Conner TToo

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An autonomous community design near Fishers, Indiana by 1984 Ball State University College of Architecture and Planning thesis student Dean Mellinger.

CREDITS

I would like to thank professors Robert Koester, Sonny Palmer, and Jack Wyman for their help and patience wile I was designing this project. I would also like to thank Nancy and Jack Todd for their pioneering in the concept and development of bio-shelters. Further, I would like to thank freinds Mike Balay, and Scott Summerville for their dialogue and criticism.

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GOALS

The goals for this project include those for the site context, the site itself, and the built form.

The site context goals seek to link the Conner TToo community to the areas around the site. To the west and northwest of the site context is Conner Prairie, home of William Conner, who in 1802, settled some land near White River. Conner Prairie has since been transformed into a pioneer museum settlement. People may go to the settlement to participate in a living pioneer "play" successfully created by the pioneer "players."

The north side of the site context is Lynwood Hills, a modern suburban housing complex built in the 1950's and 60's. One need not go far to see examples of this type of housing, it has become the norm for many people who do not live in a city but commute to it several times a week.

The south side of the site context across the creek includes more suburban homes but on larger acreage. Beyond these houses is Sunblest Communities, a suburban development which has tripled the size of Fishers in four recent years.

One of the primary goals of this project is to explore the advantages and disadvantages of these two types of living experiences. One may view this exploration as a three sided philosophical and temporal argument. Conner Prairie represents the thesis of the argument, the way in which people lived before the industrial revolution. Lynwood Hills represents the antithesis of the argument, the way in which many people live today. Conner TToo is seen as the synthesis of the argument, the way in which people could live in the future.

Conner TToo would seek not to be a retreat from industrialization into a Conner Prairie-like pre-industrial lifestyle but would make use of many advantages offered by pioneer life, namely: autonomy; self-relience; use of ecological, solar, and biological energy systems; and use of site-available materials. Likewise, Conner TToo would not totally reflect Lynwood Hills but would make use of techniques and technologies which have minimal if not negligable impact upon the environment. Conner TToo might not be in a philosophical position somewhere between the thesis and the antithesis of our argument but could be somewhere to the side to gain a different perspective. This perspective would hopefully be in a position where ecology and technology co-exist and are not necessarily mutually exclusive.

Conner TToo would seek to integrate into the physical context of both Conner Prairie and Lynwood Hills. The master plan for Conner Prairie calls for a visitor orientation center to the west across the street from the northwest corner of Conner TToo. Some connection could be made between Conner Prairie and Conner TToo which would allow both sites to become part of a unique educational experience to any visitor. Lynwood Hills could share in the community center, recreation areas, and open spaces which would be offered by Conner TToo as part of its amenities. This gesture would allow Lynwood Hills to have more of the functions of a neighborhood. Through a connection between all three types of communities, one could gain a unique and educational perspective.

The site goals arise from ecologic and economic concerns. The ecologic concerns focus primarily on agriculture but also natural and ecologic systems. The economic concerns focus upon commerce, cost of basic necessities, and the buying power of the individual.

Conner TToo would use land ina different way. Although an argument can be made for concentrating land use functions such as agriculture, commerce, industry, and housing into major areas, this orgainization seems to be a simple and expedient way to organize land use. The agricultural sector needed to sustain concentrated populations is characterized by the use of a petro-chemical energy base, capital intensive farming techniques, and the dissolution of small farms into larger agribusinesses as economics becomes a critical issue. Although petro-chemical agricultural techniques have been responsible for present day high crop yields while providing a solution for depletion of soil fertility caused by monocultural techniques, they have created a dependence upon petro-chemicals such that "a bigger and bigger dose of chemicals is necessary to sustain monoculture crop yields."1 There is a reduction of the amount and fertility of topsoil to a point where it becomes an inert medium and requires petro-chemicals to keep it productive.

The biological system can produce large crop yields if left to its own methodologies. Masanabu Fukuaka, a noted Japanese plant pathologist , states in his book, One Straw Revolution, that while using biological and polycultural farming techniques, he has obtained yields comperable and sometimes larger than petro-chemical monoculture methods. Complementing these yields are an increase in topsoil fertility and quantity. In addition, biological control mechanisms are also given a chance to establish themselves to help control diseases and pests.

The cost and energy use of monocultural food production is incredible. Fossil fuel consumption of monocultural food production systems requires "10-million BTU's per acre under cultivation."2 Large scale production tecniques require large scale equipment that necessitates agribusinesses to provide the captital necessary to buy and use the equipment. After large amounts of petroleum are used to produce this food, it is sometimes transported thousands of miles to concentrated population centers where people willingly pay increasing food prices.

Food could be produced in and near people's homes. This food would save them money. Conner TToo would use food production systems based on biologic and polycultural methods to reduce the cost and total energy use of of food production.

The scale of Conner TToo would depend on the amount of people which could be sustained on a given amount of land (seventy-five acres in this case). Whether petro-based or biologically based, food production for each individual requires a certain quantity of land. In a petro-chemical monoculture system, this land is divided into so many acres of wheat, corn, beans, and so forth. These divisions are recombined into large scale monocultural entities to simplify food production. Conner TToo would not divide land in such a manner, but combine the several individual acreage requirements and individuals to produce a small scale polyculture food production system which could be sustained by those individuals working together.

Conner TToo would seek to use other natural and ecologic systems. These systems would largely if not totally be site specific. Water provided by the hydrologic cycle could be captured and used in conjunction with pumps and water reservoirs to store potential energy to be converted to mechanical energy or irrigation. Aquaculture systems could be incorporated into the reservoirs to provide a valuable food source. Wind energy could be used to provide mechanical energy which could be used directly or converted to electricity. Solar energy could be used for producing heat and electricity as well as bio-mass for food or conversion into methane and alcohol fuels for use on or off of the site. Natural floral and fauna habitat could be encouraged to increase the productivity, complexity, and natural beauty of the land.

In short there are many natural systems which could be used to satisfy all basic food requirements of most people. Through use of "appropriate" technologies based on "on-site" energy systems, basic requirements of shelter could be provided for most people. The only other basic requirement, clothing, could be a mix of clothes produced by the community's individuals, by the existing clothing market, or perhaps by a Conner TToo-like community which produces clothing. The ecologic and natural systems in combination with a neighborhood sized community such as Conner TToo could provide a lifestyle not wholey like Conner Prairie and not as energy intensive as Lynwood Hills.

The built form goals seek to integrate Conner TToo's buildings to their environment. This integration could be achieved through various methods. Use of site-available materials would allow the buildings to hopefully be considered as a natural extension of the site. Materials specific to Conner TToo would include wood, earth, and stone. Wood from trees on the site could be cut, seasoned, and fashioned for different building componants. To limit the impact of the buildings toward the site, wood could be selected from the proposed lake site. Earth, as a material, could provide material for such componants of a building as walls and floors. Cement, though requiring a relatively more energy than wood or earth to produce, is readily available to the site and made from a natural material which is quite abundant. Its structural characteristics allow one to bond stones, bricks, earth, and other masonry materials into homogeneous monolithic building componants.

Various natural systems are also specific to the site. The biologic system is most apparant and has been discussed in its relationship to providing food. This system, however, can be used to produce bio-mass for conversion into alchohol fuel, methane, and heat through biologic decomposition. Deciduous vegetation, strategically used, has the natural ability to seasonaly control solar energy upon a surface and could control heat gain in a building. Solar energy and its derivatives, wind and water energy, have been investigated and found to have reasonable soundness as alternative energy sources for providing heat, work, and electricity through the ages and the more recent past. Earth sheltering makes use of the natural thermal buffering capacity of the earth. Other more temporal physical systems such as efficiency of material use and quantity are less apparent but are found in many natural organic forms. Through the use of several site-specific materials and systems, Conner TToo's buildings would, in a very real way, integrate into their environment.

FUNCTIONAL OBJECTIVES

The function of the buildings in Conner TToo is an important consideration toward realizing an architecture representative of the community. The functional goals of this project focus around four main points. The building should be functionally efficient, it should integrate with natural systems, it should use energy efficiently, and it should be built largely if not totally by its user.

The number one goal is functional efficiency. The building is a tool for its user to accomplish various tasks. As with any tool, the right one makes a task much easier to accomplish. Various functions must be analysed to determine which layout and spatial configuration would be the most appropriate for that function. The various functions must then be looked at collectively to determine how the functions want to be arranged with respect to the building circulation, orientation, massing, and other aspects at the building scale. The building should function as part of the whole community and work to make that communtiy efficient at achieving its goals.

The second functional goal is to make the building utilize natural systems as much as possible. Those systems which are already existing on the site could be easily used. Other systems which do not exist but which would be readily sustainable on the site could also be used. The building should function much like a natural organism which is linked to its environment and depends upon its environment for sustainance. If done successfully, the building would not impinge upon and exstensively disrupt the environment in which it exists.

The third functional goal of this project would be to use energy efficiently. Systems would be assessed as to their overall efficiency at minimizing the amount of material and energy required to accommplish a task. As a pattern, energy efficiency exists in nature. Trees, as an example, are very efficient at converting solar energy to power biochemical processes required for their existence. Egg shells show remarkable strength while using a minimum amount of material.

The term energy efficiency can include more applications other than its usuall association with fuel consumption. Materials have different energy usages required to make them available to the builder. Aluminum, for example, uses on the order of 112,500 BTU's per pound to produce. On the other hand, soil cement blocks require 34 BTU's and concrete 413 BTU's per pound of material.3 Task time is another important consideration. Construction methodologies would have to be assessed as to their efficiency at producing a quantity of work given the materials selection. Directly connected with task time is material quantity. Architectural forms and line languages could be assessed on the level of how much material they use to accomplish the enclosure of space.

The fourth goal is user constructability. To save on the cost of the buildings, the community members could construct their buildings themselves. This method is a time honored way for people who are cash poor but time rich and know the value of sweat equity. Such an approach, however, necessitates buildings which are easily comprehended and constructed. Materials choice, availability, and constructability would also have to be appropriate to the user skills.

FORMAL OBJECTIVES

The formal objectives of this project seek to shape how the images of the buildings present themselves to the viewer, particularly the buildings viewer. There are basically four formal objectives. These objectives range from expression of the philosophy of the users; through use of materials; to expression of natural systems, massing and function of the building.

A major shaping force for the determination of the form of the building is its users philosophy. The building's users seek to establish a genuine symbiotic relationship with nature. They realize that nature is a source for inspiration as well as sustainance. They do not accept an attitude of mind that seperates man from nature. They understand that humans and nature can nurture each other together. A formal objective of this project is to express the user's philosophy. Earth sheltering, as an example, reflects an integration with the environment. Use of natural vegetation for shading of the building reflects a relationship with nature. There are many strategies which can reflect the philosophy of the building's users and which could have implications toward the form of the building.

A second formal objective regards the building's use of materials. Materials can be used in such a way as to take advantage of their inherent qualities. Some materials have natural insulative qualities while others have good heat conducting characteristics. Some materials have good compressive strengths yet others have good tensile strength. Some materials require less energy to produce than other materials. Similarly, some materials are readily available and so have a quality which makes them desirable. These materials are site-specific materials. The form of a building, using site-specific materials, then, could be seen as a natural extension, an evolution, of the site by man similar to the way a tree produced by a seed is also an evolution of site-specific materials. Use of materials for their inherent qualities is a logical choice which represents an honest use of materials while also representing the philosophy of the users.

The third formal objective of this project is to develop an architectural language which reflects the use of natural systems. Solar energy is a system which can have a major impact on the form of a building. Elements of architecture which utilize the benefits of solar energy are elements which express natural systems. Other natural systems such as natural shading by vegetation can have architectural elements associated with their application. These architectural elements and other architectural elements associated with other natural systems can all combine to form an architectural language to be visually manipulated by a designer into an aesthetic as well as functional organization.

The fourth formal objective is to reflect the function of the building as well as its components. The function of a building is often more important than its appearance. It is important to have a building which functions well first because its users are effected by its functions more profoundly than by its form. An honest expression of the functions of the building allows the form to be more easily realized. The functions of a building can often que the user or viewer as to the purpose of the building.

ASSUMPTIONS

There were five assumptions made during the course of this project. These assumptions helped determine the direction of the project or facilitated the process of design. Some assumptions are straightforward while others are based on philosophical biases.

The first assumption is that nature has patterns and systems which if recongnized and utilized can lead one on a path of energy efficiency, ecological integrity, and energy sustainability. There are several of these systems and patterns. Solar energy, wind energy, and hydro-potential energy are the most apparent systems. The biologic system is one of the most important systems; it sustains animal communities. Other patterns are not so obvious. Physical laws govern how space and forms behave. Nature has several strategies that are used to solve many problems and can be observed to learn different strategies for solving ones own design problems.

The second assumption deals with the division of the community functions into three broad categories. These divisisons are family, work, and recreation. The family unit was seen as a basic balanced social unit essential to development of balanced individuals. Similar work functions common to all families were combined into a work-center so that an overall efficiency could be obtained by sharing work, tools, and space needed by these functions. Recreational functions were combined into community areas so that all could benefit from shared involvement in these functions.

The third assumption is that there would be a lake. The lake would add several amenities to the community. An aquaculture system could provide an efficient and valuable food source. Recreational activities such as fishing, swimming, and boating could be added. Water stored by the lake could be used to irrigate the community's crops.

The fourth assumption is that this community would be based around an industry. This industry would be the primary focus of the community in order to show how a community like Conner TToo could be organized around any common endeavor. Actually a community of this type could be organized around any cottage industry or technical industry. These industries could provide a reason why communities of this type would be organized. People with a common interest could provide a community for themselves. The industry would be the primary income producing activity of the community. Conner TToo's industry would be the making of musical instruments. Most other activities would be in the pursuit of satisfying basic needs. Surplus generated by these pursuits could provide additional income for the individual community members or the whole community.

The fifth assumption deals with the limit of time imposed upon this project. A community design of this size requires a lot of time to be developed. Major design issues which would have to be addressed would be the community master plan, a prototypical housing unit or cluster of units, a work-center, and the indoor recreational center. For this reason, the community work-center and the master plan were chosen as most representative elements of the community as a whole. The majority of design effort would be directed toward these elements.

The history of this project includes a history of the site and a history of the representative building of this site, the work-center. The history of the site includes discussion of the context, the site, and my relationship to the site. The history of the building includes discussion of the concept of bio-shelters.

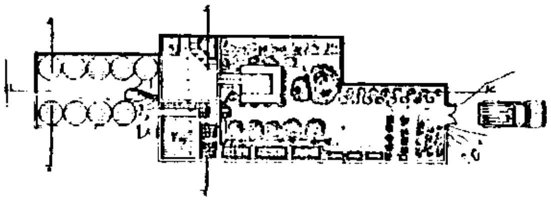
All the land around and including the Conner TToo site was inhabited by the Deleware Indians until the nineteenth century. In 1802 William Conner, a fur trader whose mother was a Shawnee captive, married a Deleware and settled 200 acres one-half mile northwest of the site on White River. After the Treaties of St. Marys, Ohio were signed in 1818, the Deleware Indians relinquished control of Indiana and moved west of the Mississippi River. Conner purchased much of the land in the area and, because his first wife went with her people, took another wife. Conner became a merchant involved with land development and speculation. He was involved with the development of Noblesville, the Hamilton County seat four miles to the north. Conner moved to Noblesville in 1837 and lived there until his death in 1855. Conner's land remained in his family until after his wife's death in 1896.

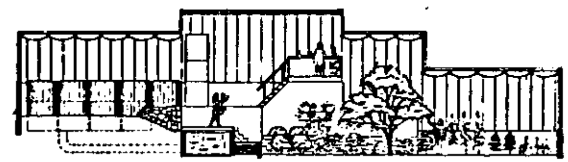
The land around Conner's property was parceled during Conner's life. One parcel to the west of the Conner TToo site and south of Conner's land was acquired by Eli Lilly, the pharmaceutical giant, who built a summer home overlooking White River. Later, in 1934, Eli's grandson purchased Conner's property and began restoration of Conner's old home, the first example of Federal architecture in the county and place where the decision for the final location of Indianapolis was made. Included in the restoration was a re-creation of pioneer life during Conner's time through the importation of period log structures from around the state. The Lilly's donated the Conner land to Earlham College in 1964 which has continued the pioneer re-creation settlement and purchased the Lilly land in the I970's.

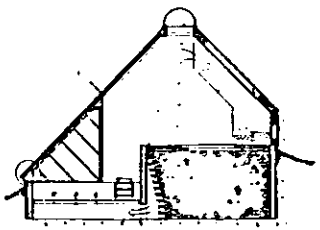
The Conner TToo site was part of a parcel of land that became a farmstead. A portion of this parcel was sold in the early 1950's and became a suburban housing development called Lynwood Hills. In 1962, my family moved into ths subdivision after purchasing a house directly across the street from the Conner TToo site. The Conner TToo site became the stomping grounds of my youth. Seeing the inevitable pressures which housing is generating upon the county and the site as well, I chose this site to study because of my familiarity with it and the desire to design housing which would benefit the site and not merely consume it.

The history of the work-center begins with a discussion of "bio-shelters". The term "bio-shelter" was coined by Sean Wellesley-Miller and Day Chahroudi who were looking for a word which denotes a structure that "at once contains biotic components and maintains a symbiotic relationship with its immediate environment.1"4 The New Alchemy Institute, a group of biologists looking for symbiotic nature/man relationships, built their own bio-shelter in 1971. This shelter was followed by two progressively sophisticated structures through the help of Solsearch Architecture. The work-center follows the concept of a bio-shelter but it includes the work functions of a whole community in a community-sized structure.

BUILDING TYPE ANALYSIS[5]





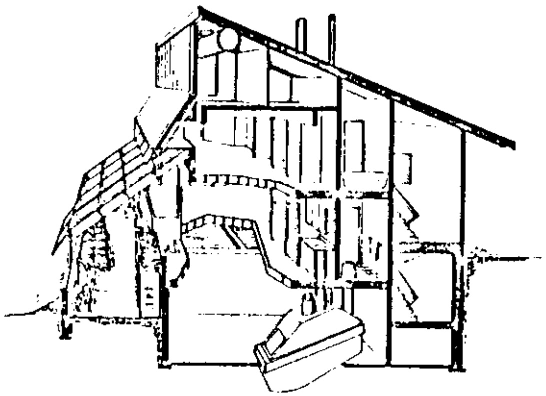


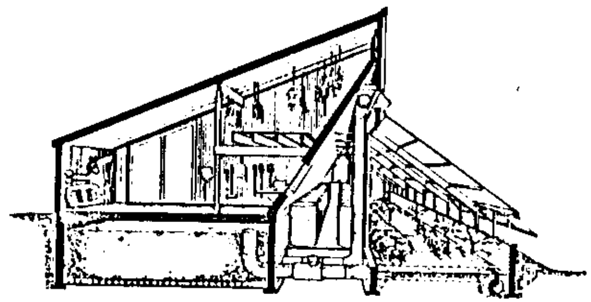
Two buildings which were chosen for building type analysis are both bio-shelters. The first is the Ark on Cape Cod concieved by New Alchemy Institute and designed in conjunction with Solsearch Architecture. It is basically a solar rather than fossil fuel energized greenhouse for the research and development of natural aquatic and biologic systems and symbiotic relationships between the two in a greenhouse environment.

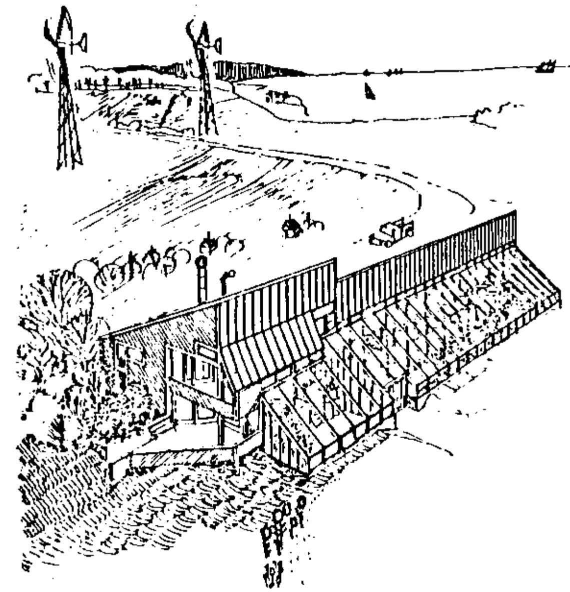
The plan is divided into two basic zones. The first zone is for phyto- and zooplankton production to feed fish, a high protein and energy efficient meat source. The other zone is for fish propagation and plant production. A third area is a research and instrumentation deck above the the floor of the plant areas.

The south elevation shows the special glazing used to benefit the plants. This glazing has a scalloped shape which, with the simple gable massing as shown by the transverse section, gives the impression, as Jack Todd puts it, "of a sailboat come to anchor in a field". This is an appropriate architectural metephor for a structure called an ark.

The longitudinal and transverse sections show much of the interior elements of the building. The west end of the building contains the translucent firberglass containers for growth of phyto- and zooplankton. These containers are also one of the major heat storage areas. To the east of these containers and in the center of the building are two other heat storage areas. To the rear of this area is the 1160 cubic foot rock storage area. The transverse section shows how heat enters from the peak of the building and is drawn by a large fan into the rock storage area and finally exhausted through spaces in a deck. In front is the 2,870 gallon fish culture pond which is fed by the nutrient rich output of the phyto- and zooplankton containers. The east end of the building contains the areas for plant propagation. This building is 100% solar heated; a back-up wood burning stove was removed after not needing to be used after two relatively harsh New England winters.







The second building which was chosen for analysis is the Institute's more sophisticated ark at Cape Spry on Prince Edward Island in Canada. This bioshelter contains areas for human habitation as well as for biologic processes. As the perspective shows, the habital zone is to the west and the greenhouse/workshop is to the east. The two zones are articulated architecturally to show a distinction between them yet use similar massing and other formal architectural elements to unify them. The glazing is a specially selective acrylic called Rohaglass SDP16 which admits ultraviolet wavelengths of light to help reduce bacterial and fungal borne plant diseases.

The section-perspective of the house shows several of the elements contained within. The major heat contributor to the house is the attatched greenhouse which is open to the house to allow direct gain by the spaces in the winter. The major heat storage devices are two water storage areas, one in the basement and the other being several containers which hold fish in the greenhouse. The domestic hot water is achieved through a passive thermosiphon system with the collector panels placed above the greenhouse glazing and the storage tank nested in the peak of the attic to capture any waste heat which may migrate upward from the house. The building is partially earth sheltered and presents a low profile to the north winds. A compost toilet is incorporated to provide on-site organic waste treatment and nutrient rich compost for the site or greenhouse soil.

The section-perspective of the agricultural zone shows how a workshop has been added to the greenhouse. The major heat storage of this section of the building is a rock storage area below the workshop and the translucent phyto- and zooplankton containers in the greenhouse. Heated air is collected at the peak of the greenhouse and drawn into the bottom of the rock storage area. Heat convectively migrates to the top of this storage and is drawn off by ducts and fans and deposited at the lower front of the greenhouse to be reheated.

FACILITY PROGRAM

The architectural program of the work center contains several different funtions. These functions are broadly grouped into human only functions and human/animal functions. Most human only functions are relegated to a "house". Human/animal functions are relegated to a "barn". All funtions create a work center which is seen as a "house" and "barn" even though people would not actually live in the "house". What follows is a brief description of the functions of the work center.

HOUSE FUNCTIONS

EARTH SHOP: This space would be for seperating soil into sand, silt, and clay. Silt would be discarded and the sand and clay used to form blocks and bricks to be dried or to be fired in a kiln.
Space Required = 800 sq.ft.

FOOD PROCESSING: This space would be for preparing raw food for storage. People would not eat meals here.
Space Required = 800 sq.ft.

FOOD STORAGE: This space would be used for storing large quantities of food for use by the community families. The space required would be divided into dry, cool, and cold storage.
Space Required = 1600 sq.ft.

INFORMATION PROCESSING: This space includes a library for books relating to work functions as well as a computer.
Space Required = 550 sq.ft.

LUTHERY: This space is for the construction of musical instruments. A Conner Too community could be organized around a cottage industry and musical instrument making is the representative commercial enterprise chosen for this community.
Space Required = 500 sq. ft.

MAIN SPACE: This space is generally for meetings and gathering of people. People could meet here to socialize and decide what work needs to be done and who will do it.
Space Required = 600 sq.ft.

METAL SHOP: This space is for the processing of metal into usable products and repairing metal objects.
Space Required = 800 sq.ft.

PAINT SPACE: This space is primarily for finishing musical instruments but could be used for any product needing paint, varnish, or any other finish.
Space Required = 500 sq.ft.

PLANT GROWING: This space is for the production of plants for food and enjoyment. Considering that a greenhouse could be used to facilitate heating of the building, no space requirement has been totaled.

POTTERY SPACE: This space is for the production of pots and other clay products other than those produced by the earth shop. This space would be closely related to the earth shop and the kiln.
Space Required = 800 sq.ft.

SLAUGHTER SPACE: This space is used for the killing and butchering of animals to produce meat to be prepared in the food processing space for storage.
Space Required = 500 sq.ft.

TANNING SPACE: This space is for the processing of animal skins for use or sale.
Space Required = 450 sq.ft.

WINE PRODUCTION: This space is used for the processing of fruits and other products into wine and beer.
Space Required = 750 sq. ft.

WOOD SHOP: This space is used for processing logs into lumber and wood products for use by the community members or for sale.
Space Required = 1500 sq.ft.

BARN FUNCTIONS

ALCHOHOL PRODUCTION: This space is used for the processing of grains and other similar products into alchohol for use as a fuel for gas engines that might be used on or off site.
Space Required = 650 sq.ft.

CHICKEN SPACE: This space is for the housing and growing of chickens and other poultry other than turkeys for eggs and meat for the community.
Space Required = 2400 sq.ft.

COMPOST SPACE: This space is for the composting of animal waste and dry litter for use as a base to form a slurry for methane gas production or for use on the gardens.
Space Required =

COW SPACE: This space is for housing of cows during inclement weather and feeding.
Space Required = 500 sq.ft.

DAIRY: This space is used for milking cows and other milkable animals and for processing this milk into dairy products.
Space Required = 700 sq.ft.

ELECTRICITY GENERATION: This space would be used for storage of equipment for producing and storing electricity produced by windwheels and solar panels.
Space Required = 650 sq.ft.

GRAIN PROCESSING: This space is for processing grain plants into seeds for storage for later use or for processing into flour.
Space Required = 650 sq.ft.

HONEY SPACE: This space is used for processing raw honey in combs into honey for storage.
Space Required = 250 sq.ft.

HORSE SPACE: This space is used to house horses for protection against inclement weather and for caring for the animals.
Space Required = 500 sq.ft.

METHANE PRODUCTION: This space 'is used to house equipment used for producing methane gas from slurry produced by water and effluent from compost piles.
Space required = 600 sq.ft.

PIG SPACE: This space is used for housing pigs for protection from inclement weather and for feeding.
Space Required = 550 sq.ft.

RABBIT SPACE: This space is used to house rabbits and their hutches for production of rabbit meat for consumption.
Space Required = 850 sq.ft.

SEED STORAGE: This space is used for storing seed produced by various plants for use in the main greenhouse area where plants are grown from seed.
Space Required = 600 sq.ft.

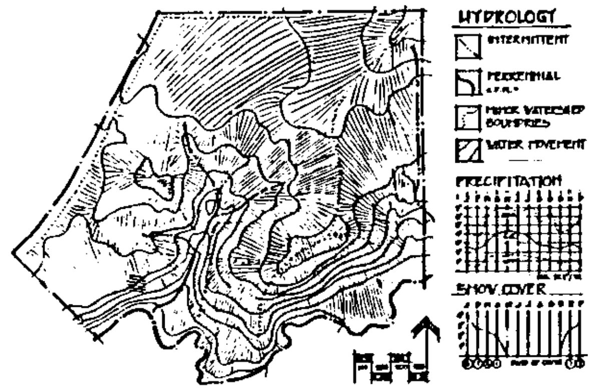
SHEEP SPACE: This space is used to house sheep during inclemnt weather and for feeding.
Space Required = 750 sq.ft.

PROGRAM SUMMERY

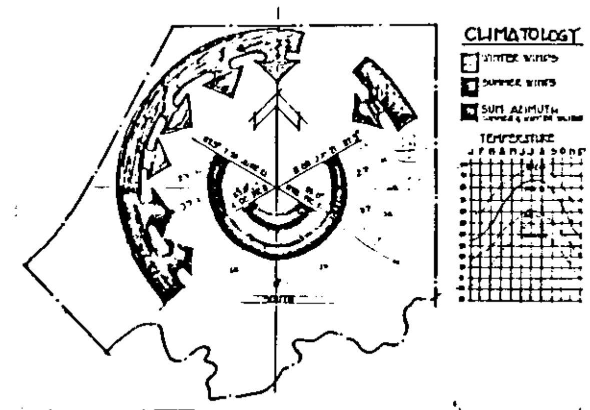
SPACE	SQ. FT.
EARTH SHOP	800
FOOD PROCESSING	800
FOOD STORAGE	1,600
INFORMATION PROCESSING	550
LUTHERY	400
MAIN SPACE	600
METAL SHOP	800
PAINT SHOP	500
PLANT PRODUCTION	
POTTERY	800
SLAUGHTER SPACE	500
TANNING SPACE	450
WINE PRODUCTION	750
WOOD SHOP	1,500
SUBTOTAL	10,050
ALCHOHOL PRODUCTION	650
CHICKEN SPACE	2,400
COMPOST SPACE	7,750
COW SPACE	2,000
DAIRY	700
ELECTRICITY GENERATION	650
GRAIN PROCESSING	650
HAY STORAGE	5,700
HONEY PROCESSING	250
HORSE SPACE	1,000
METHANE PRODUCTION	600
PIG SPACE	650
RABBIT SPACE	900
SEED STORAGE	600
SHEEP SPACE	800
SUBTOTAL	25,300
TOTAL	35,350

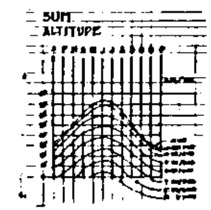
SITE ANALYSIS

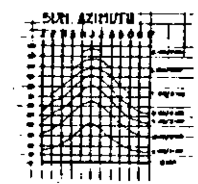
The site analysis is similar to the format outlined in Ian McHarg's Design With Nature. Different site attributes were analyzed and overlayed to derive buildable areas.

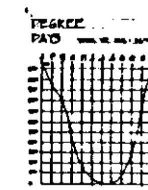


The hydrology of the site shows how water moves on the site. The south boundry of the site is Shoemaker Creek, a perennial creek which carries off most of the water falling onto the site and the Shoemaker watershed. An intermittent stream carries off water which falls on the north and southwest part of the site. Lines of gravity influence perpendicular to the contour lines show how surface water runoff and some subsurface water might migrate off the site. Minor watershed boundries are indicated on the map and show the amount of area in each minor watershed. The site has on the average 37 inches of precipitation per year in the form of snow and rain. Snowfall averages about 17 inches per year, with an average maximum snow cover of about four inches during January.

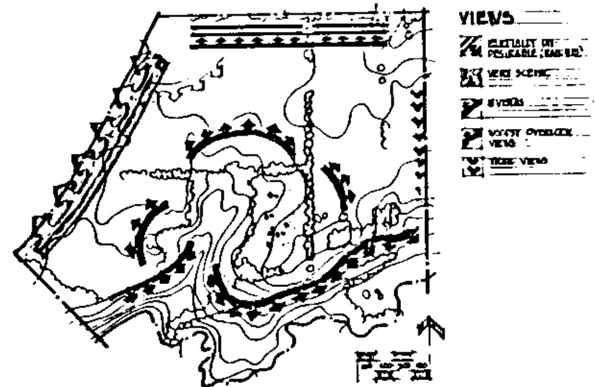


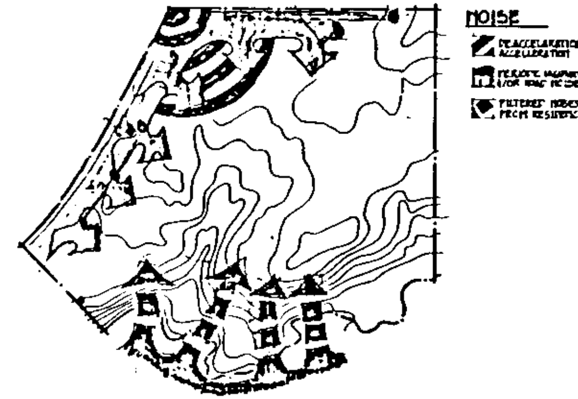






The climatalogy of the site has elements which are critical for building design. The sun azimuth angles vary from a maximum of 117 degrees to a minimum of 53 degrees north of south. The maximum sun altitude angles vary from 32 degrees during winter to 73 degrees during summer. The maximum average temperatures vary from 87 degrees to 35 degrees. The minimum average temperatures vary from 61 degrees to 15 degrees. The site averages 3,694 degree days per year. January averages 1,100 degree days. Generally, southwest winds blow during the summer and northwest winds blow during the winter.





The vegetation on the site is restricted to zones. These zones fall into three categories. All zones are delineated by natural or man-made barriers.

There are two agriculture zones on the site. These are a large open zone on the north-west corner of the site and the open zone to the southeast corner of the site.

The reclaimed zones used to be agricultural zones but have recently been reclaimed by growth such as grasses, small trees 5-20 feet tall, vine, briar, and bushes. These zones are on the eastern third of the site above the flood plain and the central zone.

The climax vegetation zone includes the floodplain of the Shoemaker Creek and the hill-sides leading up to the agri-cultural and reclaimed zones. This zone has the characterist-ics of an oak-hickory forest.

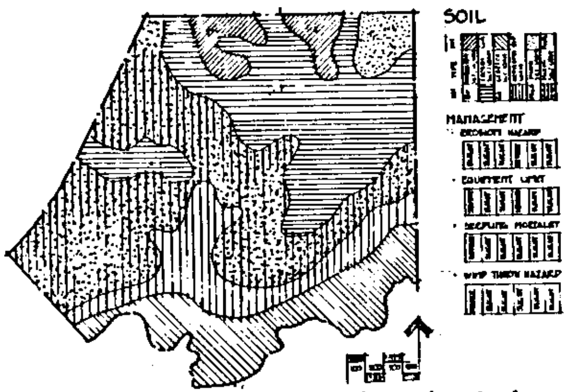
Views are considered both onto the site, off the site, and within the site. Views onto the site are from Allisonville road on the west side of the site and 131st street on the north side of the site. The views onto the site are slightly screened by growth alongside the roads and look onto the woods beyond the agricultural zones.

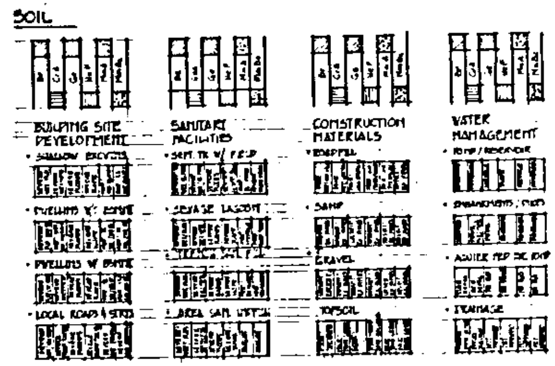
There are two general vistas off of the site. One vista is a scenic look from the woods on the site, across an agricul-tural zones, and to a woods across Allisonville road. A similar view exists toward the subdivision of Lynwood hills which consists of one-story ranch style homes.

The views within the site are very scenic. They are mostly restricted to the woods. Trails inside the woods provide scenic views with overlooks and view down to the creek.

Noise on the site is re-stricted to filtered and unfil-tered noise. Allisonville road on the west side of the site is a major road from Indianapolis directly to Noblesville. Cars, trucks, and busses pass along this road frequently and cause unfiltered noise to frequently migrate onto the west side of the site. Combined with this noise is the traffic on 131st street on the north side of the site. Deacceleration and ac-celeration noise eminates from the intersection of both roads.

Filtered noise eminates from the south boundry of the site. On this side across the creek are single family homes and a small subdivision. Peri-odically sounds from kids and lawn mowers migrates across the creek and onto the site. This noise is somewhat acceptable but destroys the peacefull tran-quility of the site.





The soil analysis includes the six general soil types on the Conner TToo site. In order of the amount of coverage, the soils are: Miami Silt Loam B2, Crosby Silt Loam, Genesee Silt Loam, Hennepin Loam, and Miami Silt Loam A. These soils have been assesed in the Hamilton County Soil Survey as to their qualities and have given clues to general site uses.

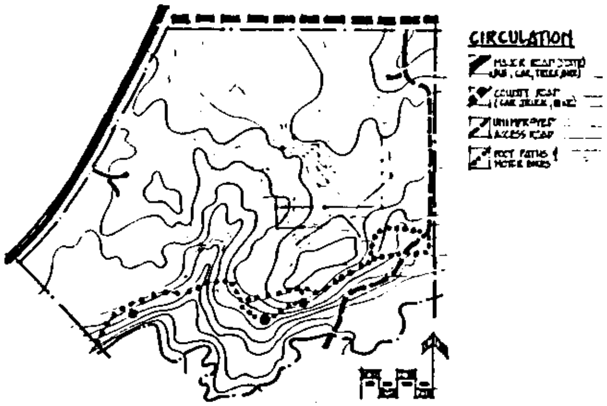
Woodland management is the first category of assessment. Generally all the types of soils are only slightly susceptable to erosion, equipment, seedling loss, and wind throw. Brookston soils, though, are severely susceptable to equipment due to their wetness. Seedling mortality is high for the same reason. Hennepins are severely susceptable to equipment use and and erosion due to their slopes.

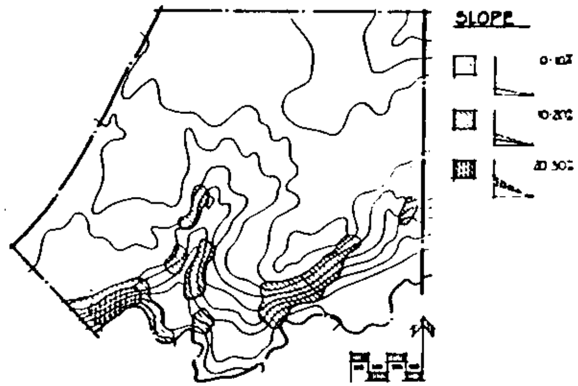
Building site development is assessed for shallow excavations, buildings with and without basements, commercial buildings and streets. Generally, building site development has a severe impact on all of the soils because of wettness and flooding, low strength, large slope in the Hennepins, or severe frost action for streets in the Crosbys. Miami B2 and Miami A, though, have a moderate toleration for development, limited by being too clayey for shallow excavations and having relatively low strength for buildings. The Crosbys have moderate toleration for dwellings without basements and small commercial buildings. While moderate susceptability to building development may be somewhat undesireable, only 1.1% of all soils in Hamilton County have a slight susceptability and then only for buildings.

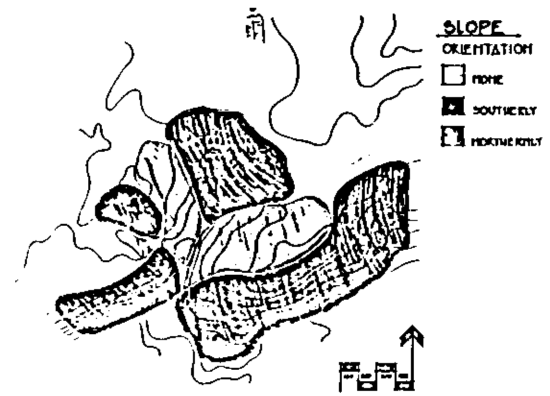
Sanitary facilities assessment includes sanitary diposal methods such as septic tank and leach fields, landfills, and lagoons. Generally, all the soil types have a very low tolerance to these types of waste disposal. Moderate toleration for septic tanks exists only for the Miami A soils. Obviously, alternate methods of waste disposal must be used for Conner TToo to process its own wastes.

Construction materials are assessed for road fill, sand, gravel, and topsoil. Generally, sand and gravel are not available on the site because the soils are have too much clay. Only the Crosbys, Genesees, and Miamis have a fair quality material for road fills. The Genesees in the flood plain have a good amount of topsoil and the Crosbys and Miamis have a thin layer.

Water management has four areas of assessment. Brookstons, Crosbys, Miami B2s, and the sloped Hennepins all will retain water well. Hennepins and Miamis are favorable for embankments, dikes, and levees. Brookstons and Crosbys are the only soils which have some aquafer refill. All the soils drain well except for the Brookstons which can flood and frost heave and the Crosbys which have slow percolation.





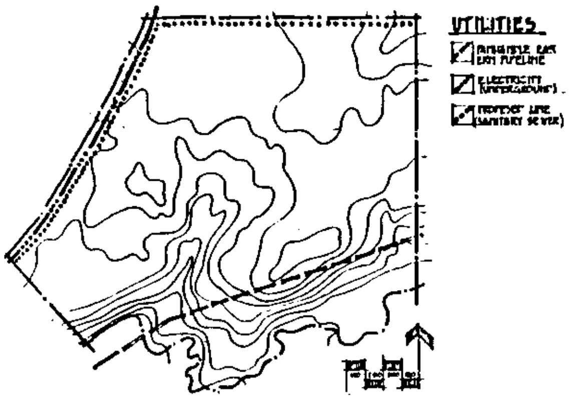


The circulation on and around the site consists of paved roads, unpaved access roads, and trails. The major road on the west edge of the site is Allisonville Road between Indianapolis and Noblesville. This road is a two lane highway. The minor road on the north side of the site is 131st street. This road is a well paved county road which carries heavy truck traffic from a concrete plant down the road.

The unimproved access road is a grassey lane. It follows the east edge of the site to the flood plain, goes west, and crosses the creek to what used to be a field for the farm which occupied the Conner TToo site.

There is one major trail on the site which follows the grassy lane but branches off and meanders up a hill, along the gas line right of way, and through the woods as indicated.

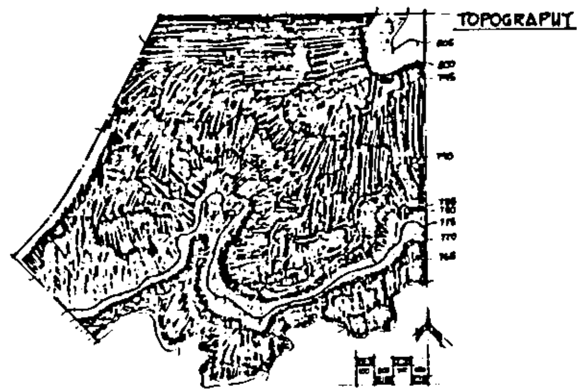
The slopes on the site were assessed for their steepness and orientation. Most of the site is relatively flat or slightly sloping. Only a few areas have a slope over 20%. Only one area has a slope of 20-30% and is subject to erosion by the creek and the agricultural zone to the north. The slopes which are oriented south and have no shadows cast on them indicate areas with good solar access for location of buildings.



The utilities on the site are very few. There is an underground electricity line on the west side of the site that parallels Allisonville. This is fortunate because it removes unsightly telephone poles and potentially dangerous overhead lines.

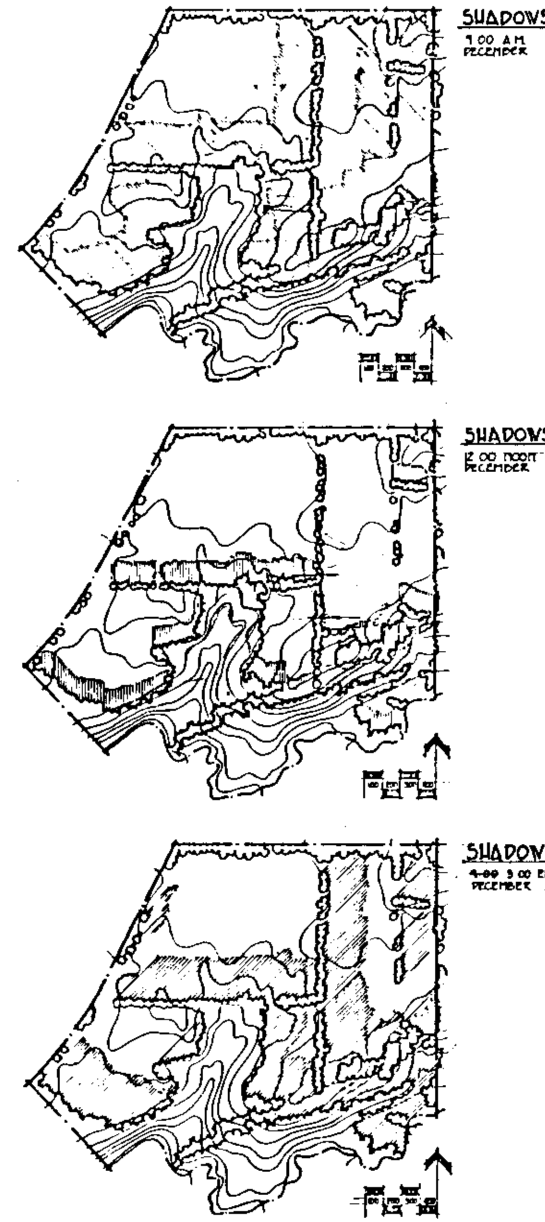
The only other utility is a gas pipeline. Panhandle Eastern natural gas company has a gas pipeline and right of way which travels along the south side of the site. The right of way is periodically cleared to prevent any trees from growing on it. Although this habit is undesirable, it facilitates possible maintainance and falls under the protection of eminant domain.

The only other utility which will be on the site is a future sanitary waste line which will tie into the existing Fishers sewage treatment plant constructed by my father.



The topography of the site is gently rolling terrain. The highest point on the site is the northeast corner of the site. From this point the land gently slopes about twenty feet to the southwest to steeper slopes. On the south side of the site is a creek which, over the years, has formed the slopes flanking the floodplain. These slopes are approximately 30 feet high and are covered by vegetation. The only other topographical feature which dominates the site is a large swale caused by an intermittent stream on the south central portion of the site. This swale seems to be a natural location for the construction of a lake for use by Conner TToo.

Overlaying and interpreting the site analysis maps provides information which can become the basis of a design for the site which respects and utilizes the site to its fullest potential.



Shadows are for December 21.

ENERGY USE ANALYSIS

The project and the building were analyzed as to their energy use. The analysis focused on ways which could be used to manipulate energy effectively before and during the design process. Several strategies were used.

Massive materials were considered to increase the thermal carrying capacity of the building. Concrete and rammed earth were the two main materials used to achieve this effect. Increasing the mass allows the building to gradually warm to a mean temperature that is relatively stable for a longer period of time than a low mass building.

Rock storage was used to accommodate short term heat requirements. A rule of thumb of three cubic feet of rock to one square foot of floor space was used. The rocks, having relatively less mass than the building, could then be raised in temperature and heat could be stored to heat the building spaces when they become cooler. The rock bed storage was placed under the spaces to take advantage of any radiative and conductive heat losses.

Greenhouses were used as primary heat sources for the building. They also have the advantage of providing a space for plants in a micro-habitat that could provide the food energy requirements of the building's users. The greenhouses would be earth-coupled to prevent space overheating and soil freezing in the winter. Deciduous vegetation such as grapes, mellons, or ivy could be grown on trellises or some other support on the outside of the glass areas to provide seasonal shading and to prevent greenhouse overheating during the summer.

A minimal geometry was used to decrease the surface-to-volume ratio. A hexagonal geometry was used because of its simplicity and efficiency. This geometry was used as a tool to help organized the spaces and have control over the surface-to-volume ratio. Energy would also be saved during construction because this geometry uses a minimum amount of perimeter wall length to a given amount of floor area.

Earth sheltering was used to buffer the buldings from seasonal and daily temperature extremes. Earth as a material provides a thermal lag which protects the buildings from any immediate affect of air temperature change. Earth also provides a moderate insulative value to the extent that a two foot thick layer is enough to keep the earth temperature above freezing. This temperature is higher than the ten degree average winter air temperature and so helps to decrease the bulding's heat loss.

Fireplaces were used to augment any additional short and long term heat requirements. They could be double firebox fireplaces which help heat space air. With special grates in which water could be circulated and stored for later heat use, these fireplaces seek to extract as much energy from a fire as possible. Firewood could be grown in wood lots on the site and would provide a renewable fuel source.

These are only a few of the energy strategies used in this project but they give a good cross section of the energy focus the project.

The aproach to the design of Conner Too started with an analysis of the site. This analysis follows the process described by Ian McHarg in his book, Design With Nature. The site was assessed as to where different land and bulding functions could be located. With this general knowledge, the next step was to decide how the different functions could be organized.

The land and bulding functions were divided into three broad categories: work, family, and recreation. The functions of work were combined into what could be called a work center. There are advantages to combining the work functions into one building. Certain functions which require large amounts of capital and would be uneconomical for an individual could be financed and used by several individuals for their mutual benefit. Functions which require lots of labor could be more efficiently performed by several people within a community. The existence of a work center would provide a place for people wanting to work. The recreation functions include those functions which were not work and not family oriented. They included indoor sports, outdoor sports, and community function spaces. The indoor sports and community functions were seen as being in an inn-type building. The family functions include typical living functions such as the main space, kitchen, bathroom, bedroom, etc. After the division of the general site and community functions, the location of these functions was then dedcided.

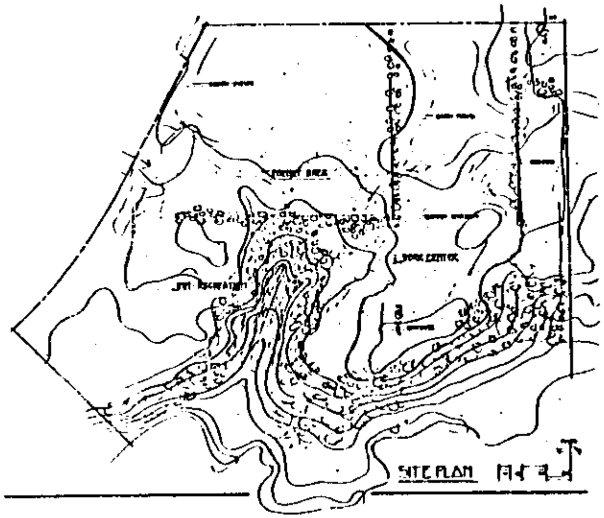
The location of a lake provided a focus around which the three general categories could be located. A lake was decided upon early in the project. A lake would provide a habitat for an efficient food production system, aquaculture. A lake would provide a collection reservoir for the water shed off the site. Finally, a lake would provide recreational and aesthetic amenities to the site. There is only one location for a lake on the site. This location began to articulate the site into different areas.

The general functional categories were then matched to the different areas defined by the lake. The work funtions were located to the east of the lake in a position at the center the site. People would then have easy access to the work center from anywhere on the site. The indoor sports, games, and community functions were located to the west of the lake. In this position they would have access to the amenities of the lake as well as access to the highway when visitors come to visit the site. The community center/inn would then act as the formal "front door" to the site. The family functions were relegated to the north side of the lake where they would be in a position between the work center and the inn. This area could then contain different types of housing configurations such as single family, detached housing or cluster type housing.

The locations of the general categories of fuctions were further fixed by using lines of constant elevation. Contour lines were chosen that connected the most areas of the site. These lines run through the general areas for the three categories of functions. They could be used for circulation that would facilitate movement of heavy materials while providing meandering natural pathways.

The project scope was narrowed to encompass only the work center. There are a couple of reasons for this decision. The scope of the whole community as a design project would prove to have been too lengthy to resolve in one acedemic design year. The work center was a unique building type and proved to be the most representative of the community as a whole.

METHODOLOGY



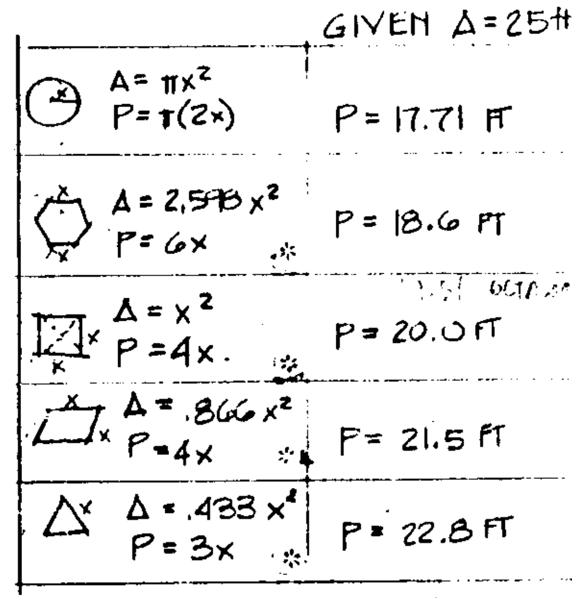
The methodology for developing the project stems from four points. The first point deals with the functional organization of the work center. The second point deals with how geometries fill space. The third point deals with a base section and how it integrates with a chosen geometry. The fourth point deals with how the above three points are manipulated to develop a building.

The functional organization of the building zones was largely determined by the site surrounding the work-center. The functions were divided into the ones which were human oriented and the ones which were animal and human oriented. Human space functions were located in the "house" and animal/human functions were located in the "barn". The house functions related either to orientation, proximity to site areas which have some functional connection, or relationship to family functions which have a connection. The barn functions related likewise.

A study of geometry was incorporated into the design development because it solved some objectives of the building. The building was first designed using mostly a rectangular geometry in conjuction with an assembled type of plan. Through the influence of Peter Steven's book, Patterns in Nature, a methodology was developed to organize and control aspects of the building's spatial design.

Shapes can fill space in an irregular or regular way. An architectural plan which uses an assembled set of shapes fills its spaces irregularly. The shapes are manipulated in such a way as to come to a balance between purely funtional organization and aesthetic organized composition.

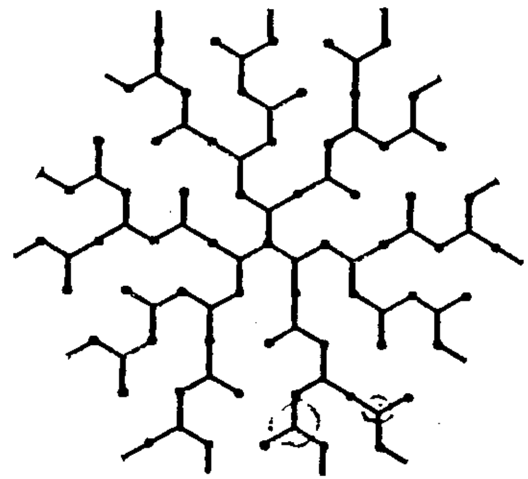
Regular ways to fill space use simple shapes. These shapes



can be organized into simple or complex patterns. Simple patterns use a regular repetition of only these simple shapes: triangles, trapezoids, squares, or hexagons. Complex patterns use a combination of two or more of these simple shapes and a few more. Examples are octagons with squares, hexagons with triangles, hexagons with squares and triangles, and so forth.

Interesting possibilities arise if one further analizes the simple patterns and their finite amount of shapes. Simple shapes have an inherent regularity and simplicity. Lines are ordered and always meet in the same way at the corners. Simple shapes can be set up in a heirarchy of perimeter per area. If these shapes are set to a given area, triangles are the least efficient at enclosing space; requiring more perimeter to enclose a given amount of space. They require eighteen percent more perimeter per given area than hexagons. Similarly, trapezoids require thirteen percent more and squares require seven percent more perimeter per given area than do hexagons. Hexagons require the least amount of perimeter than do any of the simple, regular packable shapes. Steven's book points out that, in terms of filling space, a simple radiating hexagonal network of lines has the least average path and total length of line than any other simple network of line.

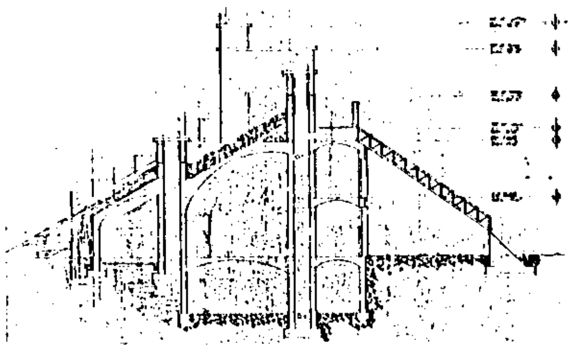
The hexagonal network of lines is further characterized by simpler connections between the repeating shapes. A triangular network of lines has six lines meeting at a joint or corner. Trapezoidal and square networks of line have four lines meeting at a corner. Hexagonal networks of line have three lines meeting at a joint and are characterized by three-way corners. All the corners are 120 degree corners; having what Frank Lloyd Wright calls a larger angle of repose or being more open.



A hexagonal geometry seems to be a rational choice which helps to organize and control aspects of space if one chooses to use a geometry. A hexagonal geometry uses a simple shape that packs well; there are no left-over spaces. It has simple corner connections which translate into an architectural plan with simple corner details. A hexagonal geometry encloses more space per unit of perimeter which translates into an architectural plan that both maximizes the area enclosed by a given amount of wall and minimizes the amount of wall exposure per given area. In terms of building circulation, a hexagonal network could result in a building which minimizes the average traveling path of the user and total length of circulation the building would require. In short , a hexagonal geometry could solve several objectives the users require in a work-center. Simple hexagonal patterns have implications on how easily a plan would be to understand and construct. Since the work center would hopefully be built by its users, regularity and simplicity of construction would be important to them.

A base section was developed to combine with the hexagonal geometry. The base section was designed to be flexible enough to accomidate its adaption into different functions. In this way a simplicity could be acheived because all sections would be basically similar.

The base section was developed to accomidate several overiding design perameters. Solar energy was seen as being a requirement which satisfied other larger requirements such as energy efficiency and philosophical integrity. In this way the base section began to have an orientation. A greenhouse sunspace was seen as a way of absorbing heat and providing an encaptulation of the environment to facilitate yearly food requirements as well as to trap heat. A rough rule of thumb of 1 sq. foot of greenhouse glazing to 1 sq. foot of heated floor space was used to determine the relative sizes of the base section.



The space to the north of the greenhouse became the area for different functions of the building. This space could have an upper or lower story as required by the various functions as can be seen by the barn section. Additional functional space or storage space for functions could be placed toward the north of the this main functional space and would help insulate it from the colder north side of the section. The roof was sloped to shed winter winds and allow maximum penetration of winter sunlight.

Circulation was placed between the functions and the greenhouse space. In this way the circulation would service both the greenhouse spaces and the functions while functions which must be heated would have minimal cross circulation space within them. Circulation space would fluctuate in temperature at the same rate as greenhouse temperatures. Second level walkways would provide shading for first level walkways in the summer.

A flexable space for various support utilities required by the spaces was incorporated into the base sections. This space was termed a multi-duct space because it holds a variety of utilities which usually require ducts or bulkwork or are hidden in unused space. The multi-duct space serves as a duct for heated air from the greenhouse to be circulated to heat storage under the functions which require heat. Fireplaces which would provide auxilary heat to functions could be integrated into the multiduct space. Doors and windows and other specific functional elements would be incorporated into the multi-duct space. A large degree of the flexibility required by the functions could be allowed by the multi-duct space and also allow the base section to be more flexible and modular.

The organization of the building includes how the functional organization, hexagonal geometry, and base section all intigrate to form a building. The functional organization of the spaces is obtained by observation of processes within the spaces and analysis of these processes. The functional organization of the building is determined by the way the spaces relate to the site. Spatial and building organizations operate with an understanding of a simple, yet efficient spatial patterns striving for an overall efficiency of the building even if the functional organization of the individual spaces may be somewhat less efficient than without these constraints. The base section adds a third spatial dimension which has a priori elements layered into it such as solar access, orientation, a functionally flexible spine, and functional positions in relationship to these elements. In this way way the building grows, having a system for growth programmed into it which allows the building to achieve certain overriding concerns such as functional efficiency, energy efficiency, growth, flexability, and simplicity. The building adapts to its functional and physical environment with elements programmed into it in a way similar to how a seed evolves into a tree. The specific form is controlled by the way certain internal forces allow it to evolve. The building has within it natural forces similar to organic life around it.

The philosophy of this project revolves around three main points. The first point is energy and its usage. The second point is ecology and how it is regarded. The third point is economics and its ramifications. These three points, woven together, show how Conner TToo is a viable community organization.

Energy is an important consideration in these days of dwindling, concentrated, nonrenewable fuel resources. As we deplete these resources we must conserve and turn toward renewable or at least more available resources if we are to survive. Transportation is the biggest use of all available energy, using twenty-five percent of the total amount.6 To conserve and reduce that percentage of energy use, we could reduce the amount of transporting we do and develop structural social organizations which use less transportation or develop fuel sources or methodologies to sustain current social organizations. Residential and commercial space heating is the second largest use of available energy, representing eighteen percent of the total amount. Use of solar energy has provided one-hundred percent of some residential heating requirements and could reduce the concentrated energy for this purpose. Industry uses approximately forty percent of all concentrated energy supplies. Many of the items produced by industry could be produced by ouselves if we had the resources at readily accessable areas. Commercial and residential water heating, refrigeration, lighting, and cooking combined use seven percent of the total nonrenewable energy supplies. These amenities could be largely if not totally tied to renewable energy resources. In effect, all the uses of energy described use ninety percent of the total amount of non-renewable energy resources and could largely and significantly be supplied by renewable energy resources.

A community such as Conner TToo could be a viable alternative structural social organization. By providing most of the requirements of a neighborhood such as food, shelter, and many of the items which go in a shelter, the total amount of transporting could be reduced significantly. Any transportation which might be necessary could be provided by renewable alcohol, methane, or electrical energy produced in the community. Vehicles, the resources needed to make them, and other necessary or appropriate technology could be produced in communities similar to Conner TToo. Residential and commercial space heating could be supplied by solar energy. Commercial and residential water heating, lighting, and refrigeration could also be provided by solar energy. Cooking requirements could be provided by methane or electrical energy produced by the community. In short, much of the total energy used by people could be based on renewable energy resources. To do this, however, people could- have structural social organizations that allow them to do less transporting, have resources available to reduce the amount of energy for goods, and have structures and systems that rely on renewable energy sources.

Another consideration in the development of a philosophy for this project is ecology. Ecology is defined as the relationship of plants and animals to their environment. Humans, as orgasisms, also have an ecological relationship to their environment but this relationship is more influential than other organisms. To develop a philosophy which does not harm the environment we must acknowledge the special relationship which humans have to the environment.

Humans have had an influence on their environment throughout the evolution of the species. Among the first ways in which humans influenced their environment was by building shelter, a primal act which was necessary for survival and which is carried out by many organisms. Cultivation of plants and domestication of animals were two revolutionary ways in which humans influenced their environment, freed themselves from their nomadic lifestyles, and allowed themselves to pursue activities that increased their knowledge about their environments. Civilizations grew as a result of a fixed base of cultivation and domestication. Civilization allowed for the assimilation and exchange of knowledge about their environment and the construction of paridigms about their environment. At this time in the evolution of our species, humans had, to some degree, influenced their environment to the extent that it became largely human centered and human made but not the same as the environment they once knew, the natural environent. As humans reached a limit on the sustainability of their ever increasing population the industrial revolution with its more complex mechanisms, more diverse use of mechanisms, and eventual use of different energy resources, allowed for a larger limit to human population still unattained today. Today we see that the human environment has grown so large that it influences and is encroaching upon the natural environment.

The human environment, though, is inextricably linked to the natural environment and both are really one environment. Humans, through necessity of their natural link, must draw sustainance from the natural environment. They do this largely through cultivation, a middle ground that is a human-made or human-influenced natural environment. Shelter and clothing are human manipulated pieces of the natural environment. Mechanisms and energy to propel these mechanisms are similarly connected. Today we see how we are connected to the natural environment and how we can manipulate and change the environment.

The Conner TToo philosophy acknowledges the delicate balance between humans and the natural environment. The natural environment has taken many years of evolution to attain a delicate balance between its organisms. Systems have arisen which are perpetual as measured by the human scale. Humans have been nurtured by this environment and evolved to adapt to it. This process has taken many years. In a relatively short span of years humans have been able to manipulate small aspects of the environment yet they do not see the ramifications of affecting only small parts of a complex interaction of different systems. Conner TToo seeks to understand the complex intricacies of the ecological environment. These intricacies are inherant in each system in the environment and in the interactions of these systems. Methodologies for understanding these intricacies would be pursued. Working with the natural systems and reinforcing them to help build the natural bounty of the site is considered a worthwhile and obligatory philosophical as well as ecological goal.

The third point in the development of a philosophy is economics. This point includes two major concerns. One concern is the cost of basic necessities. The second concern is the buying power of the individual.

Each individual in Conner

TToo must meet his basic necessities. Basic necessities include food, shelter, and clothing. By growing much if not all of their food, Conner TToo individuals could reduce the cost of food. By working together much of the intensive labor required by small scale food production could be shared and reduced. By maintaining small scale food production techniques appropriate to Conner TToo's scale, much of the need for captial re-quired to maintain large machinery used today to produce food today would be largely reduced. Smaller machines such as large garden tractors could facilitate the production of food.

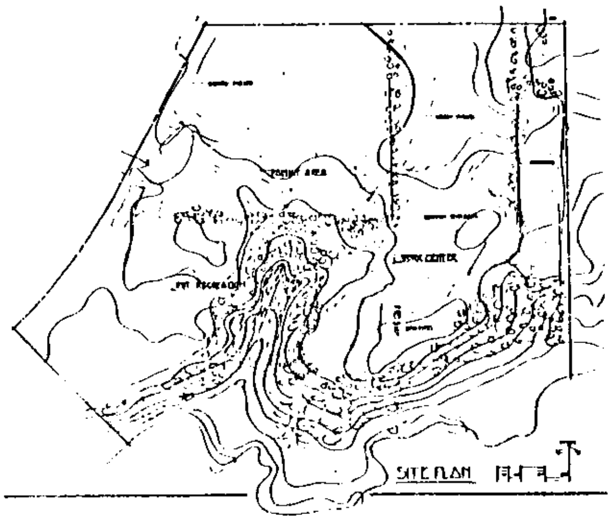
Shelter would be a basic necessity provided by the individuals at Conner TToo. The labor required to build shelter would be shared by individuals in order to reduce capital cost by utilizing sweat equity. A person could own their own home by providing labor to help build other homes as well as his own. Materials which could be obtained from the site would go a long way toward reducing the cost of shelter. Common shelter elements which all people would use could be built by all Conner TToo residents.

Clothing would be the only other basic necessity required by Conner Too residents. Enterprising individuals could produce their own clothing on looms with wool grown on the site or cotton transported in bulk from the south. These individuals could also produce clothes for others who could buy or barter for such items. Other options would be to buy clothes on the market or from a community like Conner TToo which produces clothes.

The other major economic concern is the buying power of the individual. Tools which may be too expensive for one individual to purchase but would benefit the community as a whole and the individual as a result,could be purchased by several individuals. Each person could contribute some individual net worth by buying shares in the tool desired. In this way the buying power of the individual is broadened. A tool which would not be used often enough to warrent one person buying it might be needed often enough by several individuals. Each inividual would benefit by having access to that tool and would only have to venture a fraction of the cost. Savings in energy required to duplicate the amount of tools required by several individuals who may not use these tools all the time would be an added energy conservation benefit.

A tool purchased by several individuals could also produce added purchasing power. Such a tool could be used by several individuals to produce a product or service which could be sold and be credited toward the net worth of those individuals. A product such as produce or a service such as construction provided by all the individuals could be sold and the proceeds credited toward the net worth of the community as a whole by adding credit to individual shares invested in the community. Parallels to this technique are profit sharing or employee ownership organizations that provide a specific product to the market place today. By pooling individual resources, several individuals could venture into larger investments to generate larger returns which might be more than what an individual working with relatively limited venture capital might expect.

The philosophy of this project in summary reflects three major points: energy and its usage, ecology and its ramifications, and economics and its impact on the individual.

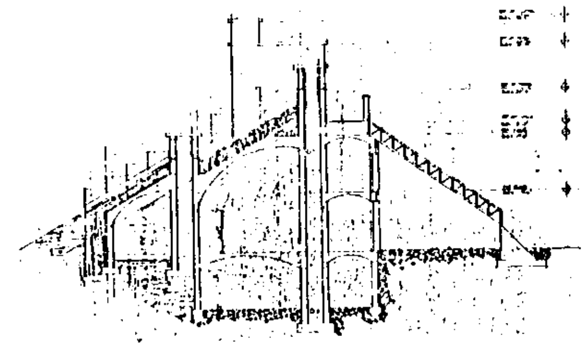


There are three major concepts used in this project. The first concept involves lines of constant elevation. The second concept deals with physical determinants of the building. The third concept deals with how the base section integrates with the building.

Lines of constant elevation were a way of integrating the building and site functions to the site. Lines which tied together a majority of the site were used to situate the work center so that it would have access to a majority of the site. Family functions and indoor recreational functions were also located on these lines to facilitate movement of people around the site. These lines, being level, would allow people to move loads around the site without having to negotiate up and down hills. Lines of constant elevation provide natural, meandering pathways about the site.

The second concept involves the building form. All forms are responces of forces acting on them. The form of the workcenter is as much a response to functional forces as it is to other forces which shape building forms in particular and all forms in general. Organic forms have built into them systems for developing through adaption to various environmental forces. The form of a tree is determined by the environment as well as the genetic response of the seed to the environment. A building is similar to organic types of forms. It has a metabolic rate and uses energy to maintain its operating temperature. It may have sytems such as water, electricity, gas, or waste removal to support various functions. By addressing "genetic" determinants in a building one can concievably design a "program" of response which could adapt o different functional and environmental variables.

The base section is one way in which the work center responds to its environment. It



is seen as a common denominator based on the different functions. It has different levels to accomidate vertical functional requirements. It has a multiduct which allows for horizontal or vertical passage of different environmental systems, gasses, or solids required by different functions. The multiduct acts as a spine which adapts to the differences in the functions and allows for growth and change by the building. The base section also has orientation to facilitate solar heating through various traditional methods. The base section responds to adjacent functions through a-priori space growth systems such as the hexagonal geometry so that the whole building has an overall efficiency even if the functions must adapt to those overiding systems.

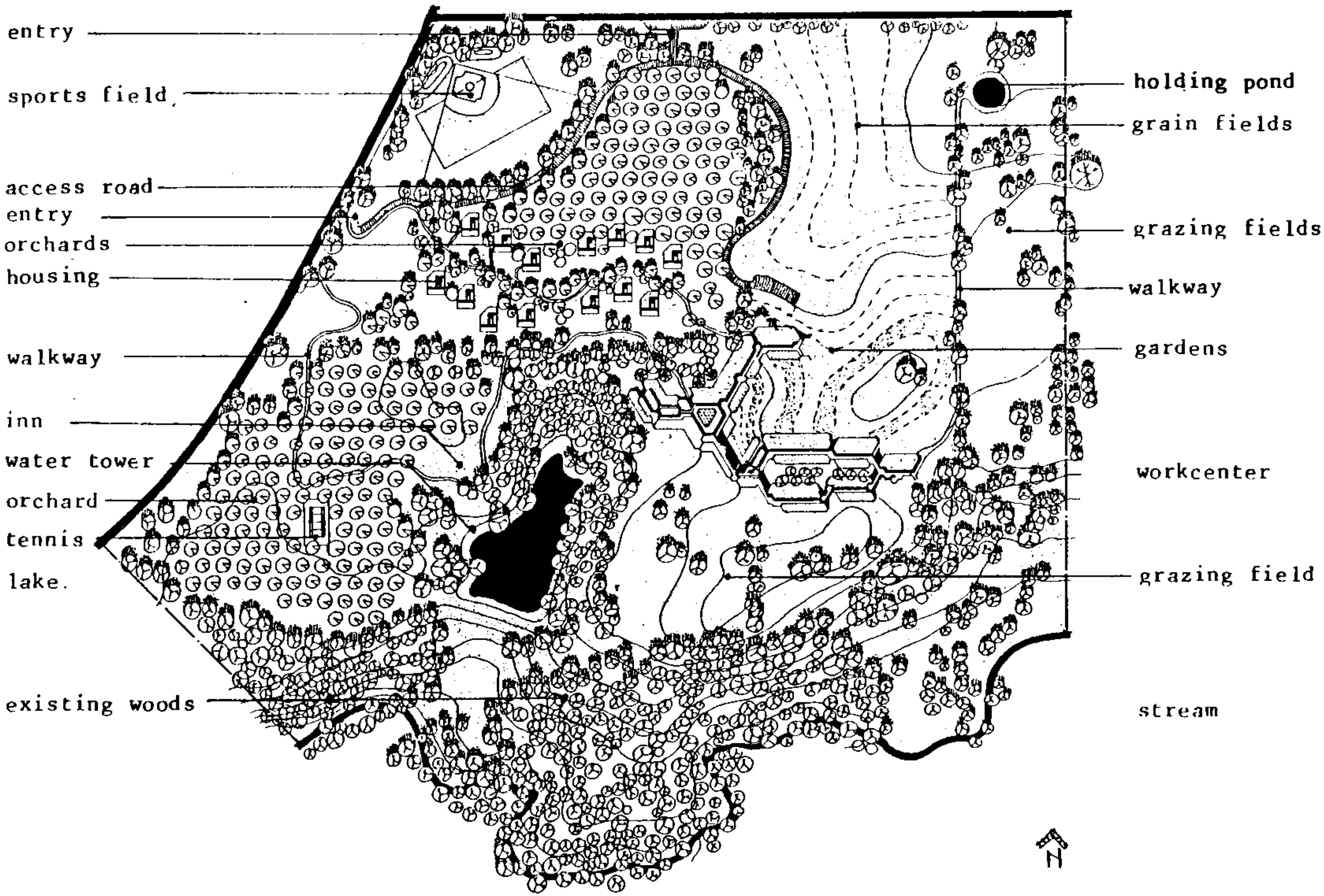
DESCRIPTION

The plan for Conner TToo can be best described by looking at different areas of the site. Most of the original wooded areas have been left intact except for the location of the lake. The lake is located in an area where the contour, hydrology, and soil of the site are most suitable for that purpose. The lake is part of the irrigation and three stage fish production systems. Water in the lake is collected from areas uphill or is drawn from the creek by use of hydrolic rams. Water is pumped from the lake to an adjacent water tower and moves by gravity to the holding pond on the northeast corner of the site. From this pond, water can be used to irrigate the terraced garden and grain areas, used for the production of phyto- and zooplankton for fish culture in the workcenter and lake, or used to operate mechanical equipment such as generators and counterbalance lifts. Some disruption of wildlife would occur but the animals and plants would relocate to other existing and proposed wooded areas. Wood culled from the lake area could be seasoned for construction of the buildings on the site.

The lake provides a focus around which to locate the other zones of the site. The work functions are located in the workcenter to the east of the lake. This location allows the workcenter to be close to the center of the site. Inside the workcenter as well as immediately to the east and north of the kitchen are the garden areas. The grain fields are to the north of the gardens. The grazing areas for cows, sheep, horses, and fowl are to the east of the grain and garden areas and to the south of the workcenter.

The housing area is north of the lake. Housing could be of any configuration and has been represented as single family detatched units. The plan and description of these units which I designed is in <u>Honeywell Parcels and Prototypes</u>, a prototypical solar development study done by 1981 fourth year architecture students under the instruction of Professor Robert Koester. Pine trees are located to the north of the housing units to protect them from winter winds. Fuel for the fireplaces is grown in a woodlot north of the housing areas.

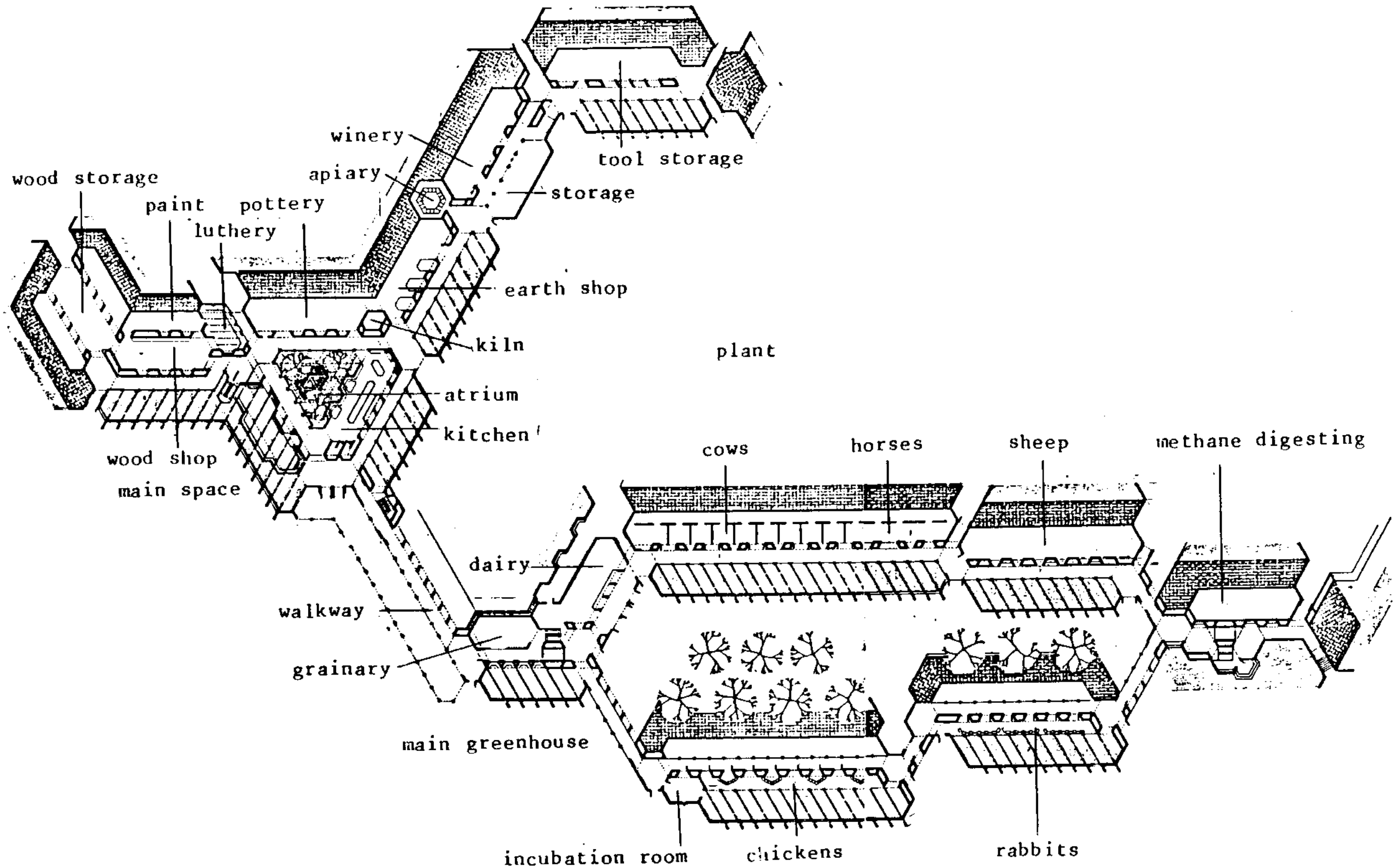
The indoor recreation and inn functions are located to the west of the lake but are not shown on the site plan. This facility is adjacent to the major thouroghfare of the site and would serve as a "front door" for the community to receive and house guests. A small store could be located next to Allisonville Road so that the community could sell fresh fruit during season, fresh vegatables from gardens and greenhouses all year round, and other items produced on the site. The outdoor recreation areas include a football, soccer, and baseball field on the northwest corner of the site and a tennis court in the orchard next to the inn. Intercommunity sports games could be played on these fields and would provide a way of meeting people from around the community. One line of constant elevation ties together the the workcenter and the recreational inn to the formal entry of the site. Another line ties the workcenter and housing area together. A third line of constant elevation is the access road which leads from Allisonville Road to the west, moves to the secondary entry on the north edge of the site, and meanders south to a small parking area adjacent to an entry into the workcenter.


entry
sports field
access road
entry
orchards
housing
walkway
inn
water tower
orchard
tennis
lake
existing woods
holding pond
grain fields
grazing fields
walkway
gardens
workcenter
grazing field
stream
N

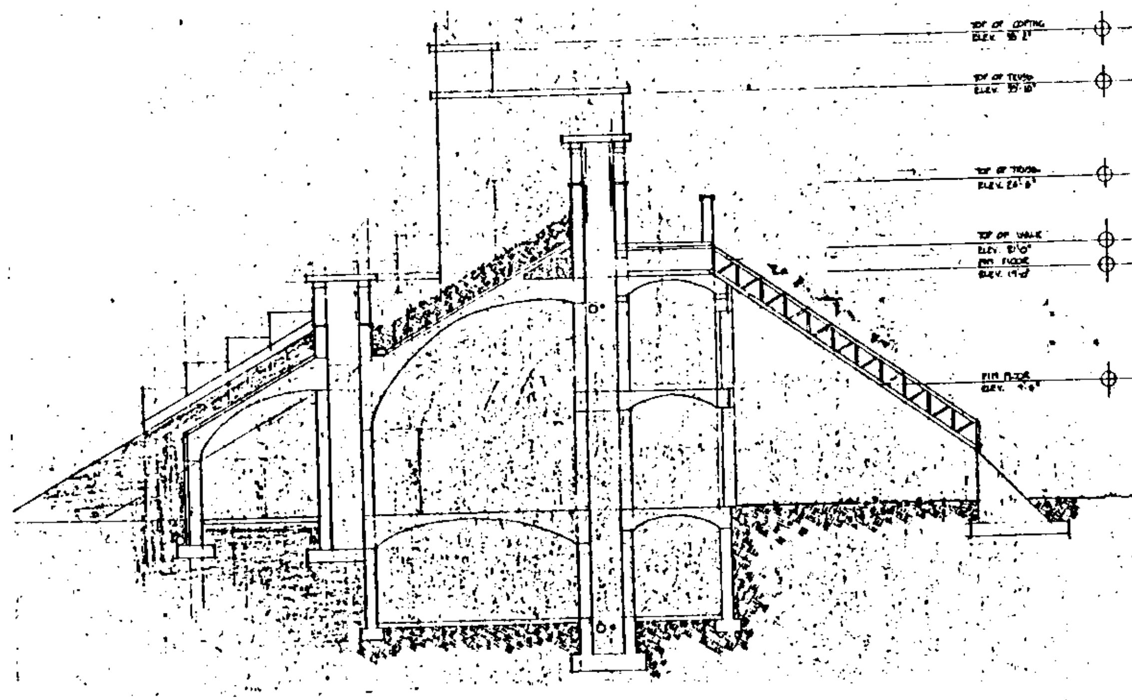
The plan for the workcenter shows several of its aspects. The most aparrent aspects are the seperation of the majority of the work functions into two different categories and the hexagonal geometry. The house contains functions which are human only oriented. The barn contains functions which are human and animal oriented or closely associated.

The house is located closer to the housing area to shorten the distance between it and the workcenter. House functions are centered around an atrium which contains vegetaion and an aquaculture pond. This organization is done to provide a focus around which the workfunctions can be organized as well as a symbolic gesture. Wood related functions are situated in the wood wing close to the wooded areas east of the lake. The luthery, a musical instrument making shop, is the representative commercial activity around which a community such as Conner TToo could be organized. It is located next to the main entry for the walkway from the housing and inn areas of the site. The earth related functions of the house are located in the earth wing to the north and northeast of the atrium in relative proximity to the gardens. The kitchen has immediate proximity to the gardens and the barn. Excavated earth can be transported to the earth shop to be sifted into sand, clay, and silt for making bricks and pottery in their respective shops. The winery is in the earth wing for proximity to the gardens. Tools are located adjacent to the gardens and on one of the lines of constant elevation to the housing. The main space is located southwest of the atrium to be within close reach of the housing and to have the view through the woods down to the lake.

The barn is connected to the house via a covered walkway. Cold storage is below this walkway and adjacent to the dry storage beneath the kitchen. In this location the cold storage can be kept cool through evaporative cooling, shading, or icing. Ice formed on the second level of the walkway during the winter can be harvested and stored next to the cold storage by passing it through the multiduct. The barn is divided into two distinct wings: large animals and small animals. Cows and horses and sheep are stored in the north wing. Hay is brought from the fields using small wagons and garden tractors, moved to the second level through water elevators, and stored on the second level of both wings to facilitate gravitational feeding. Supplementary fresh food is grown in the greenhouses to the south of the large animal wing. Adjacent to this wing and in close proximity to the house and the cows is the dairy. During milking, cows can be held in the interior courtyard or their pens until they are milked. The grainery and experimental greenhouse is also in close proximity to the kitchen as well as the greenhouses of the barn. The smaller animals such as the chickens and rabbits are located in the south wing. The chickens are located closer to the house to facilitate egg gathering. They are allowed to use the greenhouse areas and the meadow south of the barn for scratch space. Rabbits are sexed, kept in seperate cages, and selectively allowed to browse their garden to facilitate unwanted production. The end wing houses the methane digesting unit. Slurry is made from water and some of the compost beds and worm beds below the animal areas.


wood storage
paint
pottery
luthery
winery
apiary
storage
tool storage
earth shop
kiln
plant
atrium
kitchen
wood shop
main space
cows
horses
sheep
methane digesting
dairy
walkway
grainary
main greenhouse
incubation room
chickens
rabbits

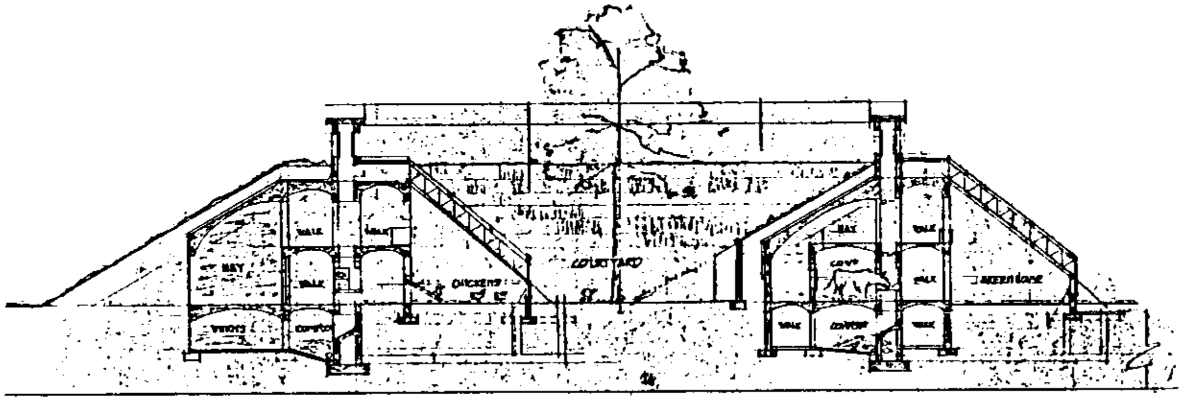
SECTIONS

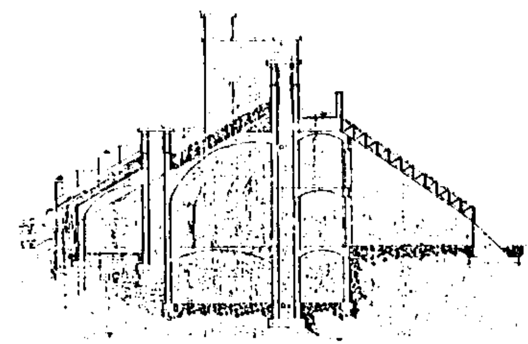


The base section is shown in an expanded form. The main feature of the section is the multiduct. It is a flexible core for vertical and horizontal distribution of various substances. The duct follows the minimal hexagonal geometry described in the methodology and helps reduce total runs of of pipe. In some instances the duct facilitates the movement of air. Warm greenhouse air can be used to induce movement of cooler, shaded air outside of the building or can be routed to a heat storage bin below the ground level by closing vents in the top of the multiduct and providing ducts back to the base of the greenhouse to complete the convective loop. In a direct gain mode the multiduct has windows in the wall adjacent to the function. The different levels of walkways serve as seasonal solar screens to control direct gain. In other cases the multiduct is a fireplace with room air convective ducts and outside air sources for quick heat required by a function. In some cases water in grilles holding the wood is circulated and stored for d.h.w demands not delivered by solar panels on the top of the duct. More specific functional requirements can be accomidated by modification of the multiduct. In the earth shop the multiduct adapts to accomidate a sifting machine run by water mechanisms or an electric motor. In several cases the duct serves as a tube for running gas, electric, water or waste water lines.

The zone to the right of the multi duct is a flexible zone. It is used primarily for solar collection in a greenhouse or other heat collecting mode. In a greenhouse mode trusses also support seasonal vines to prevent overheating of the building in the summer. In some cases this zone is a functional space as in the wood storage area or the main space.

To the left of the multiduct is the functional zone which can have as many as three levels. The functions on these levels are organized in reference to the multiduct so that mechanical equipment can use the different resources running through the multiduct. If any function needs some support, then the section can be modified by adding another multiduct and space as shown.

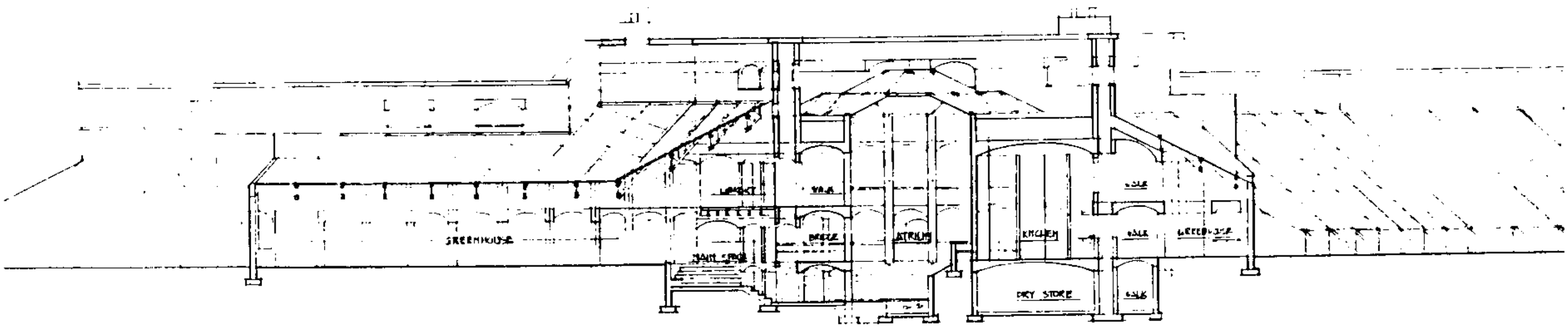




The flexibility of the base section can be further seen by looking at the woodshop and barn sections. In the woodshop section, the functional space is two stories high with a sloped roof to facilitate direct gain. A rock storage bin below the functional space is used to store heat. The paint space is treated as an auxilary space attatched to the wood shop and its multiduct provides bays for painting while facilitating the exhausting of paint fumes, liquid waste removal, and delivery of compressed air from passive trompe apparatus. The second level walkway is used to house some phyto- and zooplankton production vats similar to the ones used in the New Alchemy Arks. The greenhouse space is part of the interior food production space while producing heat for the woodshop.

The barn sections show how the multiduct space accomidates the barn functions. The multiduct has been configured in the large animal section to accomidate feeding troughs for grain fed to the cows and horses. Hay can be passed into the second level storage area through openings in the duct. The functional space has been modified to facilitate the movement of hay from the storage area directly to the stalls. Built up bedding litter can be pushed below the trough and allowed to drop to the compost piles below the stalls. The greenhouse is used to grow supplementary nutritious food for the cows. Heating the barn in such a passive mode would help reduce winter stress and bio-maintainance requirements of the cows.

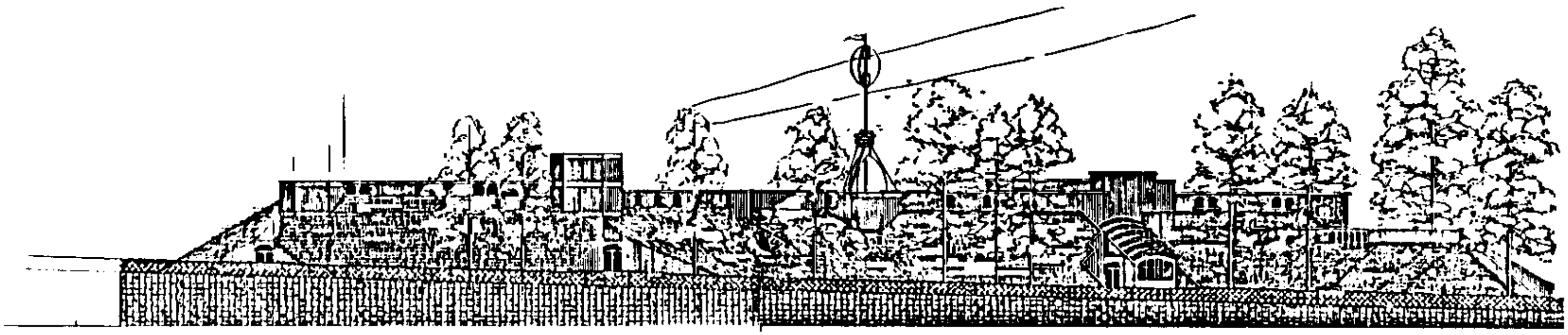
The small animal section holds to the generic form of the base section. The sunspace is given to the fowl for scratch space. Controls on the operable windows allow fowl to browse the field south of this section. The multiduct shown in this function serves a similar function of allowing feeding but is configured as shown in the plan to also allow the unobtrusive collection of eggs from the nest boxes. A second walkway is to the north of the multiduct and the base walkway becomes the service area for the chickens. Hay is stored in this wing to recharge the hay storage in the large animal section. The courtyard between the two wings is a holding area for cows when they are to be milked at the dairy. The greenhouse trusses also support seasonal vines such as grapes to provide shade and reduce heat stress on the smaller animals during the summer.



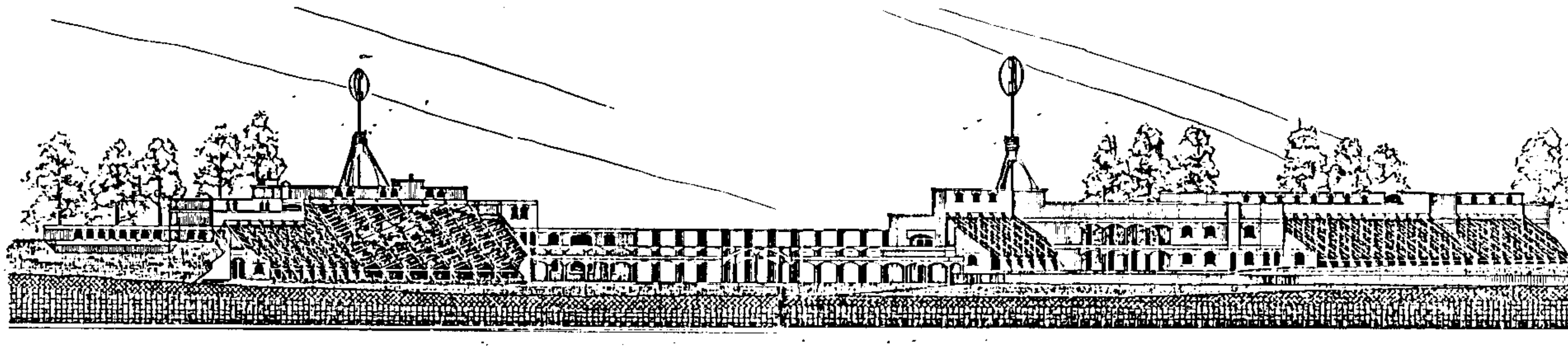
The main space to kitchen section shows the base section at its most flexable configuration. This section is actually two base sections back to back as show in the plan. In this case the space usually used for the greenhouse sunspace is actually used for the function of the main space. It is slightly lowered to accomidate the library above and to make it special by making it different. Seasonal vines would control overheating during the summer. The multiduct is shown in a configuration which would allow ventilation of the main space. The atrium could be considered the functional zone of the main space base section or as the sunspace for the pottery shop as seen on the plan. An aquaculture pond connected to the three stage aquaculture system and stream meandering through the house gardens is the focus of the atrium and is surrounded by more gardens. A large triangulated glazed area is partially operable to facilitate building ventilation by thermosiphon techniques and to allow light to penetrate into the functions located around the atrium. Acces to the atrium is from the main space via passage under the walkway bridge.

The kitchen section is more similar to the base section. To the east is the greenhouse space for growing herbs and other fresh items for processing food grown in the greenhouses and the garden. The kitchen is oriented toward the east to capture morning sunlight but reject afternoon sun. It is two stories high so that excess heat will collect at the top where racks hold food for drying. Access to the racks is from the second level walkway which circumscribes the atrium space. Dry storage is directly below the kitchen for easy access via a dumbwaiter in the multiduct. Cold storage is below the walkway connecting the barn and the house and is further described in the discussion about the plan. The multi duct provides water for the sinks and preperation tables in the kitchen as well as providing openings for views from the kitchen to the gardens and the morning sun. Gas and wood fireplace stoves and ovens are located at the far end of the kitchen.

One can see how the base section provides a starting point for organizing the functions. Through its flexability, the more stringent building form criteria can interface with the demands of the various functions.



northwest



southwest

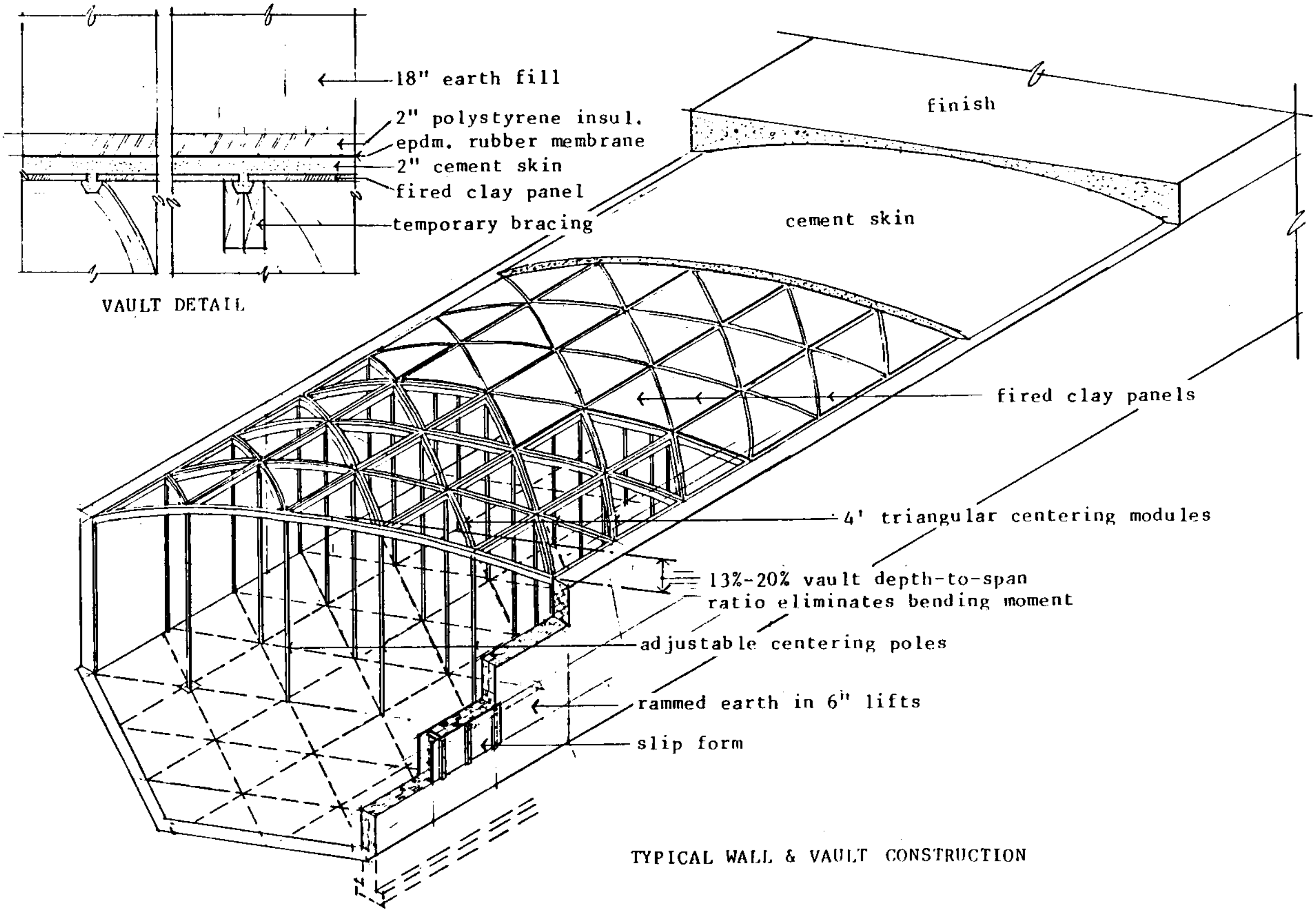
The basic construction of Conner TToo is based on site-specific materials. Most of the buildings would be built by the community members to reduce the overall cost of the construction. Buildings would be labor intensive but would use labor saving techniques such as re-usable forms and the minimal network of walls described in the methodology.

Concrete used in the building would be cast in place. Floors on the ground would be slabs-on-grade. Concrete would be obtained from a concrete plant one-half mile from the site. Cement could be purshased in bulk, however, and mixed with gravel and sand to reduce the cost of concrete.

Ceilings and floors over spaces would be cast on temporary formwork consisting of triangular centering modules. Since a triangular network of lines has the most perimeter per given area and is the common denominator of a minimal hexagonal geometry, the triangular centering modules are ideal for structuring the vaults. Each module would be slightly arched so that, when connected to other modules, a vault with a depth-to-span ratio of 13 to 20 percent would be formed and would eliminate any bending moment and structural steel in the vault. Thrust created by the arch action in the vault would be resolved either by buttressing as is achieved by the greenhouse trusses or directed into bearing walls. Each module would be attached to another with hexagonal connectors which would be supported by adjustable centering poles. After a vault has been cast and allowed to achieve working strength, the temporary formwork could be disassembled to be used to form other vaults. In this way, the amount of work and material required to build single use formwork would be reduced substantially.

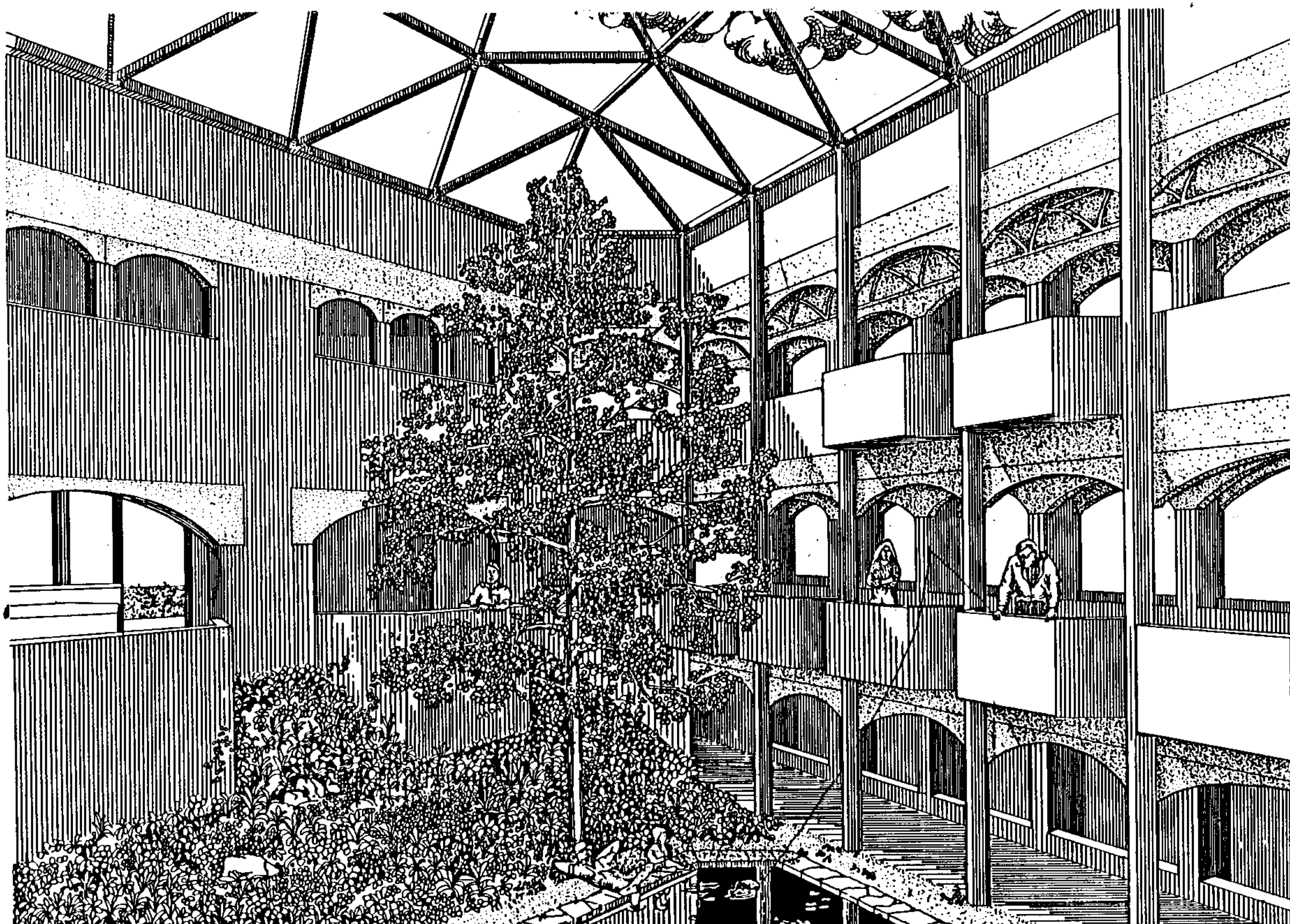
The actual vault would consist of several layers. Four foot triangular panels would be placed over the centering modules. Each panel would be made from clay excavated from the site, slightly arched to match the centering modules, and fired in a kiln to achieve structural rigidity. Concrete would then be placed over the panels to form a skin. Beveled edges on the centering modules would allow concrete to wrap around and lock the panels into place. The finish interior vault, then, would consist of triangular interlocking concrete ribs over clay panels. Clay panels could be glazed before their placement to achieve a more interesting finish ceiling. If a floor is to be placed over the vault, then a leveling layer of lightweight concrete would be placed over the concrete skin. If the vault is to be exposed to the exterior, then a layer of waterproofing made of renewable rubber would be placed over the concrete skin. The waterproofing would be covered with polystyrene insulation. Finally, an eighteen inch layer of top-soil would be placed over the insulation on the vault to moderate the temperature differential and visually integrate the building to its environment.

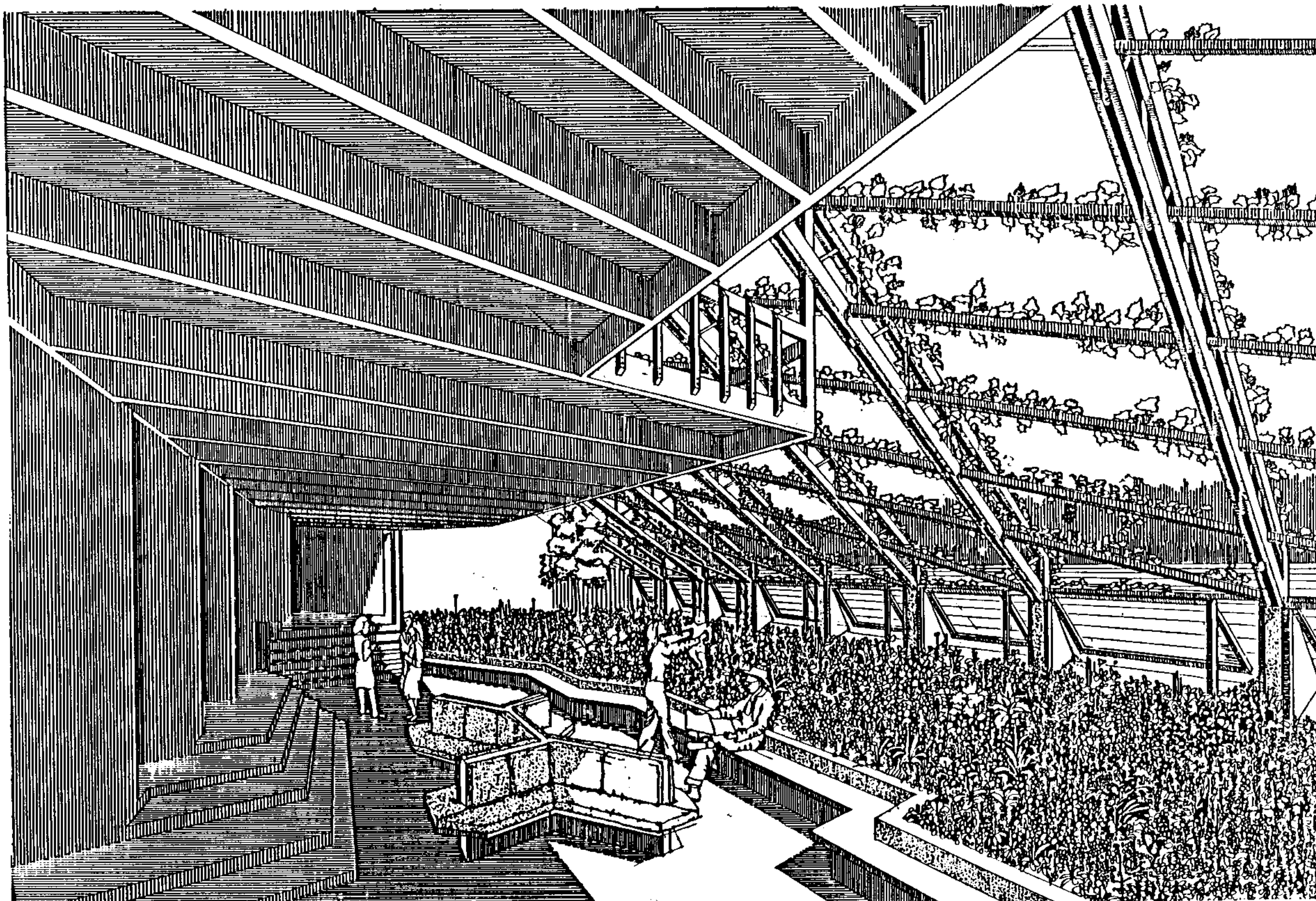
The walls of the building would be made of rammed earth. Soil on the site could be excavated and various amounts of sand and silt could be added to it to achieve a mixture adequate for rammed earth walls. This mixture would be cast and compacted in slip forms like the one shown. In this way, the formwork for the walls could also be reused. Use of rammed earth and concrete would increase the mass of the building and thus increase the thermal carrying capacity of the building.



VAULT DETAIL

TYPICAL WALL & VAULT CONSTRUCTION





NOTES

[1]Wilson Clark, Energy for Survival (Garden City: Anchor Press,1975) p. 174.

[2]Ibid., p. 171

[3]Edward Mazria, The Passive Solar Energy Book (Emmaus Pa.: Rodale Press, 1979) p. 117.

[4]Jack and Nancy Todd, Tommorrow Is Our Permanent Address (Cambridge: Harper and Row Publishers, 1980) p. 21.

[5]Drawings for the building type analysis are from Tommorrow Is Our Permanent Address.

[6]Clark, p. 145.

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on a computer and printed on one-
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