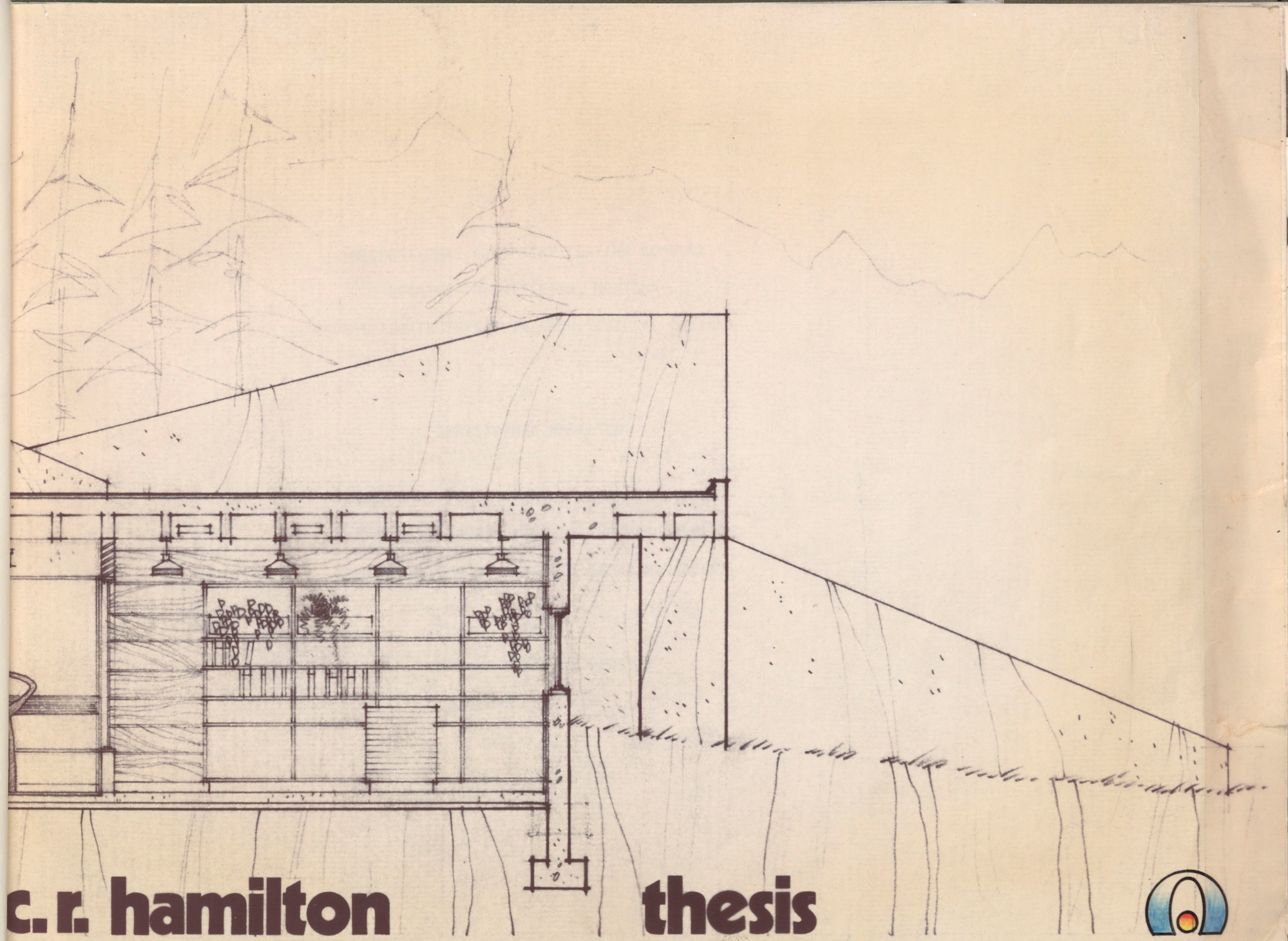
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c. r. hamilton thesis

RECREATIONAL EQUIPMENT TESTING COMPLEX

LOCATED IN WHITEFISH, MONTANA

UNDERGRADUATE THESIS IN ARCHITECTURAL DESIGN

By

CHRISTOPHER HAMILTON

SUBMITTED TO THE SCHOOL OF ARCHITECTURE

AS PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF BACHELOR OF ARCHITECTURE

AT

MONTANA STATE UNIVERSITY

BOZEMAN, MONTANA

JUNE 7, 1975

prgm. arch

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H1778

THESIS ADVISOR: James Gough

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progm. arch

PHASE I PROGRAM

A. Introduction

B. Statement

C. Site and Area

D. Construction Methods

E. Function

PHASE II DESIGN

A. Location and Orientation

B. Space Relationships

C. Energy Efficiency

D. Design Considerations

E. Conclusion

Final Design Proposal

Bibliography

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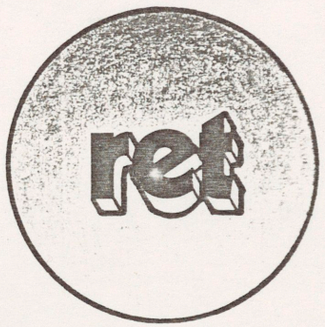
prgm.

Many times before architects chose to disregard using the elements of design and nature to achieve efficient energy use. This disregard in turn led to an over-consumption of energy and during that time all that was needed was an inexpensive plentiful energy source, which we had. In the early sixties, a "more is better" attitude crept up on us without our knowing it. The design profession picked up sloppy methods that led to energy consumption (wasted) and obese, superfluous buildings.

The most obvious answer to this is to change the "more is better" attitude. To do anything we want because technology makes it possible, is not the correct way to think of architecture and the energy situation.

design

"the proper use of the natual elements will minimize energy consumption and will influence architectural form of an architectural environment."



statement

My first step was to organize a process or procedure by which I could systematically end up with an architectural solution. This gives all my considerations a working position in my schematic and affords an easy step from one area to another.

The function of my building was the most important item that had to be set up before any further work could be started. At this point I am only explaining the set-up of my schematic and not each individual part. They will be discussed further on as I continue my explanation.

I had to understand what exactly I wanted my building to function as. While this was slowly materializing, I had begun to think of and search for a proper area in which this particular function could operate, both feasible and economically.

The function of my building was at a stage where I could start thinking of the activity as well as my area for the function. The activity for the project was closely related to the fuction and both helped set each other up.

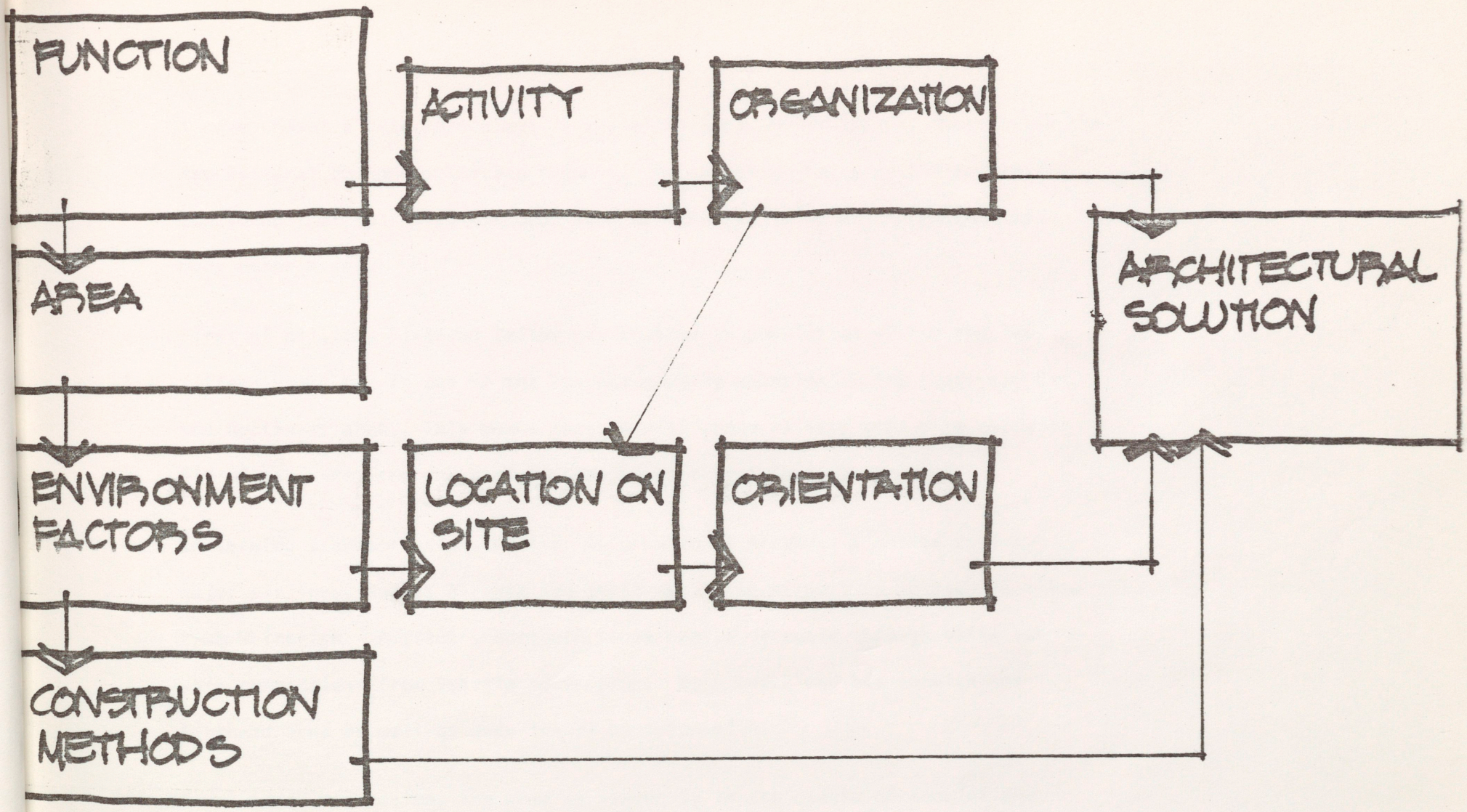
In that respect, the main concern of my thesis was to develop and design a space for a particular function but also to be very aware of the role the environment plays and to still have a humanistic building for the workers and public. I wanted to have a building or space that a function or process uses and to incorporate both energy efficiency and a pleasant working space. I also felt the desire to rid myself of the feeling that one must sacrifice human needs and desires for efficient energy use, or vice versa.

When I started on a final area, the environmental factors of this particular area were gathered and studied to supply me with adequate information so as to proceed with the next step. This step was the organization of various construction methods suitable to the area and compatible to the environmental factors of the area.

While the activity was in it's final stages, the organization of these activities had to be set in a workable manner. The organization of these activities and the environmental factors of the area led to a decision of location of the building on the site. Location of the building was in consideration of orientation.

The proper orientation was needed to insure a good working plan and to take into account the environmental factors.

The last three stages of my schematic, organization, orientation, and construction methods, lead to the final stage, the architectural solution. Obviously, some compromising was done to help all the stages work together and form a suitable solution to the original function.


FUNCTION
ACTIVITY
ORGANIZATION
AREA
ARCHITECTURAL SOLUTION
ENVIRONMENT FACTORS
LOCATION ON SITE
ORIENTATION
CONSTRUCTION METHODS

schematic

design

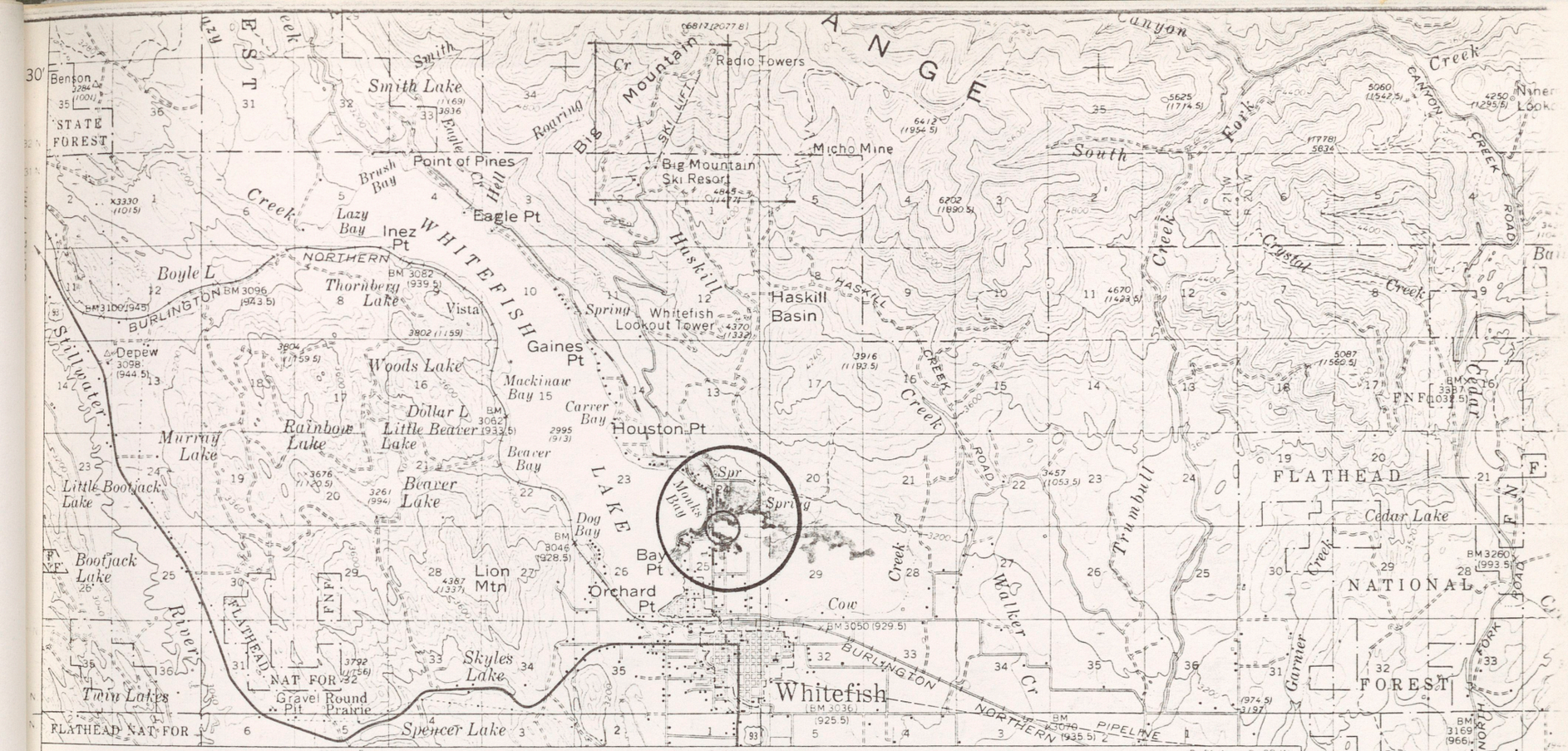
I have chosen a site approximately two miles north of Whitefish, Montana for the Recreational Equipment Testing Company. In searching for a suitable site, I concluded that this area has much more to offer in terms of recreation than many other areas.

First of all, the Flathead Valley has doubled in population within the last fifteen years and is one of the fastest growing counties in the state and in the Northwest area. This means that tourist trade is very good with quite a bit of exposure from the various people who travel through the area.

Concerning transportation, Glacier International Airport is served by two major airlines, Hughes Airwest and Northwest. The airport is located 16 miles from Whitefish. Amtrack's northern route passes directly through Whitefish with connections from Seattle to Chicago. Both truck and bus service the Flathead area as well as easy travel by automobile.

For outdoor recreation, the area is virtually in the middle of some of the most scenic country in the nation. Glacier National Park, twenty miles to the West, the Cabinet Wilderness Area, 40 miles East and the Mission Mountain and Bob Marshall Primitive Areas, 50 miles South of Whitefish.

Whitefish Lake and Flathead Lake are both extremely good water recreation areas being one mile and twenty-five miles away respectively. Whitefish Lake is the closer and ~~superior~~ smaller lake being four miles in length. Flathead Lake is the largest natural fresh water lake west of the Mississippi being thirty-seven miles in length and nine miles at its widest point. Both these lakes serve well the water sports activity of the area.



UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

GLACIER NATIONAL PARK

PART OF

WATERTON-GLACIER INTERNATIONAL PEACE PARK

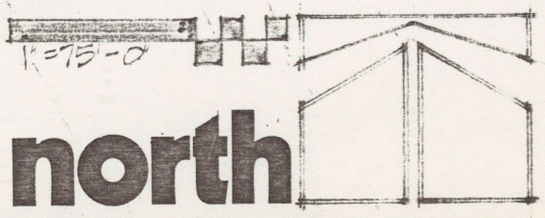
MONTANA

1968

N4813—W11310/47X80

forest

field



north

site

design

Site conditions and environmental factors of the area and location are as follows:

Winds during the warmer months generally blow out of the southeast and are tempered by the valley growth as they cross the site. As the months grow colder, the winds are most likely to come from the northeast traveling diagonally across the site.

The view from the site is most scenic when looking in a southeastery direction. Trees and foliage block the views to the east, north, and west. The highway is located to the west of the site, so no view can be obtained in that direction.

A gradual slope is noticed as it rolls to the west. At first glance, this slope is barely perceptible, but with a closer look, this can be seen. For all practical purposes this site is flat with no irregularities in contours.

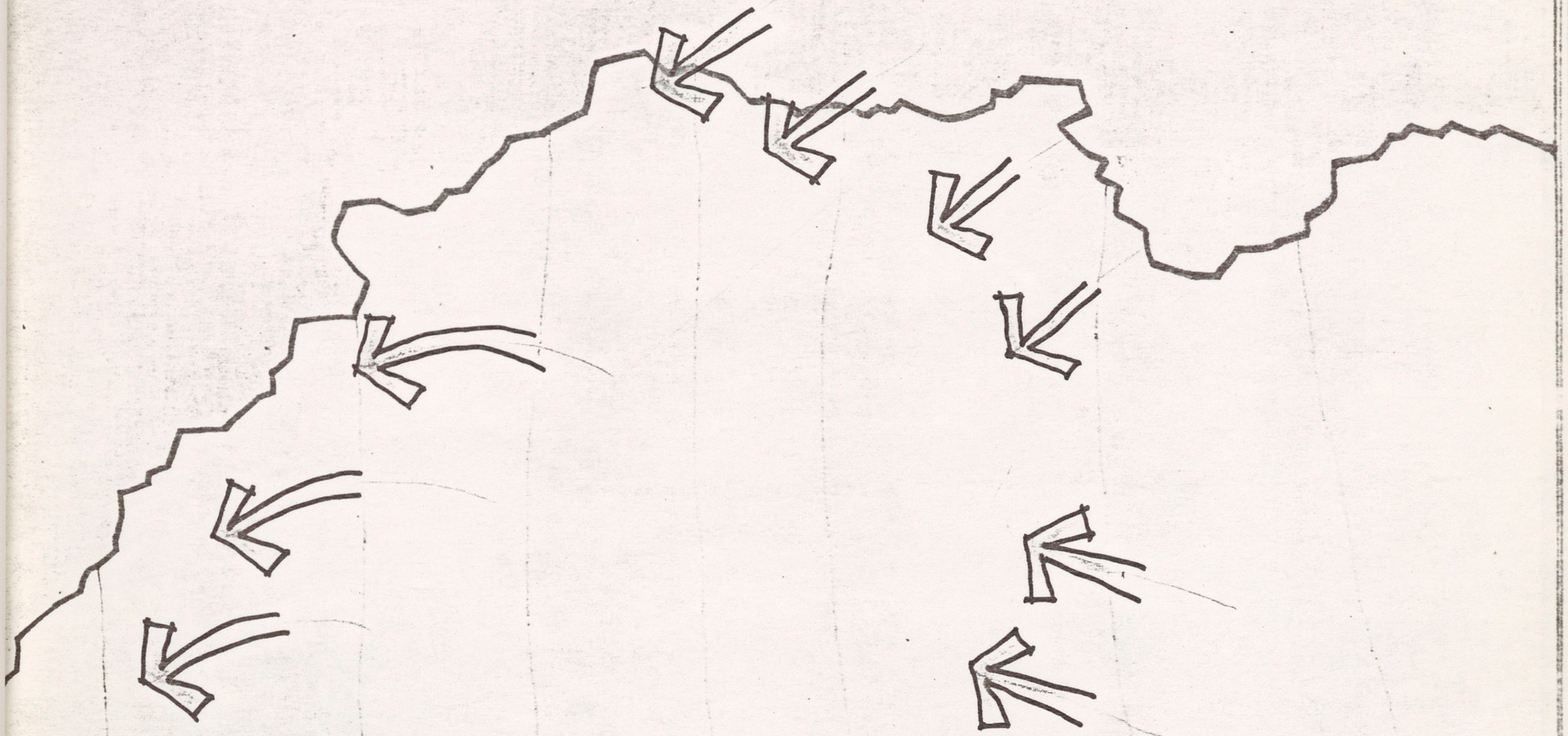
Thick forest and meadow grass are the primary ground covers of the site. The soil conditions are favorable for building and the site has been zoned for commercial development.

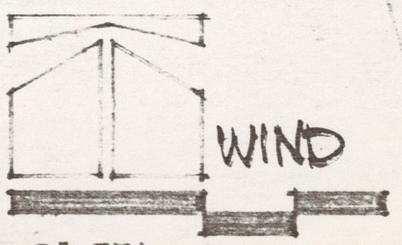
design

April through June are the wet months in the Whitefish area with June having the most rain. Rains occur on an average of 20 days in the month of June. The remaining are either partly cloudy or overcast. July and August are often very hot summer days with a seasonable average of 25-30% humidity.

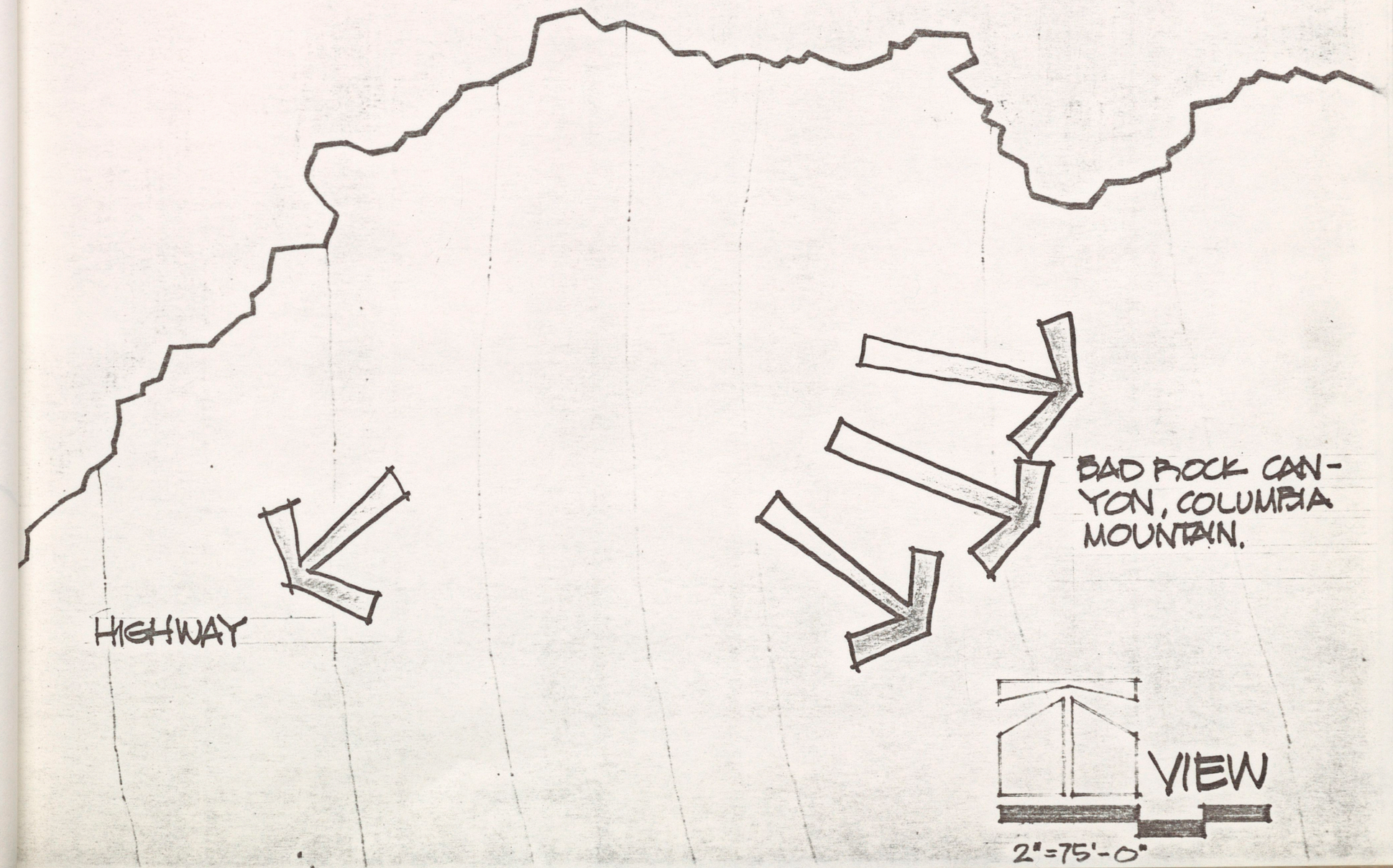
Average snow depth on the ground that will stay the entire winter season, is usually no more than 24 inches. Seasonal snow storms may happen but extreme sub-zero temperatures are not frequent nor do they last more than 6 days.

Sun angles for this area are quite adequate for solar gain in the winter and heat should be kept out during the warmer months. The maximum angle for the sun is during summer with an arc of 65°. Lowest is in December with an arc of 20°, measured from this horizontal. Using the sun as a source of solar energy (solar plates, etc.) is not feasible in this area because of cloud cover.





2"=75'-0"


HIGHWAY
BAD ROCK CAN-
YON, COLUMBIA
MOUNTAIN.
VIEW
2"=75'-0"

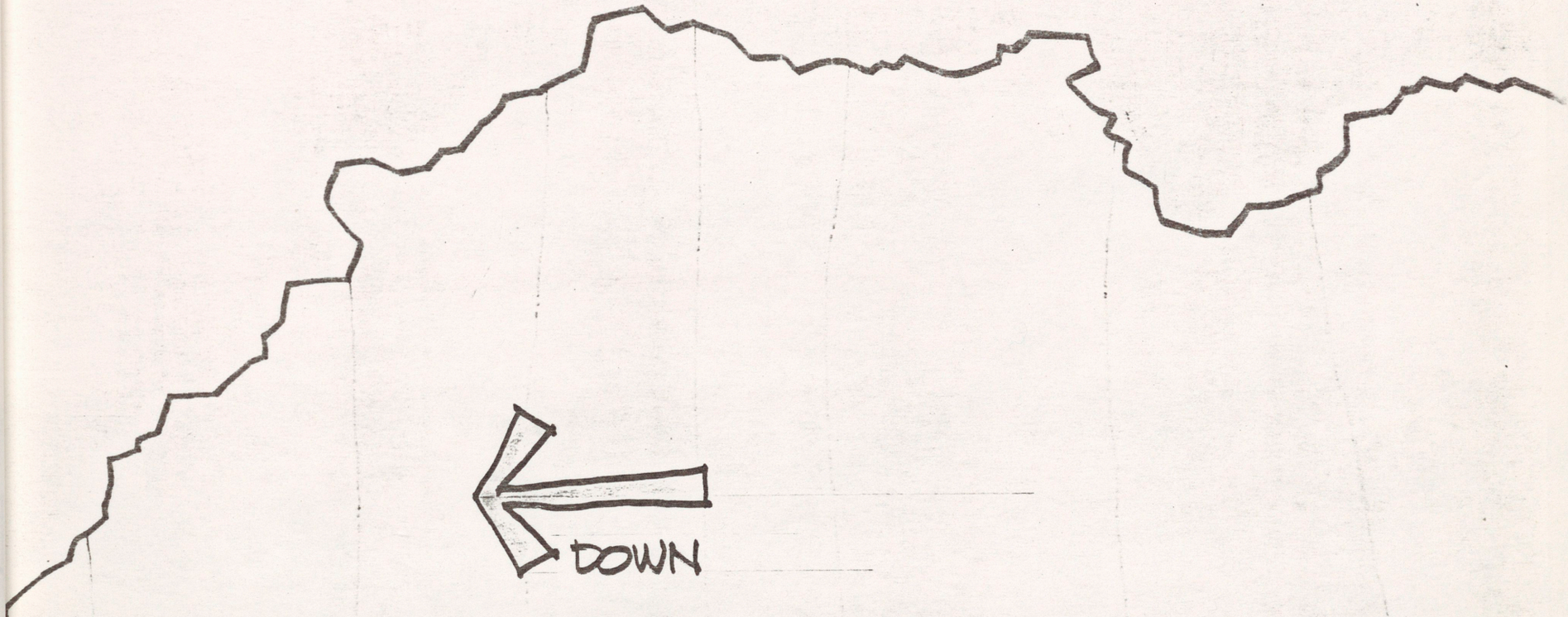
FORESTED... BIRCH, PINE, SHRUBS

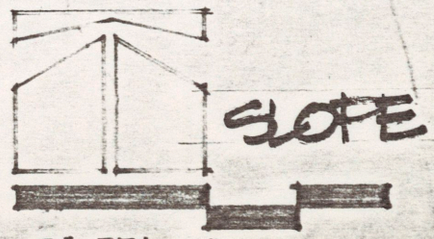
MEADOW GRASS



2"=75'-0"

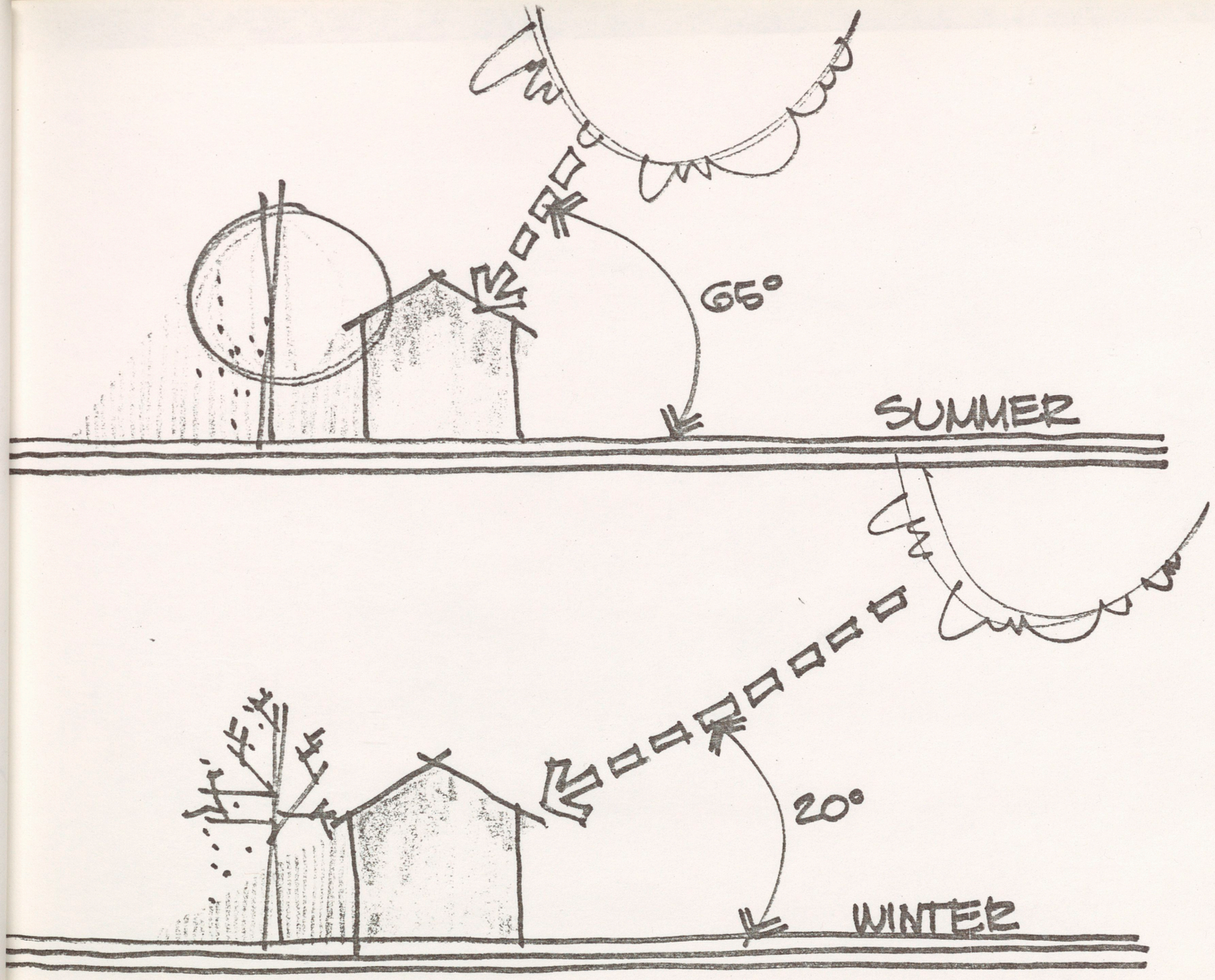
design





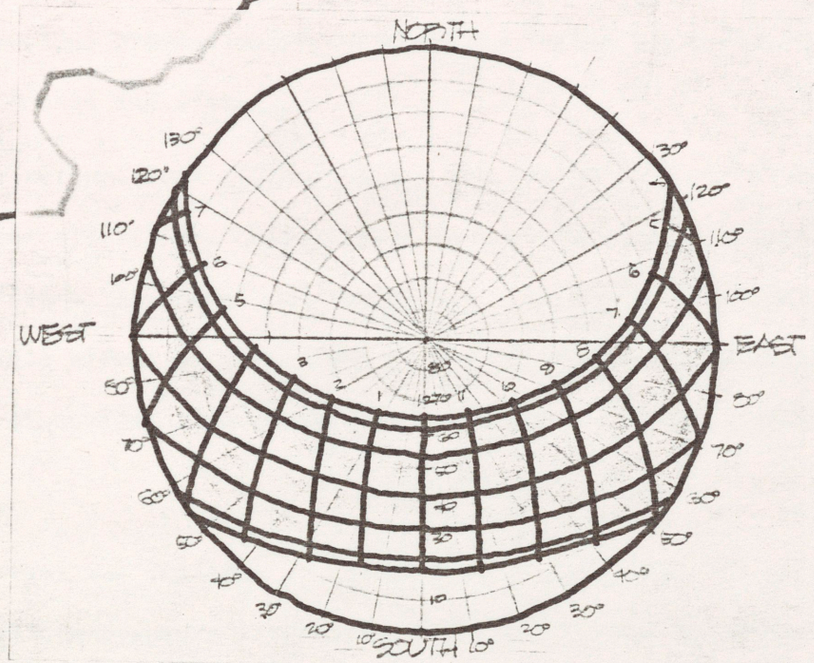
2"=75'-0"

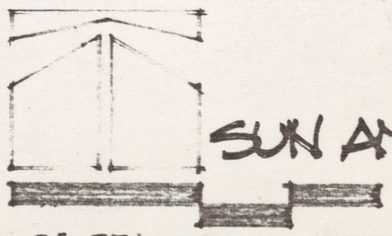
design



sun

design

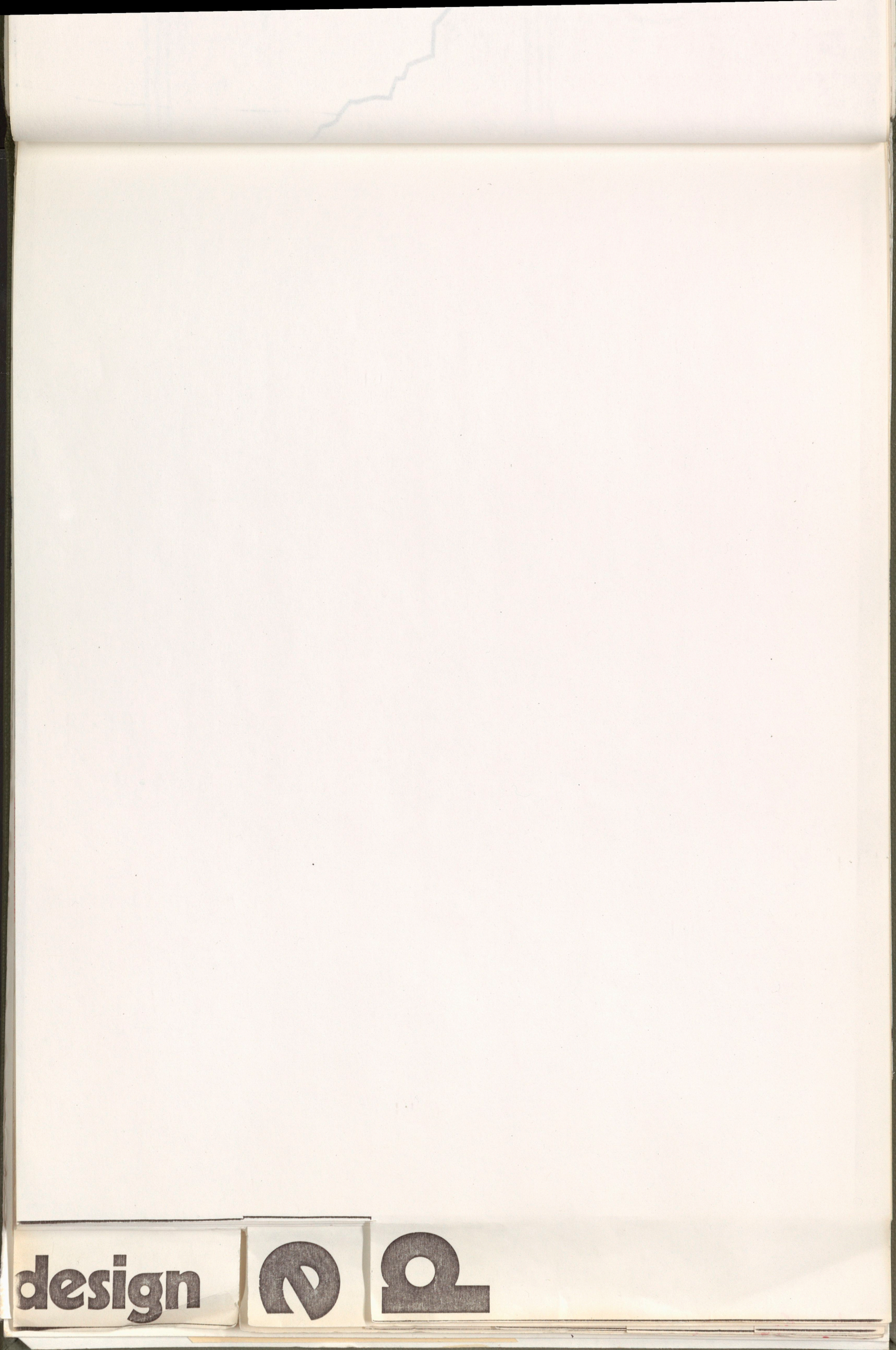




SUN ANGLES

2"=75'-0"

design


design

Construction methods were an important consideration in this project, built in an environment that has all types of weather. First things to consider were my design features for any particular climate. These are:(1.) indoor climate quality;(2.) heat capacity;(3.) type of construction;(4.) amount and type of glass;(5.) prevention of condensation inside the space; and (6.) exposure to elements and site.

The next subject was cost of the space. The quality of comfort and the desired indoor climate are both related to initial cost. In turn, initial cost then affects the annual ownership cost. If the initial cost drops, then a possible effect of this might be the desired indoor climate drops, the quality of comfort also drops, and the minimum annual ownership cost may go up.

Three items that may increase annual ownership cost, that are directly related to all temperature structures, are controlling the movement due to thermal expansion and contraction, controlling the heat movement, and controlling the water vapor movement through the building and space.

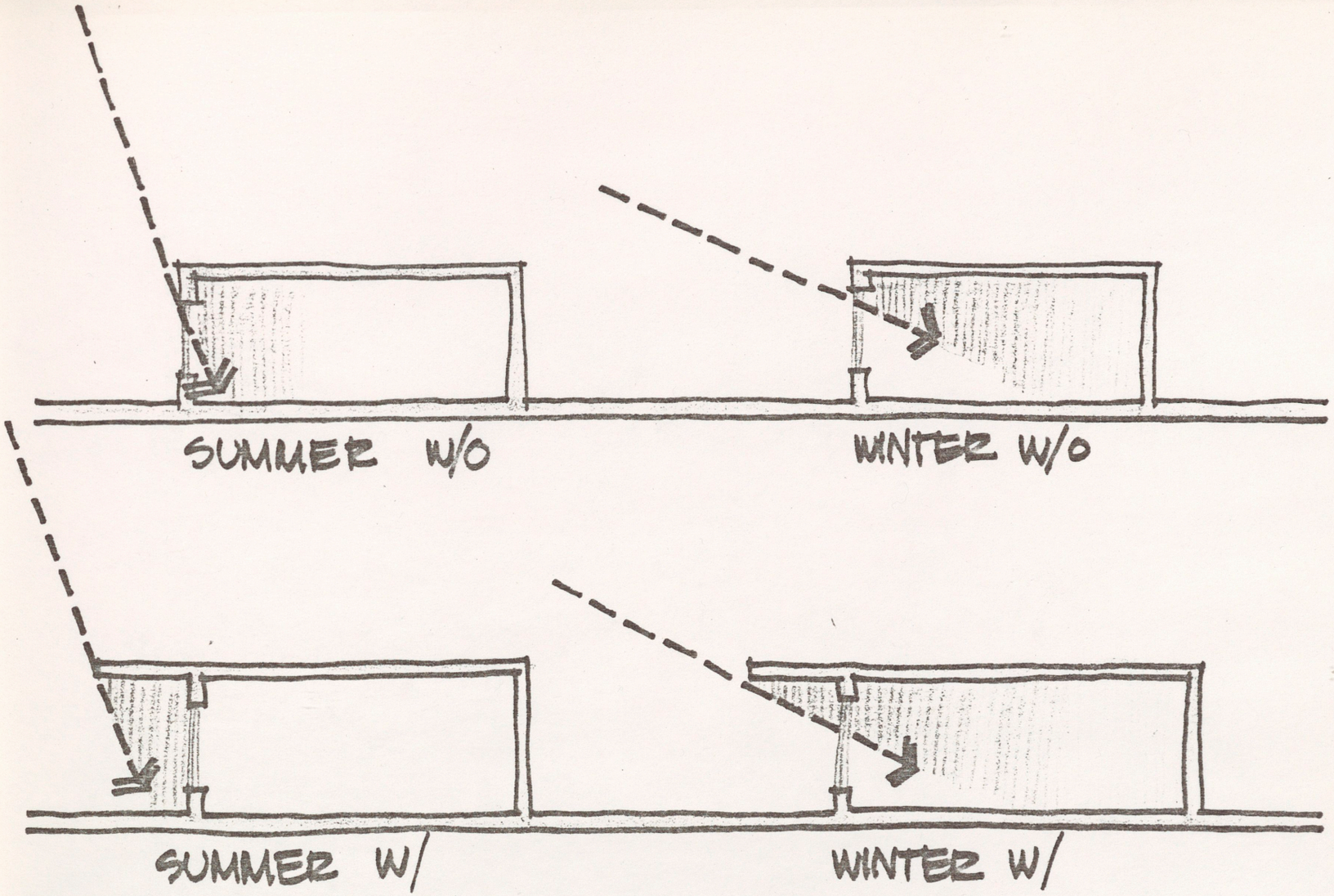
design

A comfort zone chart is a way to graphically show how and where fuel and cost can be saved. A normal comfort zone would be between 71° and 77° and having between 20% and 60% humidity. During the winter,as the humidity drops, the temperature can also drop to increase the effectiveness range of the comfort zone. The spring process is reversed during the summer to save energy and fuel.

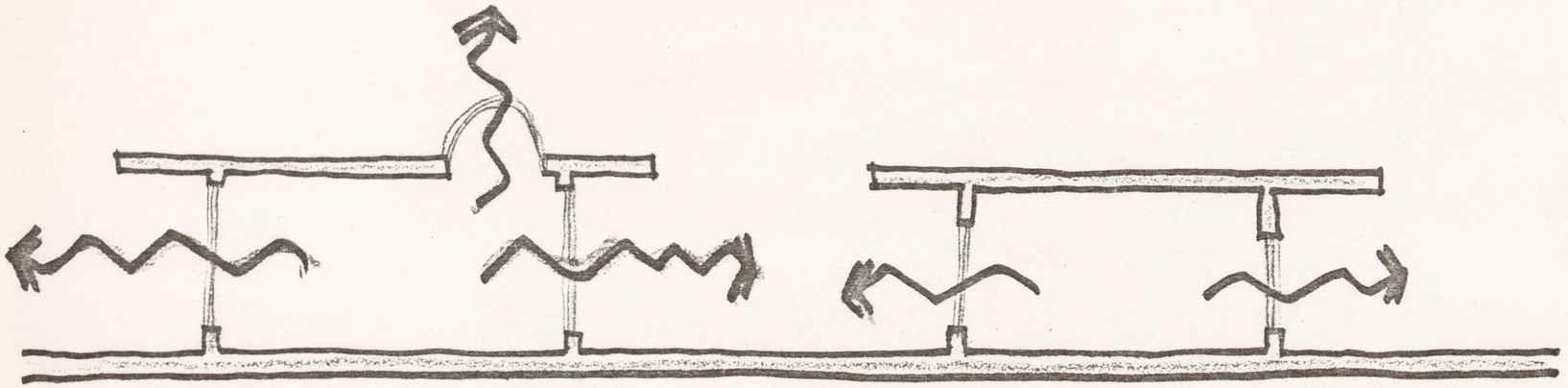
When choosing a system for a building, a committment must be made to one system, either mechanical or natural ventilation. An efficient mechanical system with a back-up natural ventilation or a carefully designed natural ventilation system with mechanical back-up. In either case though, the secondary system cannot be completely efficient.

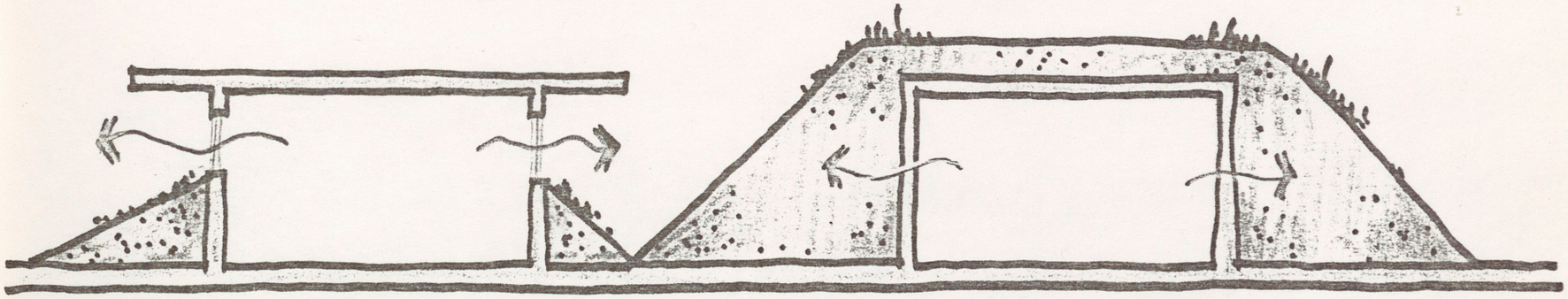
Products to be tested in this facility are a wide variety, but can be broken down into various general catagories. As the list of products was completed, services of different sorts were introduced to take care of these products.

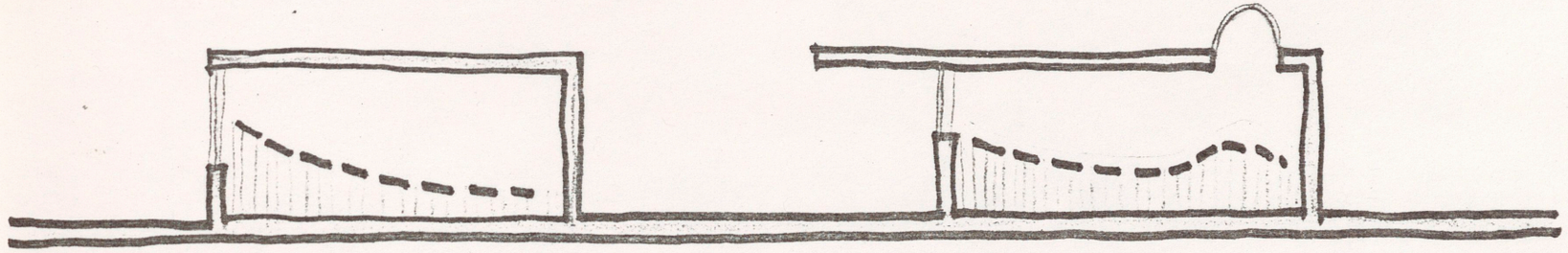
No public services such as retail or wholesale sales or renting were incorporated into this building, so as to simplify its function, and to let us deal solely with the testing of products.

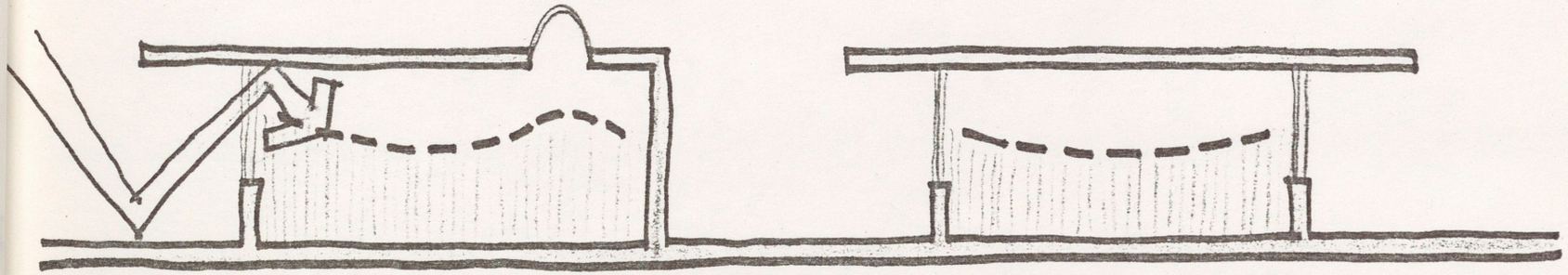


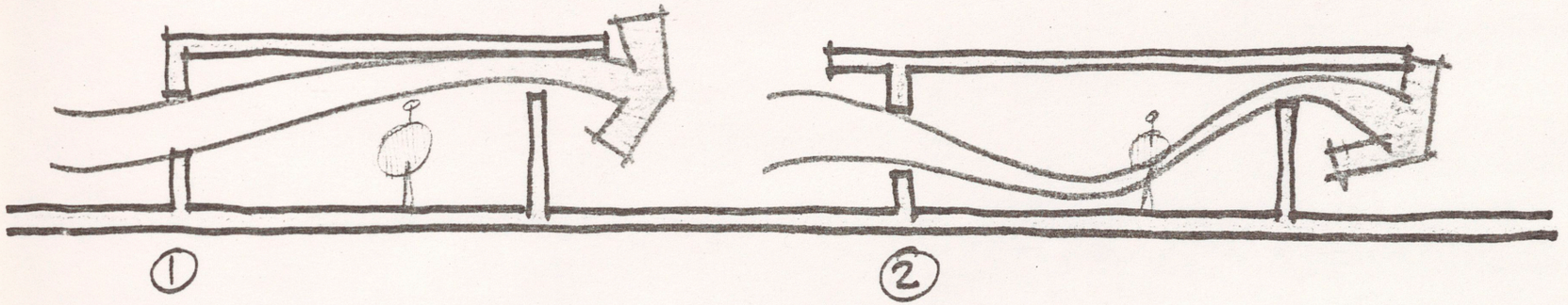
heat gain

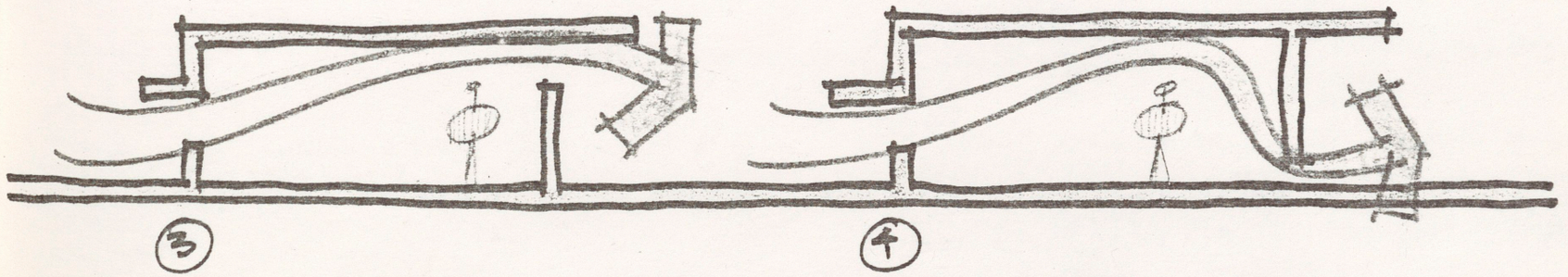








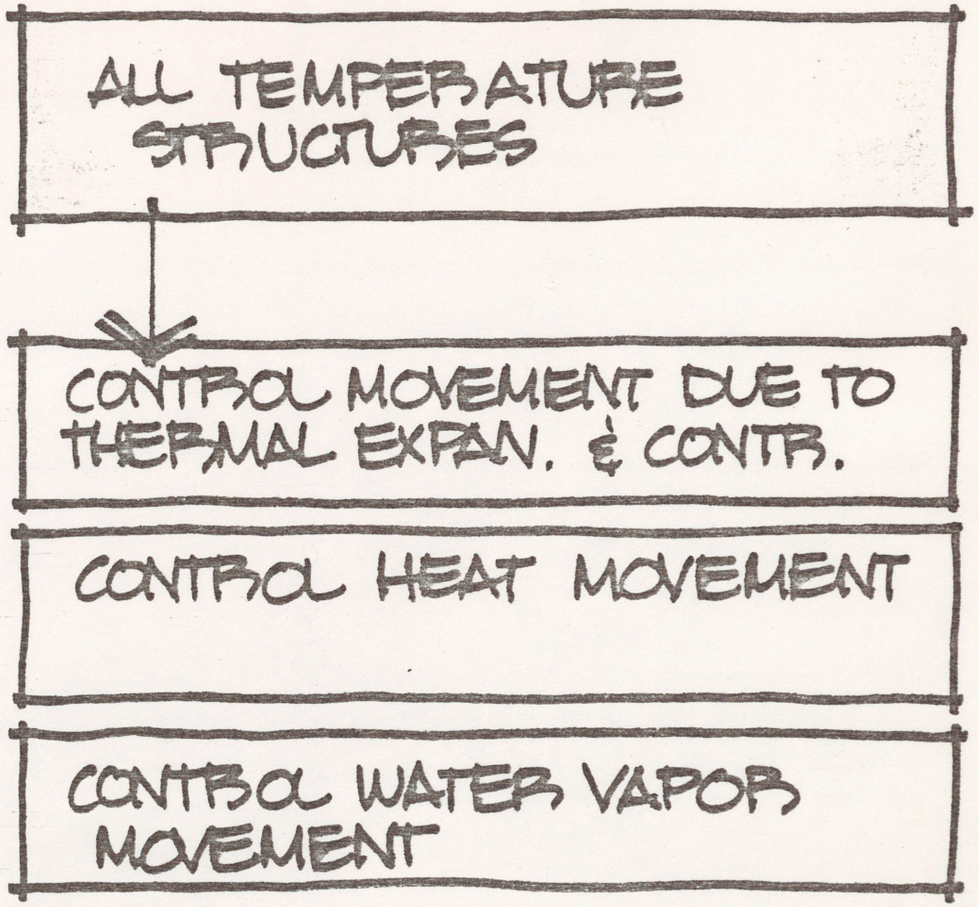

1
2


3
4

DESIGN FEATURES

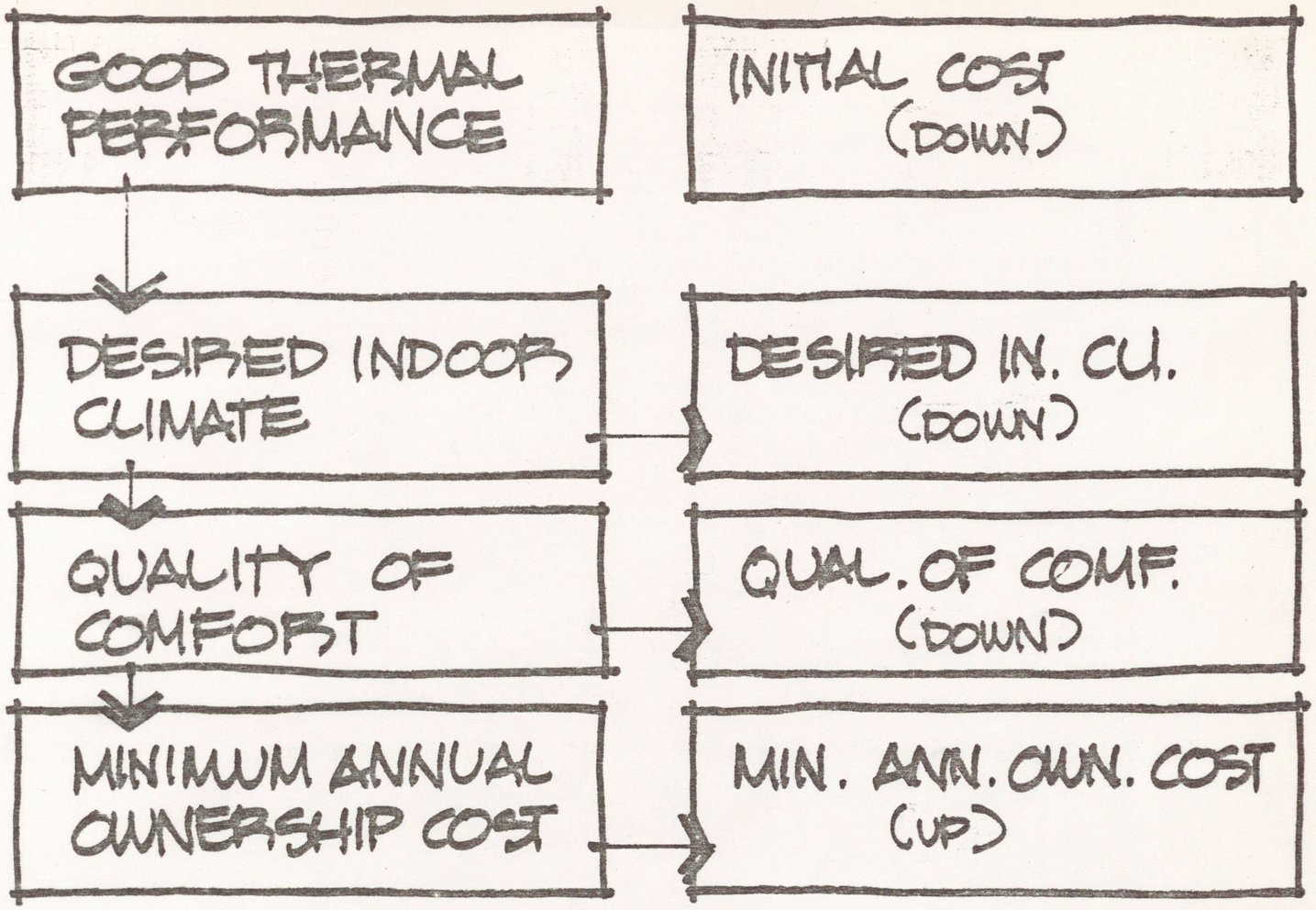
- INDOOR CLIMATE QUALITY
- HEAT CAPACITY
- TYPE OF CONSTRUCTION
- AMOUNT/TYPE OF GLASS
- PREVENT CONDENSATION INSIDE
- EXPOSURE TO ELEMENTS AND SITE

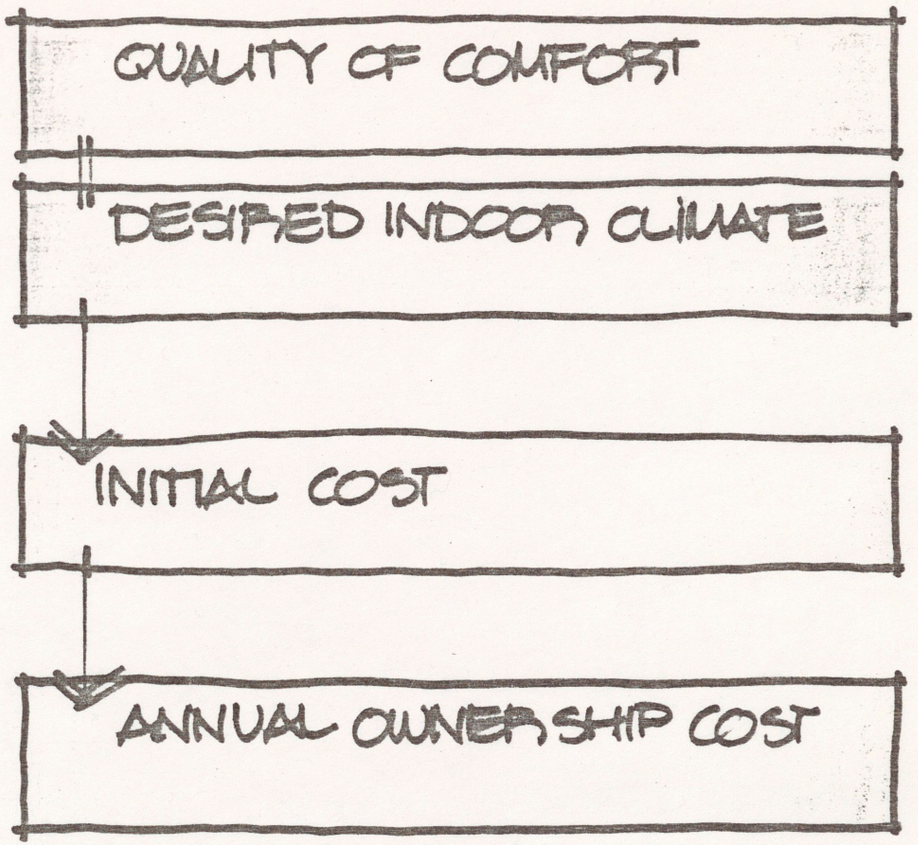
features

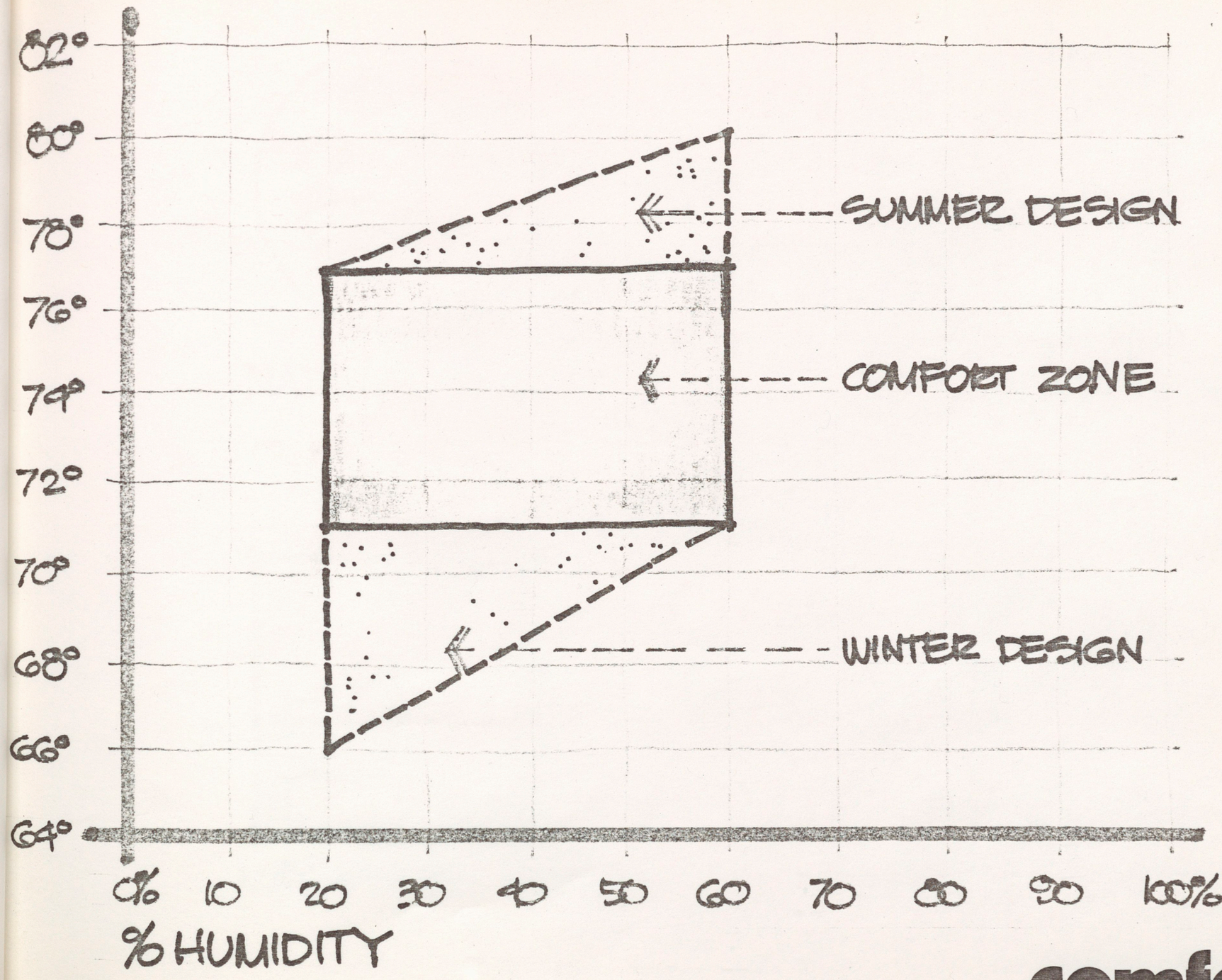


control

design

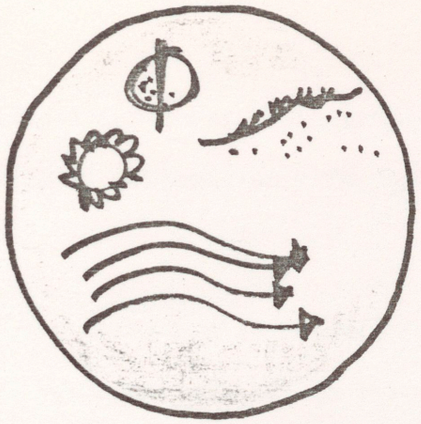

GOOD THERMAL PERFORMANCE
INITIAL COST (DOWN)
DESIRED INDOOR CLIMATE
DESIRED IN. CLI. (DOWN)
QUALITY OF COMFORT
QUAL. OF COMF. (DOWN)
MINIMUM ANNUAL OWNERSHIP COST
MIN. ANN. OWN. COST (UP)


QUALITY OF COMFORT
DESIRED INDOOR CLIMATE
INITIAL COST
ANNUAL OWNERSHIP COST

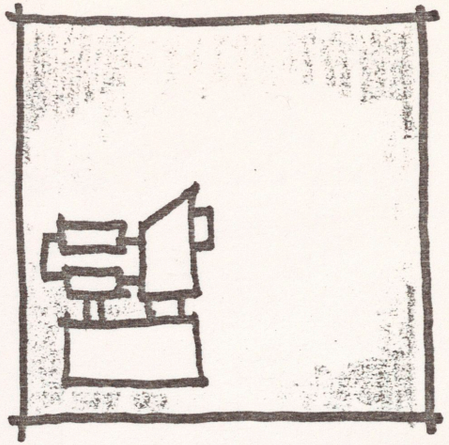


comfort

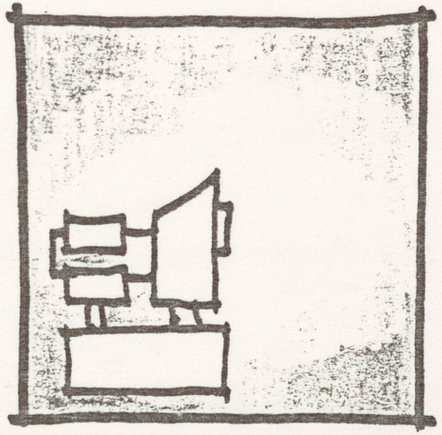
design



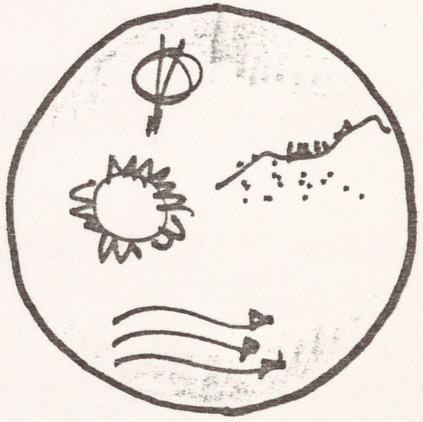
NATURAL (MAIN)



MECHANICAL (BACK-UP)



MECHANICAL (MAIN)



NATURAL (BACK-UP)

system

design

design

The Recreational Equipment Testing Company has somewhat the same function as the Underwriters' Labratories. The company from now on will be referred to as "R.E.T."

This particular company will be one of performance testing for various recreational equipment already on the market and some being tested as prototypes. As new or standard equipment is produced by sports companies, R.E.T. will be used as an independent testing company for these types of equipment. No actual designing will take place in this building except possibly to the extent of design considerations given to various companies in a verbal or written form.

The R.E.T. people will be asked by various companies to test a particular piece of equipment to insure the public that the product performs as the company says it will. Not only will the R.E.T. people test equipment in a controlled environment but also in an actual working situation under normal and extreme conditions.

As the testing of the product is completed, representatives from the particular firm will arrive for a conference of the found data, or the R.E.T. company will notify the firm by written or verbal form.

design

For the most part seven basic catagories were used to set up the services of the R.E.T. Company. They are: demonstration inside, demonstration outside, storage, maintenance, assembly, testing inside, and testing outside. At this time all the products were taken through the list of services to find which services would be able to be given each product.

After this was completed, each service was placed as to what function or space the service should be properly used in. Whether product-public, product-private, employee, or support.

As all the building spaces were completed and decided which were needed, schematic design was now able to start.The basic concept,as it came about, was concerned with two primary spaces. Public and private and in the transition of these spaces. Two important elements are needed when mixing these two spaces. A barrier between them and also a transition between the two major spaces.

PRODUCT - PUBLIC

DISPLAY

DEMO-IN

DEMO-OUT

EMPLOYEE

OFFICES

CONFERENCE

EMPLOYEE'S ROOM

PRODUCT - PRIVATE

STORAGE

REPAIR / MAIN.

ASSEMBLY

TESTING-IN

TESTING - OUT

DARKROOM

SHOP

SUPPORT

MECHANICAL

RESTROOMS

CUSTODIAL

SHIPPING / RECIEVING

bldg spaces

SKIS (NORDIC)

SKIS (ALPINE)

SKIS (WATER)

BOOTS (HIKING)

BOOTS (SKIING)

BACKPACKS

TENTS

SLEEPING BAGS

CLOTHING

BINDINGS

SWIM EQUIPMENT

MISC. GADGETS

products

design

product	SKIS (NORDIC)	services
		sales
		renting
		display
		demo...in
		demo...out
		storage
		maint.
		assembly
		testing...in
		...out

services

design

product	skis (water)	services
		sales
		renting
		display
		demo...in
		demo...out
		storage
		maint.
		assembly
		testing...in
		...out

services

design

product	BINDINGS	services
		sales
		renting
		display
		demo...in
		demo...out
		storage
		maint.
		assembly
		testing...in
		...out

services

design

product	BOOTS (SKIING)	services
		sales
		renting
●		display
		demo...in
●		demo...out
●		storage
		maint.
		assembly
●		testing...in
●		...out

services

design

product	BOOTS (HIKING)	services
		sales
		renting
	●	display
		demo...in
	●	demo...out
	●	storage
	●	maint.
		assembly
		testing...in
	●	...out

services

design

product	SLEEPING BAGS	services
		sales
		renting
		display
		demo...in
		demo...out
		storage
		maint.
		assembly
		testing...in
		...out

services

design

product	TENTS	services
		sales
		renting
		display
		demo...in
		demo...out
		storage
		maint.
		assembly
		testing...in
		...out

services

design

product	BACKPACKS	services
		sales
		renting
	●	display
	●	demo...in
	●	demo...out
	●	storage
	●	maint.
		assembly
		testing...in
	●	...out

design

services

product	CLOTHING	services
		sales
		renting
		display
		demo...in
		demo...out
		storage
		maint.
		assembly
		testing...in
		...out

services

design

product	SWIM EQUIPMENT	services



sales
renting
display
demo...in
demo...out
storage
maint.
assembly
testing...in
...out

design

services

product	MISC. GADGETS	services



- sales
- renting
- display
- demo...in
- demo...out
- storage
- maint.
- assembly
- testing...in
- ...out

services

design

design

PHASE TWO: DESIGN

Traffic, view, winds, sun and site growth were the major factors in location and orientation of my building. All are very important and seemed to work well with one another in the shaping and setting of the R.E.T. Company.

Since major views and prevailing summer breezes are to the southeast, the windows are oriented in that direction. The windows for the public spaces are operable to facilitate ventilation and are kept to a size that enhances the long-range views in that direction. No views are available to the west and north so no fenestration was placed on those sides of the building.

Also, the summer breezes coming from the southeast will help in ventilation during hot summer months. Just as the colder winds arrive from the northerly direction, no fenestration was placed on these sides of the building.

As the sun travels over the site, morning light is caught for direct natural light and then becomes used as indirect, diffused light during warmer times of the day. No west burning sun is available because of the line of trees so no fenestration was provided in this area.

Trees on the site occur on the north edge and provide a pocket for the building and create a natural traffic flow into the site. Traffic from the highway (west side of site) gradually follows the trees until the pocket, and then opens to accommodate the parking and service space for the complex. This, in turn, hides the majority of the paved area from the public as they pass the site to enter into it.

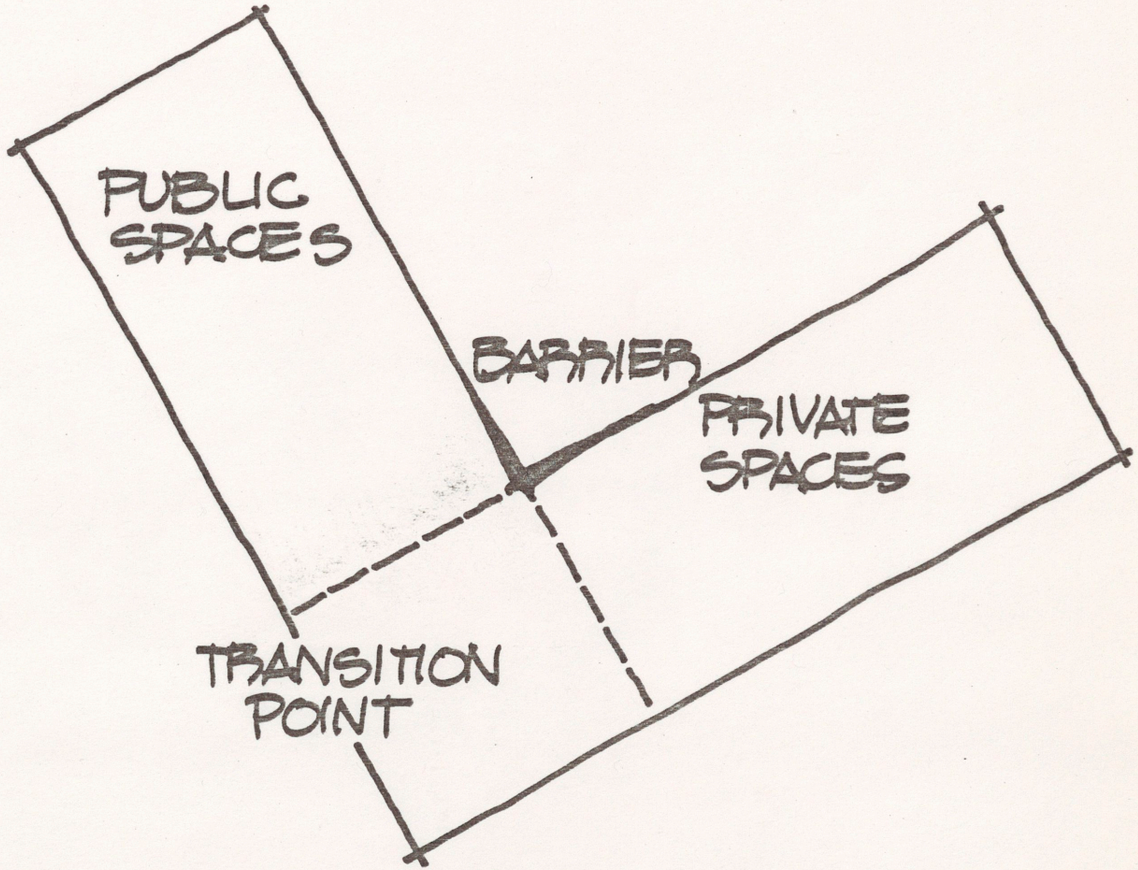
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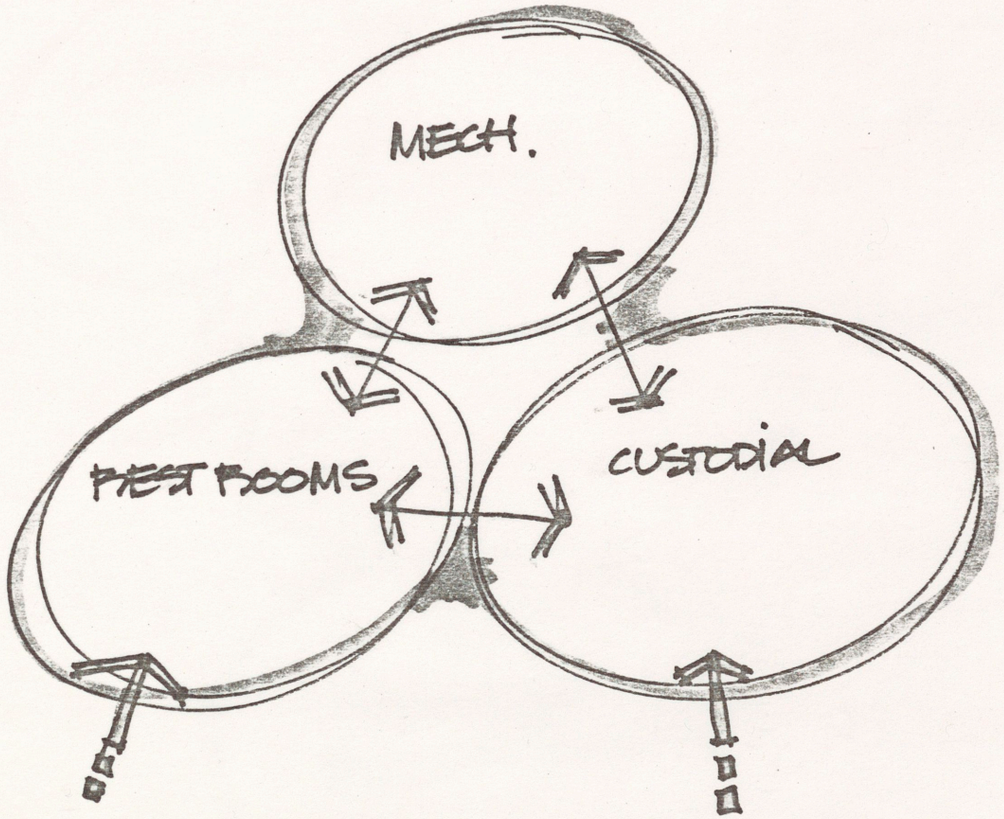
The connection between the public and private spaces is one that flows into the public space. This serves as a visual transition and a physical transition for the traffic to the private spaces. This connecting piece is in the form of a court or atrium flowing into the public space. As the public and private spaces work around this connection, both the public and private spaces have elements that serve as a core with traffic flowing through and around them.

The private or "production" spaces have the three thermal rooms as their core element. Traffic can flow around and through these elements and are served by either the storage side or the testing side of the space.

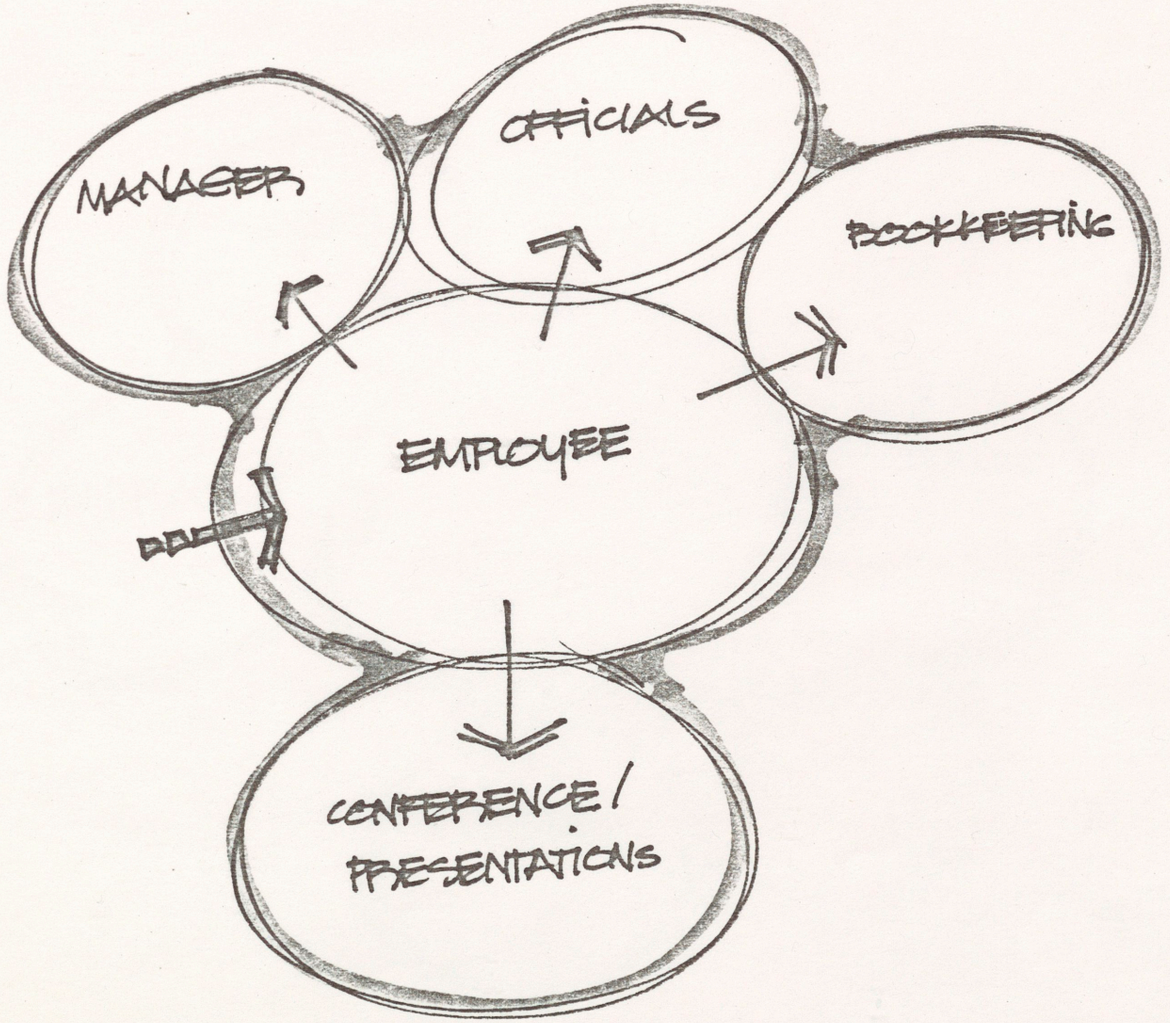
The north side of the space is used for mechanical, shipping/receiving, and storage uses. These spaces are placed there because of traffic and service to the building from the outside. Also, those spaces do not need natural light to function well and no viewing from the area. These are basically the service spaces for the private section.

The south side is used as the visual and technical portion of the space and, therefore, is afforded the natural light for adequate and quality lighting. The fenestration on this side also lets in the ventilation as mentioned before.

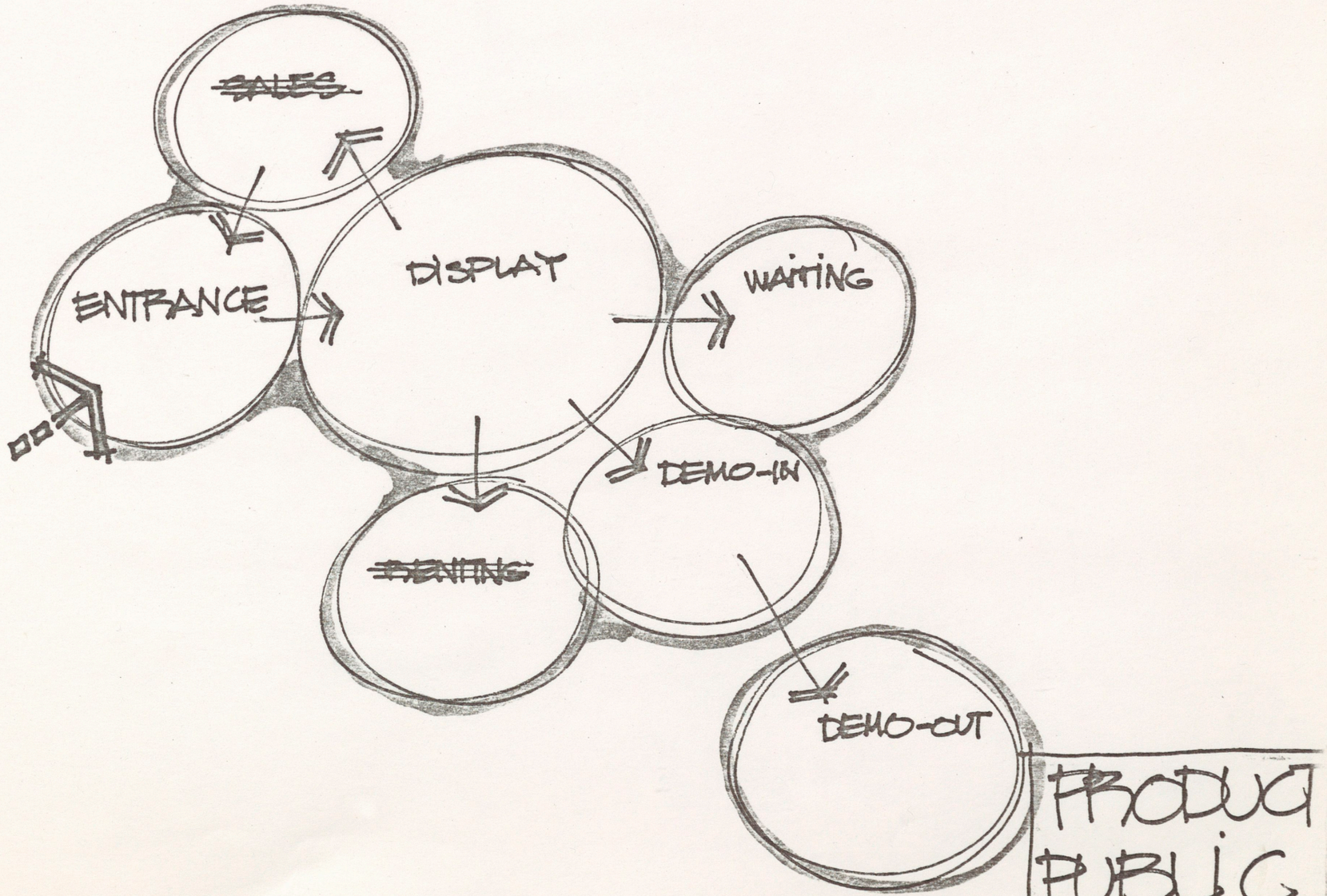

PUBLIC SPACES
BARRIER
PRIVATE SPACES
TRANSITION POINT

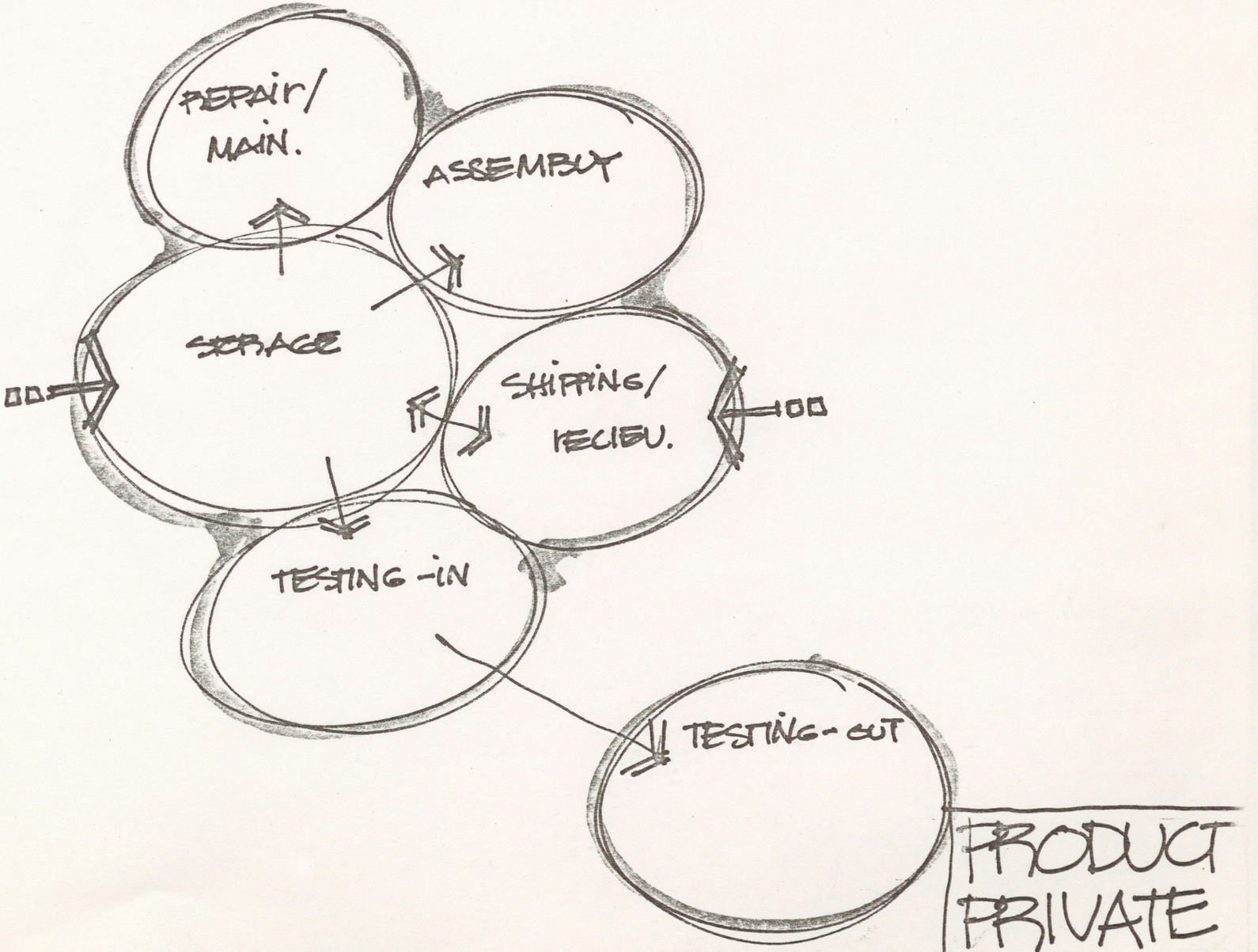


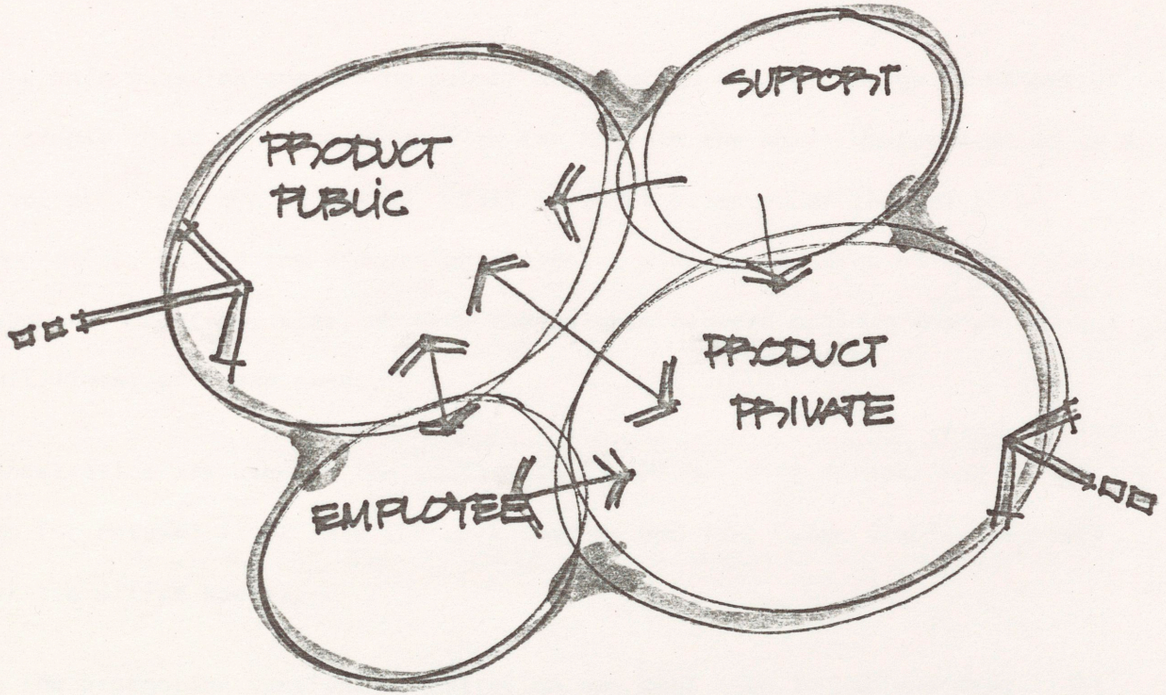
SUPPORT


MANAGER
OFFICIALS
BOOKKEEPING
EMPLOYEE
CONFERENCE/
PRESENTATIONS

EMPLOYEE


SALES
ENTRANCE
DISPLAY
WAITING
DEMO-IN
DEMO-OUT
PRODUCT PUBLIC


REPAIR/
MAIN.
ASSEMBLY
STORAGE
SHIPPING/
RECIEV.
TESTING-IN
TESTING-OUT
PRODUCT
PRIVATE



SPACES...
COMBINED

cde

The R.E.T. Company building was designed to be supported by ordinary energy means: gas, electricity, etc. Although so designed as to use a minimum of these sources, but still retain the humanistic feeling and needs.

"The main question concerning proper orientation and the design of fenestration is simply this: What do we do with the hole in the box? Whatever we do is a trade-off. But that's design. Call it total balance, or the beautiful compromise, but in the process of designing windows in terms of type, function, exposure, location, size, we seek the balance between optimum energy use and fulfillment of human needs."

Fenestration was used on the south side of the building to make use of the sun for natural light into the work spaces, and long range viewing purposes for the office spaces.

In the production section, fenestration was kept high to achieve deep light pentration to the working spaces. Glass block was used for the majority of the window space because of its insulation qualities and light transmission qualities over regular flat glass. A bottom row of operable windows were incorporated to help in the ventilation of these work spaces. These are

double glazed windows to cut heat loss during colder periods of weather.

Large over-hangs were used to cut the direct sun in summer and let it in during winter months. These over-hangs also serve to direct the summer breezes through the operable windows and down into the spaces. Directing the breeze down into the space is more beneficial for the people using space.

Heat loss was greatly reduced, as well as heat gain, by use of the earth berming on the majority of the perimeter walls. This earth creates a heat lag for the building and keeps a more consistant temperature on the wall surface.

Using the berming around the building, it also cuts maintenance costs for the exterior of the building and the surrounding site. The natural meadow grass will be allowed to continue its growth and cover the berms. In this manner, it will also help the structure to be more closely connected and integrated to the site.

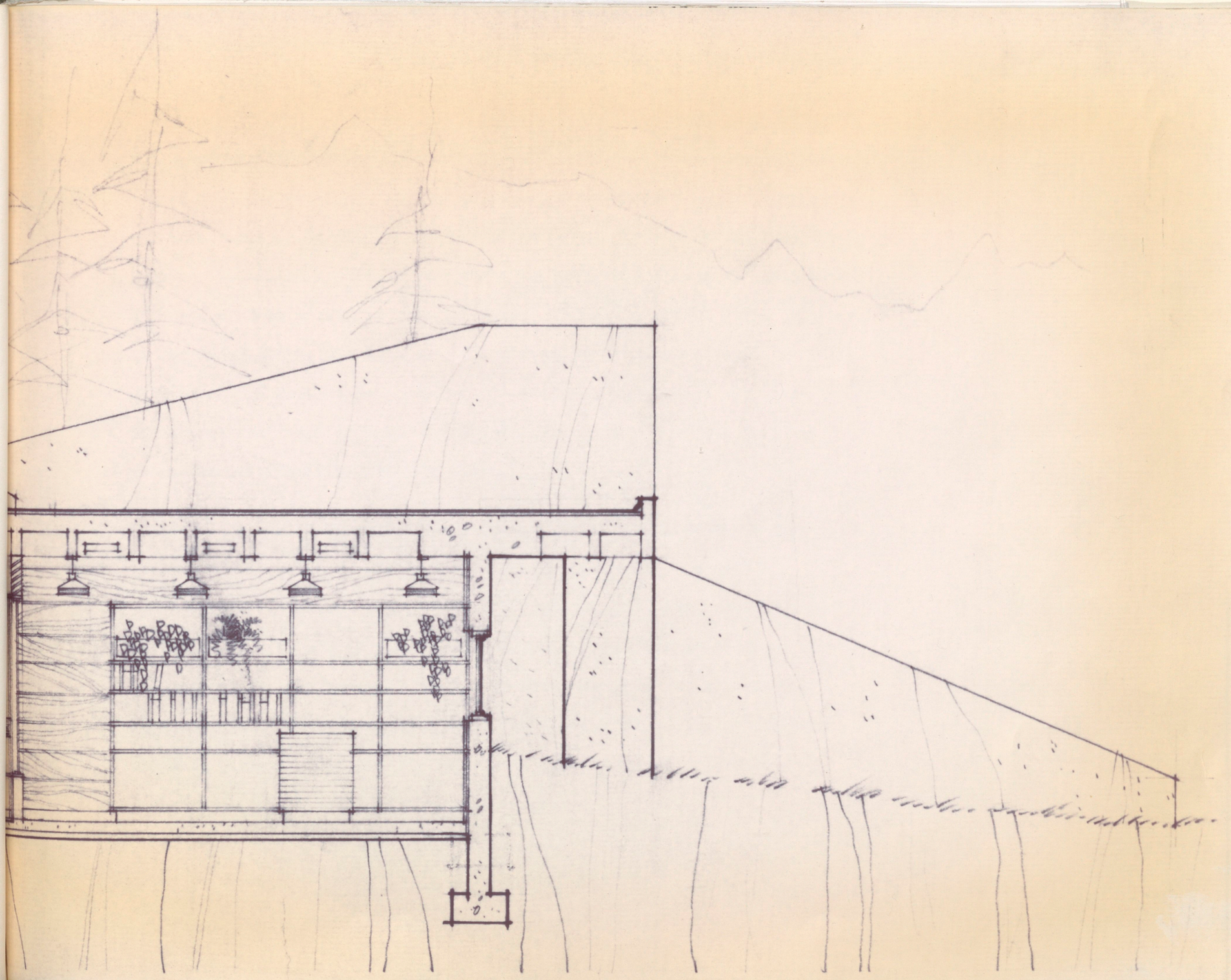
"How do we measure the total effect of a sunbeam? We can tell how much it heats a wall or how many foot candles it provides on a certain task surface. But what does it really do to a person? What does it do to a plant on a window sill - to the person who wants that plant to live and grow? What

happens to the atmosphere as the scattered clouds turn the sunbeams on and off during the day? The variable rays spotlighting interior surfaces is an esthetic experience to many people. Can we put a numerical value on any esthetic experience?"

The basic material for this project is concrete because of its long-lasting nature, mono-chromatic coloring, low maintenance standards, and forming capabilities. The concrete can be worked easily and materials for construction are close by.

Because of the space requirements, concrete became economical and functional. Columns were used inside to free the space of bearing walls and create an orderly system to work with inside. The perimeter walls are bearing and the flat plate roofing system ties into the wall.

All the concrete is exposed and sand blasted to show the aggregate and give the concrete a texture. Since much of the concrete is showing, softer materials such as wood and ceramic tile is being incorporated for accent details and to compliment both the soft and hard materials.



de

To direct people into the building, trees are used as a funneling effect toward the main entrance. As one gets closer to the building and entrance, the trees squeeze in and the person is led to the front door and into the lobby. As one enters the lobby, the sight line is directed by three rows of trees with an insulated skylight above. The ~~rises~~ TREES direct the people to the receptionist and then onto the offices or conference room. If a waiting period does happen, seating and display arrangements are mixed throughout the trees to offer a browsing and meandering affect once the person becomes familiar with the space.

The sunlight was incorporated for a variety of reasons. Of these are natural light, natural ventilation, short range vision, and opening up of a traffic space. Since the R.E.T. Company deals with recreational equipment manufacturers, the demand for public relations in terms of environment is very strong. The atrium space was used for a gathering area and mixing zone for people using the space. The skylight is also operable to permit breezes through and to experience the fragrance of forest area, while still in a working situation.

The skylight also offers more foot candles per unit and has less of a heat gain than flourescent lighting in the same space. The skylight will also be insulated to insure ~~maximum~~ MINIMUM heat loss from the glass area.

CONCLUSION

The main concern of my thesis proposal was to incorporate the environment to a building solution. I was not primarily concerned with the particular function of a particular process, but rather how will I bring a design solution together using energy efficiency and keeping a humanistic feeling within the spaces involved.

The final solution is neither strictly functional and technical nor purely esthetic. My hope was bringing these together into a workable environment.

Through my programming and design I became aware that this can be done and done well.

"Our challenge for the future is to conserve energy, yes. But we must, at the same time, preserve the dignity of man."

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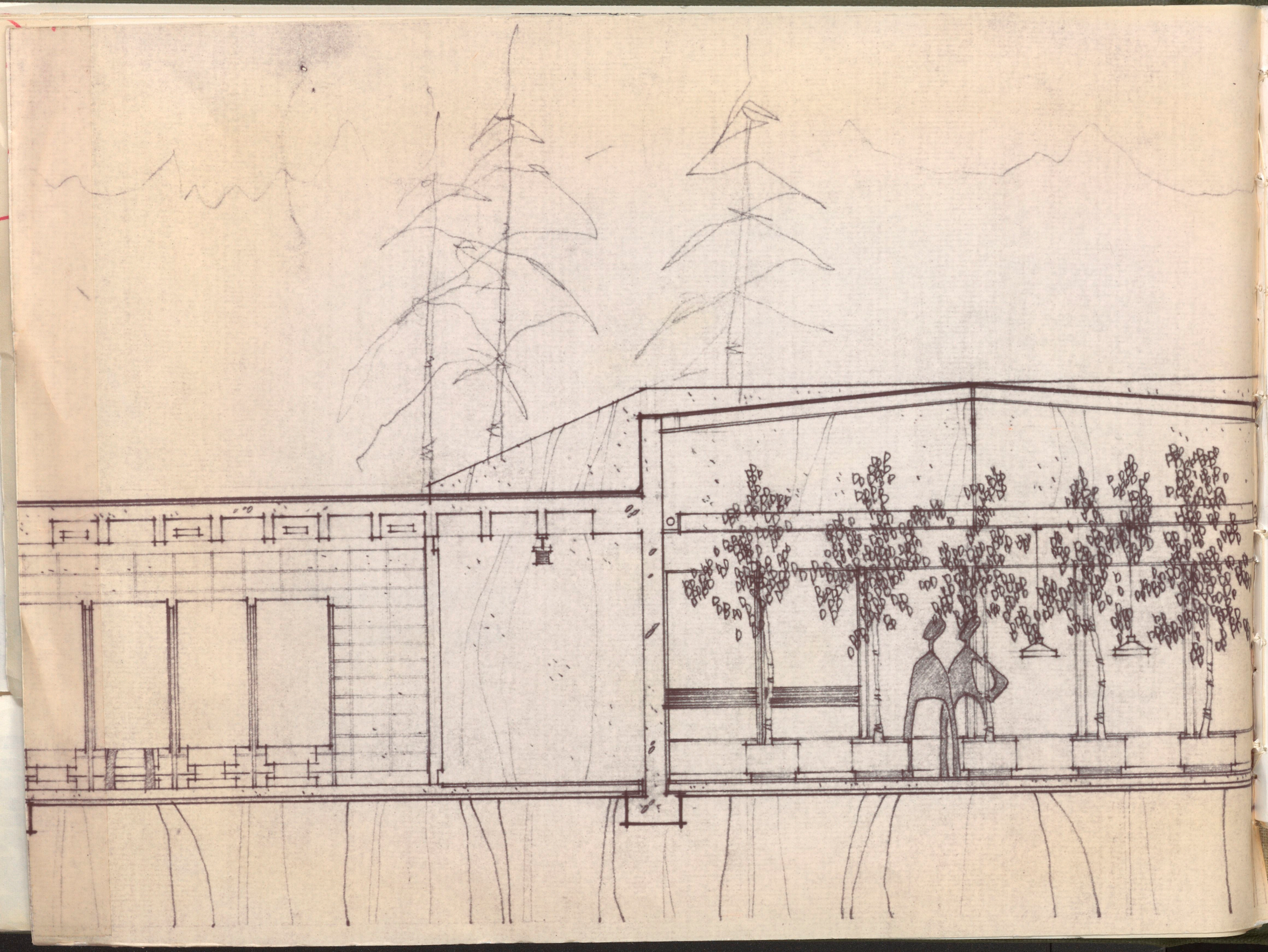
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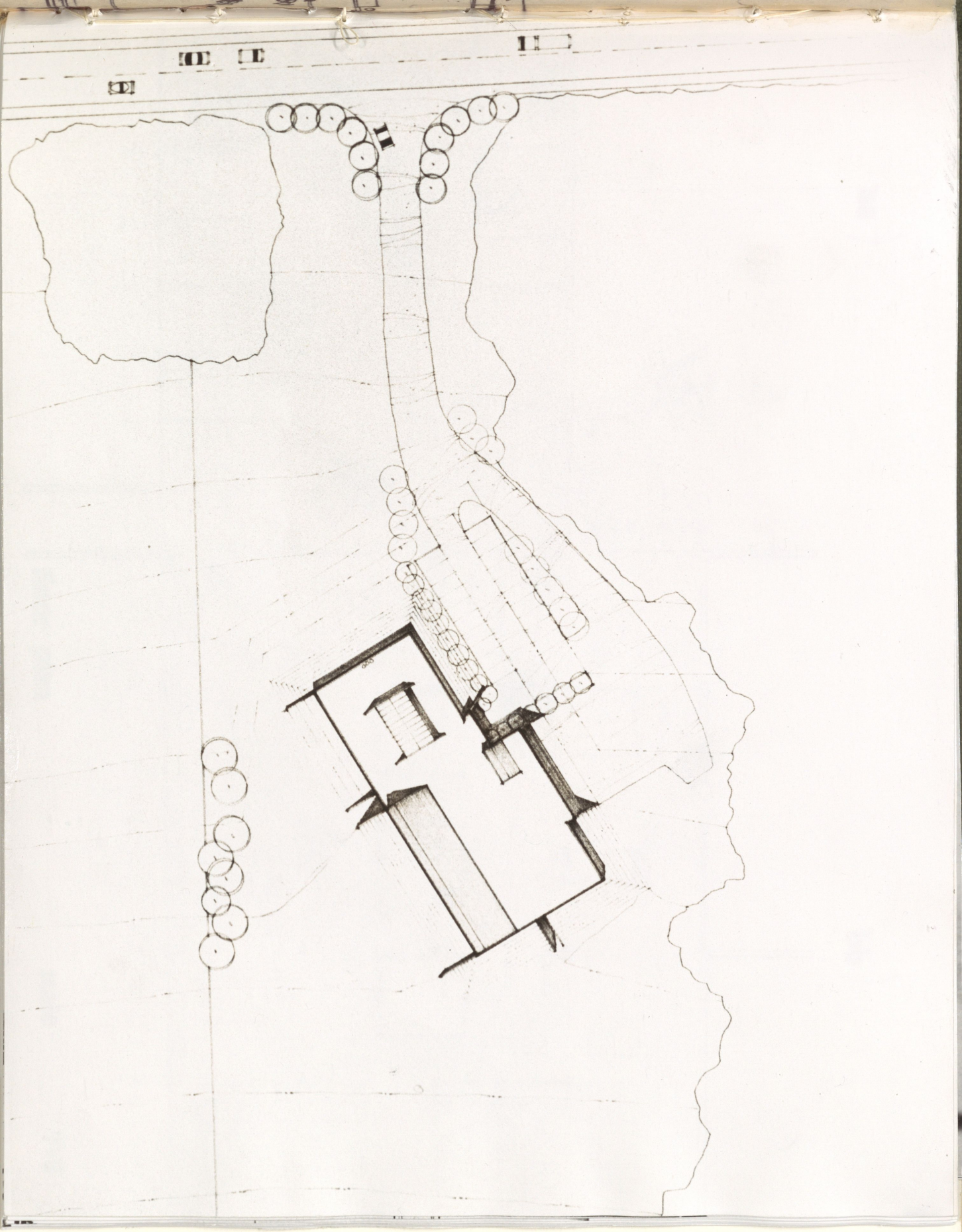
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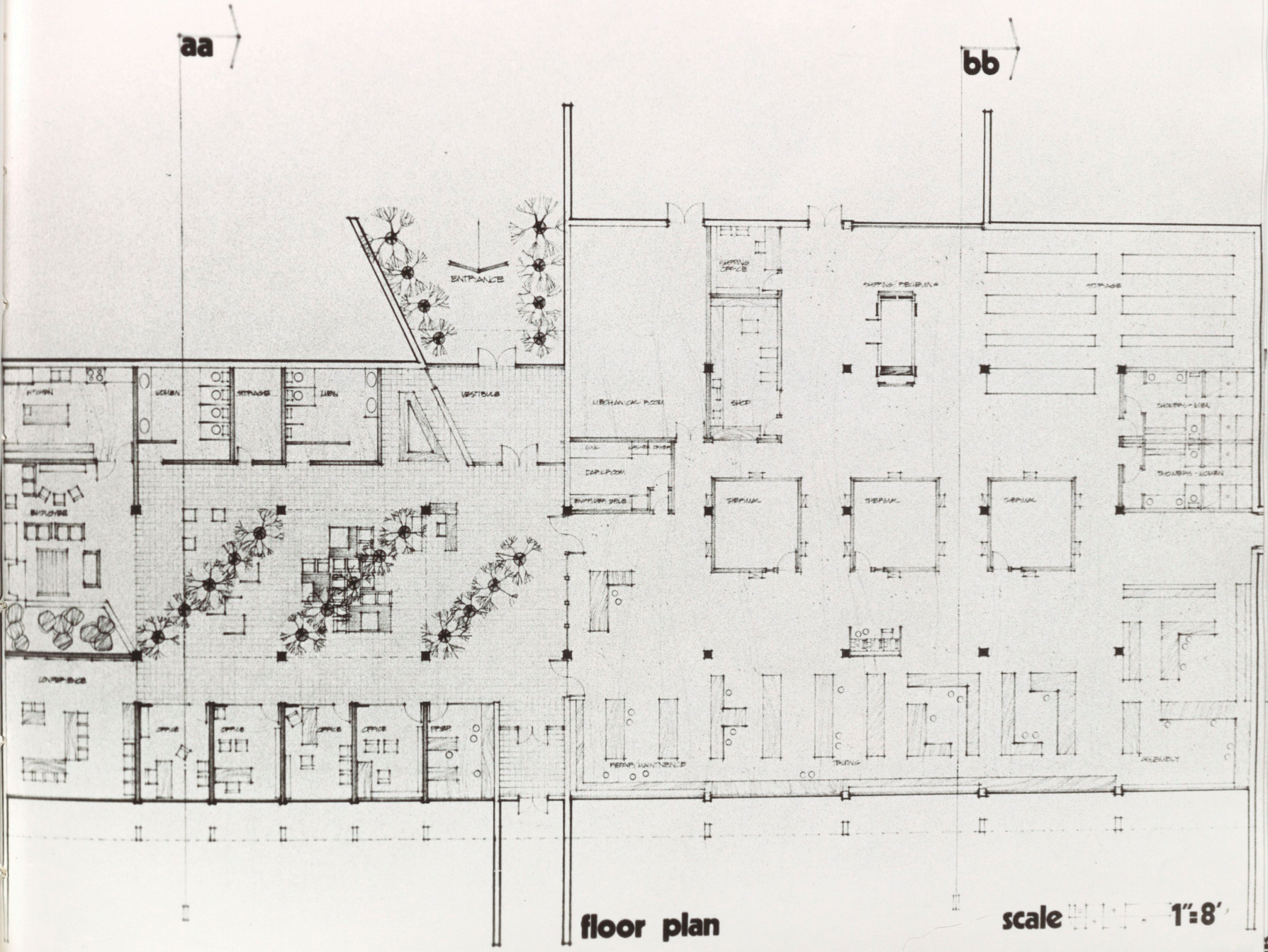
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CHRISTOPHER HAMILTON
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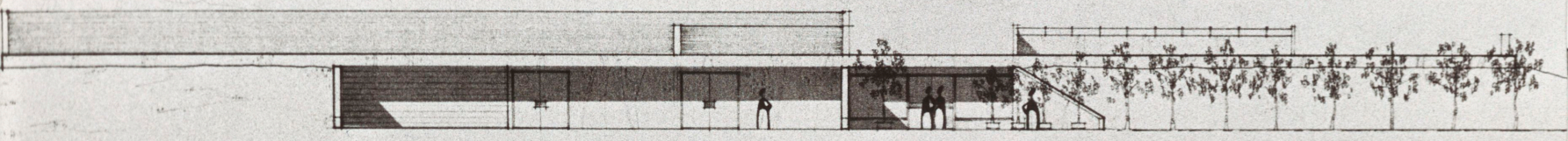




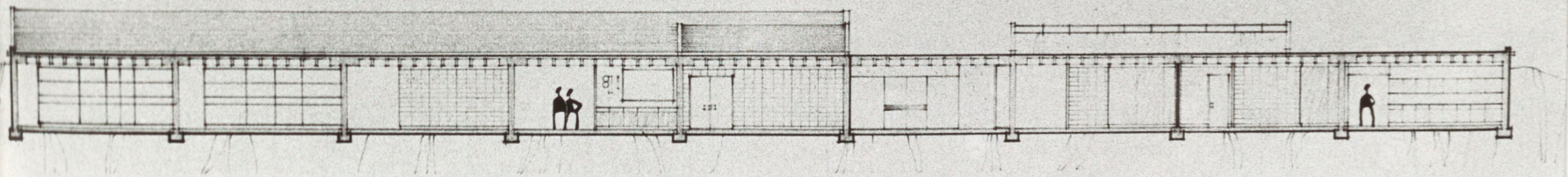


floor plan

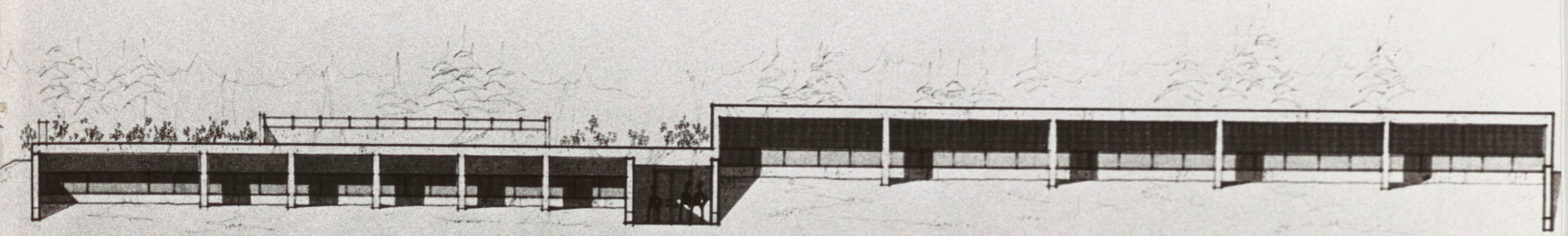
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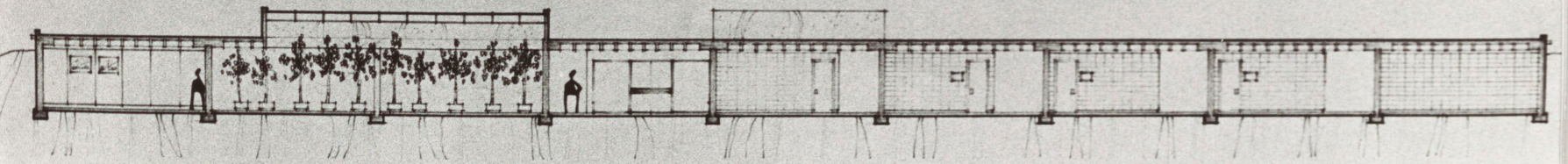
north elev.



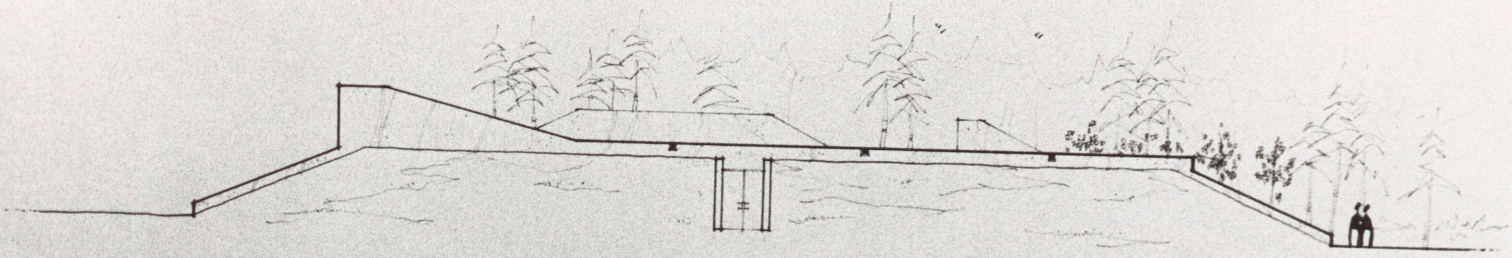
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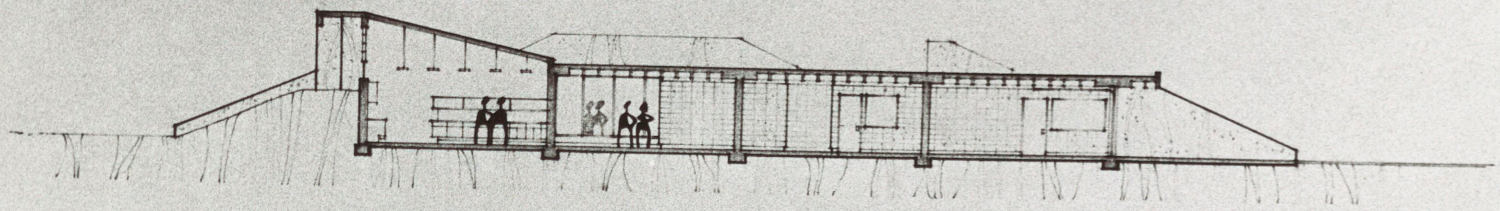
south elev.



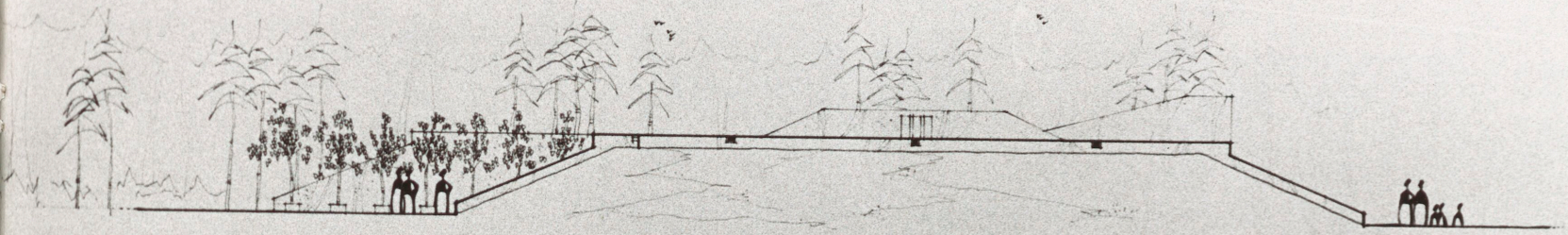
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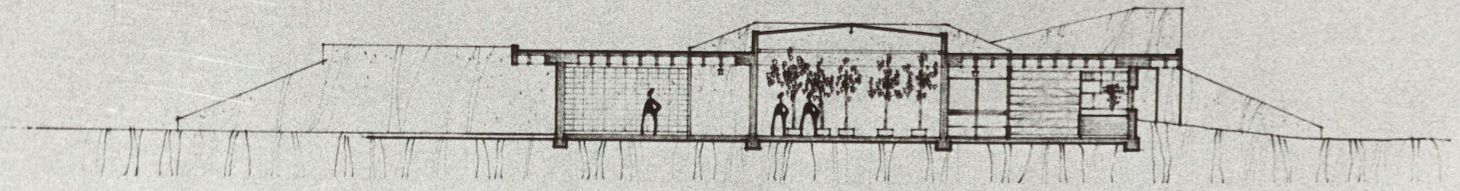
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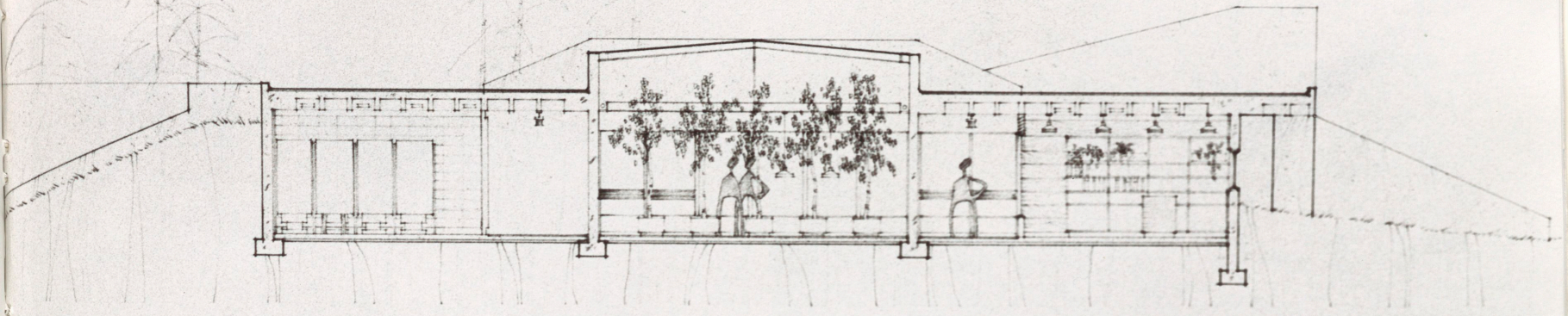
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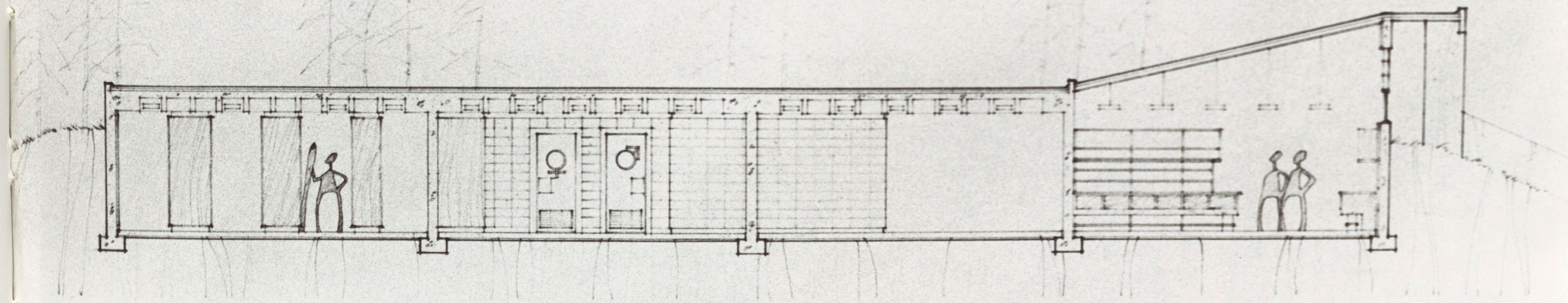
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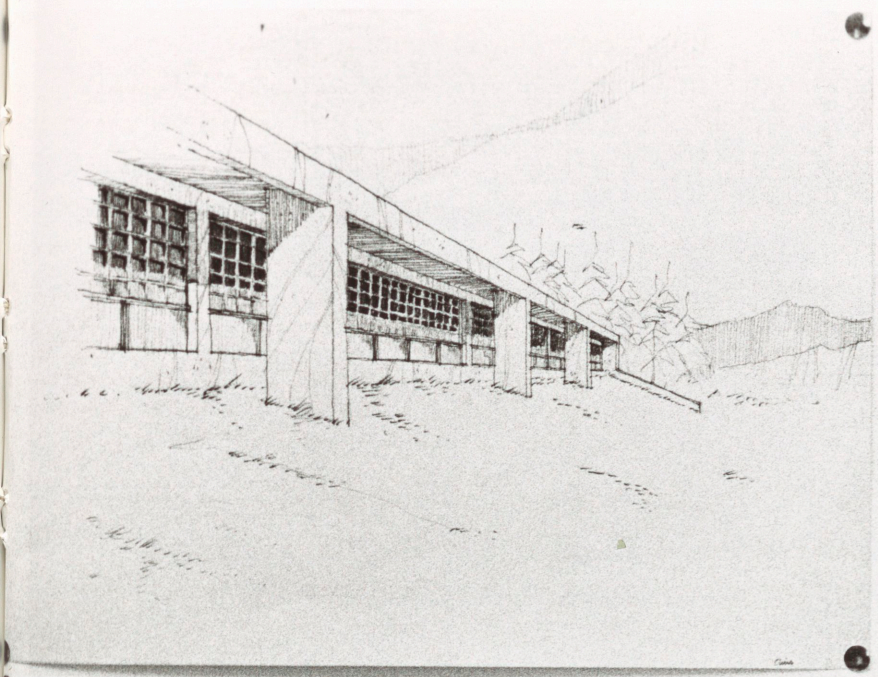


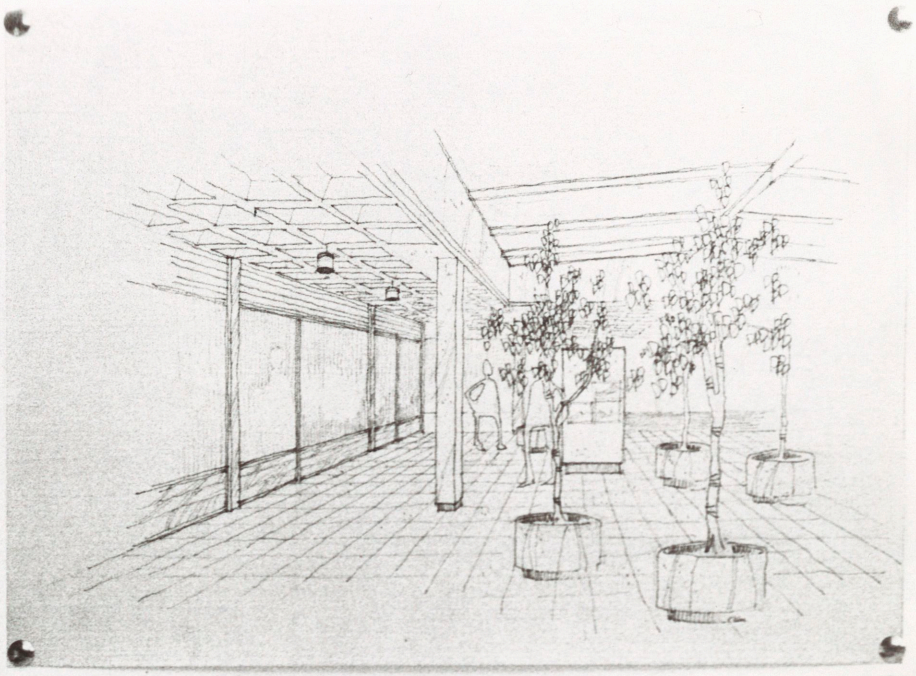
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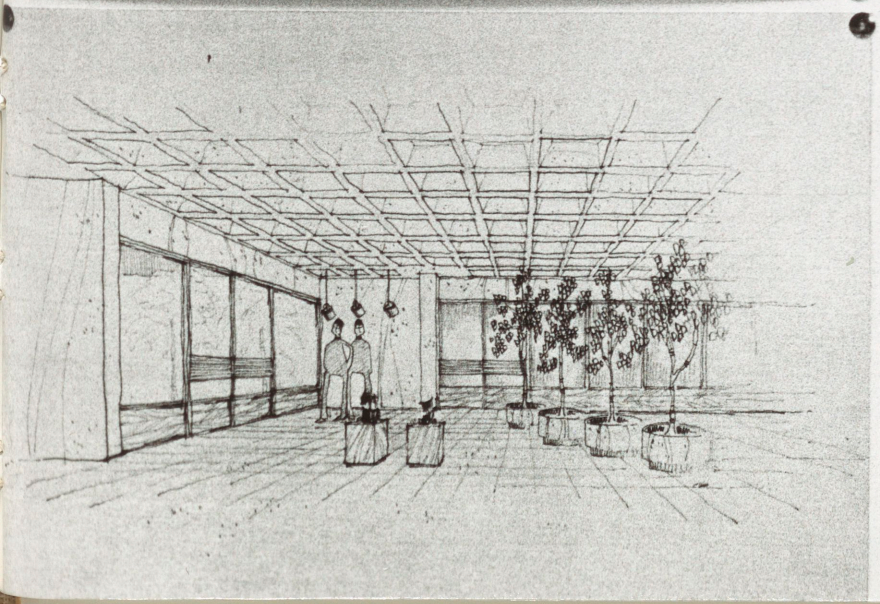


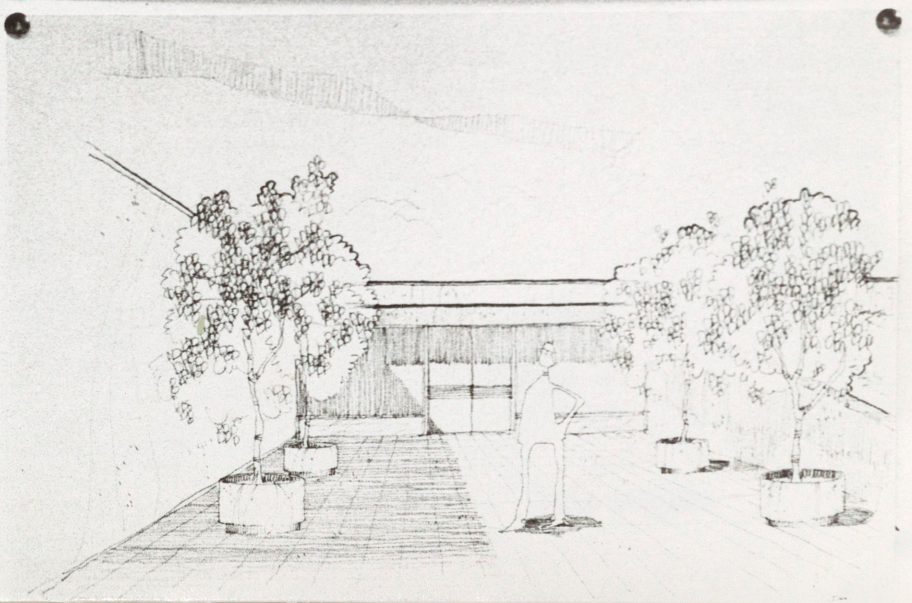
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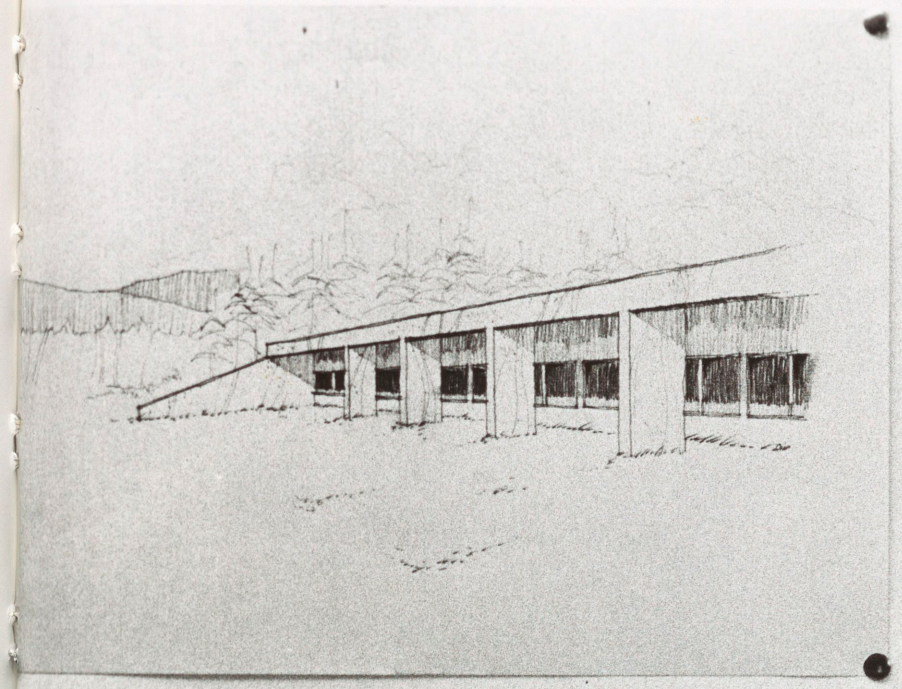
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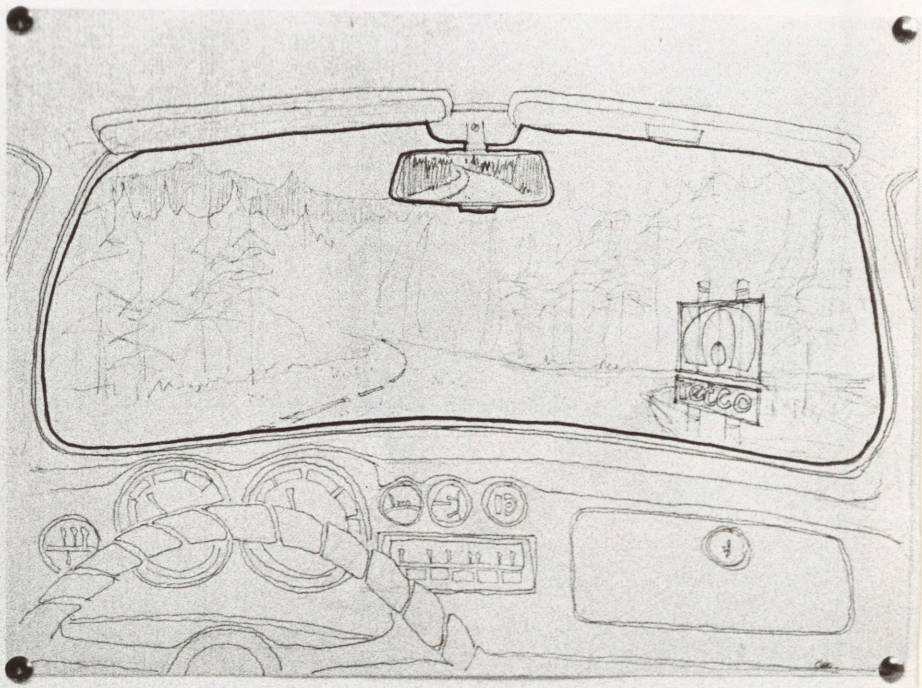


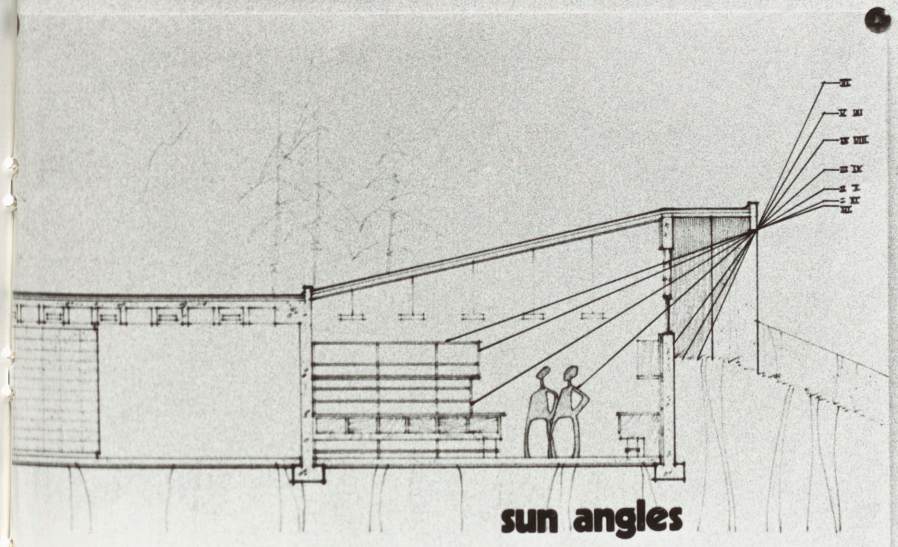




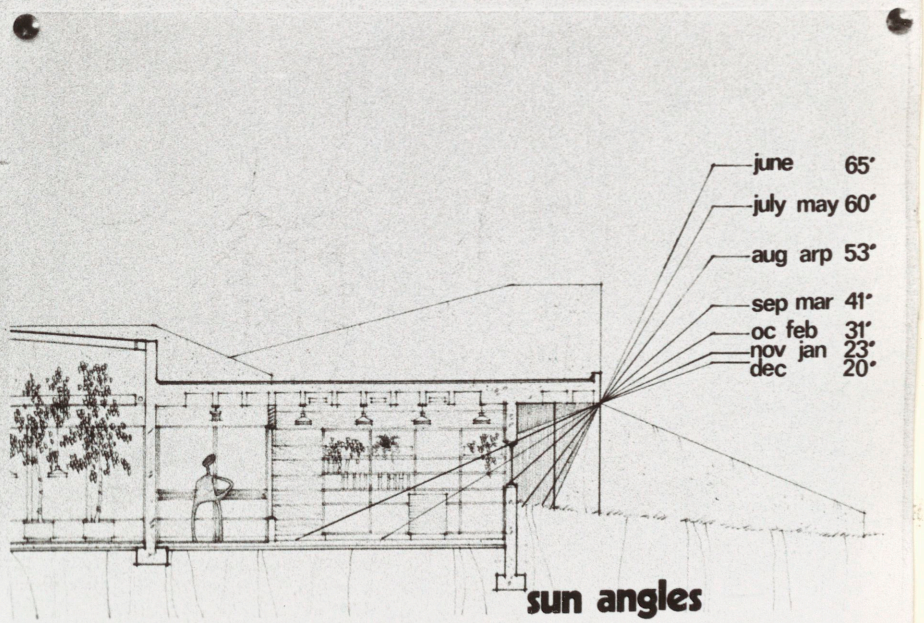




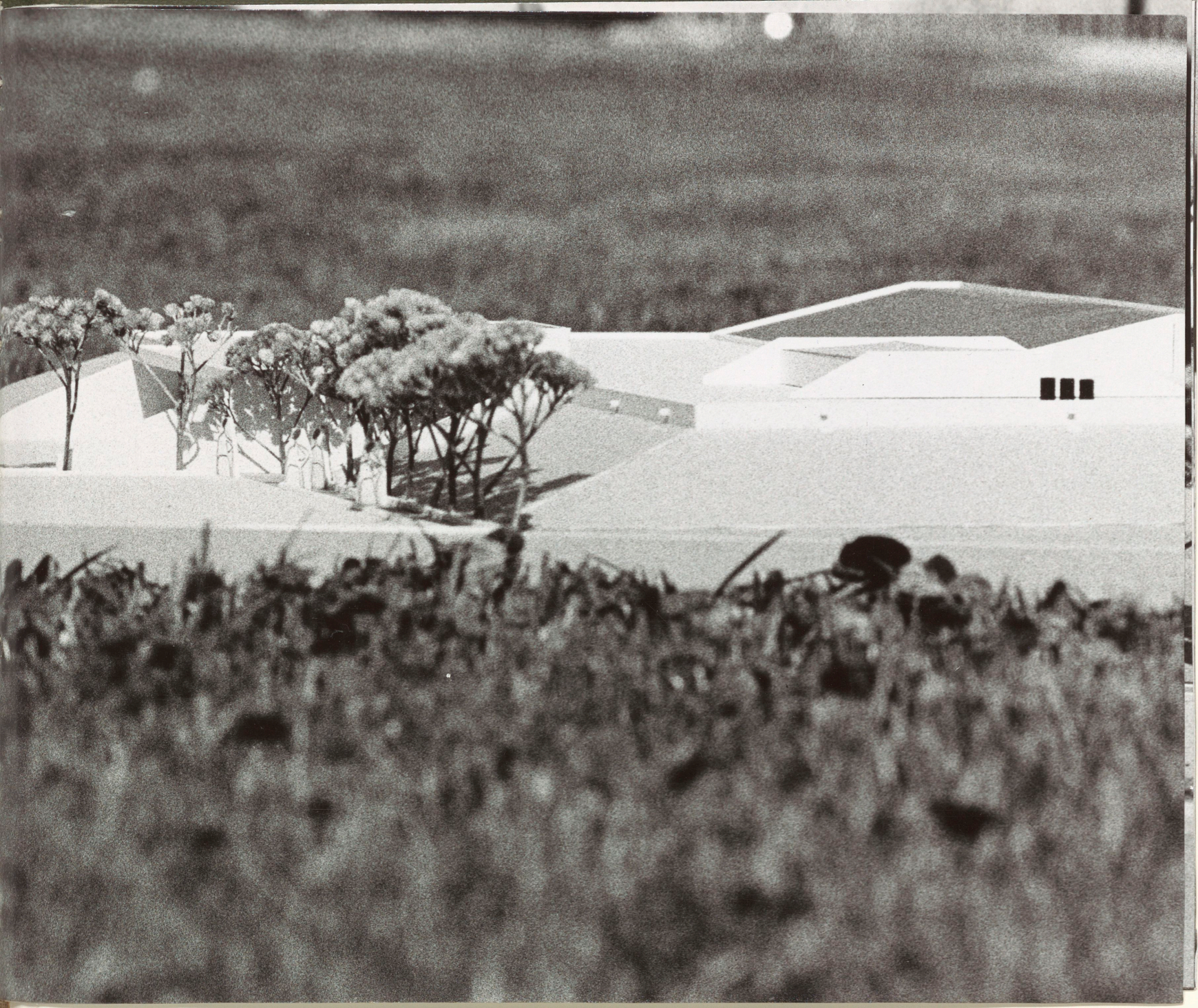




sun angles

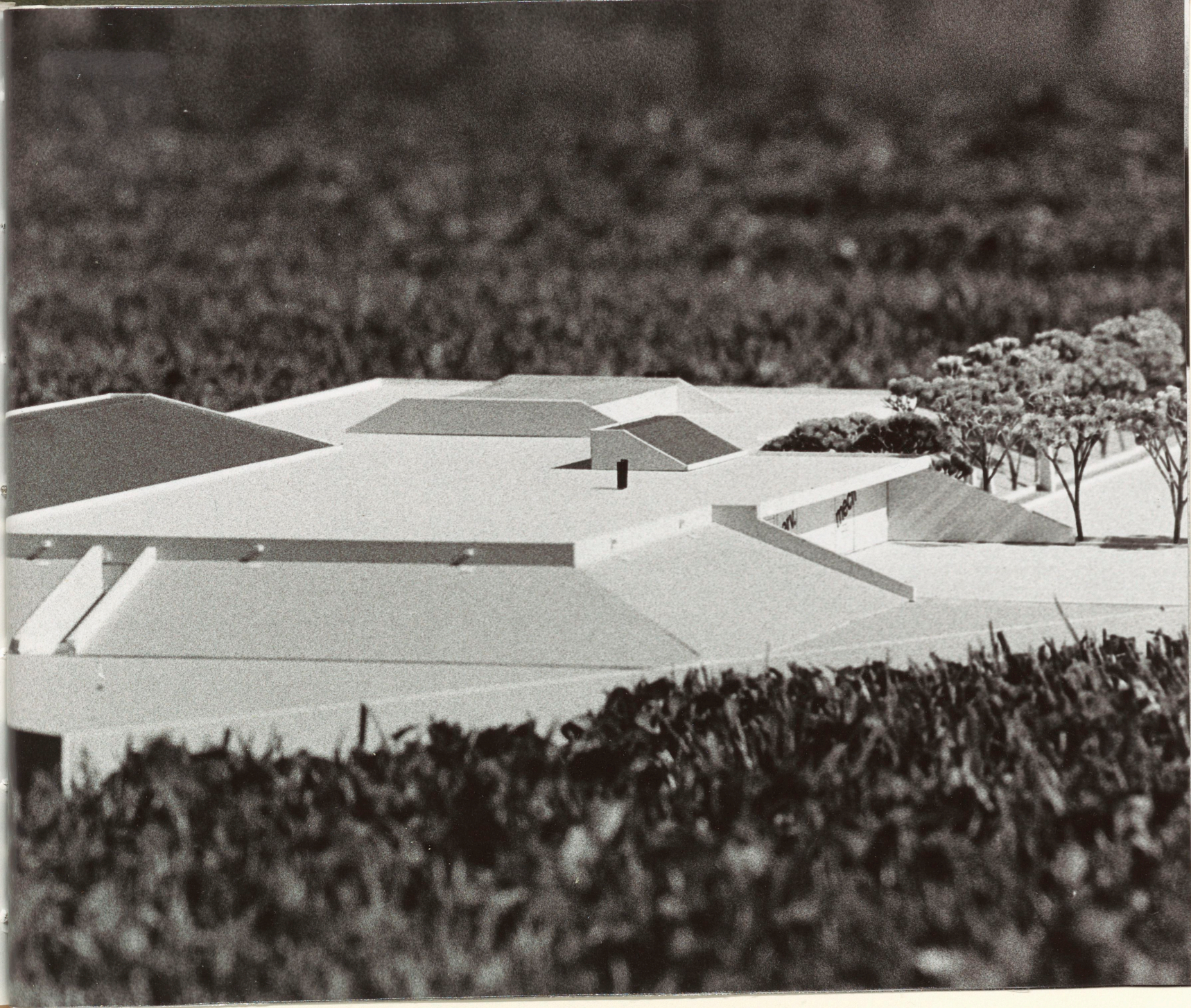


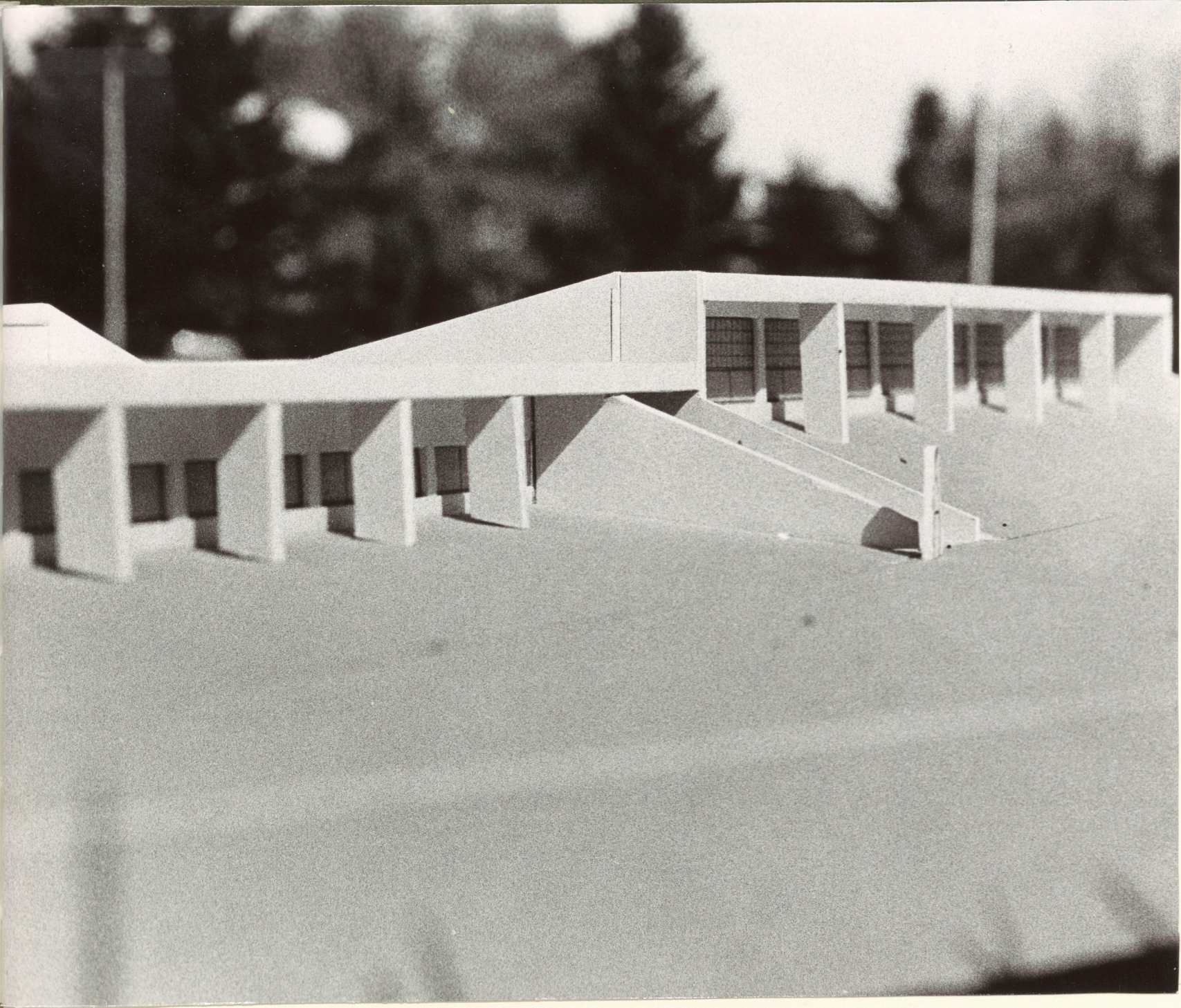
sun angles











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