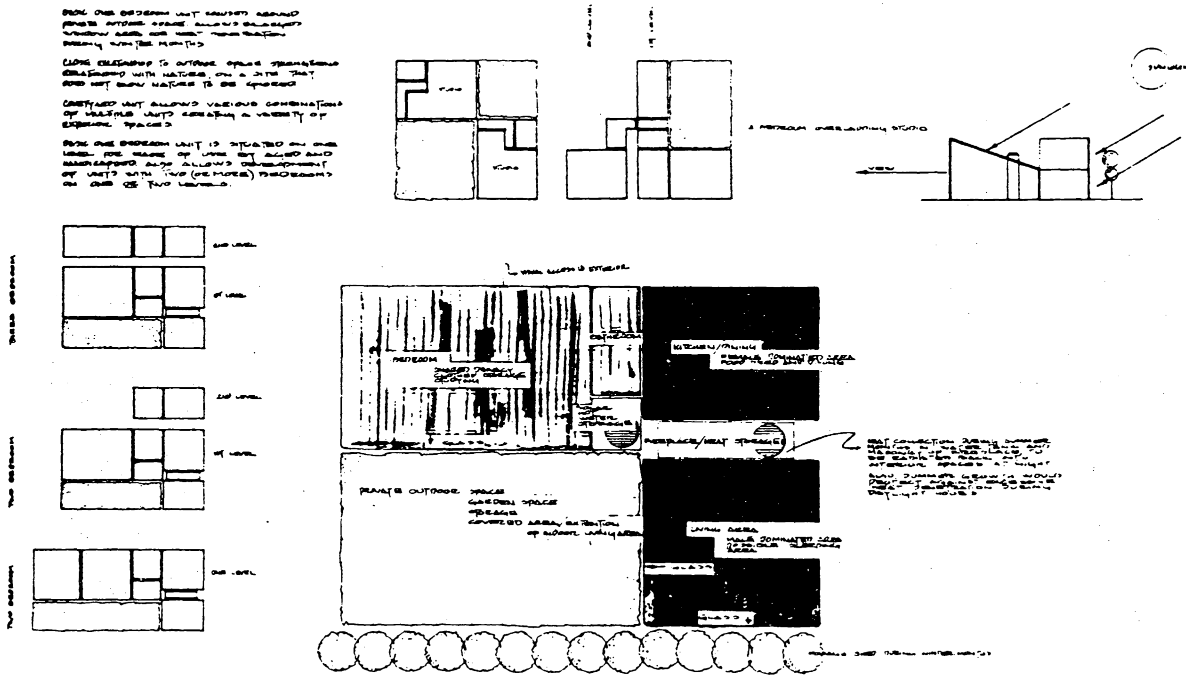
7 PROGRAM analysis







PROGRAM & analysis



PART 3
DESIGN

The Design

The units produced for the housing program are based on the information derived from the collection of data in three basic areas: 1) energy conservative construction, 2) alternative energy systems, and 3) barrier free design.

Energy Conservative Construction

Data collected in the area of energy conservative construction led to the selection of a precast concrete box as the basic building module. The box, altered to consist of three walls of reinforced concrete jointed by wet joints, had exterior dimensions of 26'0" x 13'0" x 11'0". The one box system was expanded by the addition of a similar box 16'0" x 13'0" x 11'0". (Drawing BM/1)

Concrete was selected as a building medium because of its heat retention properties. The relative thickness of the walls (six inches) act much as did the adobe of the southwest indians and the limestone blocks of the Kentucky Shakers, by maintaining even temperatures in the interior in contrast to temperature variations outside.

Additionally, the absence of large glazed areas in the direction of the winter winds, the use of airlock entries, solariums, double pane glass, and maximum insulation values aid in the prevention of heat loss.

Alternative Energy Systems

A study of alternative energy systems began with a study of solar energy systems. Varying from low technology (passive systems) to high technology (solar storage cells), consideration of the technical background (or lack thereof) of many low-income families led to the selection of a low technology or passive solar energy system, the Skytherm solar roof ponds. This is a natural heating and air conditioning system which appears to be ideally suited to a climate where summer heat may actually present more of a problem than winter cold. (Drawing E/2)

In addition to the solar roof ponds, each housing unit is equipped with one or more woodburning stoves for use during those periods when lack of solar radiation would make the roof ponds inoperable. This is also a low technology system with which many of the families would be familiar and comfortable.

The domestic hot water supply is heated by solar collectors placed on the sloped wall of the storage shed. The water is held in a storage tank, also located in this area, until it is needed. A heat booster element in the hot water heater triggers automatically to raise the water temperature on those days when overcast skies reduce the effectiveness of the collector system. (Drawing E/4)

Barrier Free Design

Designing for the aged and the handicapped involves not only the interior of the housing unit but also the site itself. Alabama Legislative Act No. 224 gives specifications for site development for maximum ease of use by the aged and the handicapped. (Appendix B)

Interior design revolves around the restrictions placed on a person confined to a wheelchair, although the same general considerations should be made for those restricted by age or other mobility factors (crutches, walkers, braces, etc.)

Basic considerations were for the accessibility of the kitchen, bathroom, and other parts of the apartment via circulation areas. Circulation spaces ideally should measure a minimum of 48" in width. The average wheelchair needs five feet square to maneuver in both bathroom and kitchen areas. Counter heights and toe spaces should allow for arms and footrests in order for the user to be able to get as close to appliances, sinks, etc., as possible. (Drawing B/F 1)

Evaluation of Design

In this design, every effort has been made to meet the physical, psychological, and sociological requirements of the families for which this program was designed.

Visits made to the site and the surrounding area, discussions with local leaders as to the needs of the locality, plus the personal experience of having lived in the general area for most of her life gives the designer certain instinctive feelings for the needs of these people. In addition to research in technical and legislated restrictions and requirements, this background knowledge assisted the designer in creating a functional living environment adaptable to the needs of a variety of people. No attempt was made to create an unusual design because it would be unacceptable to those for whom the housing is intended. An attempt was made to create a functional, habitable environ which would make technology palatable to a low technology people.

An evaluation of the design could continue but, as every architect must know, the final and most important evaluation would lay in the hands of the user.

As a learning experience, it has been extremely valuable in learning to bring together many diverse but equally important factors into a coherent design.

SPECIFICATIONS FOR THE ARKANSAS PLAN OF ENERGY CONSERVATIVE CONSTRUCTION AND THE TENNESSEE VALLEY AUTHORITY SUPER SAVER ELECTRIC HOME MUST BOTH MEET OR EXCEED HUD MINIMUM PROPERTY STANDARDS:

INSULATION:

MIN. R-VALUES REQUIRED - CEILING R-26, FLOORS R-13, WALLS R-19 (FOR ALABAMA)

CONCRETE SLAB FLOOR PERIMETERS - 1½" URETHANE (R-10)

NON-CONDITIONED SPACE DUCTWORK - 3" EXTERNAL OR ½" INTERNAL LINER OR EQUIV. COMBINATION

CONDITIONED SPACE DUCTWORK - ½" DUCT LINER

WATER HEATER - SHOULD HAVE 2" EXTERNAL LAYER

VAPOR BARRIER:

WALLS, CEILINGS, FLOORS - POSITIVE VAPOR BARRIER COVERING ALL SURFACES

POLYETHYLENE - LAPPED 6" AT ALL JOINTS

CONCRETE SLAB - MUST REST ON COMPLETE V.B.

WINDOWS & DOORS:

NOT TO EXCEED TOTAL OF 10% OF FLOOR AREA. WINDOWS DOUBLE GLAZED OR STORM SASHED

EXTERIOR DOORS - CORE-FILLED WITH RIGID INSULATION, OR WOOD WITH STORM DOOR.

OUTSIDE WINDOWS & DOORS - MUST BE WEATHERSTRIPPED AND CAULKED

WALL CONSTRUCTION:

2" x 6" STUDS PLACED 24" ON CENTER - TO ALLOW FOR MAX. 6" INSULATION.

PARTITION WALLS MAY BE OF 2" x 3" STUD CONSTRUCTION

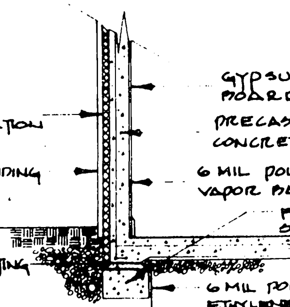
VENTILATING:

EXHAUST FANS - IN KITCHEN AND ALL BATHROOMS AND VENTED TO OUTSIDE.

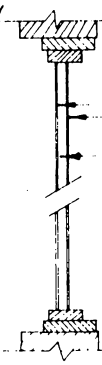
RECOMMENDED:

FLUORESCENT LIGHTING WHERE PRACTICAL, INSULATED DRAPERIES, ENERGY EFFICIENT APPLIANCES, USE OF EVALUATED ALTERNATIVE ENERGY SYSTEMS.

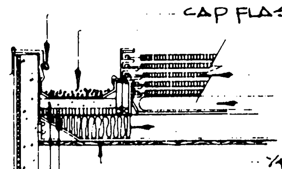
PERIMETER WALL & FOOTING DETAIL

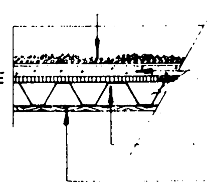


TYPICAL WINDOW DETAIL

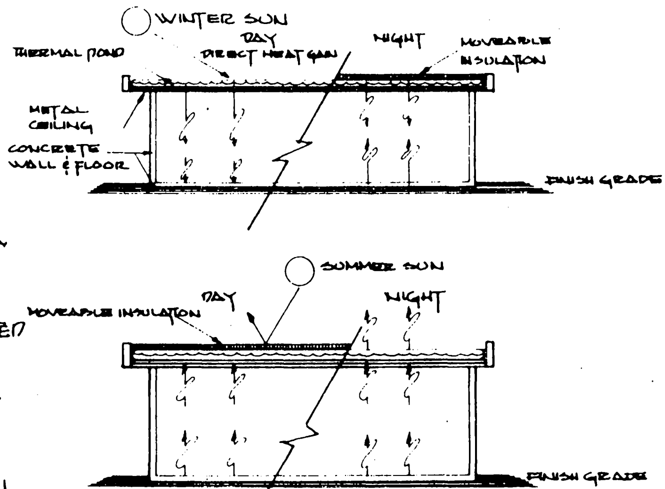


ROOFING DETAILS: FLASHING & WATERPROOFING





ENERGY CONSTRUCTION 1



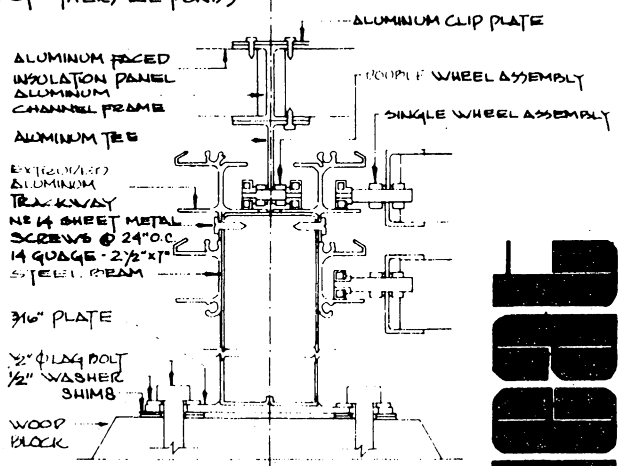
OPERATION OF THERMAL PONDS

HAROLD HAY'S FIRST BUILDING EXPERIMENT WITH A PASSIVE SOLAR HEATING/COOLING SYSTEM WAS IN A HOUSE IN INDIA 22 YEARS AGO. 10 YEARS LATER HE CONSTRUCTED AND EXHAUSTIVELY TESTED A MUCH IMPROVED VERSION OF THE IDEA, THIS TIME IN ARIZONA. IN 1973 THE ATASCADERO, CALIFORNIA, HOUSE WAS BUILT AND EVALUATED BY A HUD GRANT..

THE SKY THERM PASSIVE SOLAR ENERGY SYSTEM FOR HEATING AND COOLING IS A RADIENT ENERGY SYSTEM BASED ON THE COLLECTION OF HEAT IN WATER BAGS, OR THERMAL PONDS, LOCATED ON THE ROOF OF A BUILDING.

FOR SUMMER COOLING THE PANELS OF MOVEABLE INSULATION COVER THE WATER BAGS DURING THE HEAT OF THE DAY. DURING THIS TIME THE WATER ABSORBS THE HEAT OF THE INTERIOR SPACES, WHICH RADIATES THROUGH THE METAL DECK. AT NIGHT THE PANELS ARE OPENED TO ALLOW ABSORBED HEAT TO RADIATE INTO THE COOLER ATMOSPHERE, THUS REDUCING THE WATER TEMPERATURE.

FOR WINTER HEATING THE INSULATION PANELS ARE STACKED, EXPOSING THE WATER BAGS TO THE HEAT OF THE SUN'S RAYS. THE WATER, IN TURN, RADIATES ITS ABSORBED HEAT TO THE METAL DECK WHICH IN TURN RADIATES ITS WARMTH TO COOLER INTERIOR SPACES. AT NIGHT OR ON OVERCAST DAYS THE PANELS REMAIN IN A CLOSED POSITION TO PREVENT HEAT LOSS.



EXTRUDED ALUMINUM TRACKWAY SYSTEM

CONSIDERED A RELATIVELY LOW TECHNOLOGY SYSTEM, THE ONLY OPERATING PARTS OF THE SYSTEM ARE THE PANELS, WHICH ARE PULLED ALONG AN EXTRUDED ALUMINUM TRACKWAY (SEE DETAIL ABOVE) BY A PULLEY CHAIN DRIVEN BY A 1/4 HORSEPOWER MOTOR.

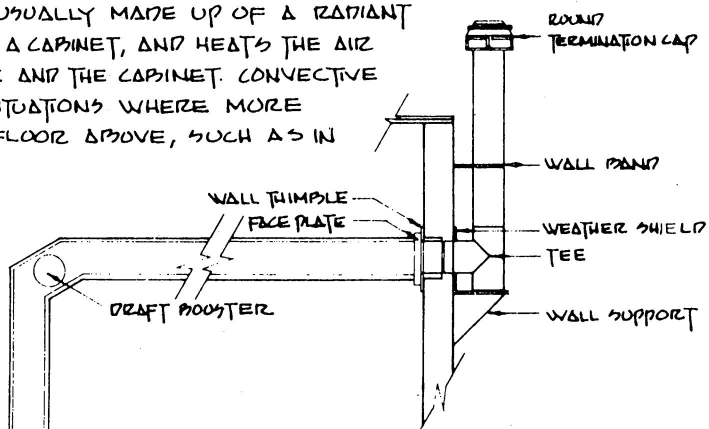
BTU GAIN:		BTU LOSS:	
1,170,000	TOTAL ISOLATION ON BAGS	90,500	THRU GLASS
45,400	TRANSFERRED THROUGH GLASS	115,000	THRU WALLS
620,400	PANELS OPEN	29,100	THRU SLAB
34,100	SUN ON WALLS	150,000	WHILE PANELS OPEN
456,000	ABSORBED BY WATER	187,000	WI[illegible]
17,000	BODY HEAT		
120,000	TRANSFERRED FROM CEILING		
44,300	APPLIANCES		

SOLAR HOME ENERGY 2

HEATING STOVES ARE DIVIDED INTO TWO GENERAL TYPES ACCORDING TO FUNCTION: RADIANT AND CONVECTIVE.

A RADIANT STOVE RADIATES THE HEAT DIRECTLY TO PEOPLE AND OBJECTS AROUND IT. THEY ARE BEST USED IN LARGE OPEN SPACES AND WHERE COMFORT IS DESIRED AT LOWER AIR TEMPERATURES.

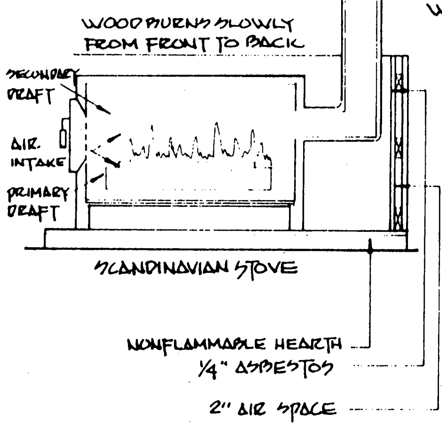
A CONVECTIVE STOVE IS USUALLY MADE UP OF A RADIANT INNER STOVE SURROUNDED BY A CABINET, AND HEATS THE AIR RISING BETWEEN THE STOVE AND THE CABINET. CONVECTIVE STOVES ARE USEFUL IN SITUATIONS WHERE MORE HEAT IS WANTED ON THE FLOOR ABOVE, SUCH AS IN BASEMENTS.



WHEN INSTALLING A HEATING STOVE A HEARTH, WHICH CAN BE OF ANY NONFLAMMABLE MATERIAL SHOULD BE USED. CHOICES MAY RANGE FROM THIN SHEETS OF METAL TO FANCY CERAMIC TILE, QUARRIED STONE OR BRICK. WALLS SHOULD BE PROTECTED BY AT LEAST TWO 1/4" LAYERS OF ASBESTOS BOARD WITH A FREELY-CIRCULATING AIR SPACE LEFT BETWEEN BOARDS.

FIREWOOD IS PURCHASED BY THE CORD. A STANDARD CORD MEASURES 4'x 4'x 8'. A FACE CORD IS 4' x 4' x THE LENGTH OF WOOD. IDEALLY, WOOD SHOULD BE SPLIT PRIOR TO BEING STACKED IN A DRY, WINDY AREA, PLACED OFF THE GROUND ON SHIMS, TO PREVENT DAMPNESS. THE STACKED WOOD SHOULD THEN BE COVERED WITH PLASTIC OR ROOFING PAPER TO KEEP OUT SNOW AND WATER.

FIRST CHOICE FOR FIREWOOD IS USUALLY OAK OR ASH. BEECH IS ANOTHER POPULAR WOOD AS ARE HICKORY AND APPLE. THE LATTER GIVE OFF A PLEASANT AROMA, AS WELL AS BURNING WELL. COMBINATIONS OF HARD AND SOFT WOODS, SUCH AS CEDAR AND OAK ARE CONSIDERED DESIRABLE BY SOME, AS THE CEDAR GIVES AN IMMEDIATE HOT FLAME WHILE ALLOWING THE OAK TO CATCH AND PROVIDE A LONG-BURNING FIRE.



WOOD STOVES

ENERGY 3

OPERATION:

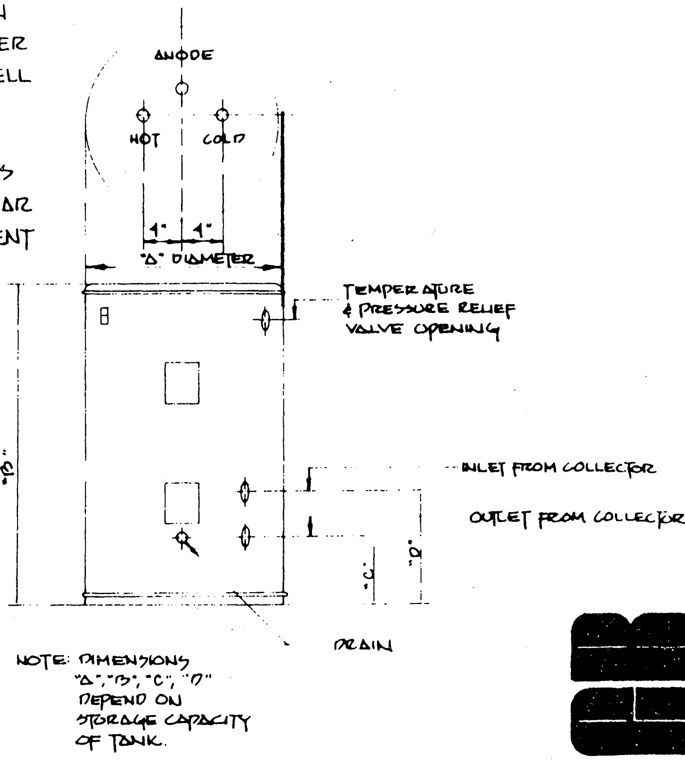
60° COLD WATER ENTERS EITHER AN 80 OR 120 GALLON SOLAR HOT WATER HEATER, UNDER EITHER CITY OR WELL PRESSURE. USING A PUMP, COSTING A NICKEL A WEEK, THE WATER IS CIRCULATED THRU SOLAR COLLECTORS AND HEATED ON AN AVERAGE SOLAR DAY TO 135°. FOR SEVERE INCLEMENT WEATHER, AN ELECTRIC ELEMENT BACKUP IS PROVIDED. THE SYSTEM IS DESIGNED FOR YEAR ROUND UTILIZATION OF SOLAR ENERGY.

DESIGN:

FREEZE PROOF - THERMOSTATICALLY CONTROLLED DRAIN SYSTEM PREVENTS FREEZE-UPS.

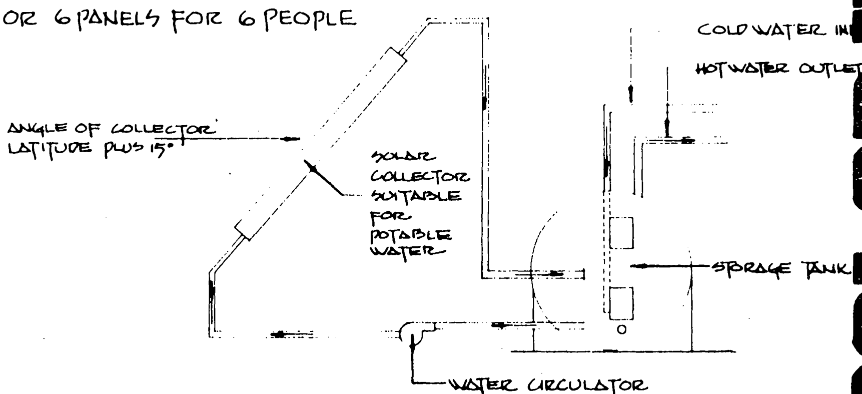
AUTOMATIC - THE TANK IS SET TO A DESIGNATED TEMPERATURE. IF IT DOES NOT MEET THE TEMPERATURE USING SOLAR HEAT, THE ELECTRIC COIL WILL SWITCH ON AUTOMATICALLY.

INSULATED - THE SOLAR TANK HAS TWICE AS MUCH INSULATION AS A CONVENTIONAL TANK (2" FIBERGLASS) AN ON INSTALLATIONS ALL COPPER PIPE RUNS ARE INSULATED.

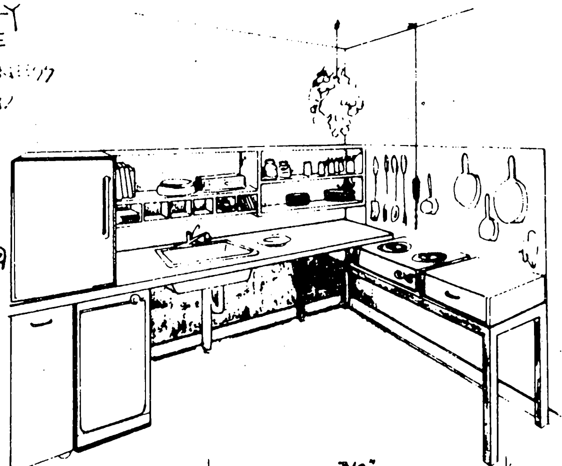


TYPICAL DIRECT SOLAR WATER HEATING SYSTEM

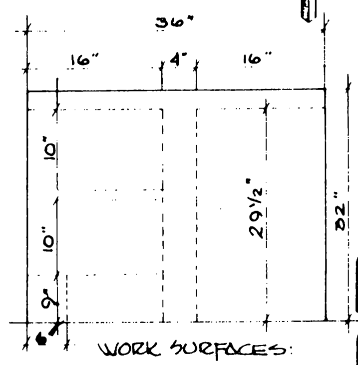
SOLAR COLLECTOR PANELS - 22" X 7'0"
50 SQ. FT. OR 4 PANELS FOR 4 PEOPLE
75 SQ. FT. OR 6 PANELS FOR 6 PEOPLE



ALTHOUGH MANY HOMES OCCASIONALLY NEED TO BE ADAPTED FOR USE BY THE TEMPORARILY HANDICAPPED, DUE TO ILLNESS OR BROKEN BONES, FOR THE AGED OR PERMANENTLY HANDICAPPED THE MEASUREMENTS BELOW ARE IMPORTANT. SOME OF THE DETAILS TO THE RIGHT ARE FOR PERMANENT INSTALLATIONS (KITCHEN, EATING COUNTER) THE OTHER IS A TEMPORARY ADAPTATION. SIMILAR PERMANENT INSTALLATIONS MIGHT MAKE USE OF COMMERCIALLY PRODUCED MODULAR STORAGE UNITS.

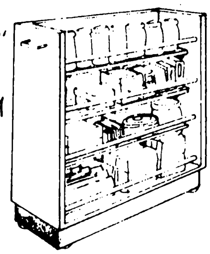


IN ADDITION TO ORIGINAL KITCHEN INSTALLATIONS SIMILAR TO THE DETAIL SHOWN, BATHROOMS IN THE HOUSING UNITS ARE EQUIPPED WITH GRAB BARS IN THE TUB/SHOWER AREA AND THE TOILET AREA LAVATORIES ARE INSTALLED WITH FAUCETS LOCATED TO THE SIDE AND SHOWERS ARE EQUIPPED WITH HAND-HELD SPRAYS.



WORK SURFACES:
32" HIGH
29½" CLEAR KNEE SPACE
9"x6" TOE SPACE

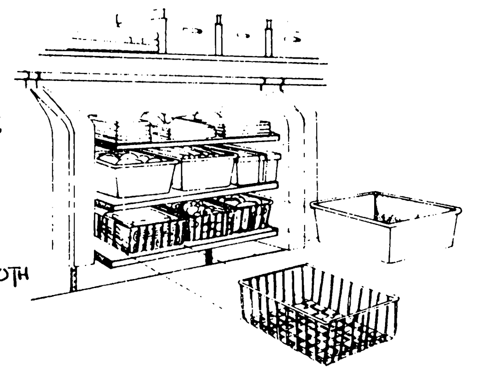
MEASUREMENTS:



DOORWAYS: MIN. CLEAR OPENING OF 32" WITH AT LEAST 24" CLEAR SPACE AT SIDE OF IN-SWINGING DOOR. (UNITS 36" DOORS)

HALLWAYS: MINIMUM 48" WIDE FOR AVERAGE WHEELCHAIR. (UNITS RANGE FROM 40"-48")

BATHROOMS: CLEAR FLOOR SPACE OF 60" x 60". GRAB BARS 33" ABOVE FLOOR. (STUDIO, 1 & 2 BED UNITS MEET 5'x5' FLOOR SPACE REQUIREMENT. ALL HAVE GRAB BARS)

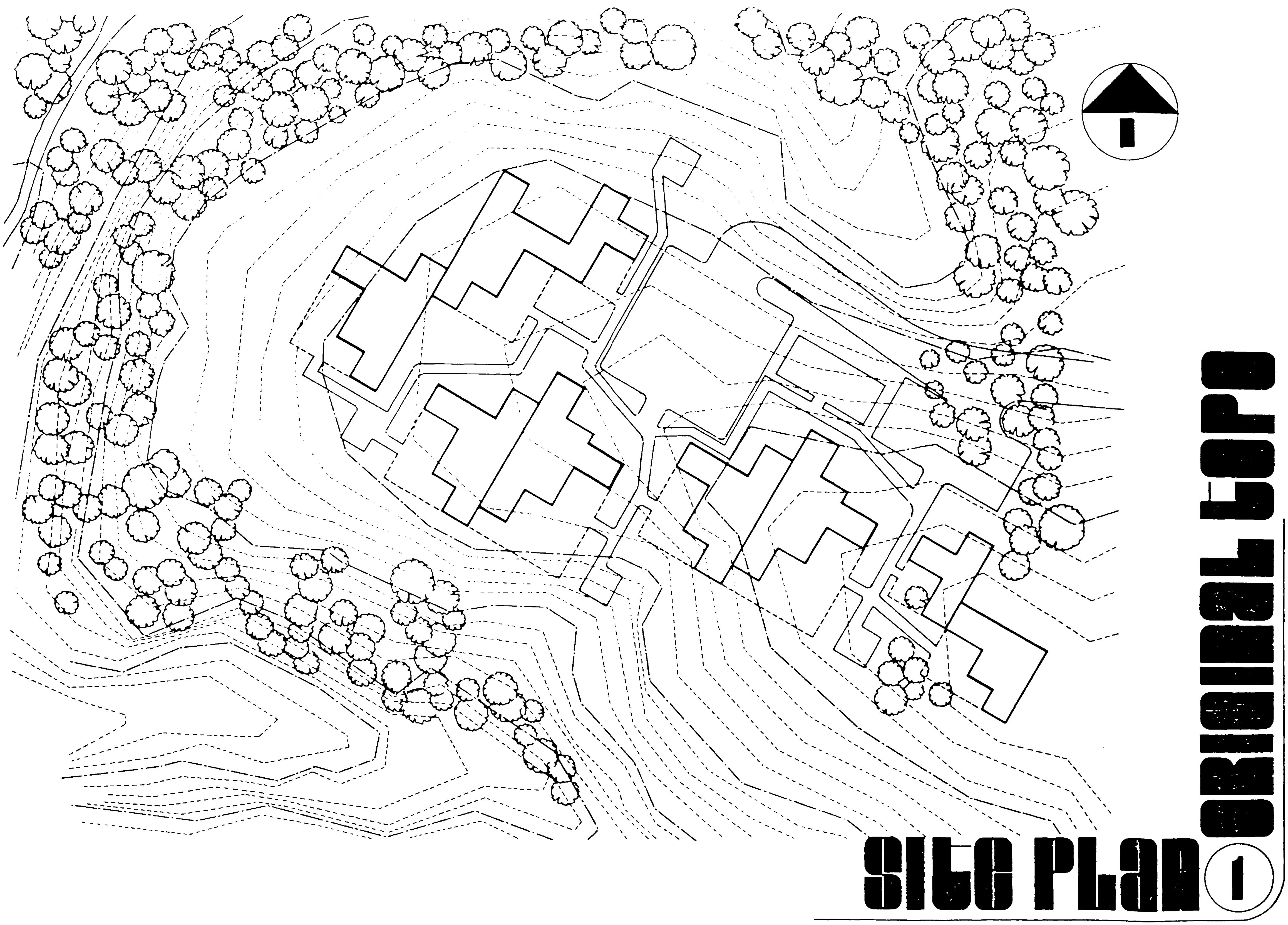


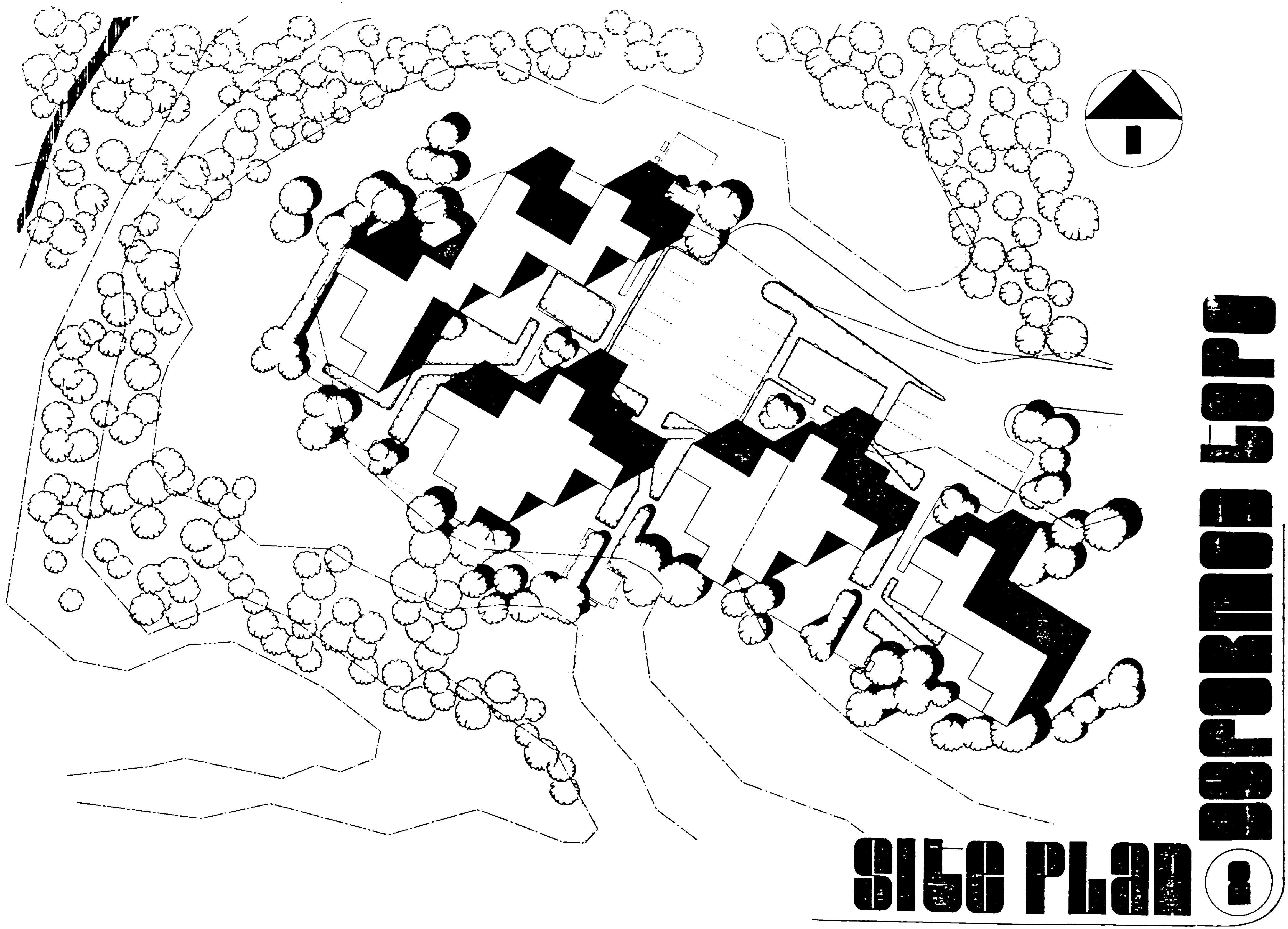
CLOSETS: HANGING RODS NO HIGHER THAN 48" OR 36" FOR SMALL PEOPLE AND CHILDREN.

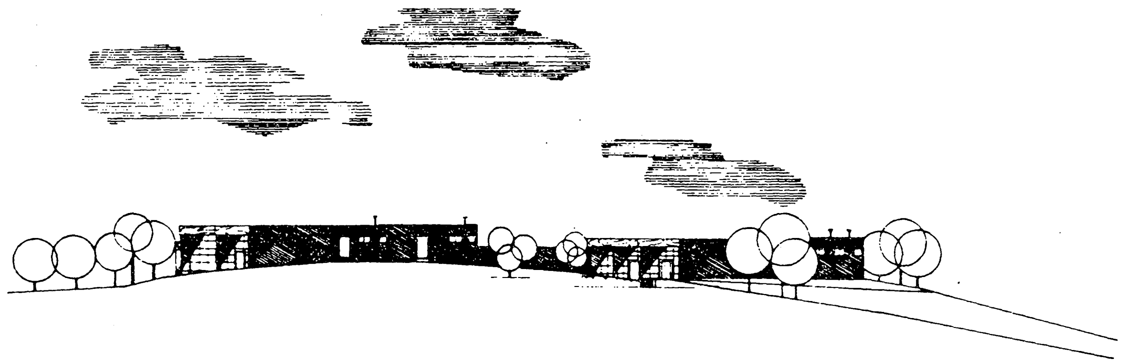
SIDEWALKS: 36" TO 48" WIDE WITH SMOOTH BUT NOT SLIPPERY SURFACES.

RAMPS: 1 : 12 SLOPE RATIO

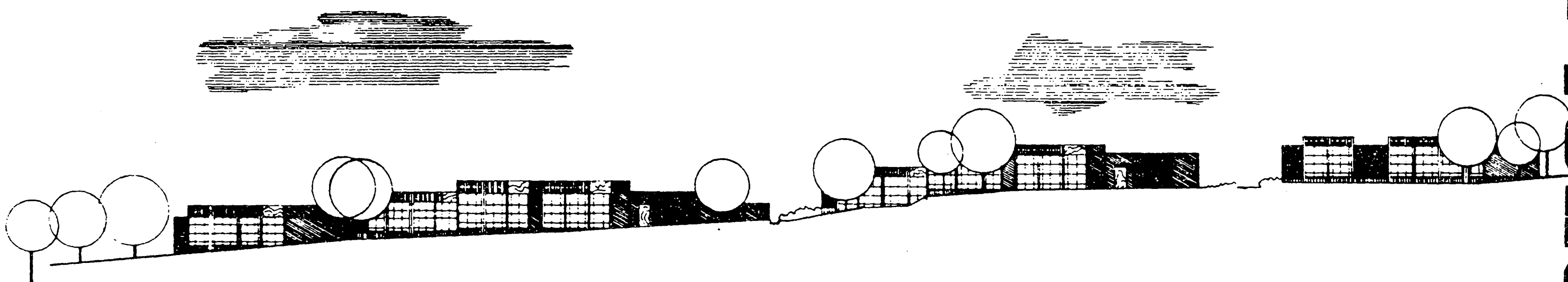
BARRIER FREE EVALUATION 1


ORIGINAL CORE
SITE PLAN
1


SITE PLAN



VIEW LOOKING WEST

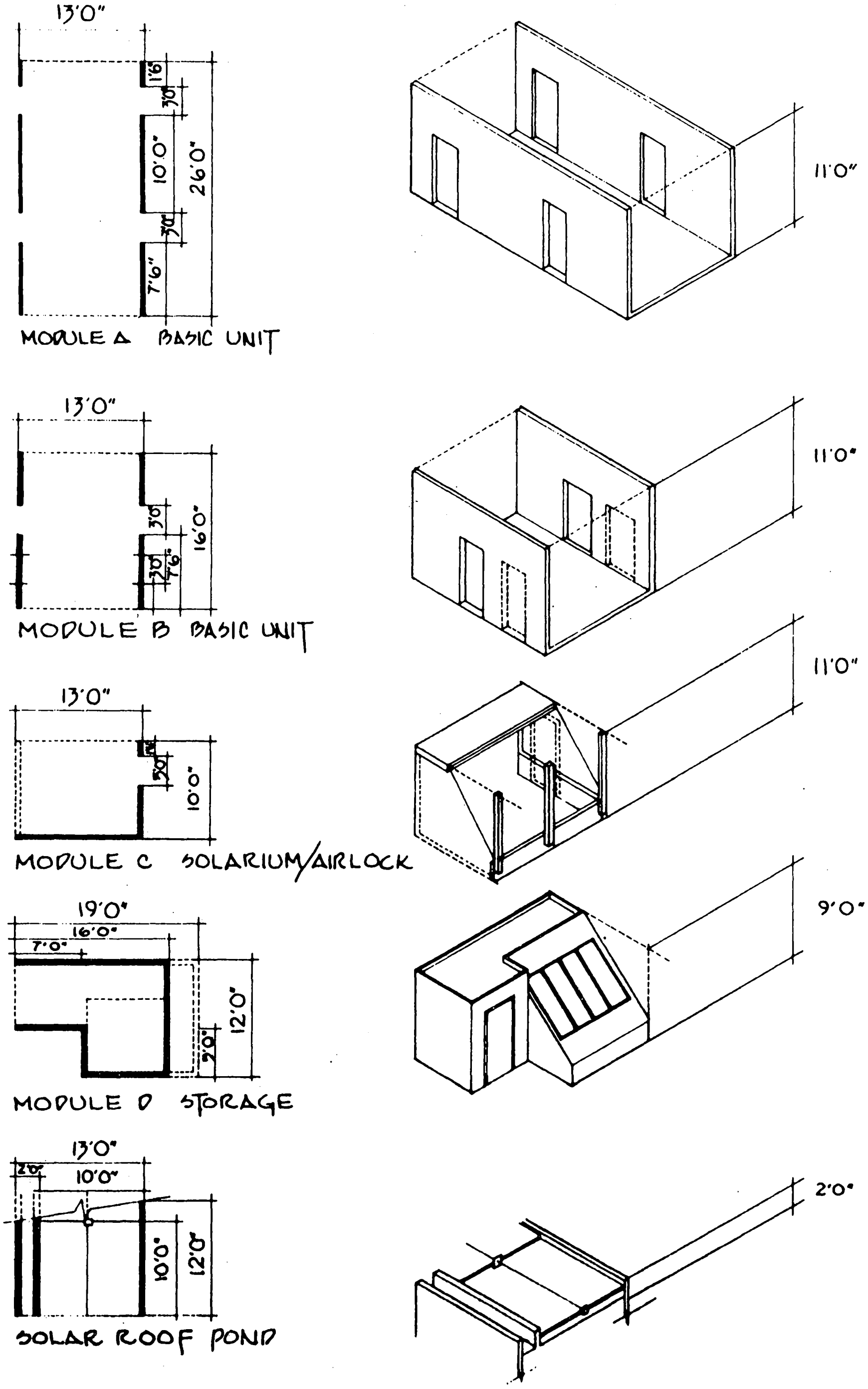


VIEW LOOKING NORTH

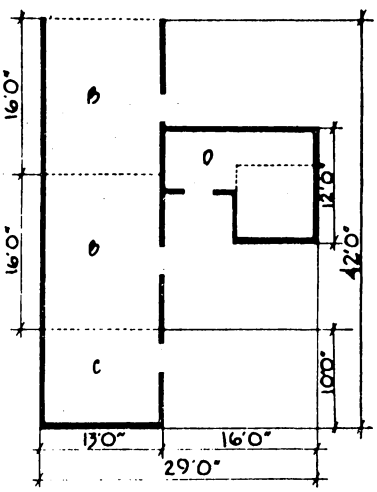
ELEVATION

SCALE 1" = 20'0"

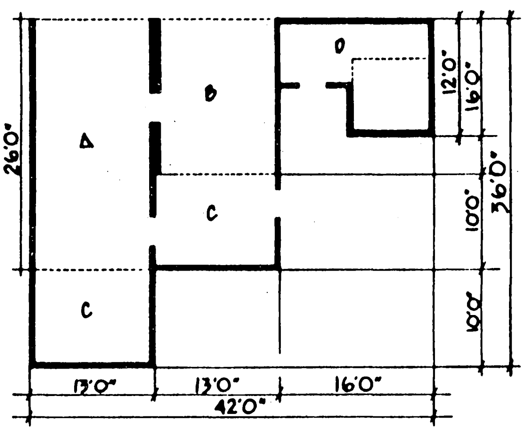
SITE PLAN 3



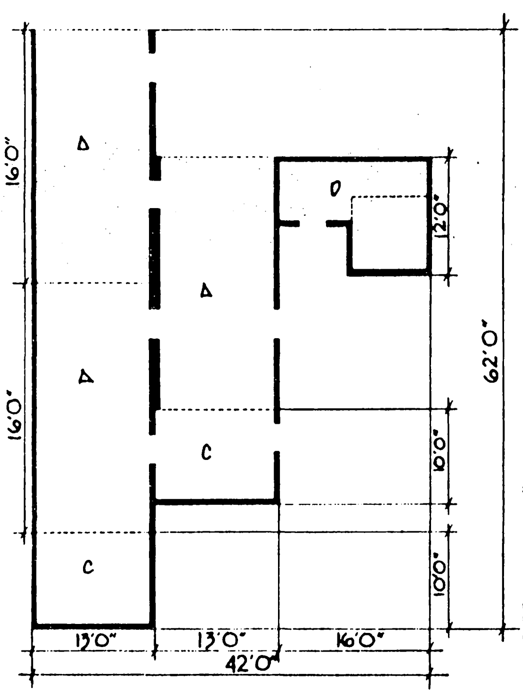
BUILDING MODULES PARTS 1



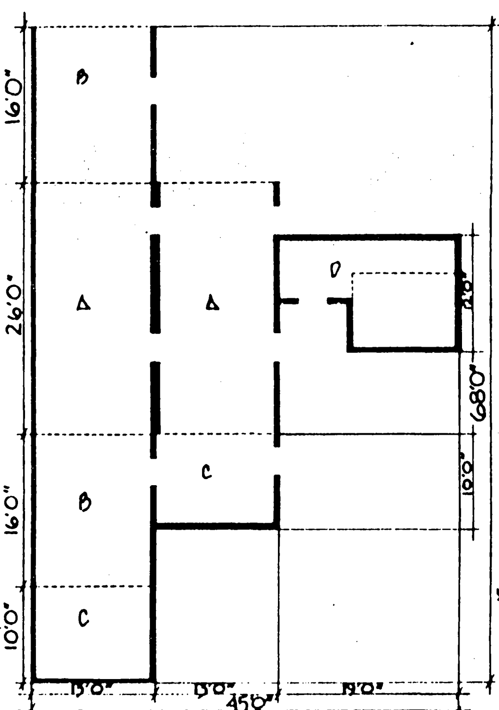
STUDIO UNIT



ONE BEDROOM UNIT



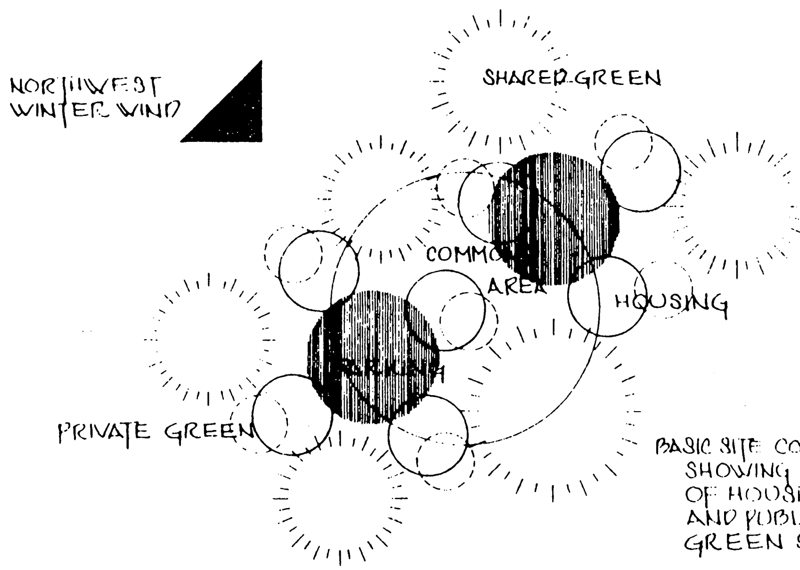
TWO BEDROOM UNIT



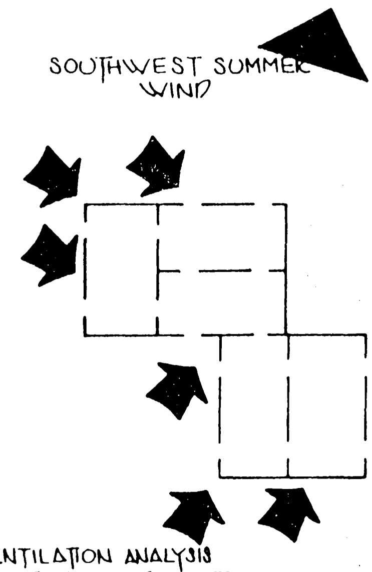
THREE BEDROOM UNIT

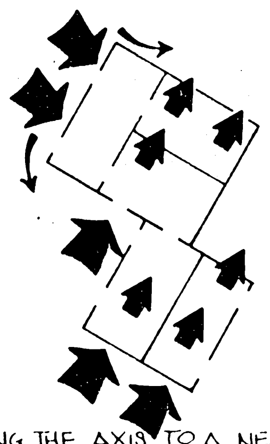
BUILDING MODULES 2

PLANS



BASIC SITE CONCEPT
SHOWING INTER-RELATIONSHIP OF HOUSING, PARKING, AND PUBLIC AND PRIVATE GREEN SPACES.



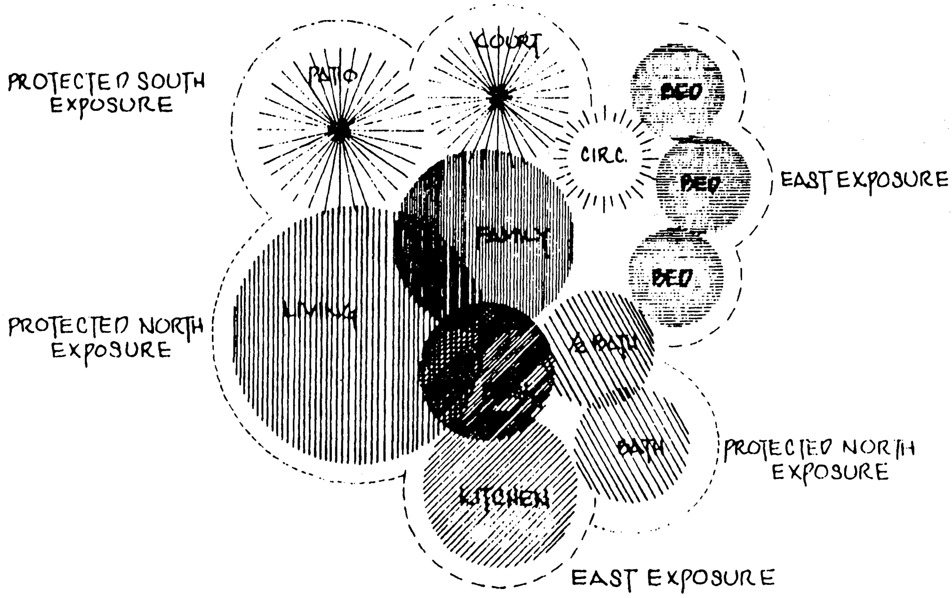


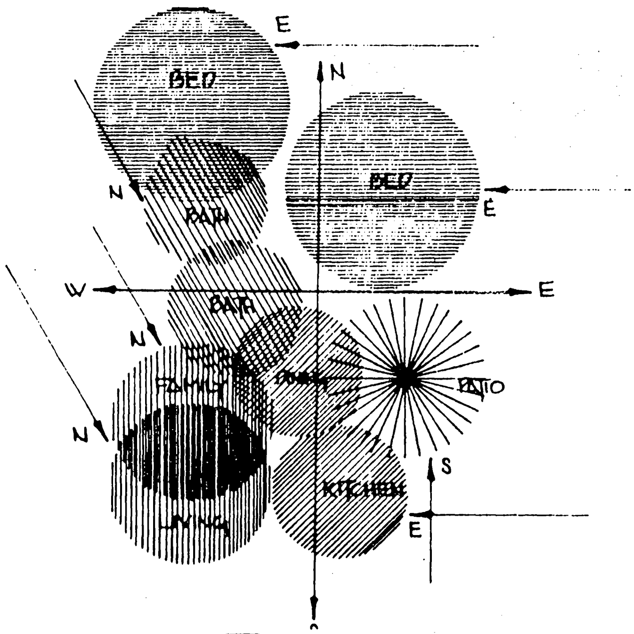
VENTILATION ANALYSIS OF A PRELIMINARY UNIT CLUSTER INDICATES THAT A MAJOR AXIS AT A 45° ANGLE TO THE WINTER WIND CUTS ITS VELOCITY BY 50-60%.

CHANGING THE AXIS TO A NE/SW ORIENTATION ALLOWS THE SUMMER BREEZES TO FLOW ALONG THE LONG AXIS OF THE UNIT, AND, THROUGH ELIMINATION OF MAJOR OPENINGS, BLOCKS PENETRATION OF WINTER WINDS.

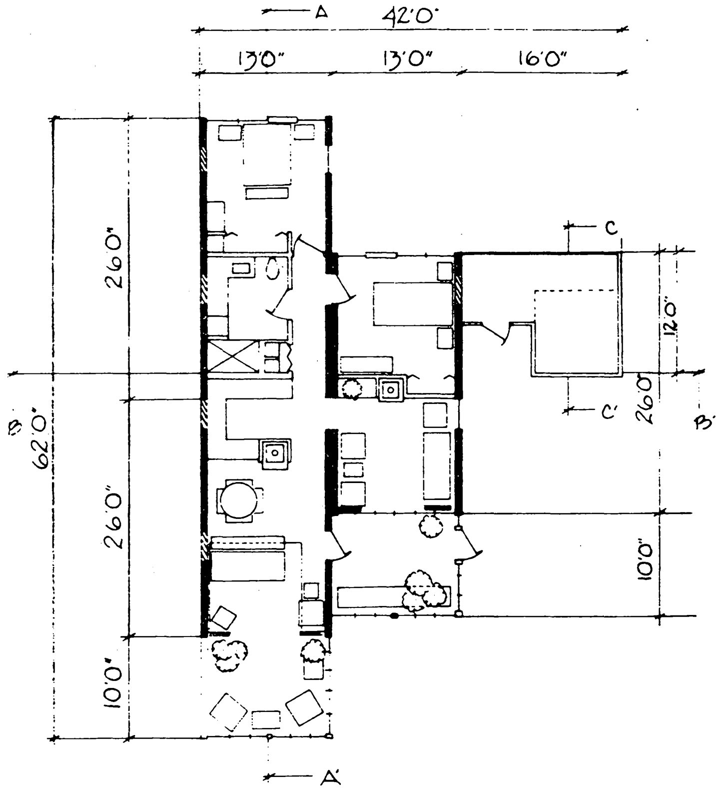
DEVELOPMENT

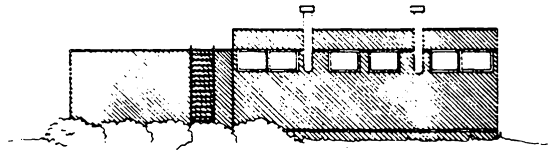
2 BED UNIT (13)



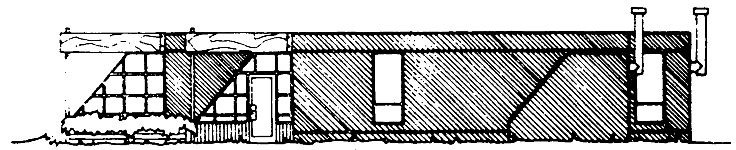


2 BED UNIT (1B) DEVELOPMENT

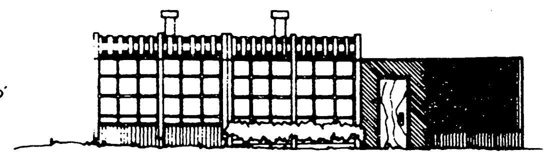




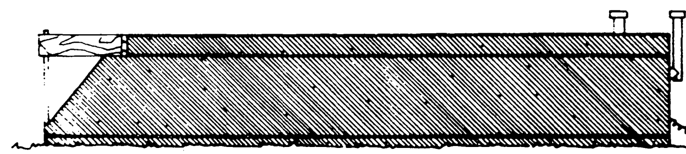
NORTH ELEVATION



EAST ELEVATION

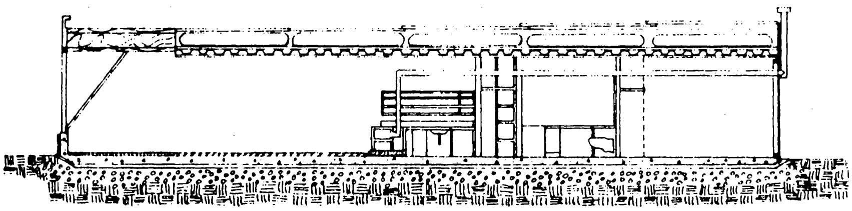


SOUTH ELEVATION

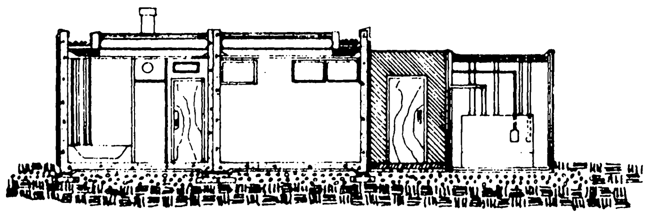


WEST ELEVATION

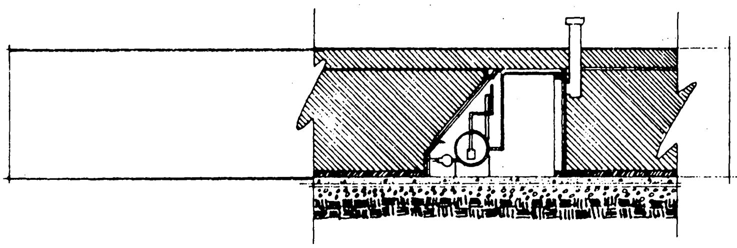
2 BED UNIT 2 PLANS



TYPICAL SECTION AA'



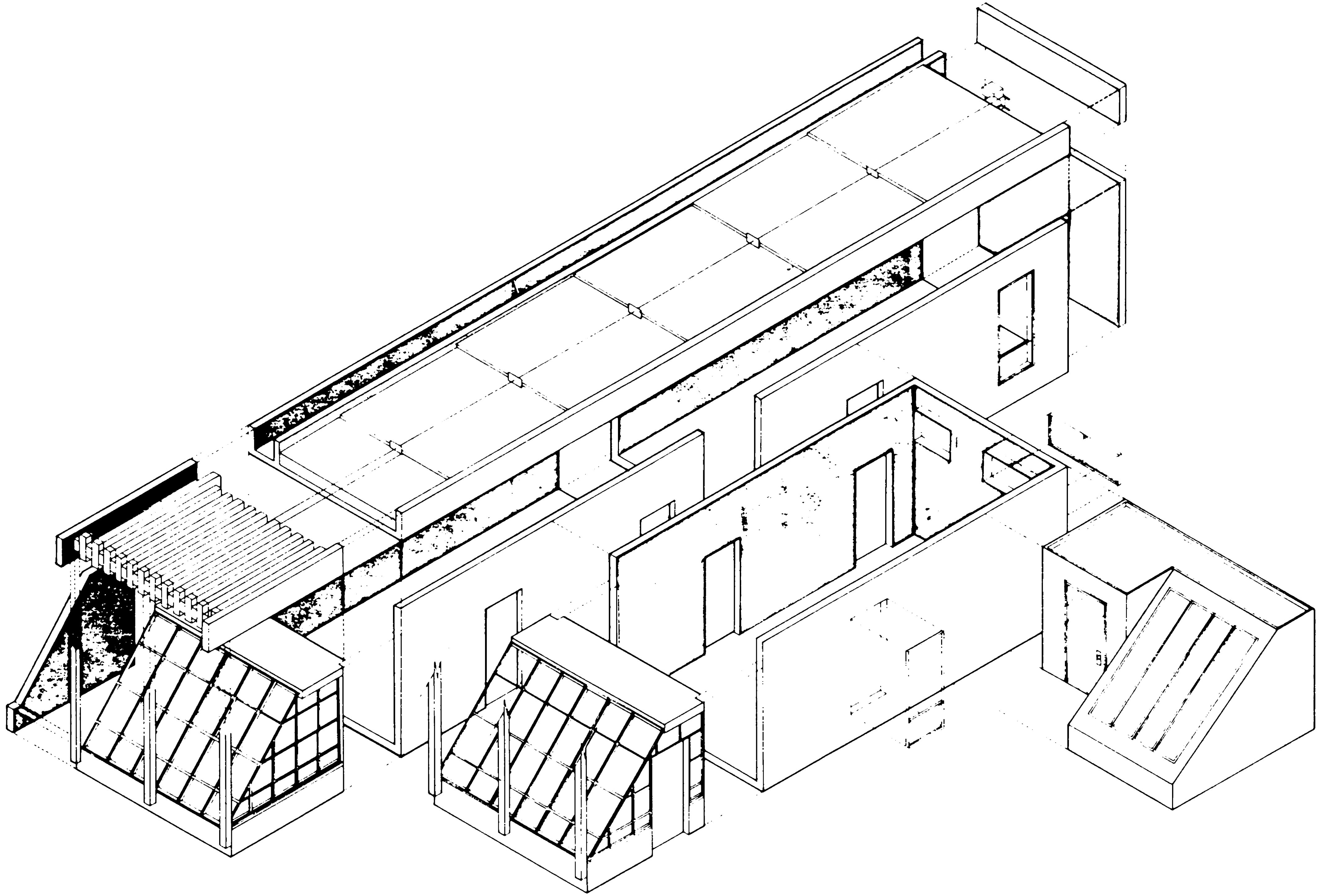
TYPICAL SECTION BB'



TYPICAL SECTION CC'

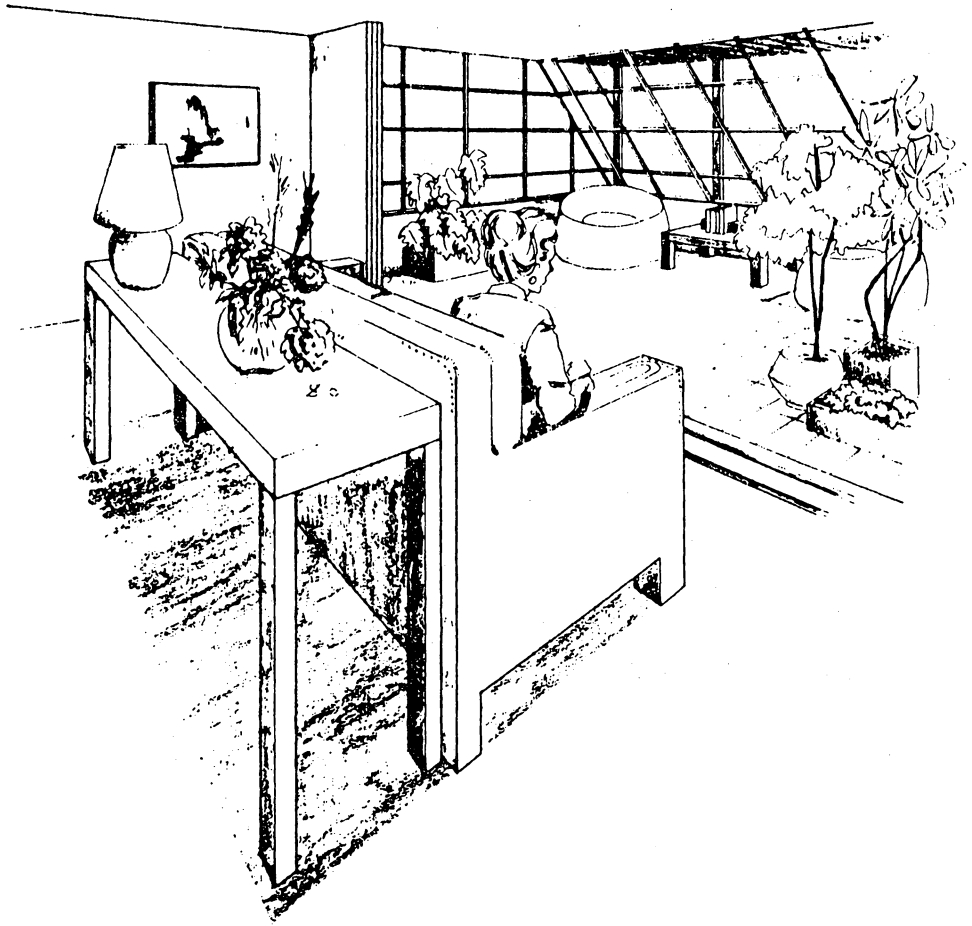
SECTIONS

2 BED UNIT 2a

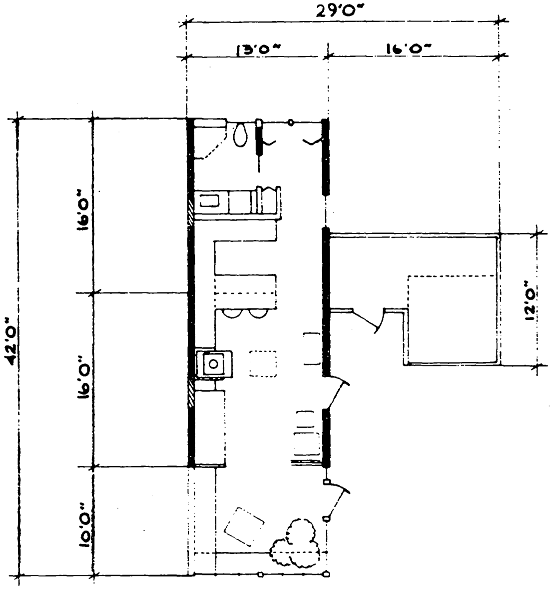


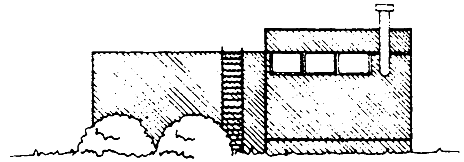
2 BED UNIT ISOMETRIC

B

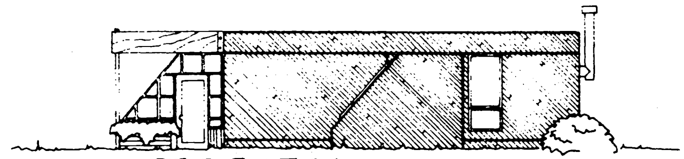


2 BED UNIT PERSPECTIVE 4





NORTH ELEVATION



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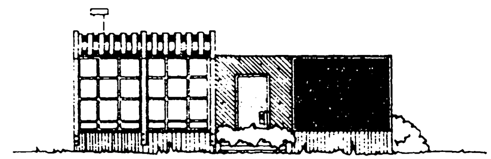

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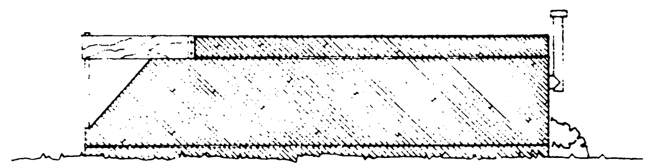
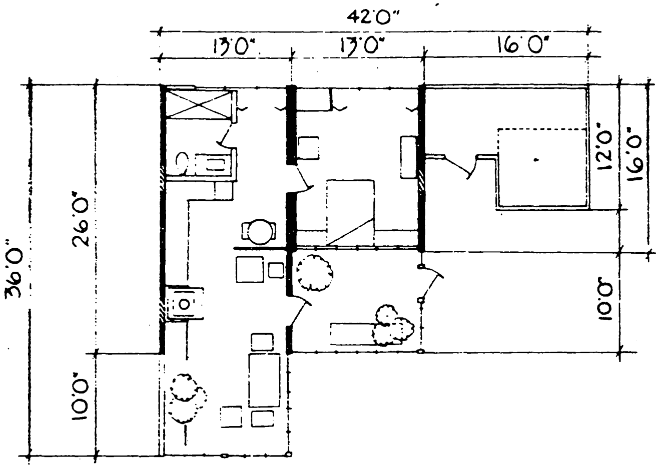
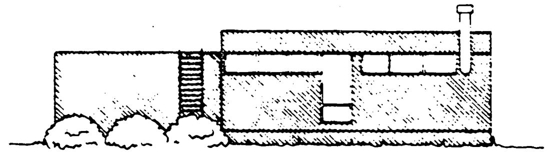


WEST ELEVATION

STUDIO UNIT 1 PLANS





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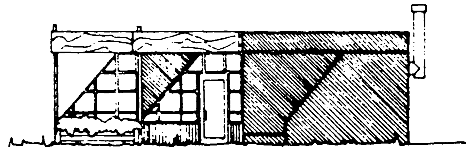

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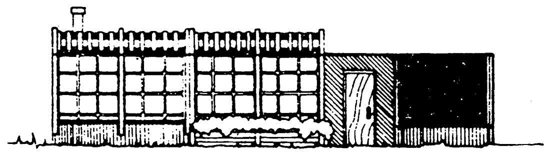
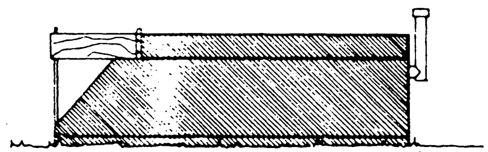
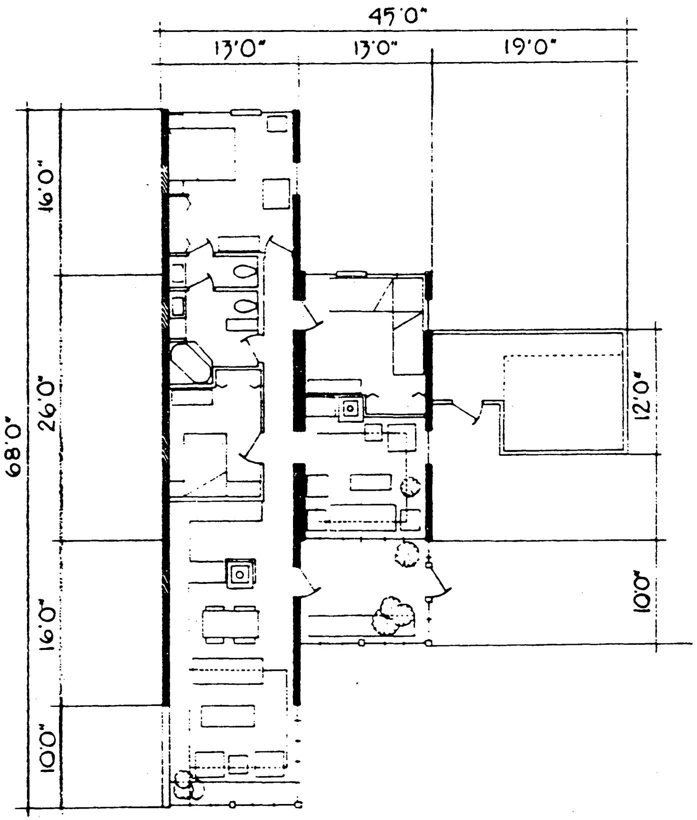


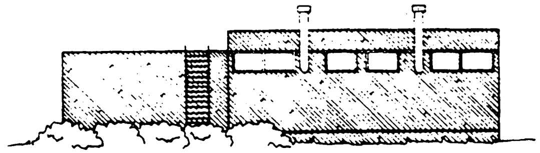
SOUTH ELEVATION



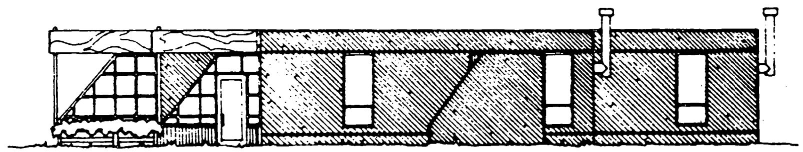
WEST ELEVATION

1 BED UNIT 1 PLANS

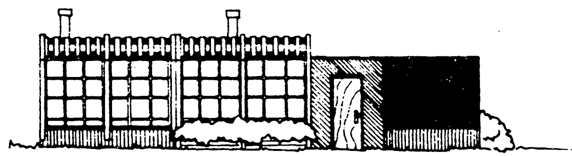




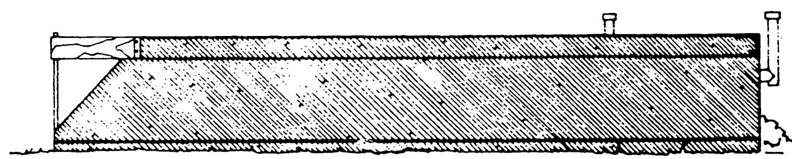
NORTH ELEVATION



EAST ELEVATION



SOUTH ELEVATION



WEST ELEVATION

3 BED UNIT 1 PLANS

Part 4

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Part 7

APPENDICES

APPENDIX A

HOUSING PROGRAM

Introduction

This housing facility is to be occupied by low and fixed income families who now occupy substandard housing. All efforts should be made to create an environment in which these families will feel comfortable. To this end a maximum cluster size of ten units has been established. Studies by Oscar Newman, as well as the findings of DeChiara, Koppelman, Cooper, et al., indicate that the conditions that create the most favorable living environment limit the number of families using an entry or courtyard to a maximum of 15. (27) This increases neighbor recognition and a sense of possession of the grounds surrounding the cluster. This in turn should foster a greater sense of neighborliness and family interaction.

Demographic Data

The Elkmont Rural Village will be located on the town limits of Elkmont, Alabama, population 394. The primarily white population are employed, to a great extent, in non-farm occupations, which is indicative of the commuting status of many residents to nearby Huntsville. Although the median income is $6013.00, 25.85 percent of the families have below poverty-level incomes. (28)

In Elkmont the average family consists of 3.49 persons. (29) The majority of these families consist of a husband and wife with one

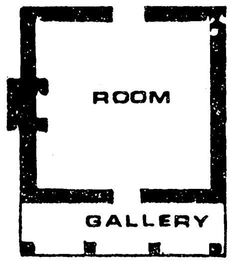
Regional Design Concepts

The South was, until after the Civil War, primarily a rural region with an economy based on agriculture. Those families whose fortunes had been made might have two homes: one, located "in town," used primarily during the "Season" and the second, most often the family seat, located on the land from which the fortune was made. Because of the importance of the land (a bad year could make or break the family fortunes of all but the wealthiest planters) and because of the generally mild climate, the Southern family has traditionally lived outside as much as possible.

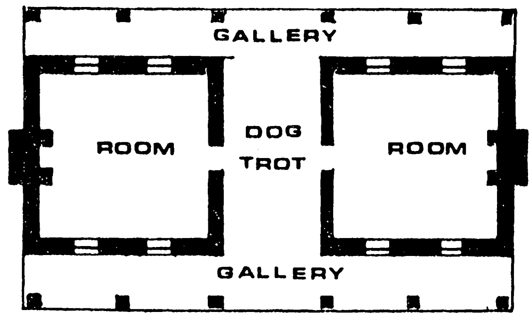
Both the townhouses and the country seats of these wealthy Southerners were built to take advantage of the climate. Although the minority of homes built in the region were of the "Southern Mansion" variety, they stand as good examples of the climatic adaptations of most Southern Housing.

Basically there are four outstanding design characteristics found in vernacular Southern residential architecure: 1) columns, 2) floor-to-ceiling windows, 3) central hallways, and 4) porches or galleries.

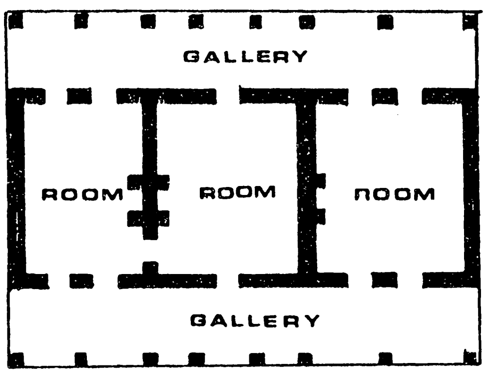
Columns are traditionally the single most famous characteristic of the antebellum mansion. Derived from the classic Greek temple built in the post and lintel manner, the column or pillar was/is used to support the pediment of the classic Greek Revival mansion and, in a smaller version, the galleries and verandahs of the southern home from slave/tenant quarters to Victorian mansions. (Figure 6)



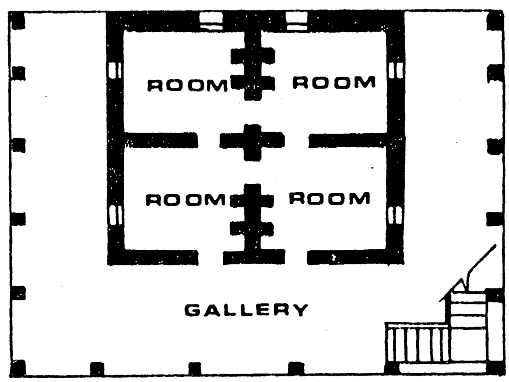
TYPICAL
CABIN PLAN



TYPICAL DOG TROT
HOUSE



TYPICAL PLAN
ONE ROOM DEEP

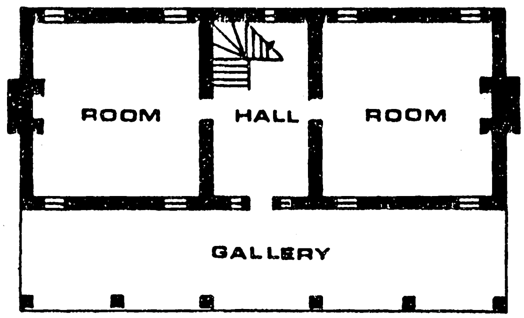


TYPICAL PLAN
TWO ROOMS DEEP

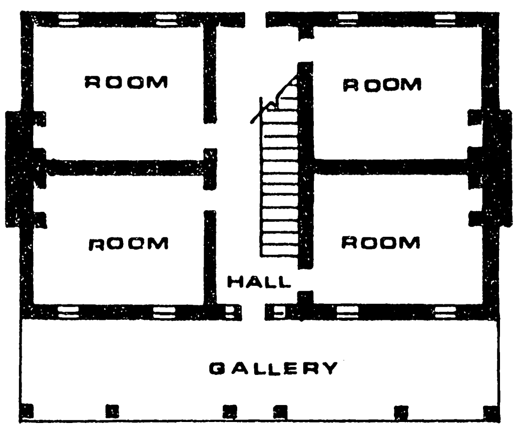
EVOLUTION OF THE SOUTHERN "MANSION"

NO SCALE

FIGURE 6



GLORIFIED PIONEER HOUSE
FIRST FLOOR PLAN



TYPE OF FINAL DEVELOPMENT
FIRST FLOOR PLAN

NO SCALE

FIGURE 6 CONTINUED

or two children ranging in age from one to eighteen years of age. In only 2 percent of the cases will there be an elderly member of the household, as only 4 percent of the population is over 65, and some of these maintain their own households.

Housing Aspirations

A recent unpublished study by Dr. James Montgomery, formerly of Virginia Polytechnic Institute and State University, and others, indicates that low-income families aspire to the values of the middle-income class. (30) Answers to a series of questions regarding housing values indicated that the most sought-after housing was single family detached, with an exterior of wood and brick or stone. A two story house was preferable to one story and, if possible, it should have at least one and one-half baths in addition to a separate living and dining area, kitchen and bedrooms.

Although many low-income families rent their homes, the study indicated that they would prefer to own their home, regardless of size or condition.

Architectural Concepts

The architectural concepts inherent in this facility should incorporate regional design concepts, with special consideration given to the traditionally close relationship to nature of these people. In addition, certain restrictions concerning overall housing and site development in the Village should be conformed to. (Appendix B)

The floor-to-ceiling window probably was derived from the front and back door of the cabin from which most mansions grew. At that time, it served as both window and door, to let in light and air and to pull the summer breeze through the house. As the house grew in proportion to the affluence of the family, the number of windows grew also.

The central hallway also was derived from the early settler's cabin which consisted of two rooms--one on each side of a "dogtrot" or hallway. The dogtrot evolved into a circulation hall which stretched the width of the house and might also contain a stairway to the second floor.

In some instances, especially in the deep South, the gallery or porch might take over the function of the central hallway. In this instance the floor-to-ceiling windows (or french doors) would open directly onto the gallery, which encircled the house, and the interior circulation space would be limited. In addition, exterior stairways would be located at one or both ends of the gallery. The gallery was, and still is, an extremely popular gathering place during the warm months as it offers a shaded spot to sit and take advantage of any prevailing breezes, and watch the surrounding area.

On-Site Amenities

The housing facility shall be composed of a variety of unit sizes and configurations, ranging from studio to three bedroom units, located on one or more levels. Each unit will be equipped with energy-saving appliances: stove, refrigerator, dishwasher, and washing machine. Outside drying areas for clothing will be provided. Hot water will be provided by solar heating.

Space conditioning will be through natural means. Solar energy, in combination with such auxiliary heating systems as are necessary to maintain comfortable temperatures shall be used.

Overall care of the cluster will be by the general maintenance crew of Elkmont Rural Village. In an attempt to create personal interest in the appearance of the facility and its grounds, space should be provided, in the design concept, for flower and vegetable gardening for each unit.

The close proximity of Village tennis courts and playing fields eliminates the need for playgrounds adjacent to the cluster. This does not eliminate the necessity, however, for play spaces for young children, under parental supervision.

Play areas for young children should fall into several age ranges. Areas for children ages 1-5 should be located near entries to housing, and should include seating for adult companions. (31) This proximity to parental supervision fosters a feeling of security in the child. Play areas for older children, ages 6-12, should have clearly defined perimeters to discourage wandering off. (32) Plantings or seating areas for adults are satisfactory ways of providing this definition.

Location of the play areas under visual supervision of the housing units serves two purposes. One, it enables supervision of the children playing at the same time as it allows observation of the entrances to protect from vandalism or burglary. (33) Two, it serves as a buffer from more public to more private spaces and shields more active spaces (parking areas, streets, etc.) from more passive spaces.

Active play areas for older children should be placed further from housing areas due to the increased amount of noise created by older children. (34) These areas should still be within the realm of adult supervision either by visual contact from the housing or by a paid adult supervisor.

Garden spaces for both flowers and vegetables are enjoyed by older persons. Adequate nearby play areas and seating, as well as judicious planting, will help to create and preserve these quiet areas for adult enjoyment.

Parking areas should be provided within the grounds. A minimum of one space per unit, regardless of unit size, should be provided. In addition, one guest parking space for every two units should be provided.

GENERAL SPATIAL REQUIREMENTS FOR ONE HOUSING CLUSTER

General Facility Requirements:

Tot Lot	1500	SF Minimum
Semi-Private Terrace	200	SF Minimum
General Storage	1000	SF Minimum
Drying Yards	45	SF Minimum per Unit

General Housing Unit Requirements:

Studio	250-450	SF Minimum
	100	CF General Storage
	200	SF Minimum Outdoor Space
One Bedroom	400-600	SF Minimum
	100	CF General Storage
	200	SF Minimum Outdoor Space
Two Bedroom	600-800	SF Minimum
	140	CF General Storage
	200	SF Minimum Outdoor Space
Three Bedroom	800-1100	SF Minimum
	180	CF General Storage
	200	SF Minimum Outdoor Space

APPENDIX B

In response to the necessity to coordinate the development of the Elkmont Rural Village along compatible lines, the Alabama Elk River Development Association will establish an Architectural Control Committee. It will be the function of that committee to "watch for any proposals, programs, or activities which may adversely affect the residential value of the properties of the Village." (35) The Committee will approve all site plans and all plans and specifications of buildings proposed for the Village.

The criteria on the following pages were developed along the lines suggested by Mr. Harry Smith, TVA Co-ordinator for the Lower Elk Concept, in an interview on March 17, 1976, in Knoxville, Tennessee.

CRITERIA FOR GENERAL HOUSING DEVELOPMENT

1. Use of Super Saver Program for energy conservation construction. (Drawing # E/1)

2. Use of alternative energy sources where economically and technologically feasible.

3. Maximum use of renewable resources in building materials.

4. Use of exterior finishes that blend with the rural nature of the setting.

5. General accessibility for the elderly and the handicapped:

    a. signage

    b. site entrance

    c. parking

    d. building entry

6. Integration of various regional design concepts, within the scope of the housing areas.

7. Designed-in space flexibility in the housing units.

8. Restricted use of open fireplaces in favor of wood-burning stoves.

CRITERIA FOR GENERAL SITE DEVELOPMENT

1. Maintenance of rural setting through use of natural construction materials and vegetation native to the area.

2. Landscaping to aid in energy conservation and design definition.

3. General site accessibility for the elderly and the handicapped, as provided for by Alabama Legislative Act No. 224:

   a. waiting areas: preferably located within 300' of building entry; area located between roadway and sidewalk to avoid traffic congestion; an overhead shelter is recommended for protection from the weather; adequate seating and lighting should also be provided.

   b. signage: should be provided to direct pedestrians to various destinations or areas of the site.

   c. site entrance: well identified; obvious relationship to direct vehicular and pedestrian traffic to destination on the site.

   d. walkways: should provide clear, direct route throughout site; surfaces should be firm and level; curb cuts and ramps provided where necessary.

   e. rest areas: provided where pedestrians must walk long distances; keep rest areas off walkway thoroughfares.

   f. parking: related directly to buildings which they serve; "handicapped" stalls no more than 100' from building entry.

   g. drop-off zones: located as close to building entry as possible; no grade change between road surface and adjacent walkway. Direct vehicular connections between drop-off, site entrance, and parking areas; signage should be provided to direct both vehicles and pedestrians to destinations on the site.

   h. building entry: clearly identified; alternative means of entry provided for handicapped individuals (i.e., both ramps and stairs); public facilities located immediately off of entry in lobby (lavatories, phones, drinking fountains, etc.); no grade changes between entrance and facilities.

4. Separation of varying types of transportation, i.e., pedestrian, vehicular, bicycle, etc.

5. Site lighting for both illumination and security.

APPENDIX C

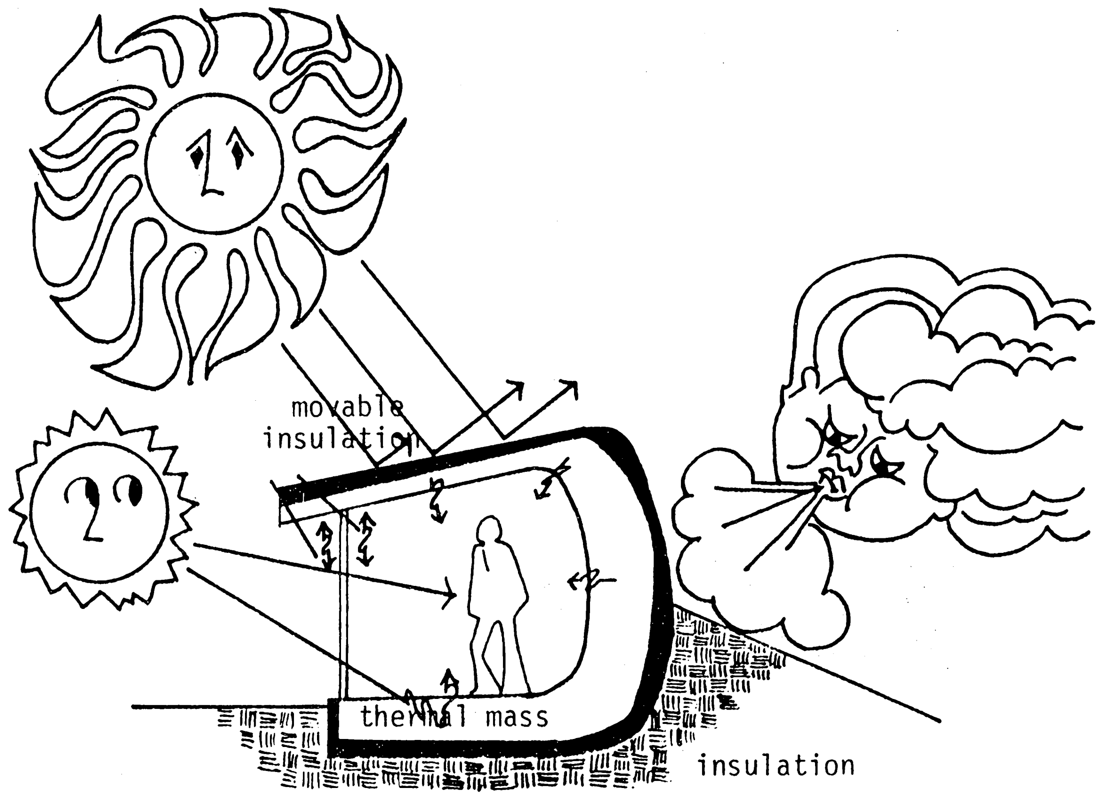
Low Technology, Passive Systems
Total Design Integration, Low Cost
Low Maintainance, Highly Differentiated

CONTEXT	EXAMPLE
SUN SPACE	David Wright Residence (74-16/53)
SUN MASS SPACE	Odeillo-Trombe Houses (56-1/13) Atascadero-Skytherm House (73-1/34)
SUN COLLECTOR STORAGE SPACE AIR: Natural Convection Forced Air WATER: Open System Closed System - Heating Closed System - Heating & Cooling Closed System - Solar Heat Pump	Paul Davis Residence (72-1/32) Lof Residence (59-2/21) Thomason Residence (63-1/26) Phoenix of Colorado Springs (74-10/47) Colorado State University (74-9/46) AFASE Solar House (58-1/16)
SUN SOLAR CELLS USE/STORAGE SPACE	Solar One (73-3/36)

High Technology, Active Systems,
High Cost, High Maintainance,
Least Differentiated

ANALYSIS--DESIGN IMPACT OF BASIC PRINCIPLES

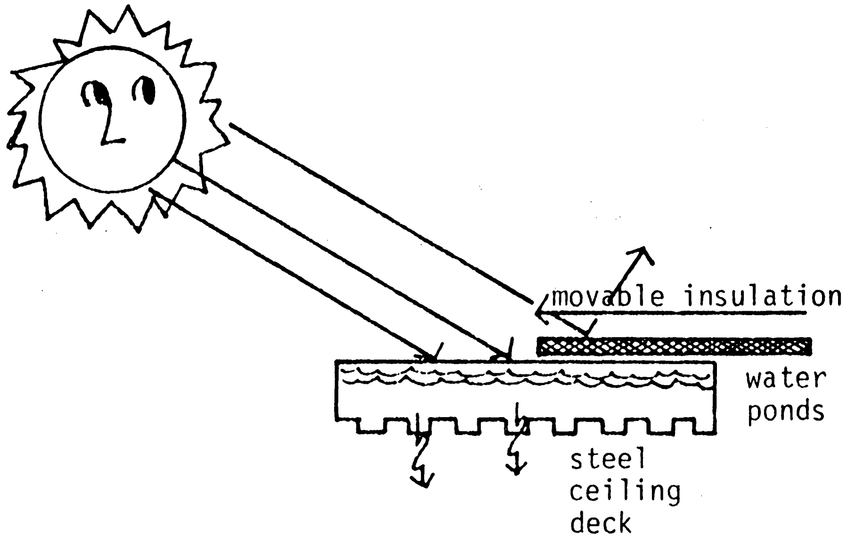
FIGURE 7



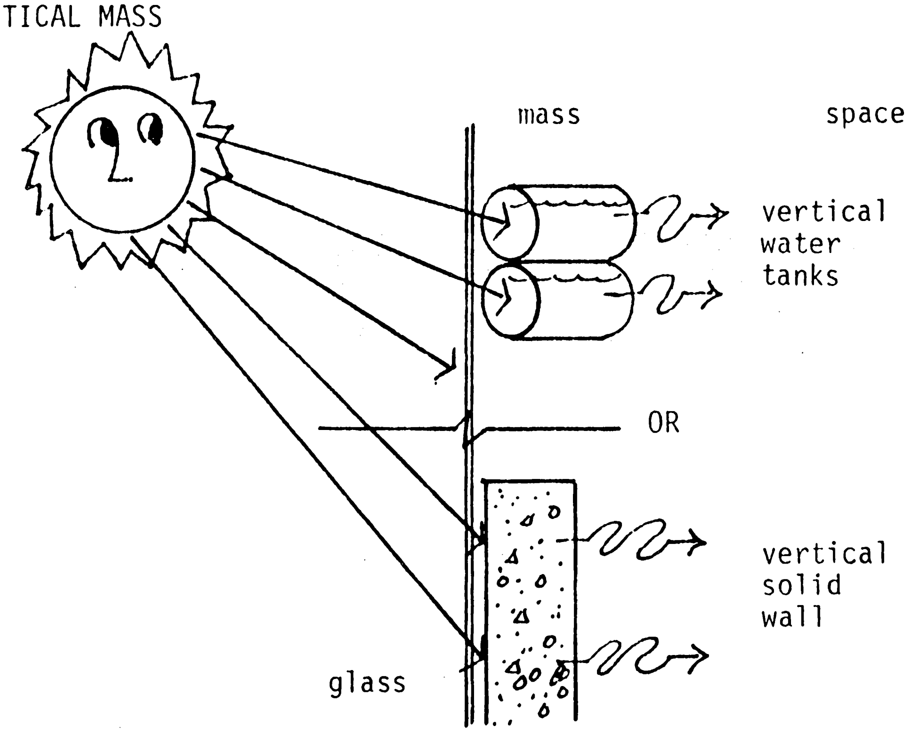
SUN ⟷ SPACE

FIGURE 8

HORIZONTAL PONDS



VERTICAL MASS



SUN ↔ MASS ↔ SPACE

FIGURE 9

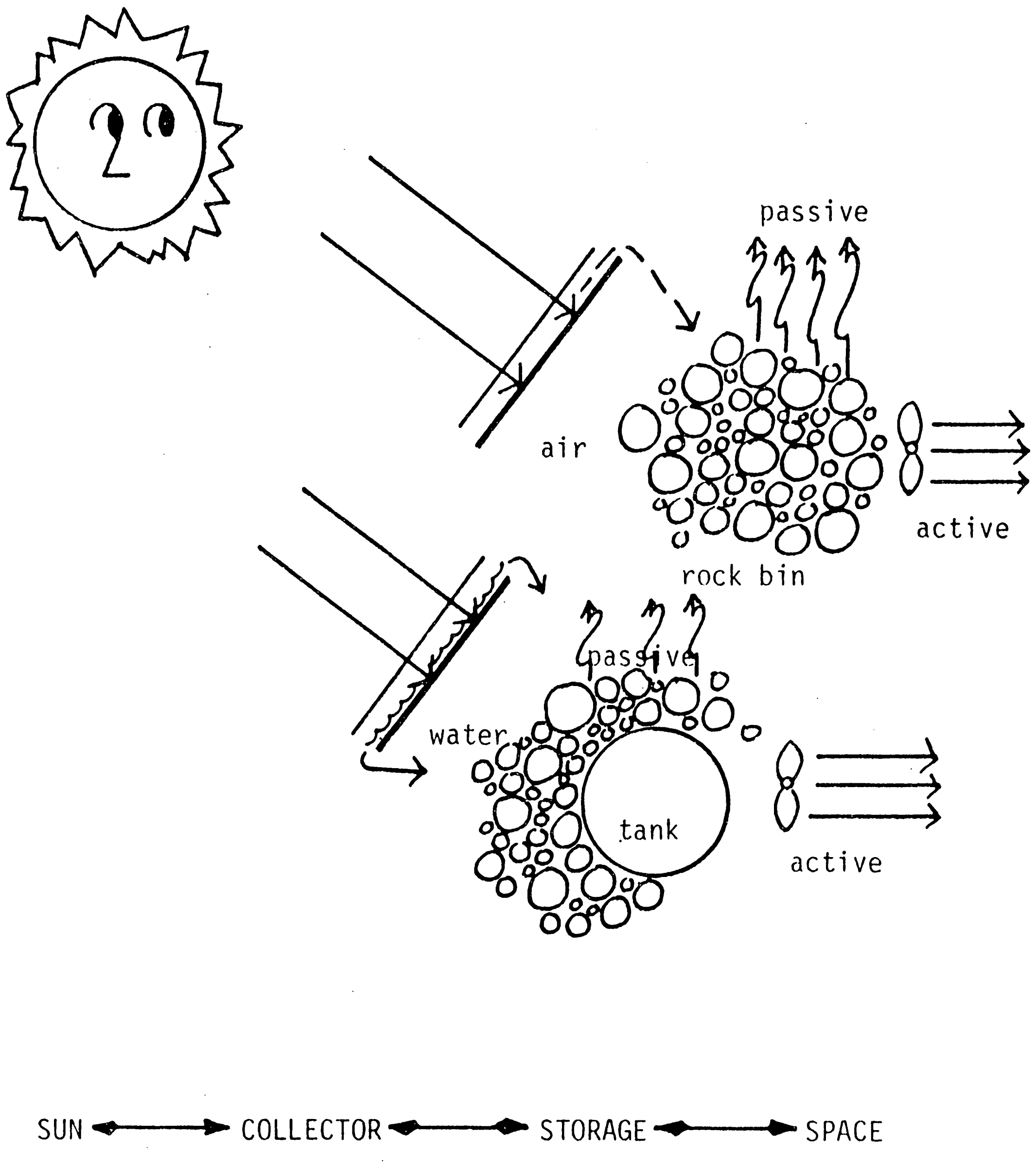
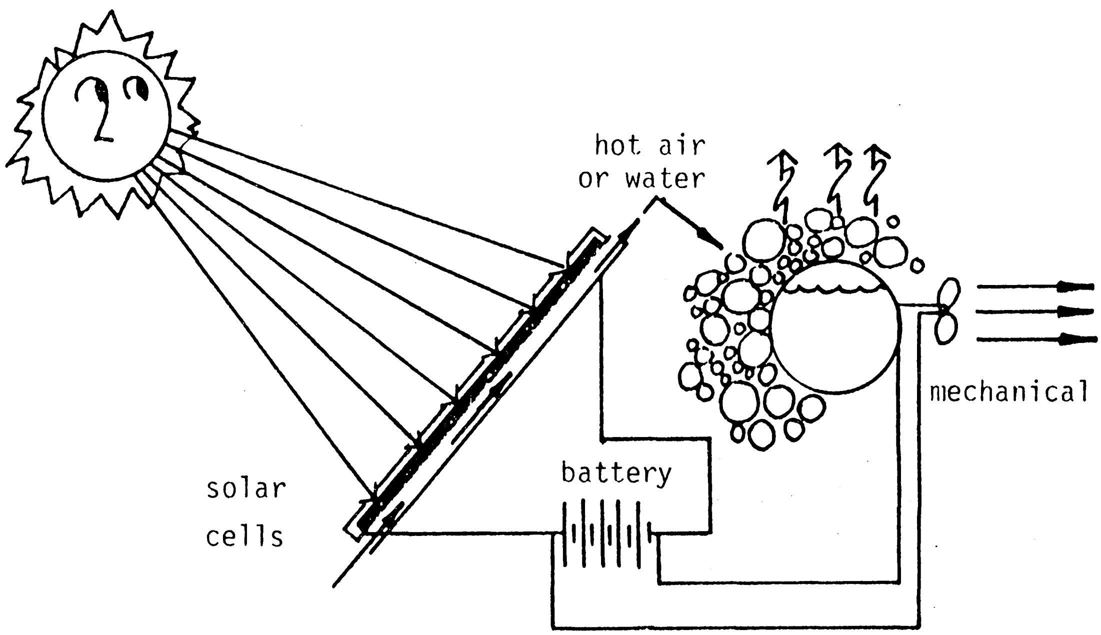

passive
air
active
rock bin
passive
water
tank
active
SUN ◄——► COLLECTOR ◄——► STORAGE ◄——► SPACE

FIGURE 10



SUN ⟷ SOLAR CELLS ⟷ STORAGE OR

USE ⟷ MECHANICAL EQUIPMENT ⟷ SPACE

FIGURE 11

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THE USE OF ALTERNATIVE ENERGY SYSTEMS

IN HOUSING DESIGN

by

Donna K. Emerson

(ABSTRACT)

The current energy crisis and subsequent rise in fuel costs has created extreme hardships on those persons living on restricted or fixed incomes. The objective of this design study was to create affordable housing for these people through the use of three areas: 1) energy conservative construction, 2) alternative energy systems, and 3) barrier free design.

Through the use of the Skytherm solar roof pond system, wood-burning stoves, and domestic solar hot water systems, the cost of using the units designed have been drastically lowered from that of an all-electric home. Additionally, through the use of barrier free design recommendations, housing has been created which is equally liveable for the non-handicapped and the handicapped person.