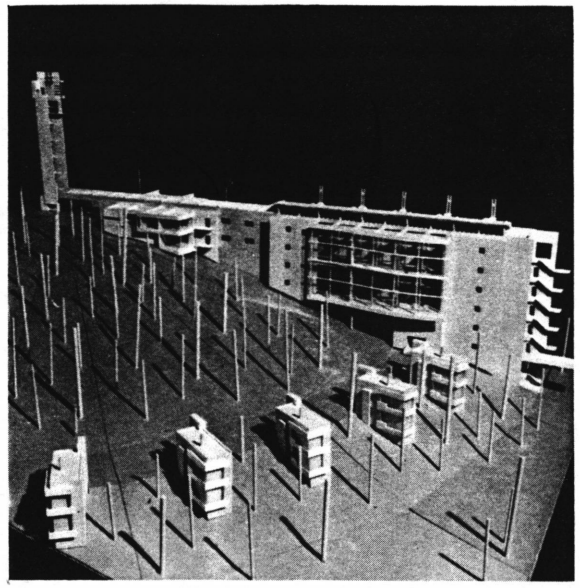


DESIGN THESIS submitted to the faculty of Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Master in Architecture

Approved

Susan Piedmont-Palladino
Chairperson

Greg Hunt

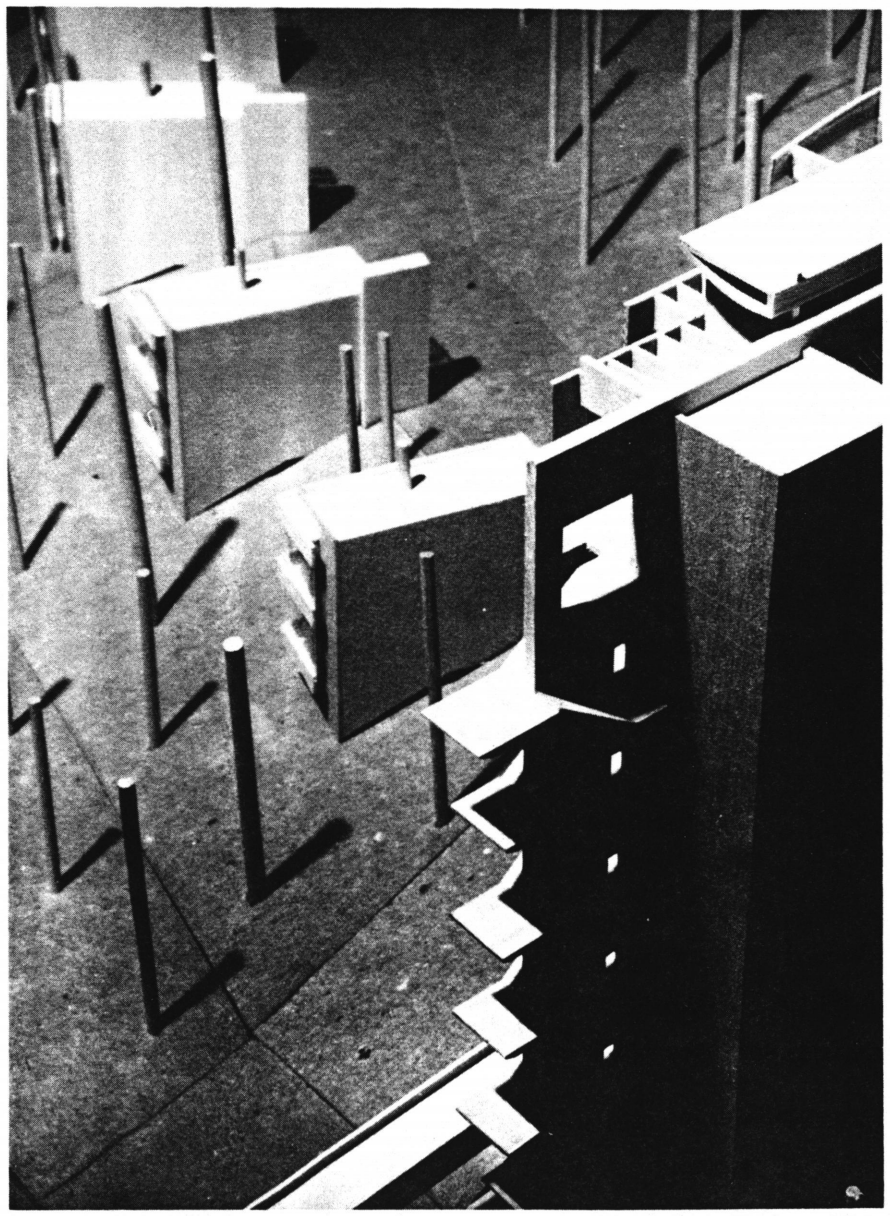
Architecture and Site

A Field Research Center for the Studies of Environmental Science, Horticulture, Landscape Architecture, and Forestry

by
Curtis H. Chi

Eric Jenkins

December 1992
Alexandria, Virginia



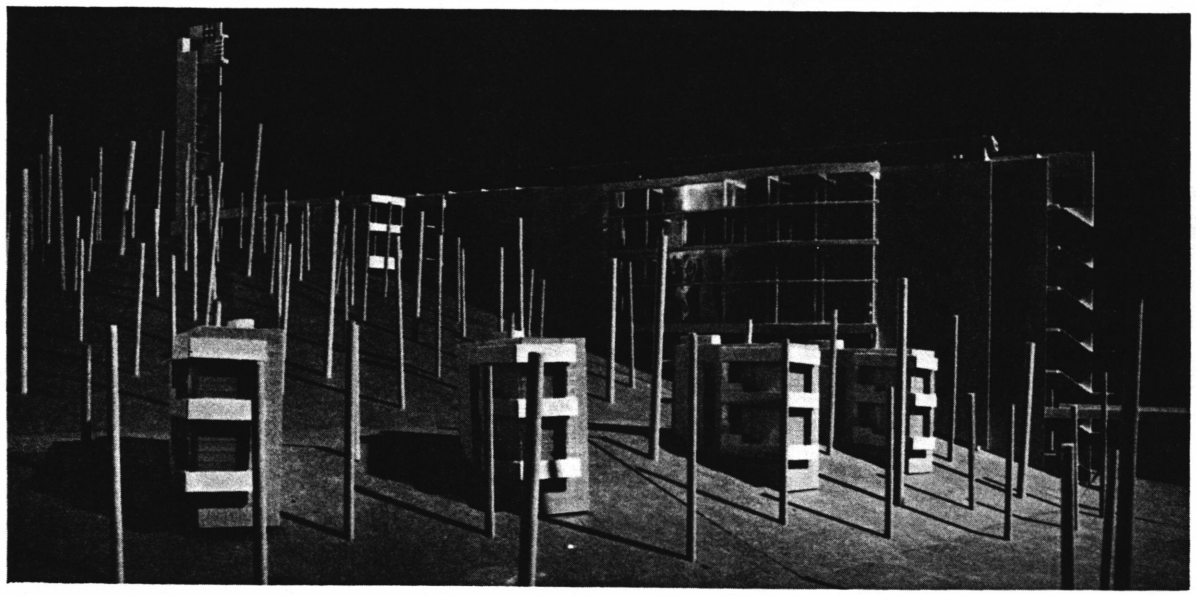
Abstract

The relationship of building to site is the most fundamental aspect in the creation of architecture. As man is a product of nature and his environment, the way in which he chooses to alter that environment in the process of building reveals not only his attitude towards his physical surroundings, but his purpose and justification for dwelling there. Not all attitudes will be the same, just as purposes will vary from person to person and structure to structure.

Mario Botta has said, "The first step in the architectural act is taking possession of the site. It is a conscious act of transforming a unicum, an awareness that grounds the new intervention in the geography, history, and culture of a particular site. The architecture is the construction of this site. There can be no indifference toward the site. It is the very territory of architecture as well as the primary condition determining the laws by which one must build".

Within the scope of my project I hoped to define this awareness within myself, this conscious act of defining and creating architecture against a background that demands the site be recognized as a primary generator of architectural form and attitude.

Contents



Introduction

"Man takes a positive hand in creation whenever he puts a building upon the earth beneath the sun...if he has birthright at all, it must consist in this: that he, too, is no less a feature of the landscape than the rock, trees, bears, or bees of that nature to which he owes his being"

Frank Lloyd Wright

"...order, for me, is the matrix of all artifice; it is the concretization of thought, of reason, in relation to the natural world. Architecture is the activity which transforms nature into culture. Order, which is often based on geometry, is the vehicle of this act of transformation...The juxtaposition of an artificial element with a natural one creates a rapport and a clash that, in its intensity, typifies the architectural event."

Mario Botta

Project

"In our corner of the Southern Appalachians, we do not have a major forestry school. The larger forestry schools of the south lie in all directions, none within 120 miles, and silvicultural training in hardwood management is still lacking in most of them. Graduate foresters will admit that their preparation in college for writing silvicultural prescriptions was inadequate. Practicing foresters have little foundation in the ecological principles that guide their silvicultural decisions."

Marsha L. Wikle
Program Manager
Bent Creek
Demonstration Forest

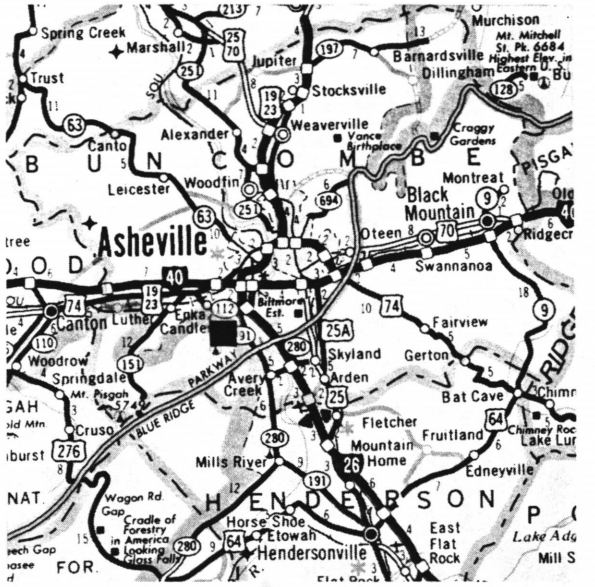
"The Bent Creek Experimental Forest is one of the oldest maintained by the USDA Forest Service. Since 1925, research there has been improving the mountain economy by developing and demonstrating sound forestry practices. Results on fire, insects, diseases, timber, wildlife, water, and recreation are being applied over a wide area of mountain land. With intensity of land use increasing, research conducted in areas like Bent Creek plays a vital role in the conservation of our natural resources."

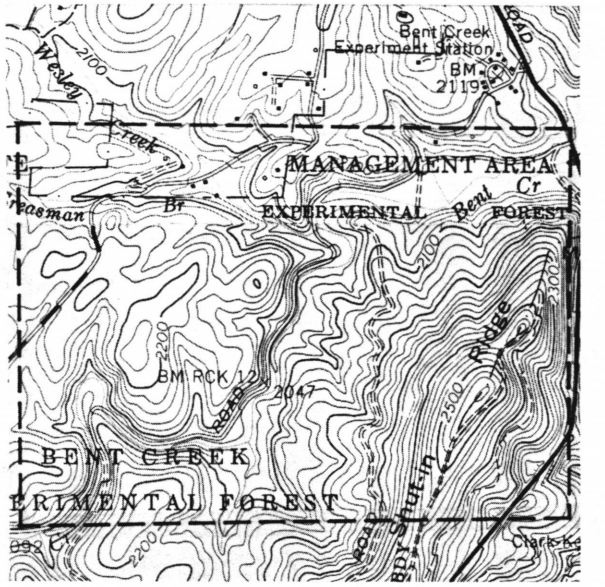
USDA Forest Service
Visitor's Guide

Project (cont'd)

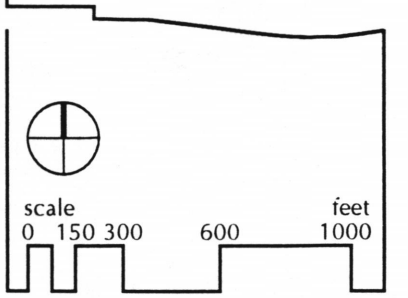
The project is a Field Research Center for the Studies of Environmental Science, Horticulture, Landscape Architecture, and Forestry. The management of our natural environment has become an ever-increasing concern in today's society, and, to that end, education in environmental techniques will become steadily more important in the university system and private sector. Although each of the schools in the North Carolina University system has at least one program related to environmental studies, they are all located within an urban setting which is not always conducive to that field of education.

By creating a consortium-type study facility at the Arboretum, students in these various fields would be able to spend a semester or a year studying in a facility dedicated to environmental education, and situated within a relatively undeveloped setting. Students from different schools and programs would be able to pool their resources and knowledge, and learn not only from their teachers and surroundings, but from each other. In particular, the fields of forestry and environmental science, traditionally at odds with one another, would have the opportunity to learn to work together.





Location Map

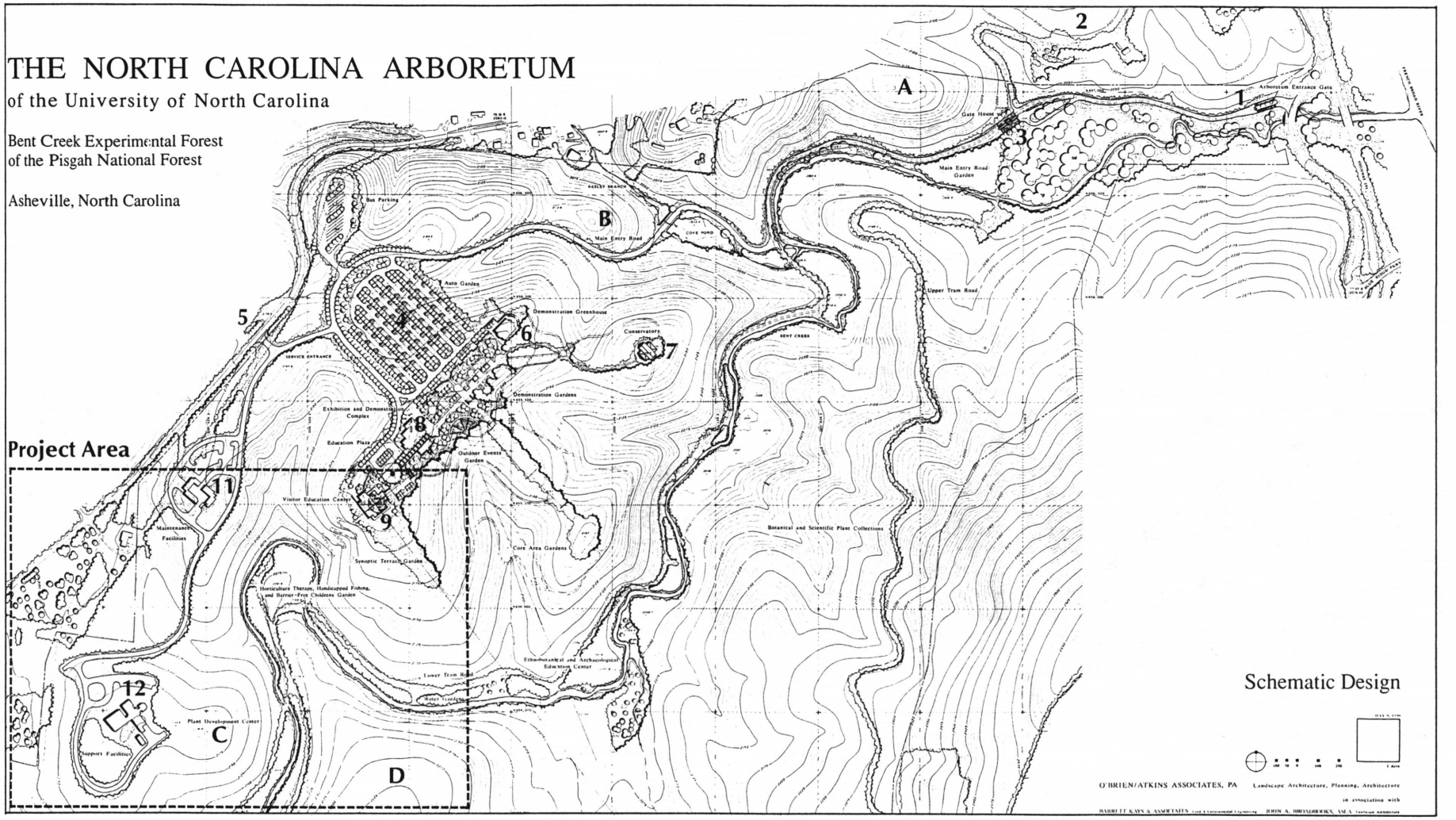


THE NORTH CAROLINA ARBORETUM

of the University of North Carolina

Bent Creek Experimental Forest
of the Pisgah National Forest

Asheville, North Carolina



Schematic Design

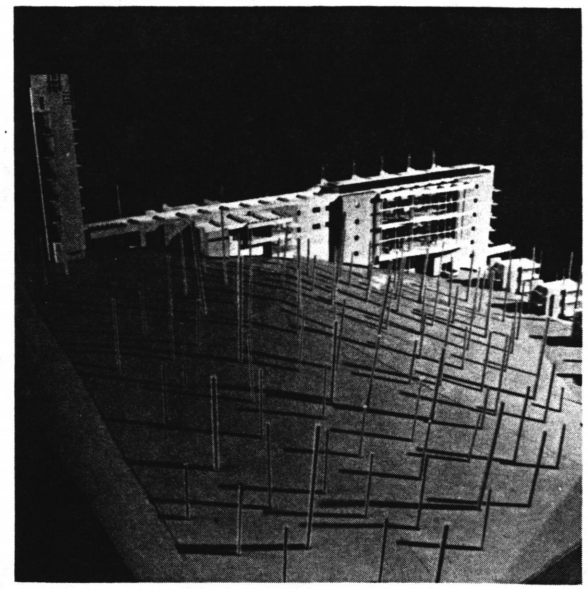
O'BRIEN/ATKINS ASSOCIATES, PA Landscape Architecture, Planning, Architecture
in association with
HARRIETT KAYS & ASSOCIATES
JOHN A. BROADBROOKS, ASLA

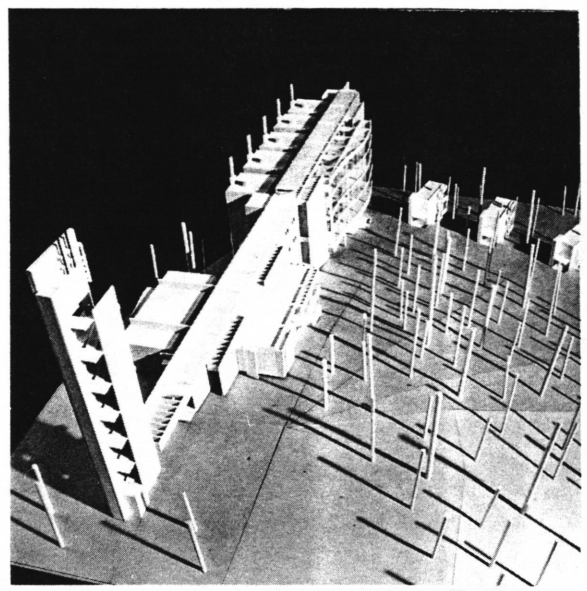
The North Carolina Arboretum is located on the outskirts of Asheville, North Carolina, at the southern tip of the Blue Ridge Mountains. This 424 acre facility is within the Mt. Pisgah national forest, and is adjacent to the Bent Creek Experimental Forest.

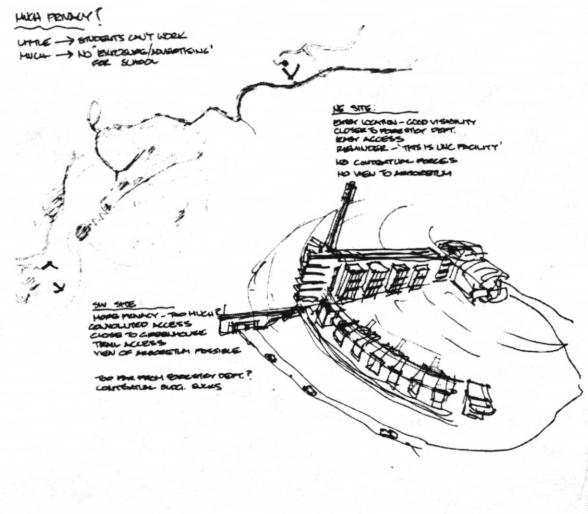
The Arboretum itself is the result of a collaboration between the various schools in the University of North Carolina System. While it is the 'state' arboretum for North Carolina, it is also intended to serve as an educational setting for these seven schools. They include: North Carolina State University, UNC-Chapel Hill, UNC-Wilmington, UNC-Asheville, UNC-Charlotte, UNC-Greenville, and Western Carolina University.

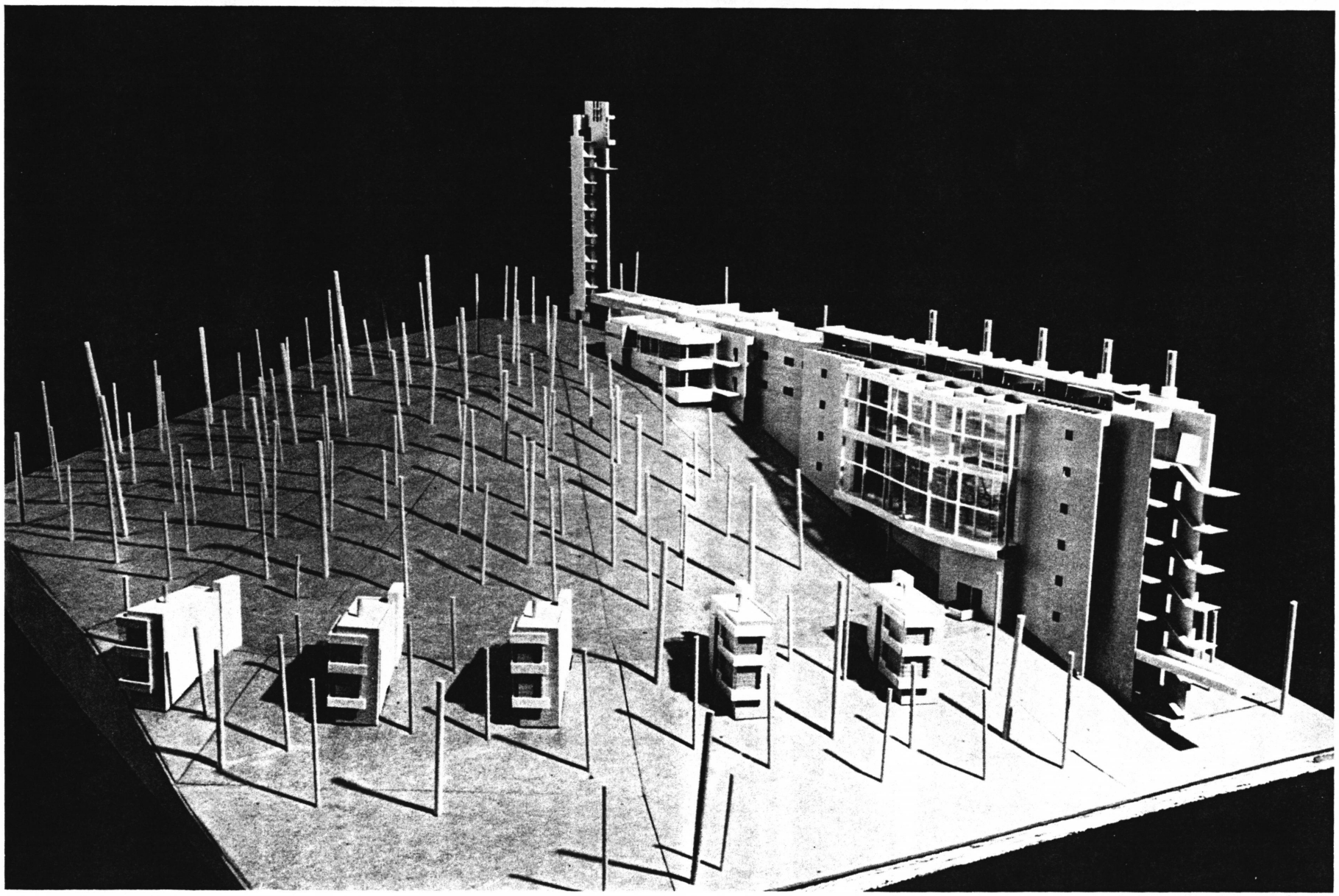
The arboretum is only in the very first stages of its development. As it exists now, it functions mainly as a public education facility, offering seminars and lectures to the local residents and visitors. These seminars center mainly on the use of local flora in residential landscaping, rather than introducing foreign species for such a purpose.

It was my belief that this facility is a vast, untapped resource for education within the North Carolina University system that led to the genesis of my project.





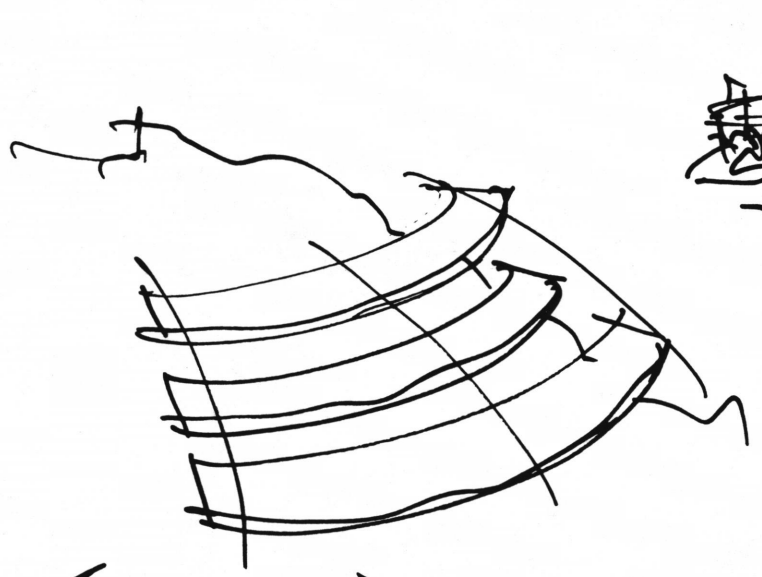


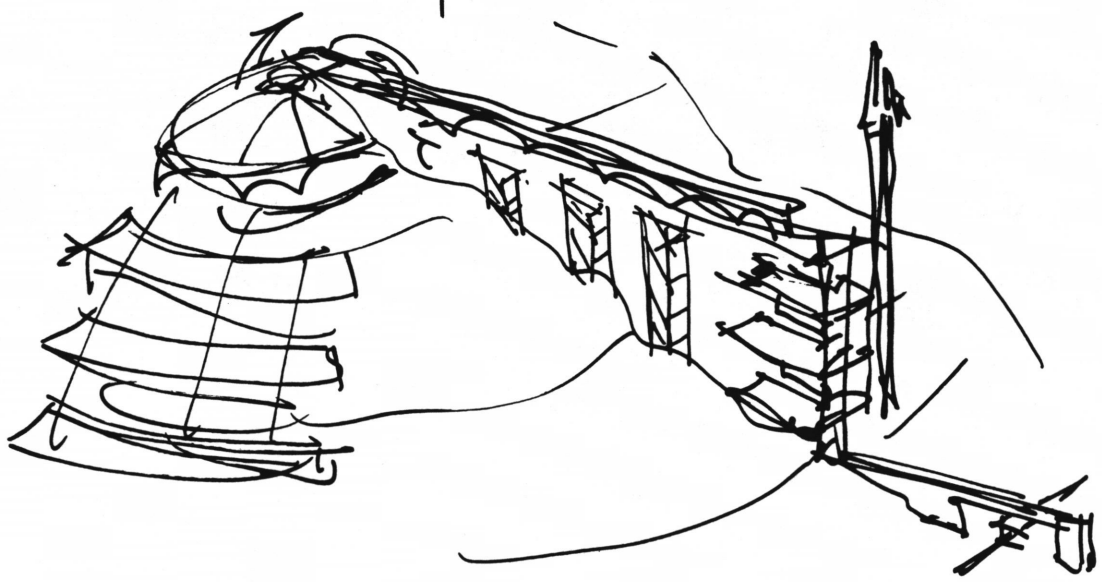


Program

As a multifunctional facility, the field research center would require a variety of elements within its program. Because it would be relatively isolated from other university campuses, many support functions such as housing would need to be provided.

- Administrative Spaces
  - -Reception
  - -Offices
  - -Meeting rooms
  - -Support spaces
- Auditorium/Lecture Hall
  - -Projection room
  - -Support spaces
- Reference Library
  - -Bookstacks
  - -Reading area
  - -Support spaces
- Multifunctional Lab Spaces
  - -Research laboratory use
  - -Studio space use
  - -Classroom use
  - -Support spaces
- Common Area
  - -Lounge
  - -Wintergarden
- Observation Tower
  - -Observation deck
  - -Climate data station
- Faculty/Student Housing
  - -Apartment units
  - -Support facilities



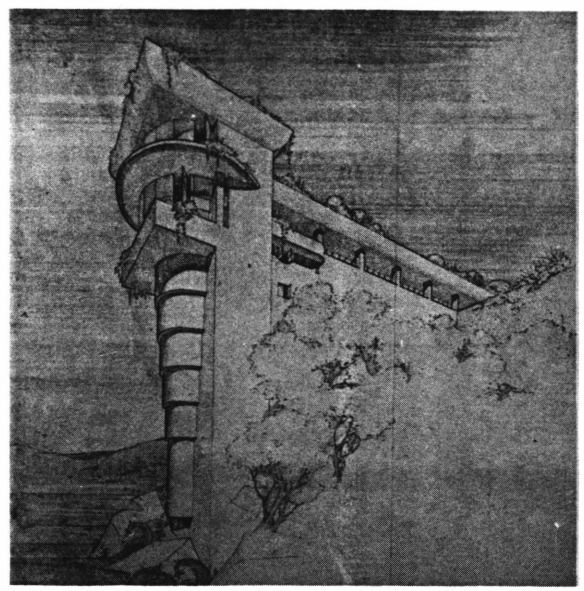


Concept

The most critical aspect of the area chosen for my project is that of *slope*. Located in the mountains, it is impossible and architecturally irresponsible to ignore this overriding factor in the design. Existing buildings within the Arboretum have sought to avoid dealing with this problem by razing the tops of the mountains and placing buildings atop them as though they were located on a flat plain.

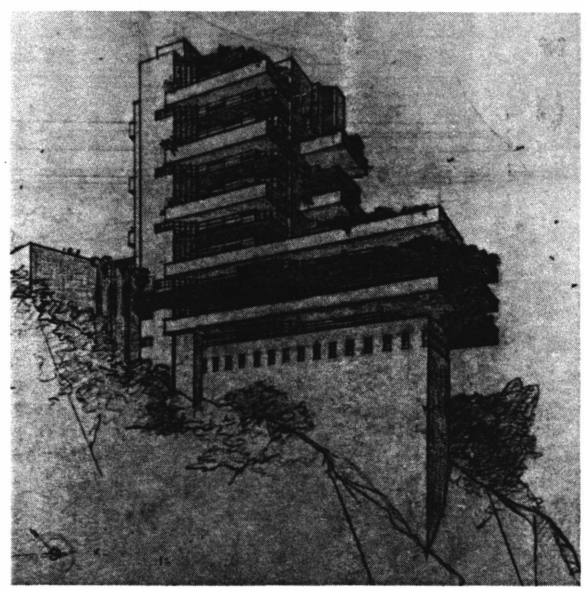
It seemed to me that in dealing with the issue of slope there were only two basic ways of approaching the design: by building *with* the slope, or by building *against* it. One could follow the contours of the hill, or cut across them. The two approaches are diametrically opposed in their attitudes towards the slope; one submissive and one assertive.

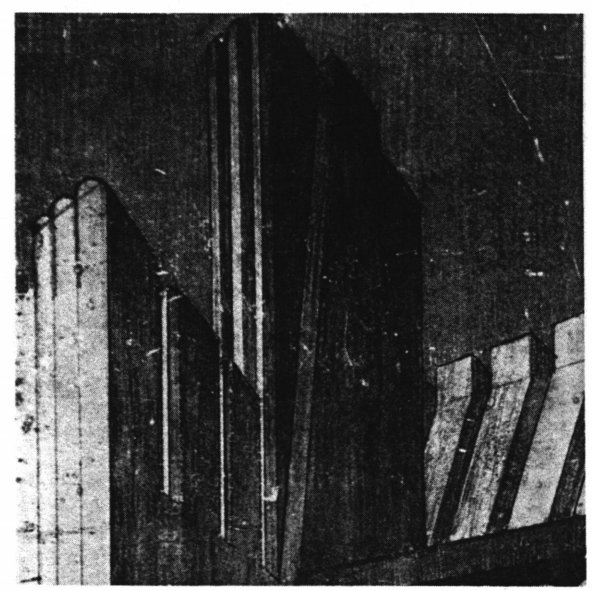
After much analysis of my project outline and program, I decided that the assertive attitude was more appropriate. The Arboretum is a university facility, and yet it has no educational buildings. As my building would be the first of such, I felt that it should stand proudly upon its site, a symbol of the university system visible to all within the boundaries of the facility, a "machined object standing in the midst of a natural world" which would "...enhance, by contrast, the beauty of the landscape" (Meier, 1984).



Inspirations

Once I had decided that the attitude of my project should be that of the building defining the site, that the structure would seek not only to declare itself unashamedly to be a work of man and a place of order, but also by its contrast to enhance the very nature of its surroundings, I began to study the works of several architects in which a similar approach had been taken. The most relevant projects included:





top left:
The Douglas House, Richard Meier, 1973

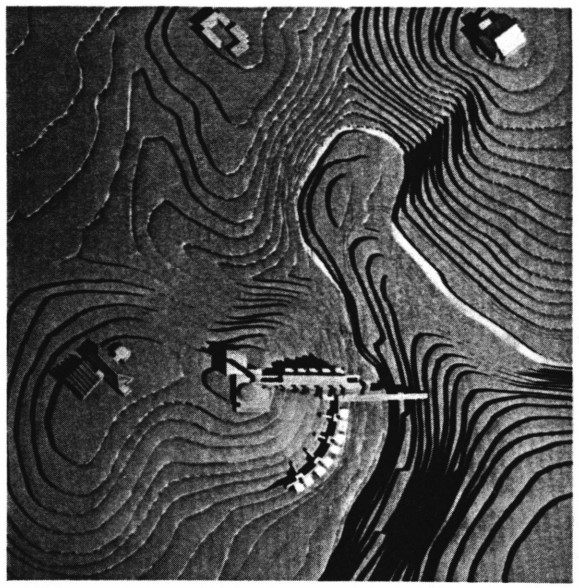
top center:
SeaCliff, Frank Lloyd Wright, 1945 (unbuilt)

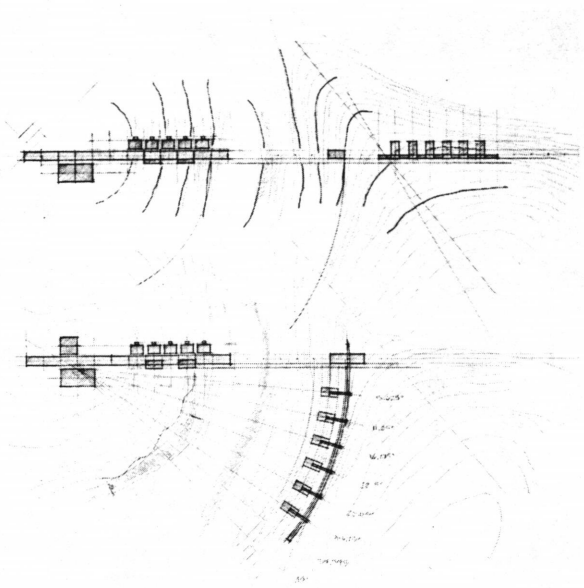
top right:
House at Riva San Vitale, Mario Botta, 1973

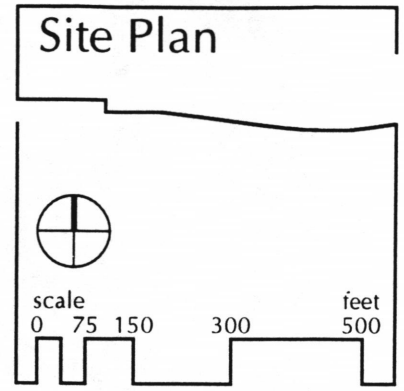
bottom left:
The Middleton Inn, W. G. Clark, 1986

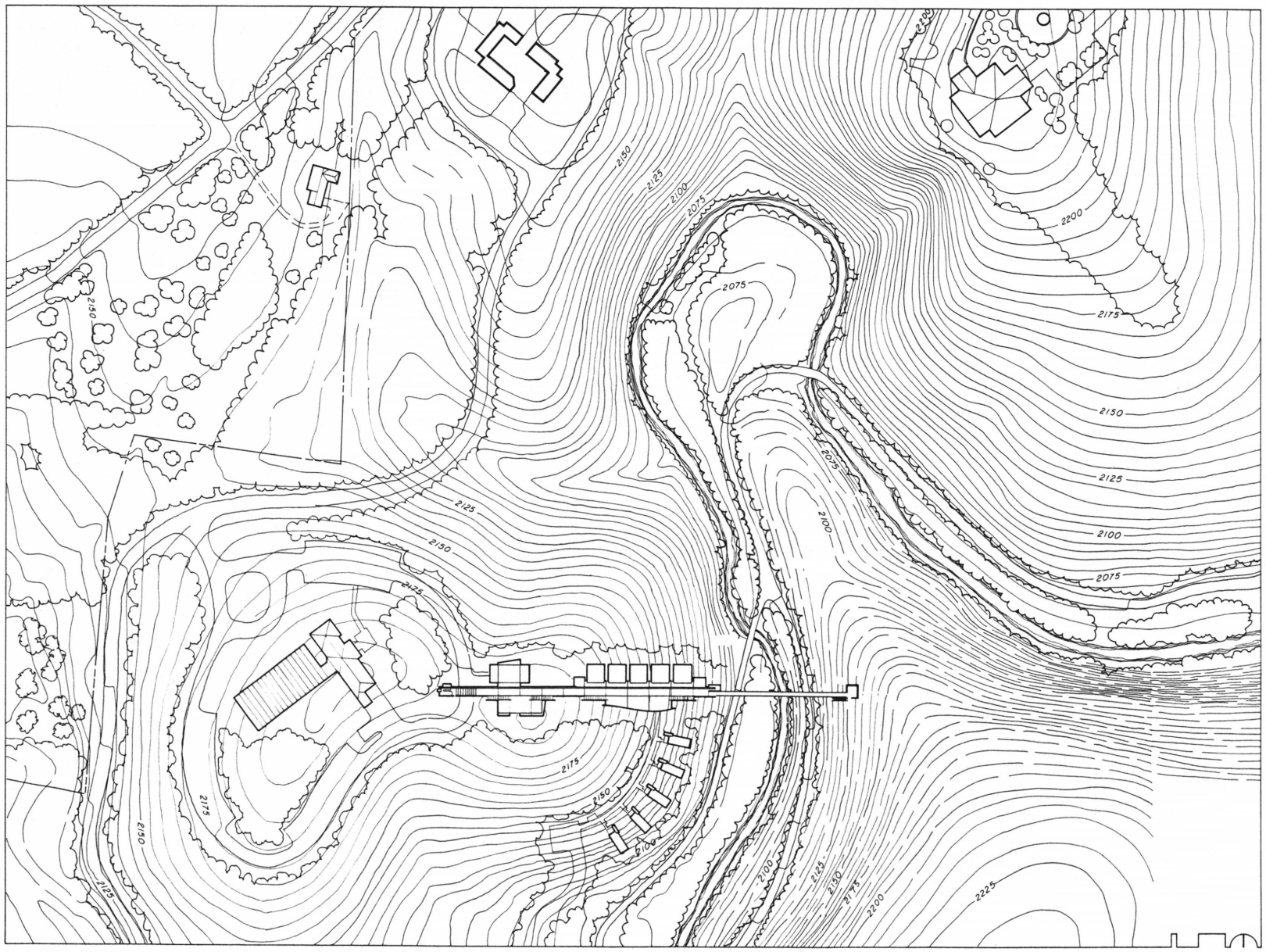
bottom center:
Point View Residences, Frank Lloyd Wright, 1952 (unbuilt)

bottom right:
Architectural Forms, Antonio Sant'Elia, 1913 (unrealized)
Although not truly a building, the architectural forms envisioned by Sant'Elia served as great inspiration for my own project.





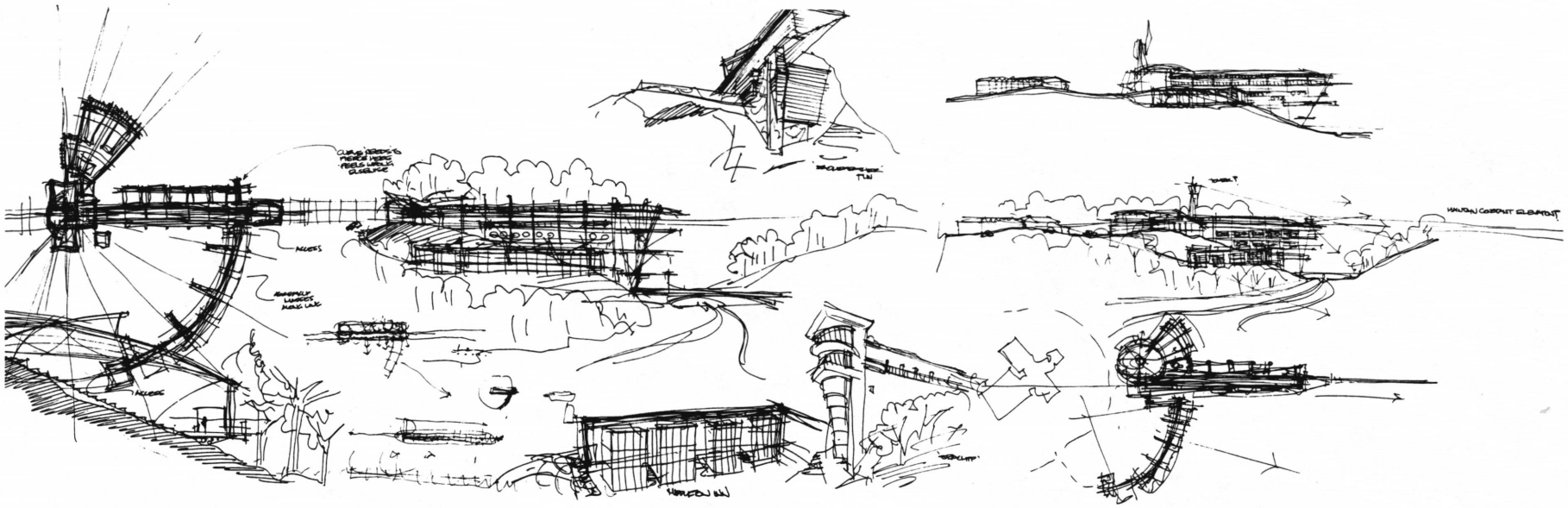


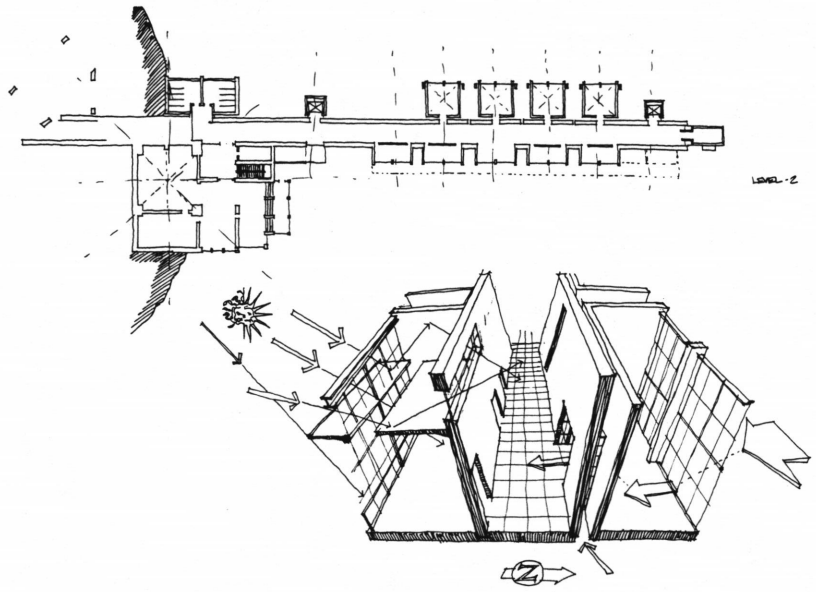


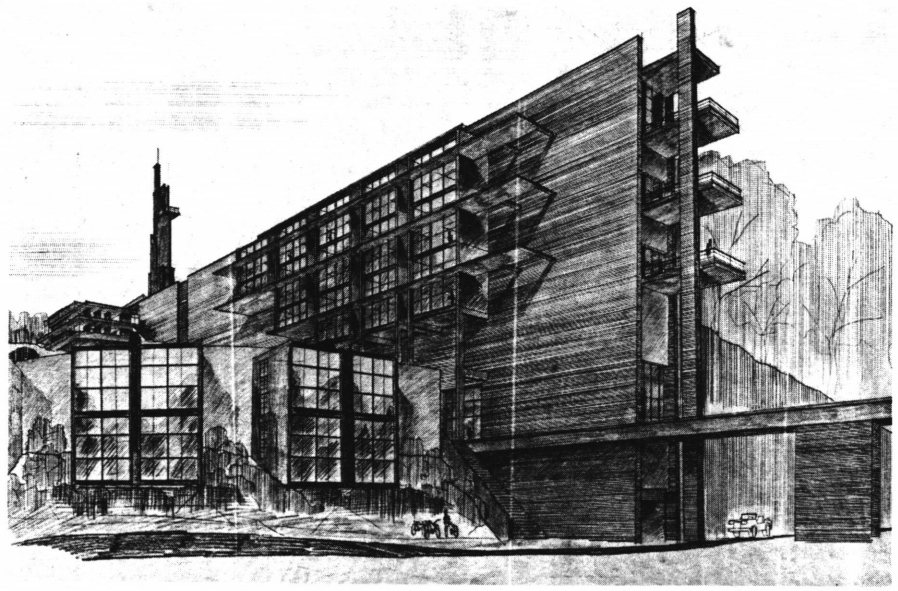
The specific mountainside taken for the project site was chosen for several reasons. Within the original master plan for the arboretum, this site had been designated as the location for a future plant development and education center. Also, it is adjacent to the existing research support facility, which includes greenhouses necessary for cultivating research plants.

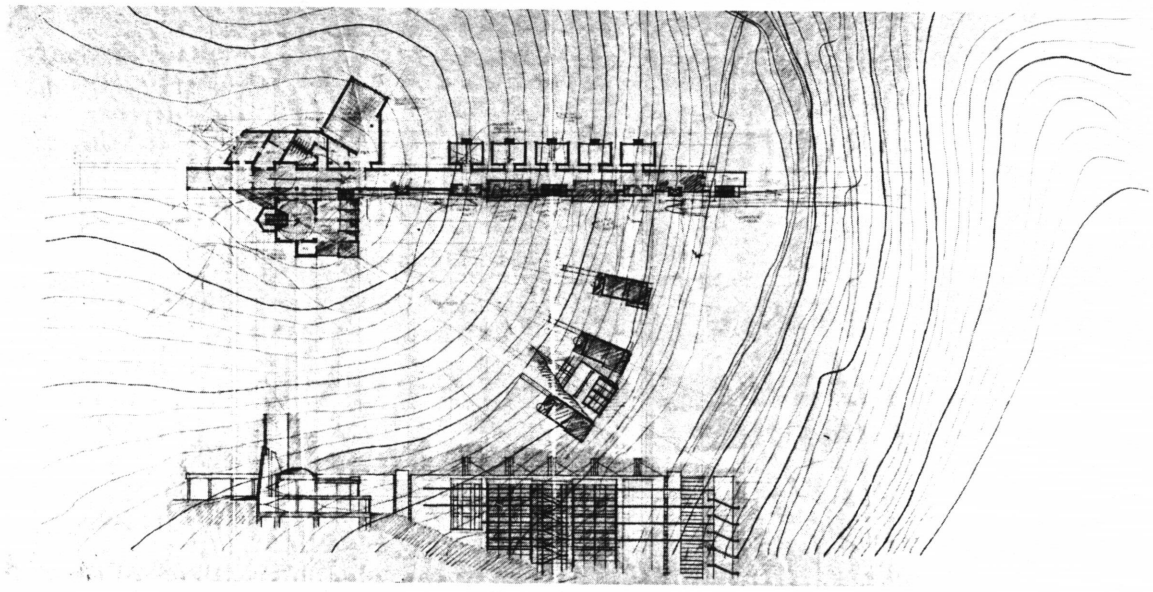
This site is also isolated enough from the visitor's center so as to prevent the casual visitor from wandering through, while close enough to allow convenient access to those who have business at the university building. The proximity of the service entrance gate allows after-hours access to the building when the public facilities are closed.

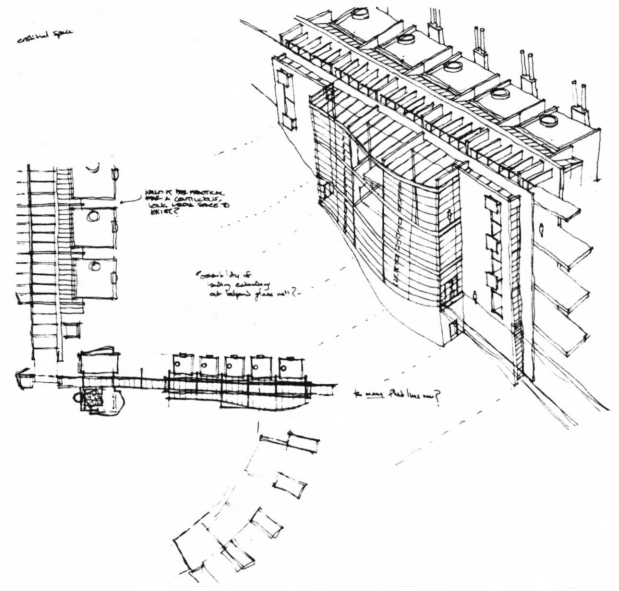
The master plan for the arboretum is based on a series of axes extrapolated from the interconnecting ridgelines and sightlines present within the area. The basic layout of the research center was created according to these rules. The main axis of the building follows the line connecting two adjacent ridges, and the housing is oriented to take in the views and privacy to the south. The laboratory units view the public complex, while the auditorium frames a single view up the Bent Creek to the French Broad River.











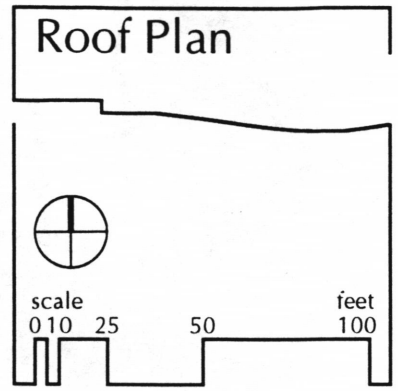
Development

"Designing from the outside in, as well as the inside out, creates necessary tensions, which help make architecture. Since the inside is different from the outside, the wall – the point of change – becomes an architectural event. Architecture occurs at the meeting of interior and exterior forces of use and space... Architecture as the wall between the inside and the outside becomes the spatial record of this resolution and its drama."

Robert Venturi
Complexity and Contradiction

The form of the project remained fairly true to the original partii concept throughout the design process. Originally conceived as a literal translation of a wall extruding across the contours of the site, the main axis of the facility eventually evolved into a much more complex element.

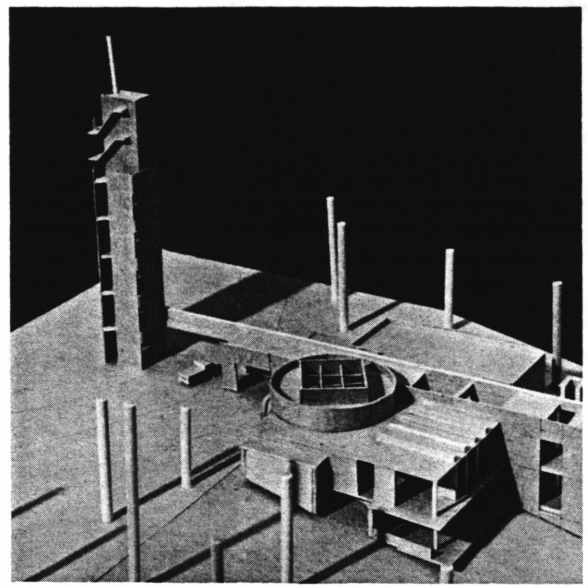
Using Venturi's philosophy of the wall as an event, the spine of the building changed in both form and intent. Rather than remaining an almost literal wall with passages and spaces within, the axis became a series of layers and events, a space of changing transparency. While proceeding linearly though the spine remains a direct event, passing across the axis one perceives a sequence of unfolding events.



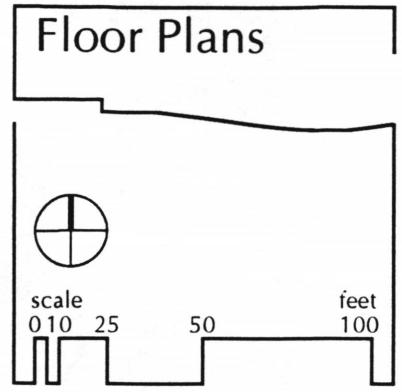
The building extends from the mountaintop directly east, following the natural ridgelines. In this location, it faces perpendicular to the Bent Creek as it winds around the valley below. The spine then serves not only as a datum line for the elements of the building, but also as an element within the sitelines of the master plan for the arboretum.

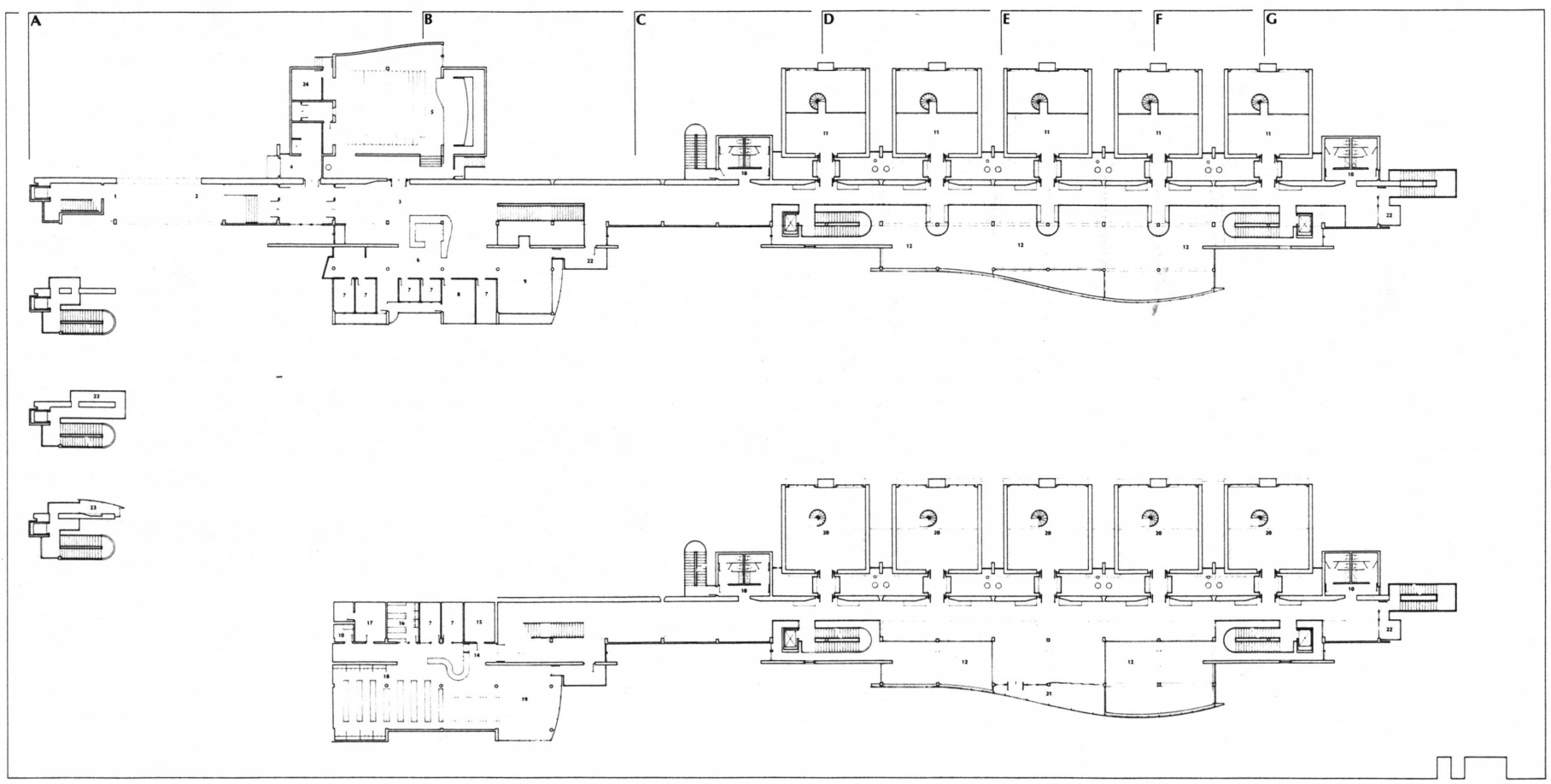
Within the building plan, the spine serves as the primary organizer of the various program elements. It also functions as a terminator line between light and dark, between north and south – those elements which benefit from direct sunlight are delegated to the south side, and those which prefer indirect lighting are placed on the north.

Main public access to the building from the top of the mountain is from a circular drive which passes under the entry portico, punctuated by the observation tower. Secondary access is available from a service road which leads both to the housing units and to the stairway which descends from the bridge to the outer gardens.



Floor Plans



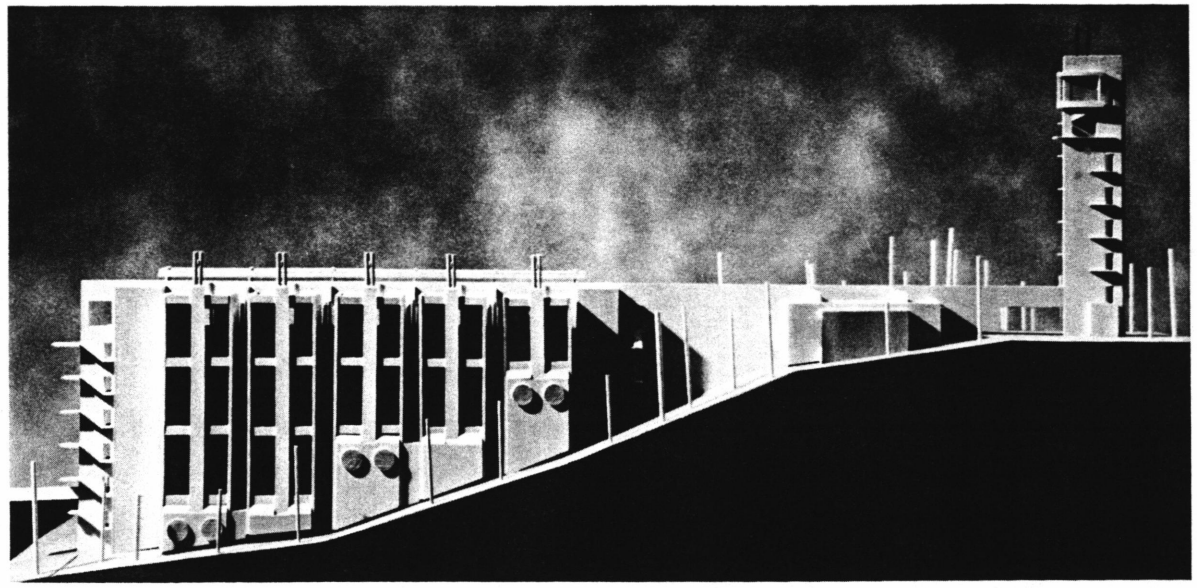


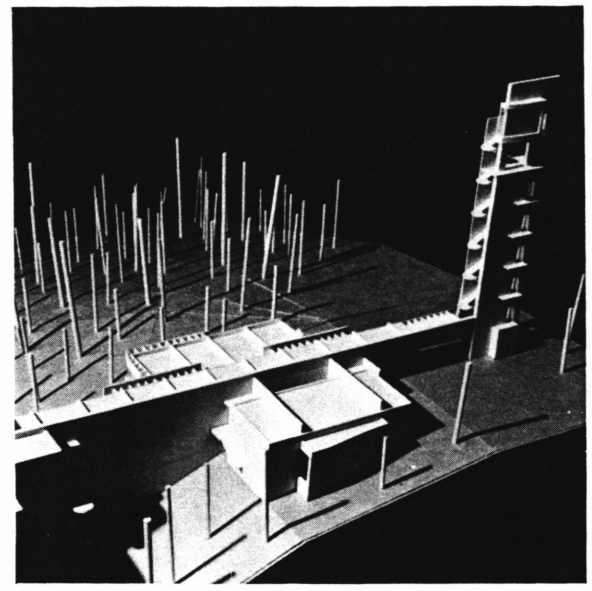
Entry from the outer portico guides one directly onto the main axis of the building. Controlled access to both the auditorium and the office spaces is provided by an information/reception area. Past this, a grand staircase leads down into the library, while the main corridor continues on to become the upper mezzanine level of the atrium.

The office lounge area provides a panoramic view to the southeast, and overlooks the library reading area. Glass baffles prevent unwanted sounds from reflecting down into the library.

The vertical circulation for the atrium is located in two cores, which hover at each end of the wintergarden space.

Access to the laboratory spaces is provided through doorways recessed into the thickness of the northern wall. The doors lead onto short bridges spanning a glassed-in support space which separates the lab cores vertically from the main spine. This interstitial space serves two functions: It provides a space for the building's ductwork and piping to run vertically, creating a metaphorical 'forest' of metal tubing, and, more importantly, it creates a layer of vertical space which the users must pass through in order to reach the labs, a constant reminder of the intrinsic nature of the mountainside they inhabit.





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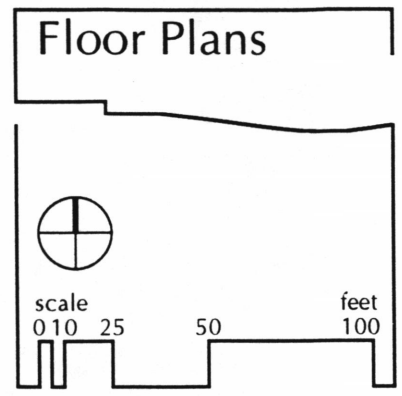
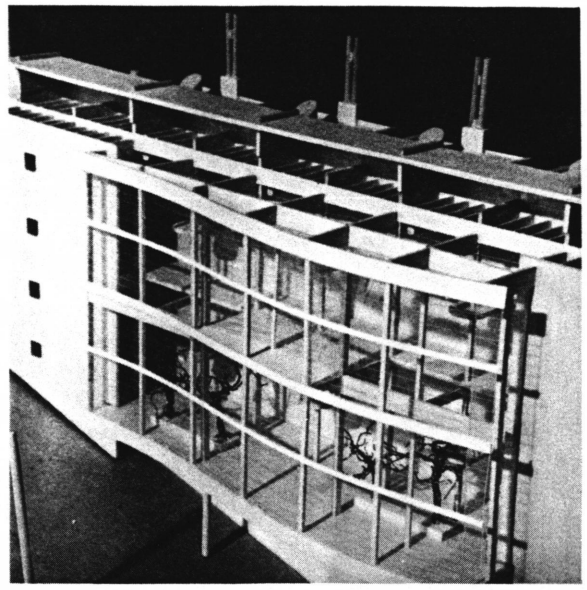
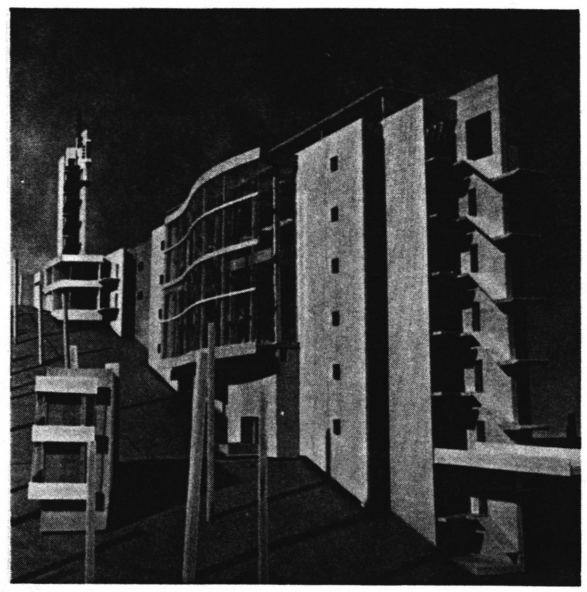
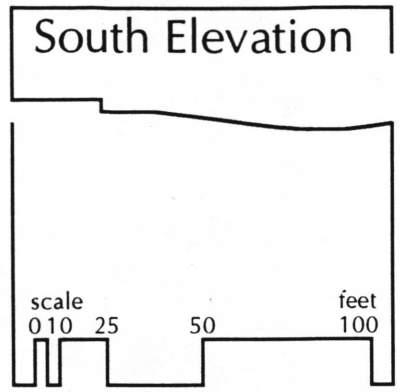


Key

1. Tower entry
2. Entry portico
3. Reception desk
4. Shipping/receiving dock
5. Auditorium
6. Administration area
7. Offices
8. Conference room
9. Office lounge area
10. Restrooms
11. Upper laboratory spaces
12. Atrium/wintergarden
13. Library entrance
14. Circulation desk
15. Maintenance/storage
16. Special collections
17. Audio/video collection
18. General bookstacks
19. Reading area
20. Lower laboratory spaces
21. Exterior balcony lounge
22. Tower observation deck
23. Climate data acquisition
24. Mechanical room
25. Housing level entry
26. Laundry room
27. Bridge to hillside gardens







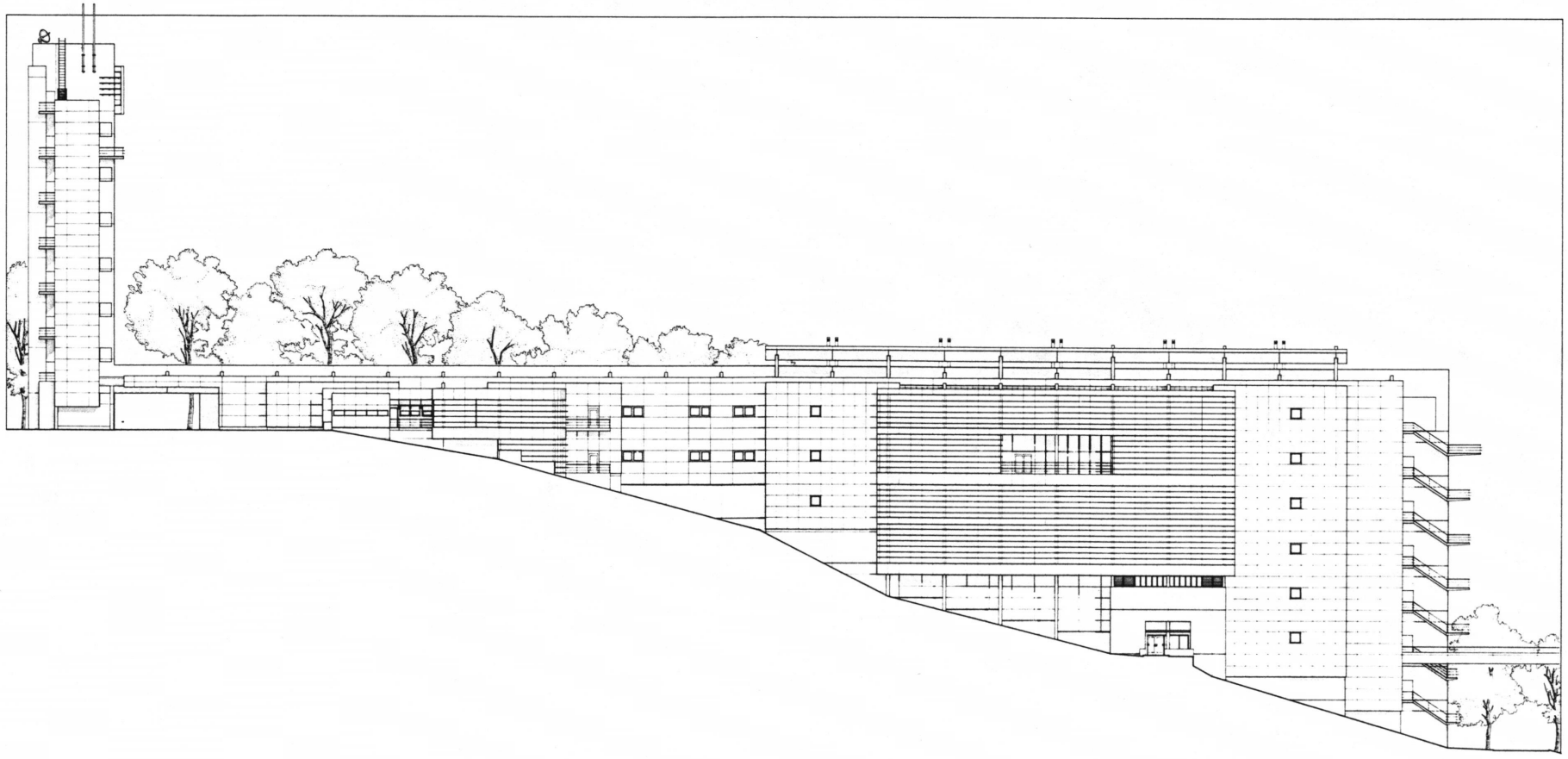
The southern face of the building holds the administrative spaces, the atrium/wintergarden space, and the housing units. These spaces take advantage of the view to south, which is of the experimental forest area and is completely unbuilt. They also receive the best southern light.

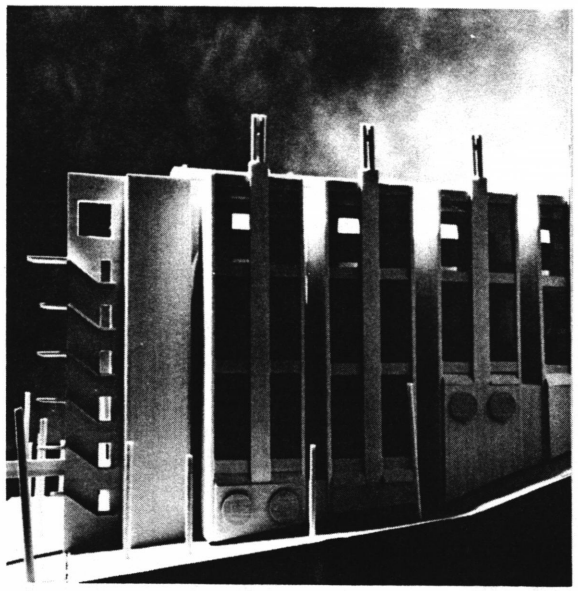
The southern side is clad in a curtain wall system of enameled, insulated metal panels. The wall panels move away from the main axis in a series of layers of phenomenal and literal transparency, becoming opaque or glass according to the activities within.

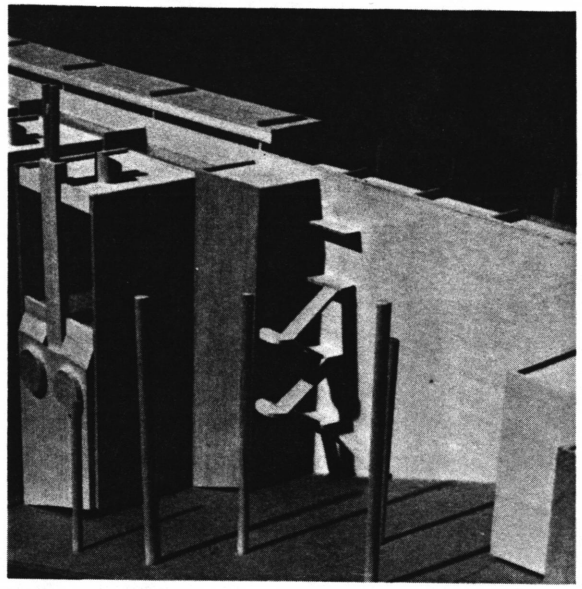
The office lounge and library reading room look down the slope into the Bent Creek valley. The large curved glass wall of the atrium signifies the public nature of that space, as do the walls of the office lounge and library and the auditorium.

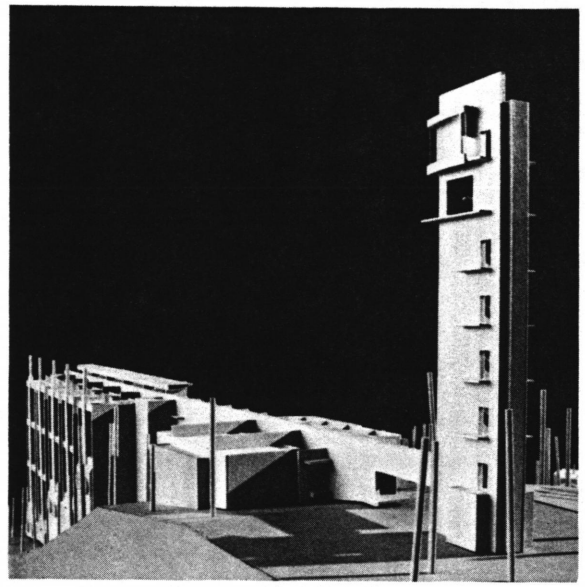
Though generous amounts of sunlight are needed for the trees and flora growing inside, extended flanges on the window mullions serve to control the excess amount of heat gain during the summer months, while also functioning as stiffeners for the glass panels.

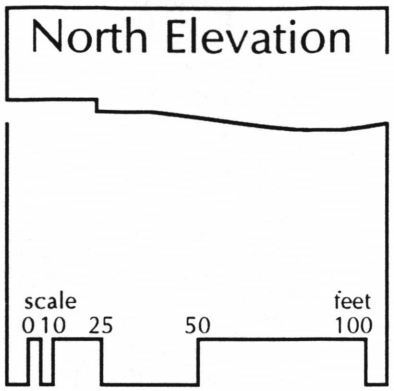
Below the atrium, the housing access entrance opens onto a curved pathway which leads to the individual housing units, and, eventually, the lower parking area and access road.









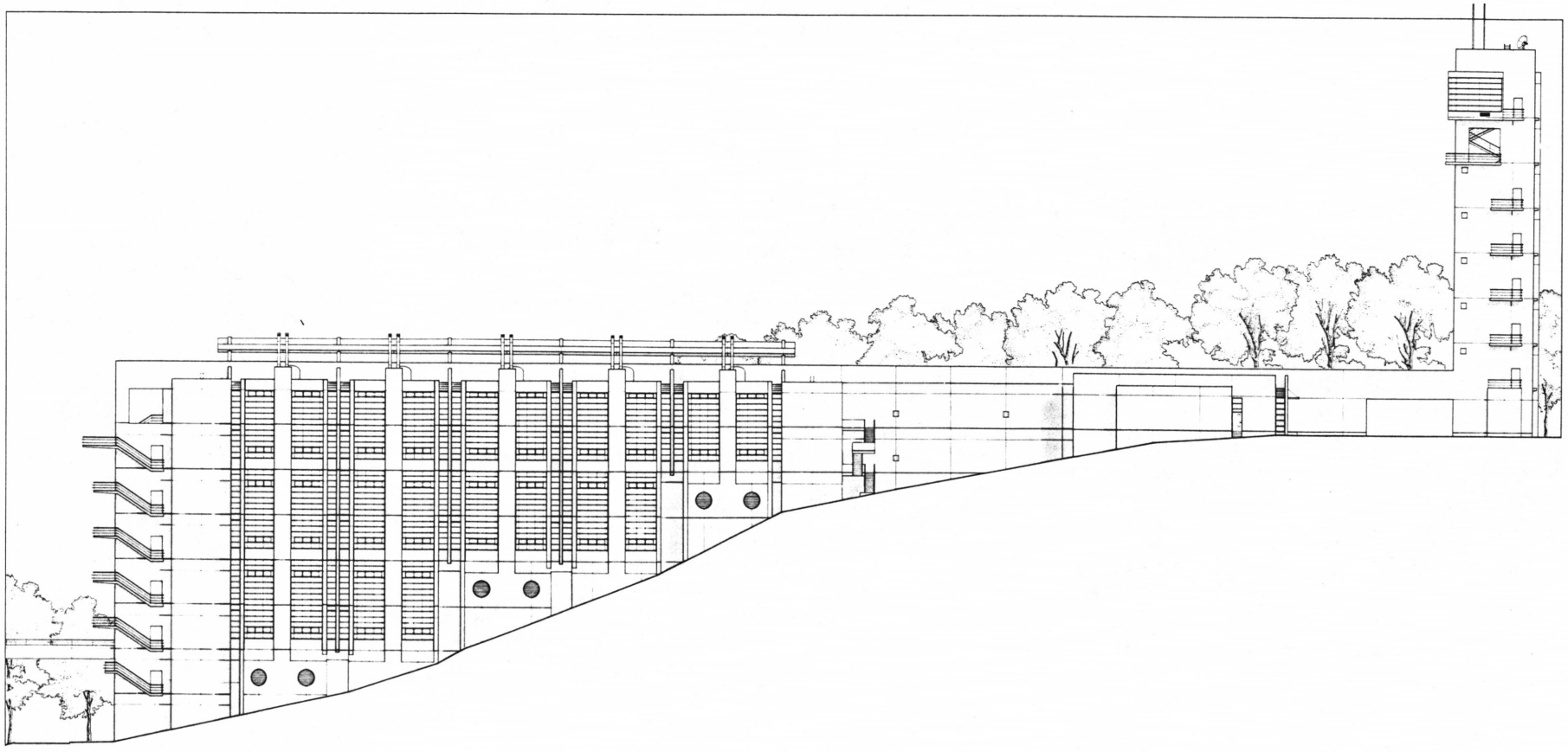


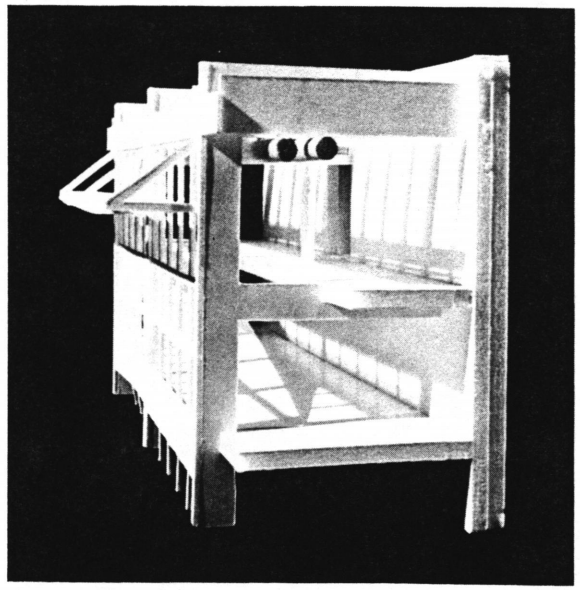
The northern side of the building holds the auditorium and laboratory spaces. This side of the building axis is constructed of reinforced concrete bearing walls. Passages through the spine are punched openings to allow views or passage through this most solid layer of the building.

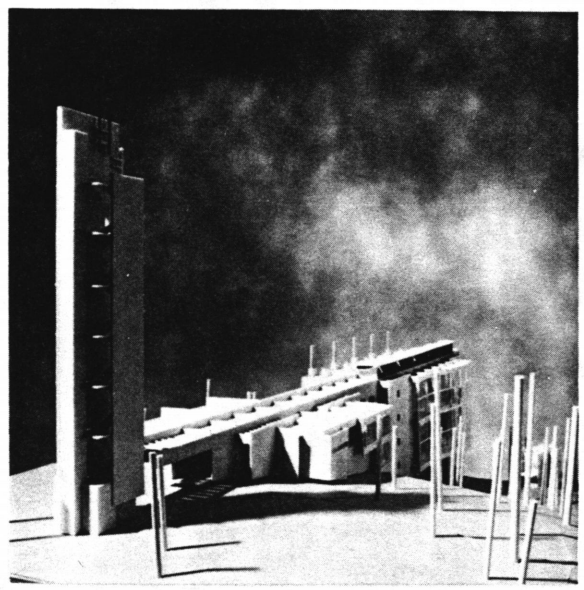
The auditorium space requires little in the way of natural lighting, although the curved wall indicating the public nature of the space holds a window which frames a view up the Bent Creek valley towards the French Broad River.

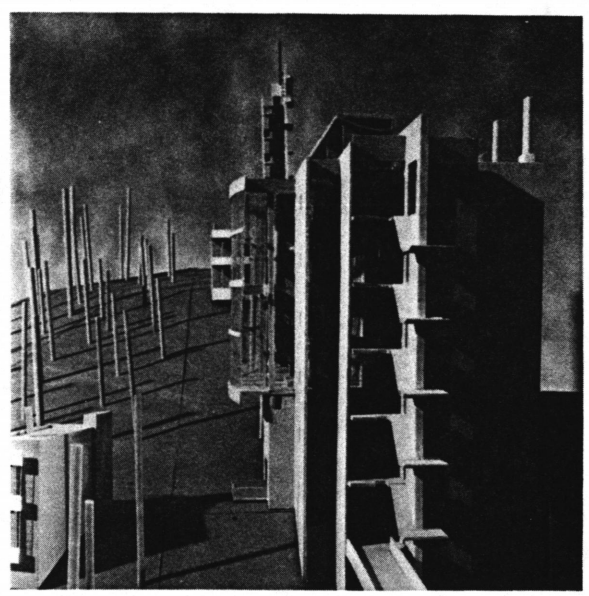
The laboratory spaces contain glass walls facing north. The windows are interrupted only by the concrete exhaust stacks for the chemical hoods in the laboratories. The view provided by these windows is that of the public area of the arboretum and visitor's center, and, likewise, public visitors to the arboretum who look across to the research center will see the lab spaces where the actual educational activity takes place.

These broad expanses of glass allow not only ample views, but also large amounts of ambient light without greatly increasing the heat load of the laboratory spaces.

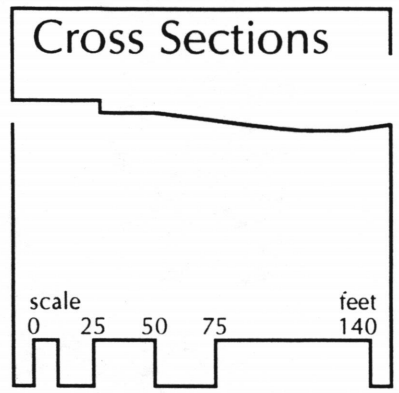






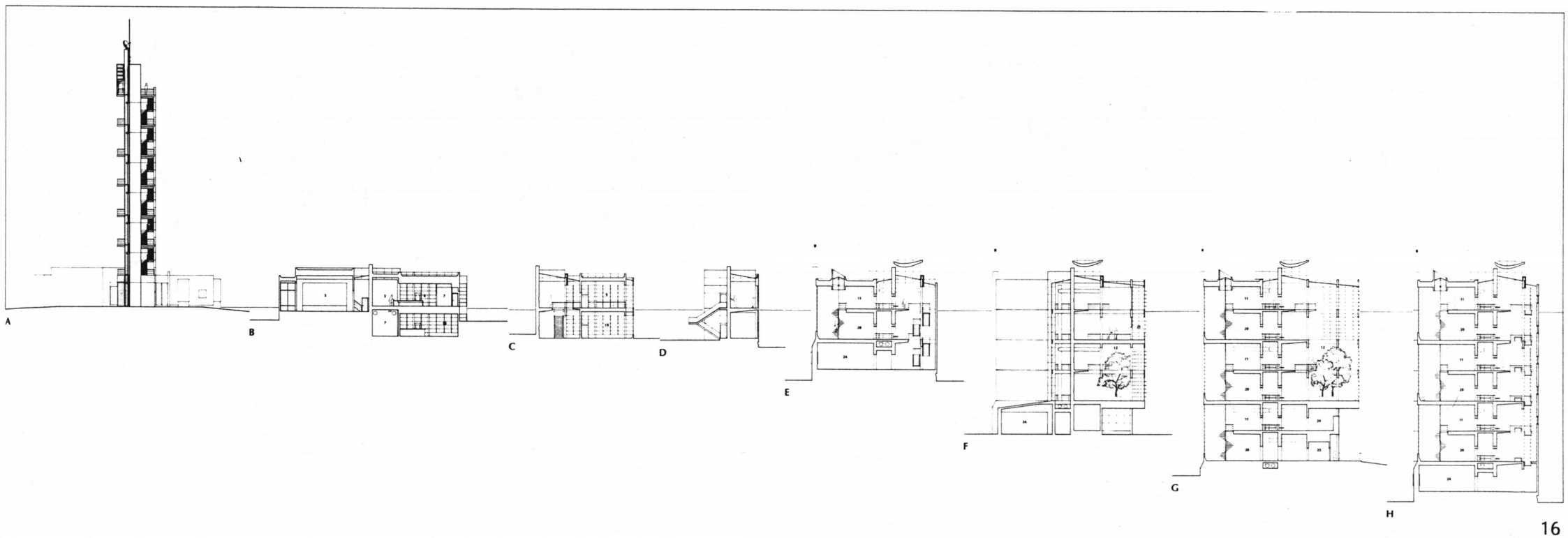


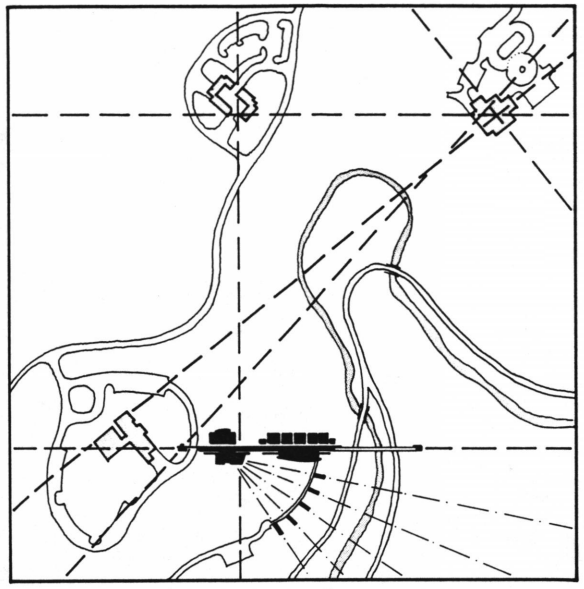
Cross Sections



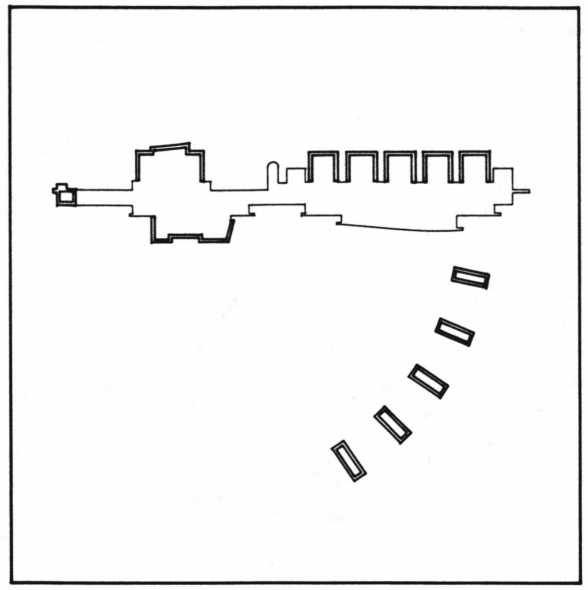
The cross-sections of the building show the progression of spaces downward from the entry level. The true mass of the building is not apparent from the initial approach, but reveals itself as one travels down the axis towards the central atrium/wintergarden.

The atrium unfolds as a series of layers moving away from the datum of the spine, creating a cascade of levels and spaces which reaches from the entry level to the floor of the wintergarden, four stories below. The transparency of the southern wall increases as the layers move away from the central corridor.

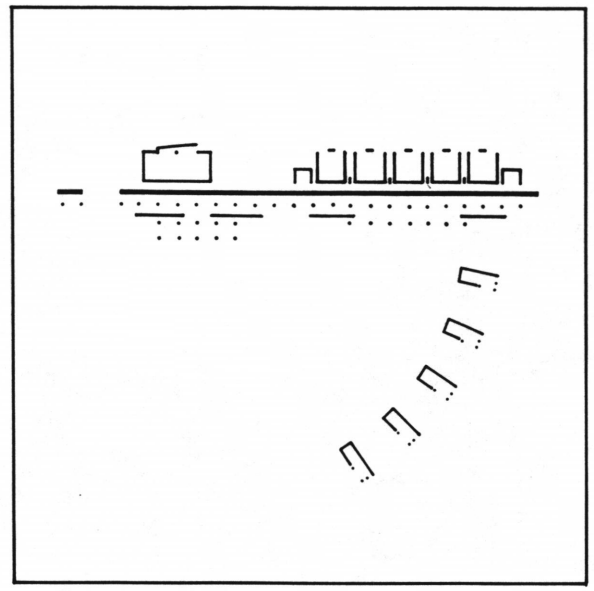




Site



Program



Structure

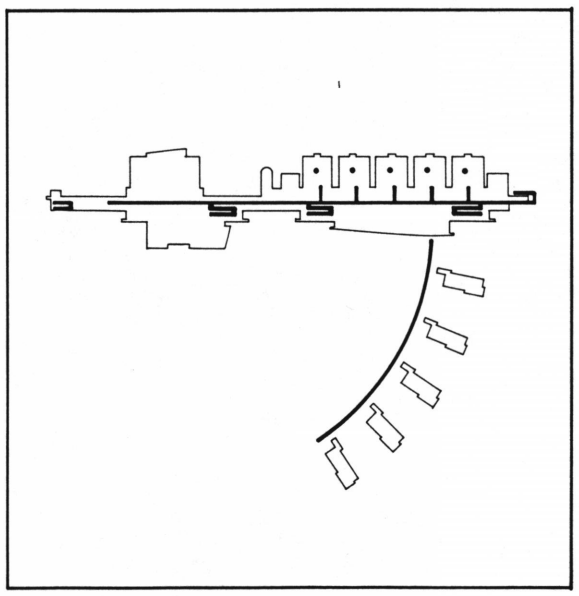
Analysis

The fundamental datum of the building is the spine, the organizational axis which extrudes horizontally from the peak of the mountain. All functions depend from this element, which serves not only as a circulation line, but as a filter between private and public, solid and transparent, and layers of structure.

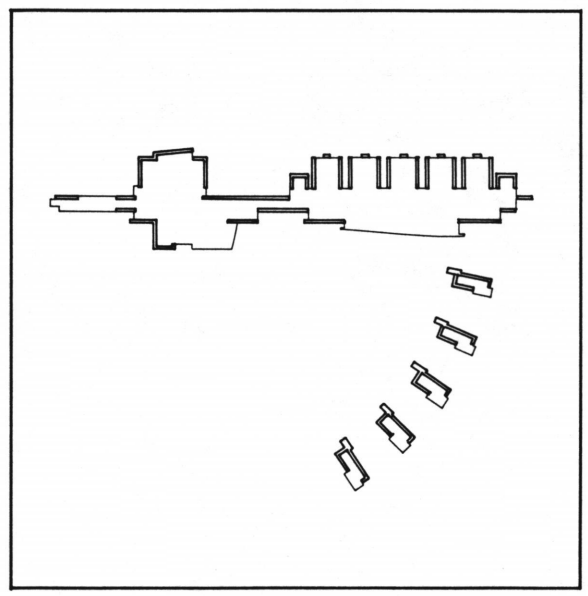
The individual elements of the program are distributed along the main axis according to their function, lighting, and access requirements. Administration and public common areas face the south for the sunlight and views. Laboratory spaces and the auditorium face north to take advantage of the manageability of ambient light. The housing units are placed in an arc around the southern face of the mountain, both for privacy and to enjoy the views to the south.

Circulation takes place almost exclusively along the main axis. Stairs and walkways are placed so that, no matter where one is headed within the building, one is always aware of the verticality of the site on which the facility is located.

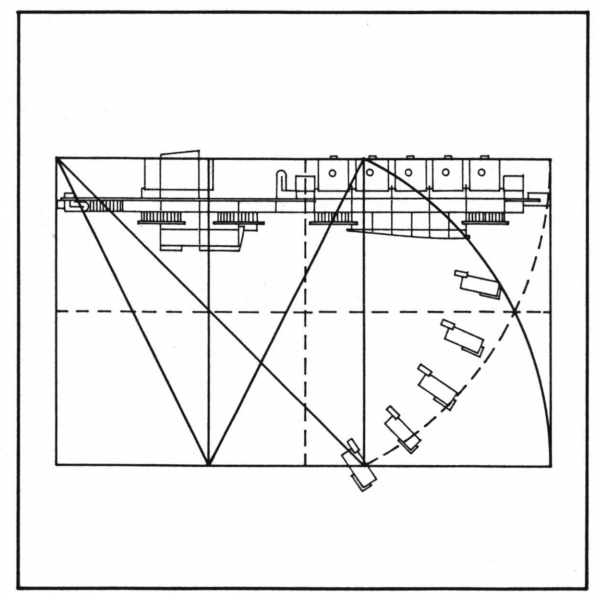
Circulation

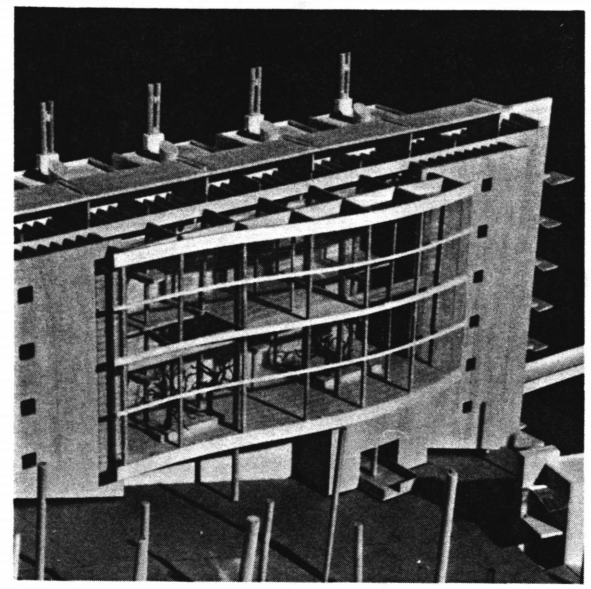


Enclosure

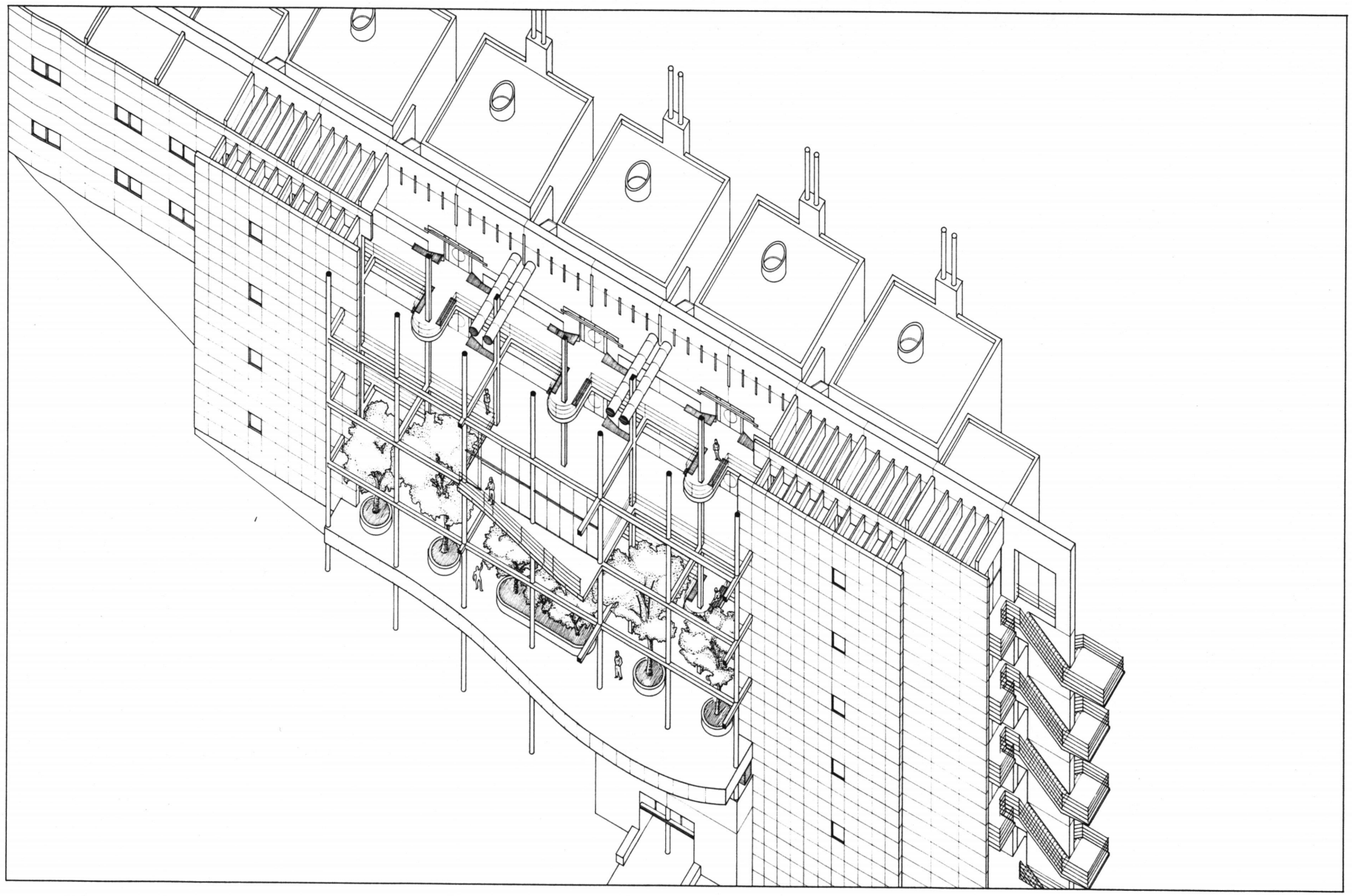


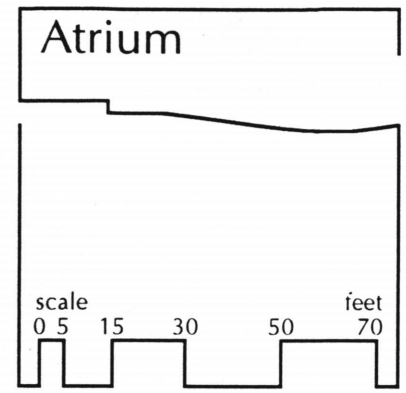
Geometry





Barcelona Art Museum, Meier, 1992.



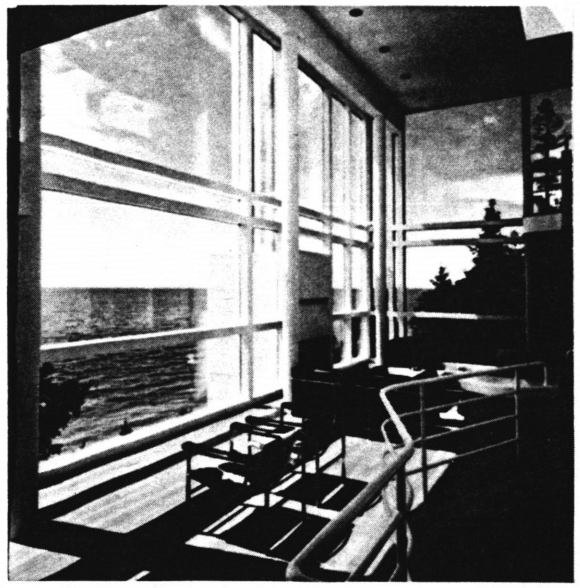


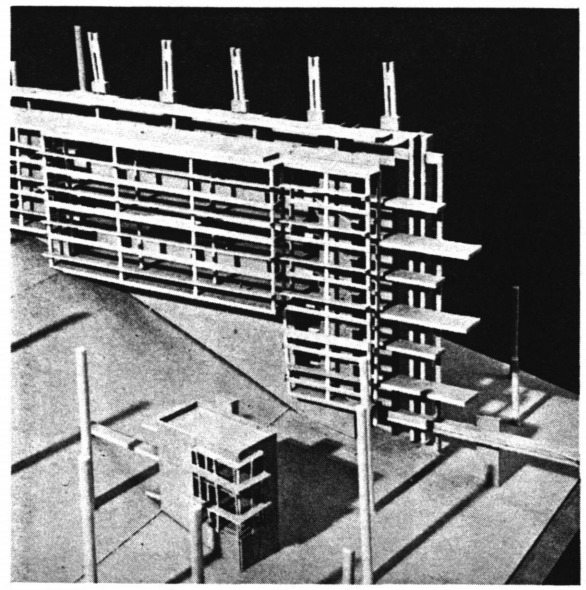
The atrium provides the most important spatial experience in the building. It functions as a central common area for student and faculty to gather between classes. It also serves as a wintergarden, supporting native North Carolinian plants and trees which are not acclimated to the cooler Appalachian climate.

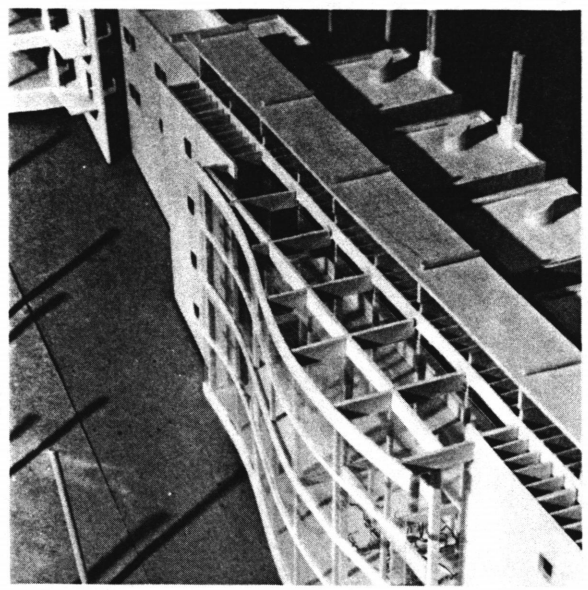
The atrium is enclosed within a sweeping curved skin of glass, symbolic of the public nature of the space. It represents the final step in a progression of layers and transparency from the reinforced concrete northern wall.

There is a cascade of floors from the entry level to the base of the atrium. The entry corridor becomes a mezzanine walkway with overlook seating. Below, a balcony extends from the second level of the building spine into the center of the four-story atrium space. The third level produces a second mezzanine walkway, while the fourth level is the floor of the atrium.

The second floor balcony reaches across the interior space of the atrium to pierce the glass skin, allowing the suspended floor to continue outside as an exterior balcony. This outside space overlooks the treetops, and is separated from the interior by large sliding glass doors which may be opened during clement weather, creating a continuous space from inside to outside.

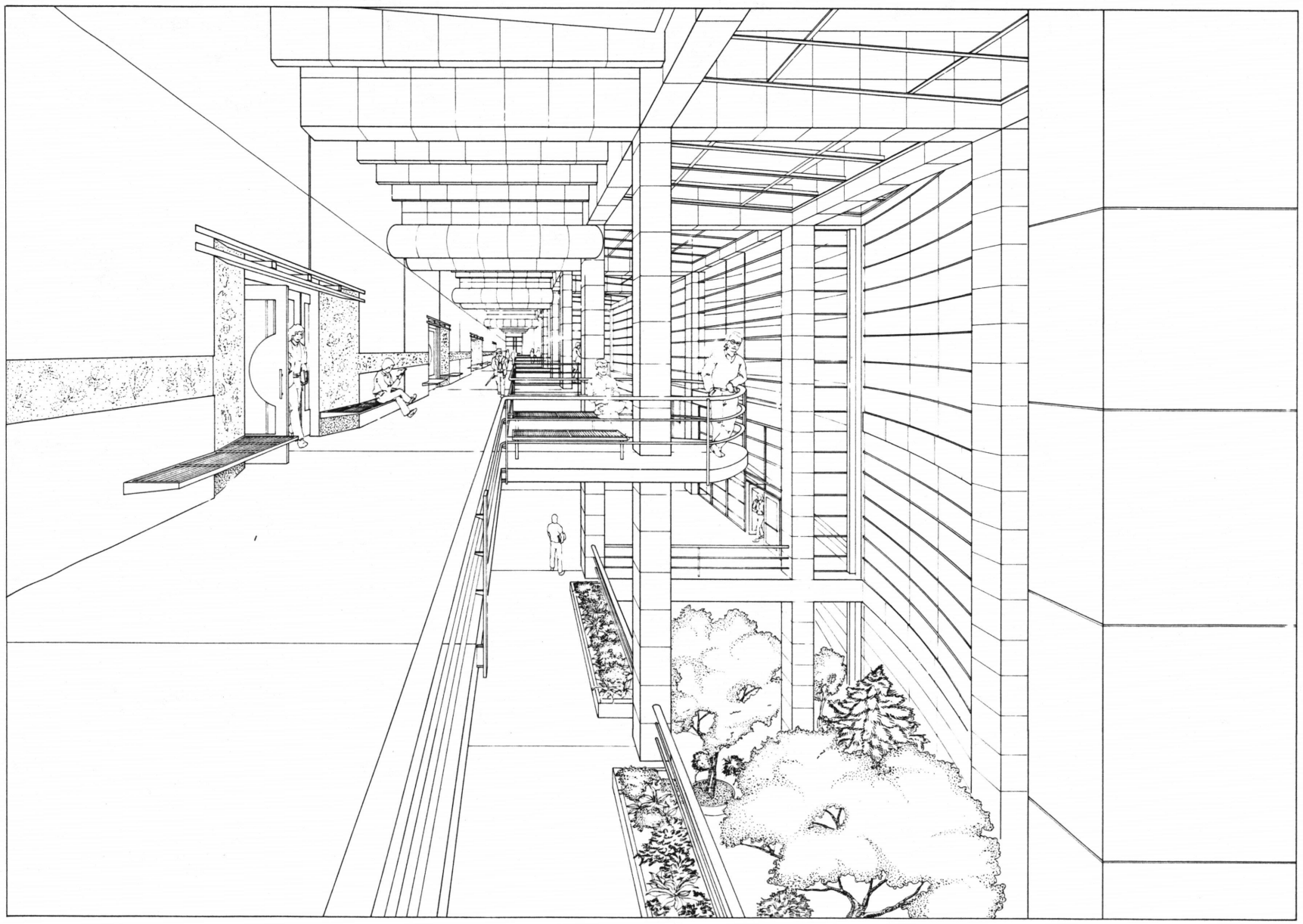






Douglas House, Meier, 1973.

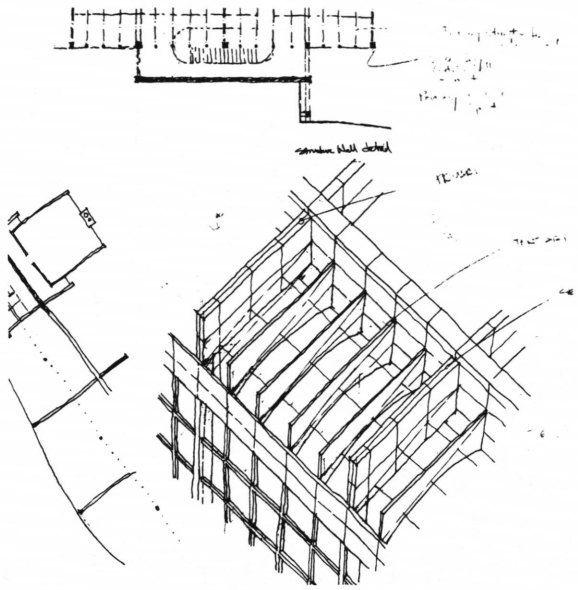
Atrium View

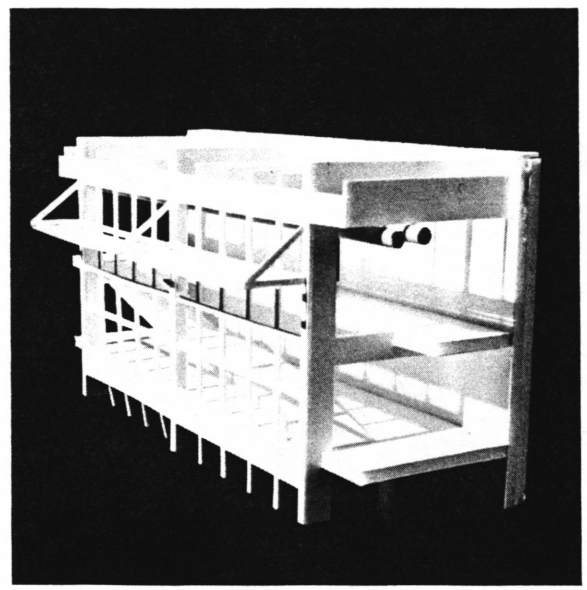


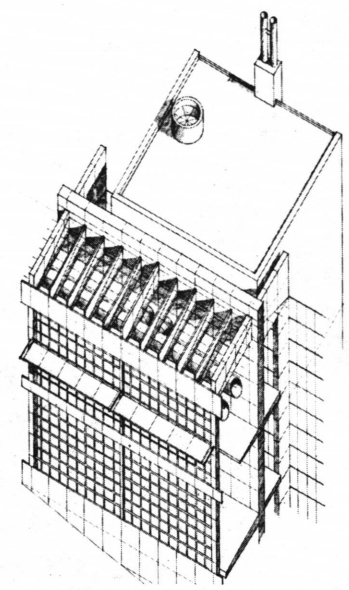
The entry level changes into a mezzanine as it reaches the atrium space, allowing access to the upper laboratory spaces to the north and views down into the wintergarden and outside to the south.

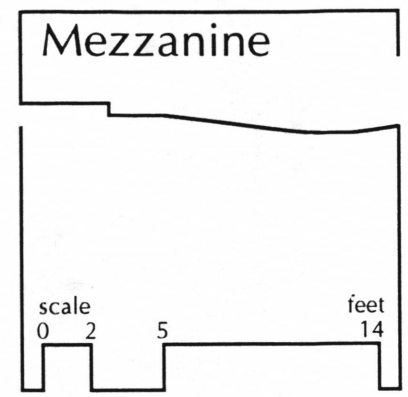
Running along the wall at shoulder height is a continuous reveal, where the smooth surface of has been stripped away to reveal the impressions of various native leaves and plants in the concrete. These 'fossil' bas-relief images continue for the length of the corridor, running into the laboratory entry recesses where they expand to cover the entire area 'cut away' by the door. This additional line of datum carries the viewer down the corridor from entry way to entry way, finally terminating in the exit at the end of the building spine.

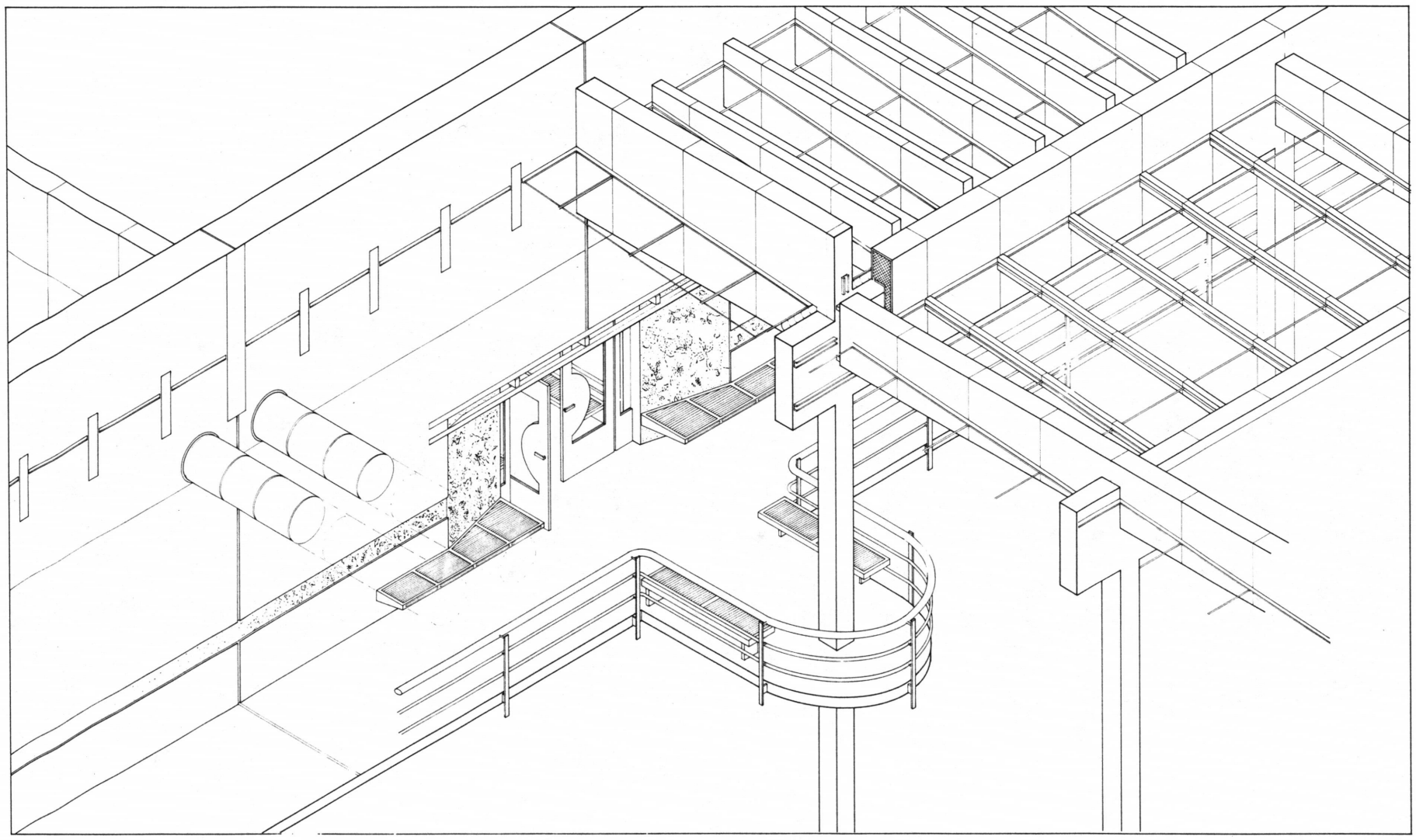
Ventilation in the atrium is provided by ducts which pierce the concrete wall, extending into the wintergarden from the interstitial space beyond.







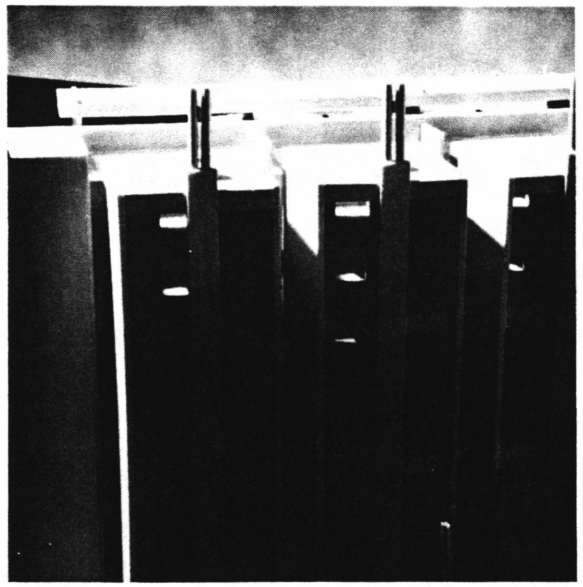


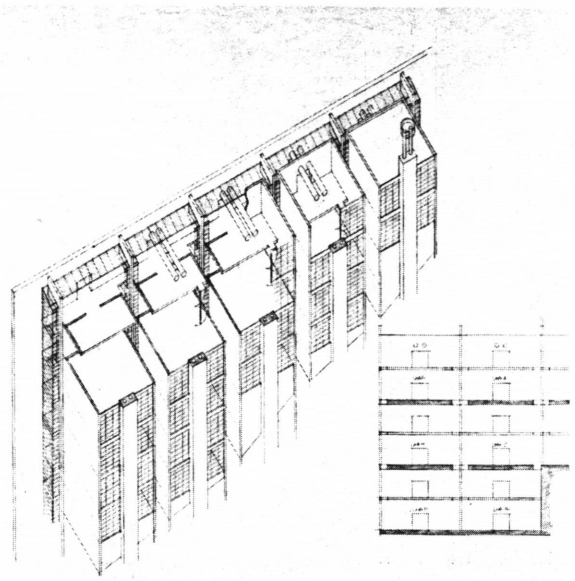


The laboratory entrances are recessed into the concrete of the northern wall. A steel lintel and benches extrude from the concrete, echoing the transformation from the concrete wall to the steel frame of the glass atrium wall.

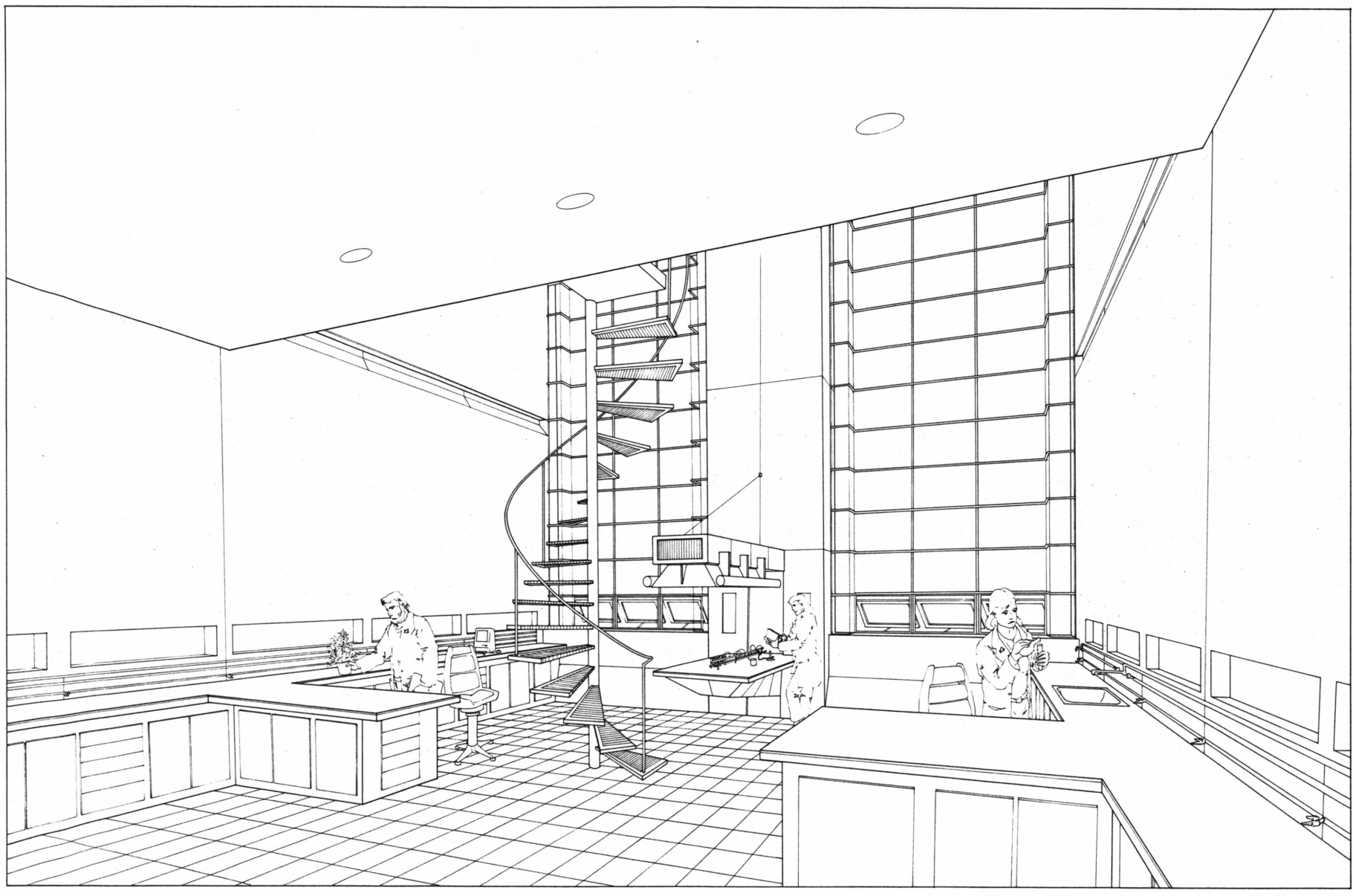
Directly across from each entry way is a section of overlook seating which extends into the atrium space. These overlooks wrap around the concrete frame , tying it to the concrete bearing wall. The overlook benches, as well as the benches extruded from the laboratory entrances, provide seating for students before class.

The layers of the building are visible as they move away from the generator, the reinforced concrete northern wall. From that wall, structural ribs extend across the corridor to engage a concrete frame. This frame becomes the southern wall of the main axis. From this concrete layer, a steel framework sheathed in insulated panels extends out to form the atrium. As the layers move away from the north wall, they become lighter structurally and more transparent.





Laboratories



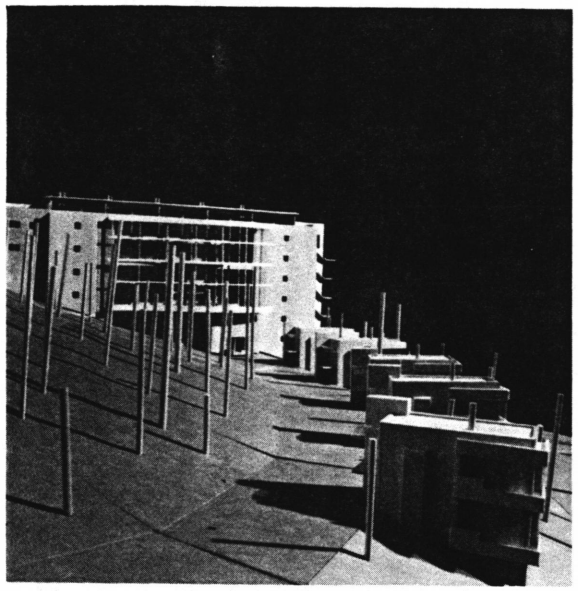
The multi-use lab spaces are purposely left as an open plan. In some cases the rooms will be used as research laboratories, in some cases as studio spaces, and in other cases as classrooms. The layout of each room can be changed with a minimum of remodeling.

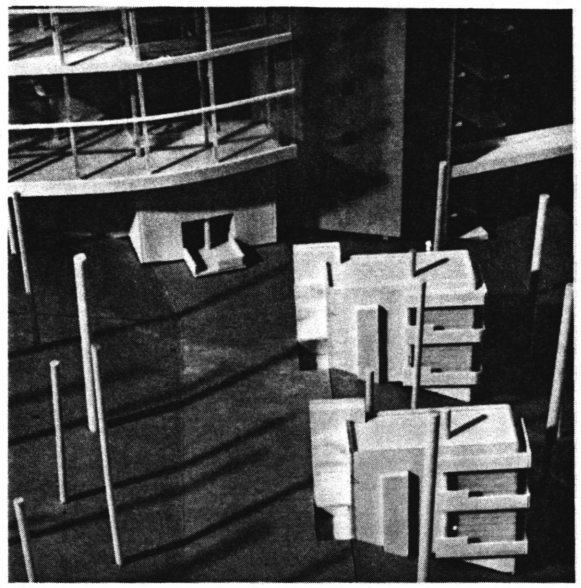
The view through the window wall to the north is bisected by an exhaust stack, which carries the gasses from experimental work out of the labs and vents them high above the building and forest floor. Ventilation is brought into the room through ducts from the interstitial space to the south, so the flow of air though the labs moves in a constant direction.

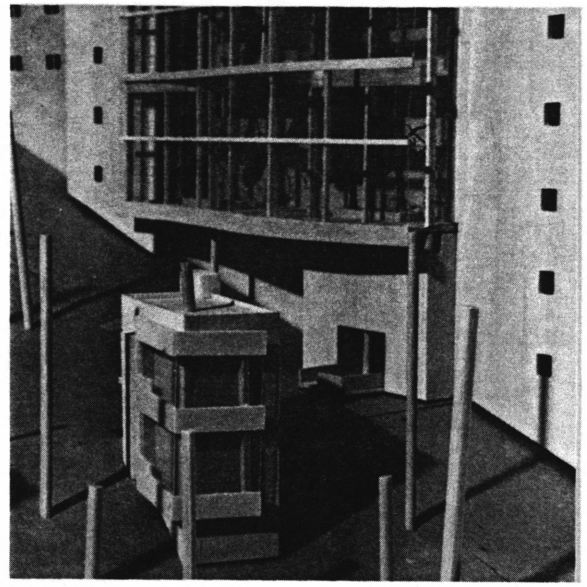
When exhaust hoods are required, they may be extended from the exhaust stack into the lab. They may be removed entirely when the use of the room does not require them.

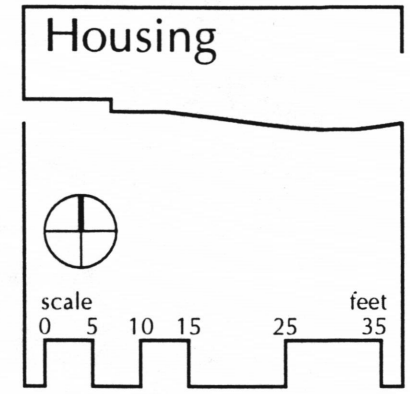
A spiral stairway serves as a direct connector between the upper and lower laboratory levels. The upper laboratory levels are half the size of the lower levels, and are intended to be used as classroom, studio, or media preparation spaces.

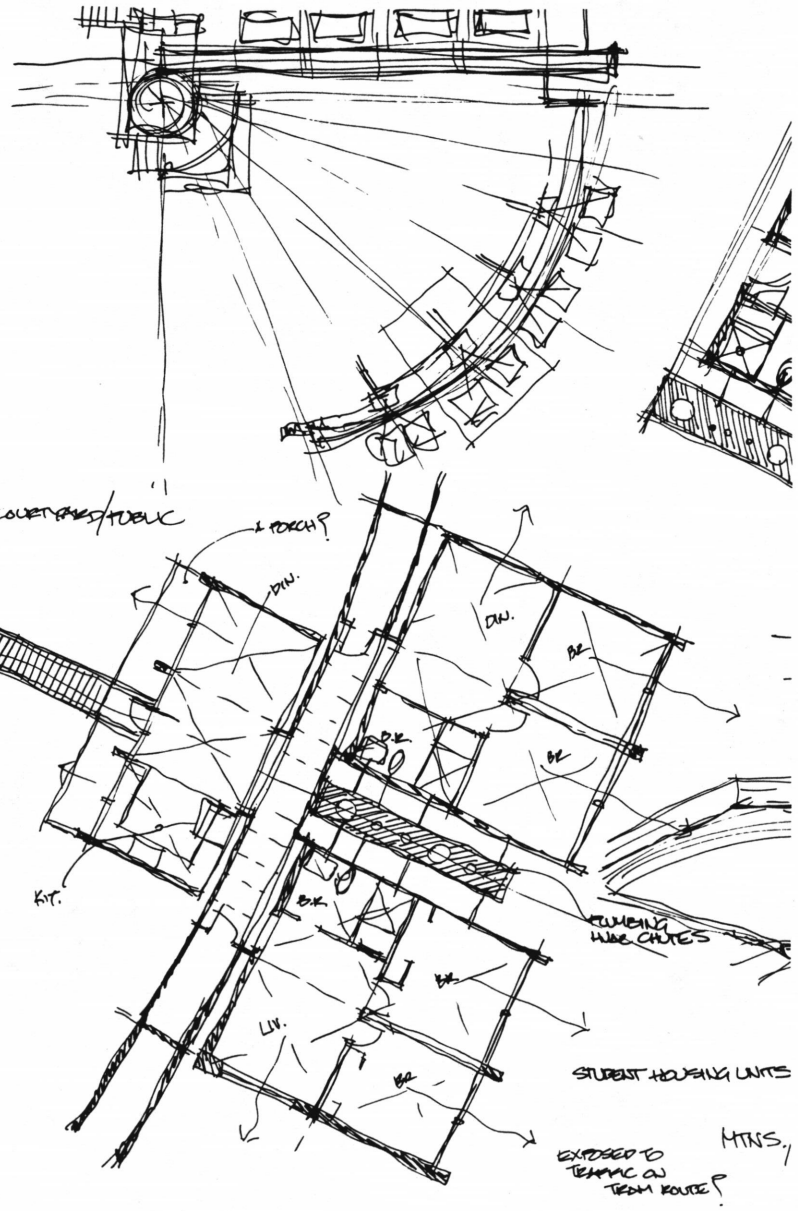
Shelves recessed into the concrete walls at regular intervals provide storage, as well as cove lighting set below eye level to illuminate the lab benches without glaring.

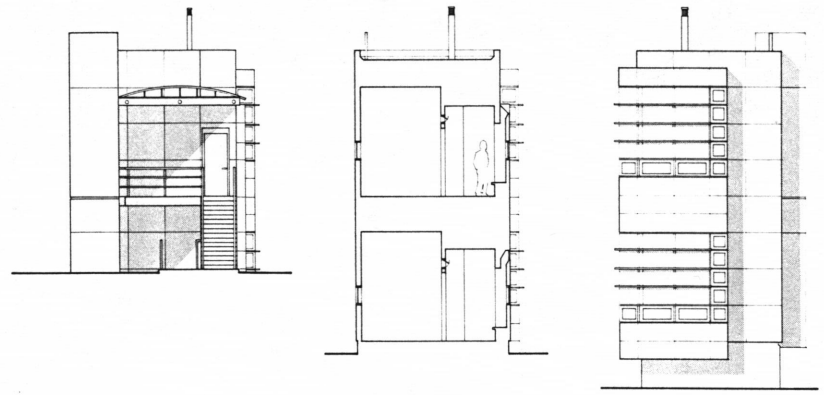


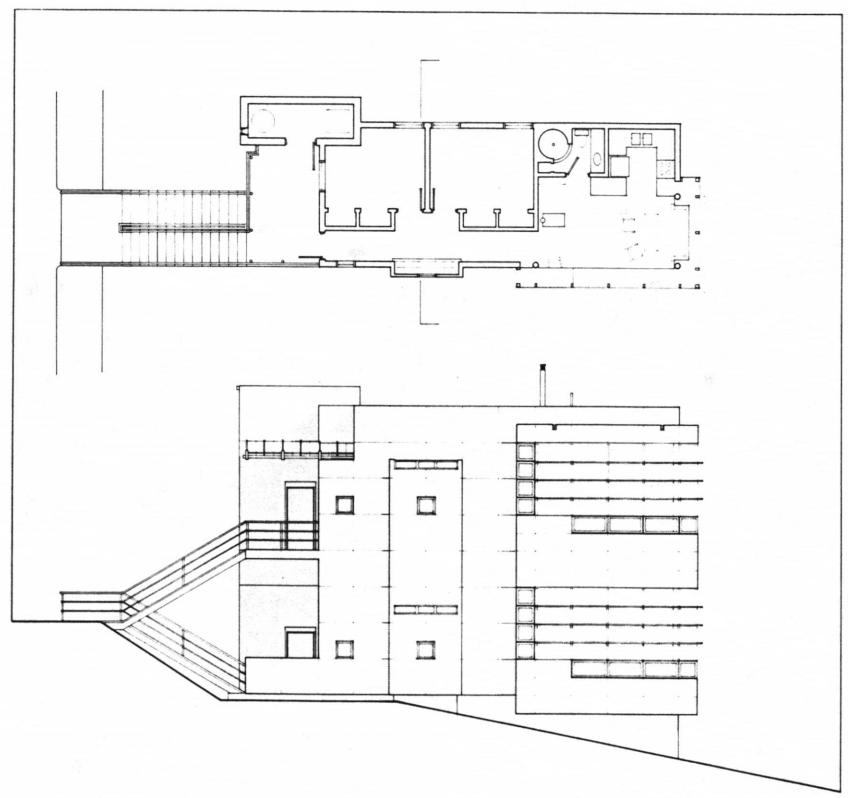










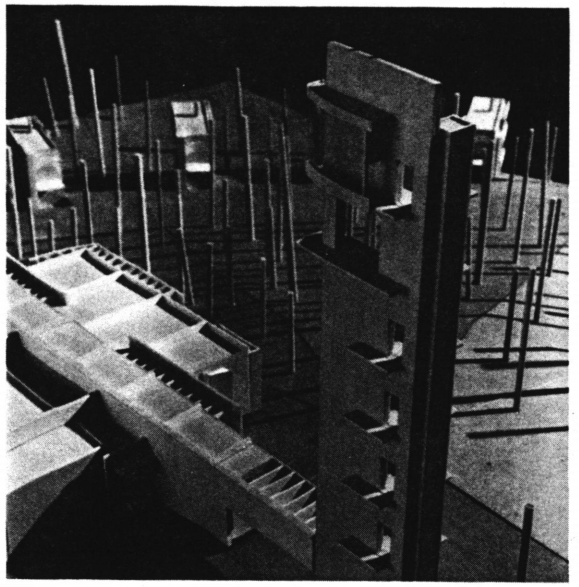


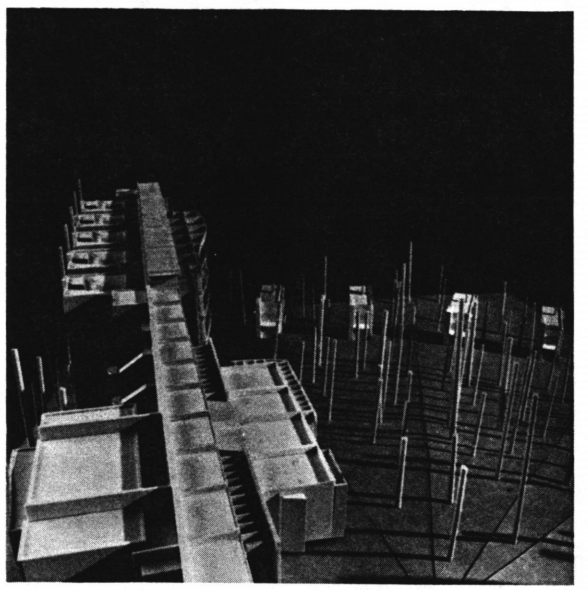
The housing units serve as accommodation for visiting lecturers and faculty, as well as graduate students or teaching assistants who will be at the facility for only a short period. The apartments rest in an arc which follows the curve of the mountainside to the south of the main spine. Though smaller than the main building, they retain the same presence as machined objects within their natural hillside setting.

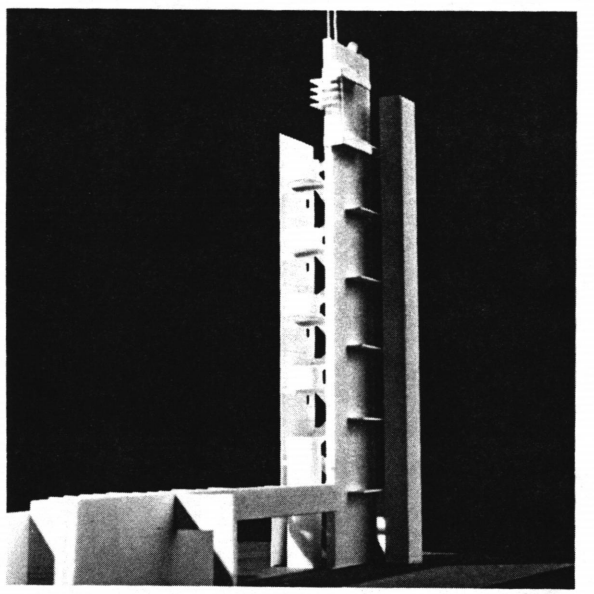
Access to the units is by either of two ways: An entrance at the sixth level of the main building, or a short path from the parking area and access road to the south. A split stairway leads from the pathway to either the upper or lower level of each unit. A concrete utility core adjacent to the entry patio of each unit houses the mechanical functions and provides storage.

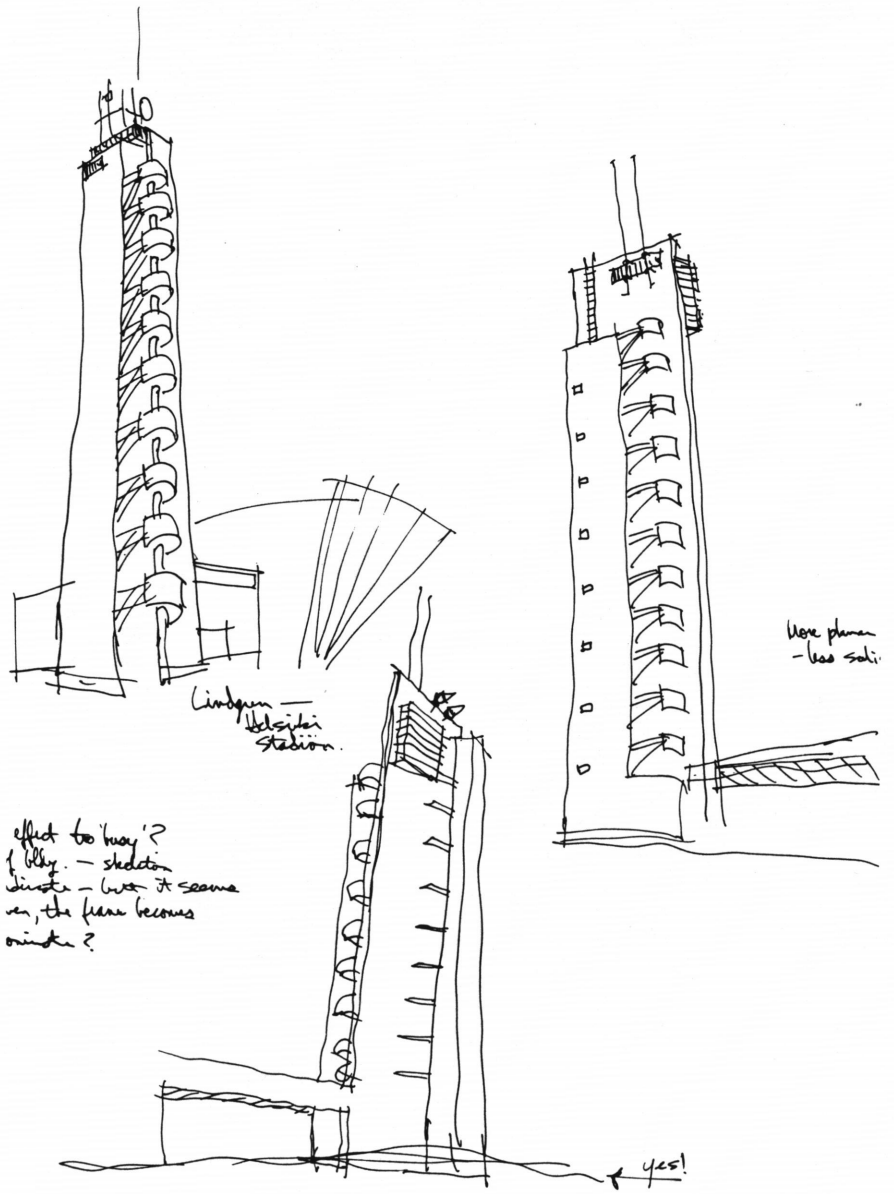
Inside, each units provides two bedroom spaces, a bath, kitchen, and a common area with built-in furnishings. Each unit may house from one to four persons, So that the maximum housing capacity is 40.

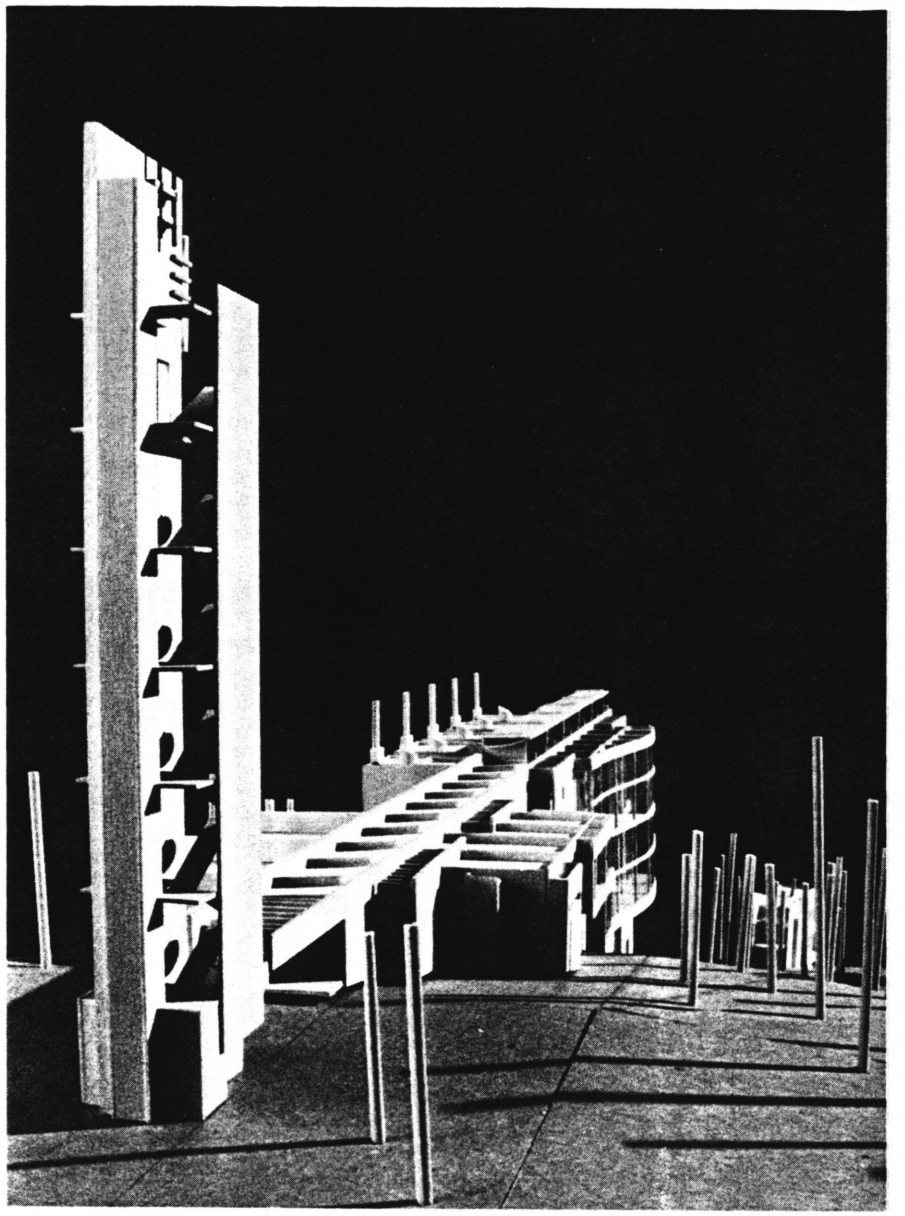
The housing units are built to the same construction module as the main building. Aside from the concrete utility core, their structure is steel frame with insulated panels on the exterior.











Tower

The observation tower serves several functions: Located at the peak of the mountain, it anchors the origin point of the building while taking advantage of the high view point. Its height, an extension of the natural peak, balances the opposite end of the building, a counterpoint which may be seen as an "anti-tower" extending below into the Bent Creek valley.

The tower serves in a vital symbolic role as the only point within the arboretum from where it is possible to view the whole facility. From everywhere else the arboretum is composed of parts dedicated to different functions, but from the tower it will be possible to take in the layout of the master plan. Only from the tower will the ridgelines and axes which compose the arboretum be visible.

A small room atop the tower houses instruments for recording local climatic data used in environmental monitoring.

The tower attempts to express the layered structure of the main building in a vertical dimension. The main body of the tower is formed from an upturned wall of reinforced concrete. Lateral support is provided by a concrete tube housing the elevator, and a steel frame system which also provides stiffness for the stairway. A curtain wall channels views from the stairway up or down.

Postscript

I would like to thank Susan Piedmont-Palladino for her exceptional help and guidance during this project, as well as Eric Jenkins and Greg Hunt.

Also thanks to my parents for their help and support, as well as Maria for her patience and understanding.

Typesetting for this book was laid out in Aldus PageMaker® 4.0. Layout graphics were designed in Aldus Freehand® 2.02. The font is Adobe Optima®.

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