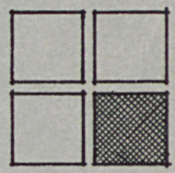
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Signature: Jean M. Vecimovich

Date: March 20, 1981

The Nature of Materials in Architecture

by

Jean M. Hecimovich

A thesis submitted in partial fulfillment
of the requirements for the degree

of

BACHELOR OF ARCHITECTURE

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This book is dedicated to my parents. . .

Preface

I will always remember the old gymnasium in my hometown, especially when I pass the site where it once stood and see what is there now in its place. It had always seemed to fit among the other school buildings, being of comparable scale and materials. It was a massive structure, entirely sheathed in a beige stucco, the same material that banded the parapets of the surrounding brick structures. Sadly though, it burned as older buildings sometimes do, and was replaced with a structure that didn't "feel" quite right there, its presence was disturbing. Now there stands a shiny, olive green, metal sided building with fake (imitation) rock at its foundation. What was so offensive to me about the new structure was not its purpose, we needed a new gymnasium, but rather the insensitive and inappropriate selection of materials, and the lack of consideration for the surrounding environment. The use of materials in particular applications, whether appropriate or not, to people within an area is exhibited in many structures and is always something I have questioned.

That first observation, surrounding the use of materials in that gymnasium was a step forward, to this thesis. It is through this endeavor that I hope to more clearly understand the use of materials within a place, and how their use responds to the surrounding contextual fabric. Within a specific environment, they also come to convey meanings and ideas to the people of a place, in response to that vernacular. It is how materials, as a system of symbols, may be used within environmental and contextual (context defining that also known as place) parameters to convey meaning within architecture that is the intent of this thesis.

Thesis, I have come to feel is a means of exploration, a time to question. It is a means to challenge, a process of looking, asking and testing myself throughout. Perhaps it will provide me with a new awareness and a way to look in yet further and new directions. It also is a means to look at myself, and to the ideas I have formulated through the years. Now is a time to consider why I feel the way I do about specific issues. By no means is this the culmination of my education, but rather a platform from which to start.

This book is my attempt to document my thesis process, to acknowledge those thoughts and ideas I have sought to understand. It is a process of exploration throughout, from the approach of an idea to its application in the built form.

There are many who have supported my efforts, without them my thesis would not have been as meaningful as it has. Thanks go to the staff and faculty of Montana State University's School of Architecture for their assistance now and through the past years. Also, to my family and friends, who may not have understood my hours, but always supported my efforts.

Special thanks to go my committee for their invaluable patience, guidance and efforts:

David Matthews, Advisor, Assistant Professor, M.S.U. School of Architecture.

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Dr. Leslie B. Davis, Professor, M.S.U. Anthropology, Curator, Museum of the Rockies.

Also, I would like to thank Elmira Smyrl, Professor, M.S.U. School of Architecture for directions through portions of my thesis.

And last, a special thank you to one who has been especially close -- Jerry Anderson, because he was there when I needed to be understood.

Thesis Statement

The design of space demands an understanding of materials and how, through their applications within specific contextual parameters, they come to convey design ideas.

Thesis Project

A center for archaeological research for the Northwestern Plains and Rocky Mountain Region, located in Bozeman, Montana.

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Introduction

Architecture is normally conceived (designed) and realized (built) in response to an existing set of conditions. These conditions may be purely functional in nature, or they may reflect, in varying degrees, social, economic, political, even whimsical or symbolic intentions.[1] Whatever the impetus, the response should by some means acknowledge and react to those existing conditions of a place. These variables provide a framework from which to begin, and will be known throught this book as the contextual arrangement; "the interrelated conditions in which something exists or occurs -- environment."[2] The contextual arrangement involves a variety of forces that describe and define a particular place, the vernacular. Once these attitudes, expressions, and culturally based norms, which distinguish one area from another are realized, an architectural response may be better approached. The architectural response may become both useful and meaningful within an area when the contextual identity of a place is sought to be understood.

In order that architecture (buildings) may be both useful and meaningful to people, the place of which they are a part needs to be understood by those who wish for architecture to do more than to simply meet functional and programmatic needs. This understanding includes an appreciation for those attitudes, expressions, and culturally based norms that contribute to the identity of a place. Those buildings which are useful and meaningful to people within an area do respond in some fashion to such things, the vernacular. They do come to communicate meanings, elicit responses, and promote activities. This implies that there needs to be a concensus, an agreement among a social group (those specific to the contextual situation or place addressed) that something, here architecture, possesses a meaning for them because it evokes response. This is applicable to all structures within the built environment, but is exemplified most in those buildings that do more for people than to simply meet their needs. At the point where architecture evokes response reinforces or contrasts to the structure of a place (context), it may become meaningful to both the social groups of the place and those

outsiders who view it as part of a contextual whole. It may also be considered symbolic if shapes, textures, scale, (to name a few) recall and evoke images while currently establishing a new form within such a place. Therefore, it is those forces which facilitate design ideas, and contribute to the existence of meaningful forms within an environment that need to be explored. They establish meanings over time through repetition and sameness (symbols) and contribute to the vernacular -- that which we identify as "place".

This thesis undertakes to study those conditions within a specific contextual arrangement, or place, that are contributing forces in the establishment of its vernacular. Those "things" when used in the context of a place evoke response, i.e., become meaningful and symbolic. In particular, the nature of materials will be explored as materials are the means by which we construct the built environment. Here too they will be examined as a system of symbols that when used within a specific place, come to elicit responses and communicate meanings in response to contextually based forces. Materials though, are best treated as modifying factors, rather than as form determinants because they decide neither what is to be built nor its form, but how. By looking to a specific place there may be gained an understanding for the ways materials have been used, and the meanings and ideas conveyed through their applications.

The implications here suggest that the presence of certain materials with their physical and symbolic properties (though it is difficult to distinguish between the two in the built form) may be highly significant for social groups within their societies. Often such associations provide a culture with a "vocabulary of contrasts which, while seemingly irrelevant to an outsider, project conventionally important contrasts of meaning to the society itself."[3] Very simply, within a particular contextual arrangement materials come to possess common modes of usage which often elicit meaningful responses from those within such a culture. That is not to say that materials have only specific uses particular to an area, but that those ways of usage that are consistent over time (repetition suggesting sameness suggesting consistency in ideas) do become meaningful, or symbolic. It must be emphasized however that materials are merely but one of many systems of the built environment particular to an area which may become symbolic as a result of contextual forces. Within a contextual arrangement materials take on a social character --

an agreement implicit between people as a whole that each (material) should have a particular meaning(s), and also that (materials) should be used in certain ways.[4] This idea applies to any place one wishes to study.

The intention of this thesis is to observe the use of materials within a specified context in order to understand how through their use, materials may have become meaningful, why they have been used, and what have been the ideas suggested through their application. In other words, how are they finally symbolic within a particular place. For this to be understood we need to recall the physical and symbolic nature of materials.

The selection and use of a material, within any contextual arrangement, is dependent upon its dual nature, physical and symbolic, which is defined by a number of characteristics. It is the varying degree of association between characteristics that gives rise to the nature of a material and serves as a comparative between materials. The characteristics define the physical nature, or properties, of a material. In their application or construction, as a result of their physical properties, a symbolic aspect may result. This is dependent however upon the response of a social group(s) to a material's use within a particular context. The following paragraphs serve to illustrate these properties -- the dual nature of materials.

The Physical Nature:

The physical nature of materials involves those inherent properties which physically distinguish one material from another. Physical qualities result and they are dependent upon varying characteristics that give a description, a delineation, or a detailed account of the qualities of a material. The degree of variability between characteristics is critical to the descriptive nature of materials because these factors distinguish one material from another.

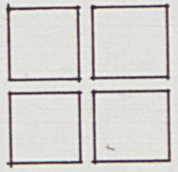
The Symbolic Nature:

The symbolic nature of materials involves those properties which symbolically distinguish one material from another. These properties function as culturally and contextually meaningful phenomeon within a contextual arrangement and result from the responses to the application of a material by a group particular to the context addressed. These

responses, although dependent on the total context, are also highly dependent upon the underlying characteristics that contribute to the physical existence of materials.

From these premises this thesis will begin and will further explore the dual nature of materials in an attempt to understand how materials are used, and why, within a specific contextual arrangement. This also includes examination of the acquisition of meanings in the use of materials, as a system of symbols, within a place, and the contextual forces that contribute to the existence of such meanings. In total, the goal of this thesis is to promote an awareness for the use of materials within a contextual arrangement, and to come to an understanding for the symbolic aspects they have acquired through their use. It is these symbolics, or meanings that are important to the outcome, or design, of this thesis because those ideas will be used as a design tool, an aid, to convey intent and ideas within this same context within the built environment.

MATERIALS: THE PHYSICAL NATURE



The selection and use of materials, the choice of, within any contextual arrangement, is dependent upon a number of factors, one of which is a material's physical properties. The nature of materials involves those inherent properties that physically distinguish one material from another. As a base for comparison this includes a variety of characteristics which evoke responses from all of our five senses. Taken together our sensory responses, which include the visual, tactile, audible, oral and the aromatic, distinguish between characteristics and come to define different materials. It is the varying degree of association between these characteristics that serves to promote the physical properties of a material. Though it is through the five senses which we experience the use of materials, architecturally we primarily employ visual forces, imagery if you will, to convey meanings and intent. The description of materials here explores their visual properties while keeping in mind the other sensory properties which define materials. The following paragraphs serve to illustrate these properties, which are inherent to all materials, and how through their variability result in specific materials.

Shape:

the principal identifying characteristic of a material, shape results from the specific configuration of a material's surfaces and edges.[5]

Size:

the real dimensions of a material, its length, width and depth; while these dimensions determine the proportions of a material, its scale is determined by its size relative to other forms in its context.[6]

Color:

the hue, intensity, and tonal value of a material's surface; color is the attribute that most clearly distinguishes a material from its environment. It also affects the visual weight of a form.[7]

Texture:

the surface characteristics of a material; texture affects both the tactile and light-reflective qualities of a material's surfaces.[8]

Taken together these characteristics give rise to the visual, physical nature of materials. They allow us to distinguish and differentiate between one material and another. Two other visual characteristics however should be mentioned in the examination of the physical nature of materials. They define the relationship of materials to that which is constructed, and these are position and orientation.

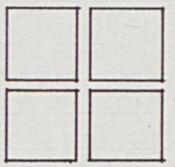
Position:

a material's location relative to its environment or visual field.[9]

Orientation:

a material's position relative to the ground plane, the compass points, or to the person viewing the material.[10]

MATERIALS: PREVAILING CONDITIONS



Prevailing conditions are those variables common to all contextual arrangements which define the working parameters within a particular environment. These conditions must be considered within any context because they effect all aspects of an environment, and more specifically the built environment. Taken together, due to their varying degrees of association, they give rise to the uniqueness of an area. It is this varying degree of association between these variables that describes the characteristics of an area, and does affect the ways in which materials come to be used within it. Decisions concerning the use of particular materials in certain applications are often based on these contextual conditions. When decisions are made that spawn a consistent use of a material, for contextual reasons, meanings may come to be conveyed as a result of a consistent application. The following paragraphs serve to illustrate these conditions and how, through their variability, they define a contextual arrangement that affects the selection and use of material within those parameters. They determine the choices that we make concerning materials in particular applications.

Climatic Conditions

Climatic conditions accounts for the weather associated with a particular contextual arrangement. Specifically, when addressing the use of materials in an area, the concern lies in the effects that weather will have on materials in particular applications. These forces work in many ways, from attributes that appear over time in a material due to the forces of weather, to the destruction of a material as a result of exposure to the elements. The weatherability of materials within a specific context come to influence the types of materials that are used, and the degree of success of each in a particular application. A main concern however of contextual climatic conditions in relationship to material use is to come to an understanding for their use dependent upon the contextual forces of weather, and look to any design ideas that have been conveyed as a result of their use.

Availability of Materials

The availability of materials within a particular contextual arrangement is a deciding factor when considering what can be employed for construction purposes. Materials that are either indigenous, or readily available to an area, generally come to have a high degree of use. If economically feasible, and if there exists an expedient method of shipment, a material may be imported into an area for use. Due to a vast distribution system within the United States, a material not local to an area may be found in use. Therefore if a material is easily acquired or imported, it generally will come to be used as a part of the building vocabulary of an area.

Economics

The economic considerations surrounding the issues of the use of materials within an area primarily addresses the aspects of costs involved in the purchase of materials for construction purposes. Costs for materials, which is considered part of total construction costs, is a factor upon which the use of certain materials in an area may be conditioned. When a material is not affordable, it is unlikely that it will become a part of the building vocabulary of an area. Generally this results when a material must be supplied from an outside source and the expenses of shipping prove to be too high, or possibly the cost of the material itself is not affordable, which also discourages its use. Thus economy of materials is dependent upon their availability in relationship to their affordability.

Economics also suggests aspects of prevention of waste, and the improper and unnecessary use of materials from occurring. The concern here lies in the idea that every material be wisely used for whatever its application.

Technology

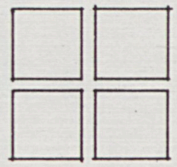
Technology specifically addresses the labor force of an area and the abilities, talents, and craftsmanship in construction. How this

group works with materials, employing various construction methods and techniques, contributes to the success of a material's application. Generally, the construction and trade industries of an area will experience a variation in the skills and abilities of its labor groups over a period of time. As is commonly seen, the trades will develop the capacity to provide a skilled work force in the employment of a variety of materials. Thus, if a material has been consistently used, with any measure of success, it is likely that its use will be repeated within an area. The successful application of materials within a specific context then is also highly dependent upon the skills of its labor force.

Traditions

The traditional use of materials in an area is found everywhere. This addresses the use of materials in a contextual arrangement over time for various reasons. It is those reasons for why a material is employed that is the concern here because these reasons promote the use of a material. Meanings are conveyed through a material's use, which come to be recognized as traditional. Those meanings conveyed through a material's use many times coincide with the reasons for its application. Traditions, and traditional uses of materials, are carried on because people, those who comprise a social group of the contextual arrangement addressed, felt a need for those consistencies and their associations.

MATERIALS: THE SYMBOLIC NATURE



As a system of symbols, materials, like language, operate in an orderly manner by specific principles. By isolating and examining these rules, a basic knowledge of this system's workings may be attained. The following paragraphs discuss briefly the rules by which the acquisition of ideas may be obtained within a symbol system by looking at the acquisition of language and applying these principles to materials as a system of symbols.

Aquisition:

The most basic principle involved in the acquisition of meanings and ideas through the use of materials, as in the use of a language, is that they are learned. We are not born knowing a language, what it means, or how to use it. It is not an inherent human quality, but we do possess the means by which we can learn. The same is true when we first encounter materials within our environment. We find that we must learn how to use them and this is done by looking to the particular context which we are a part to see how materials have been used previously, and in this we come to learn not only how, but why they are used. This suggests that materials may convey ideas and meanings through their usage because of past associations which we come to learn and accept, and in turn apply in new situations.

Second in importance in the acquisition of meanings within materials through their use, is the means through which they acquire meanings. In materials, the ways that they come to facilitate design ideas involves looking back to the contextual arrangement and the prior uses of materials within this particular environment. Through past and continuous applications there can be ideas which are consistently found to be conveyed. This suggests that we find meaning in things, materials specifically, that are consistently repetitive over time within a particular contextual arrangement. With an understanding that repetition suggests sameness, we are assured of consistent meaning.[11] In the application of materials this is manifest in many ways.

On the next level of complexity, meaning can be found in the slight adjustment or contradiction of an existing symbol (material) to alter its

meaning.[12] This requires that a symbol, in this instance a material, originally possesses meaning based on a particular application, within a specific context, and that by changing a material's application, new ideas and meanings may be suggested through this use. Therefore, to acquire a new or different meaning, considering materials as a system of symbols, the application then must also differ.

With these primary skills, man is able to achieve the third level of meaning acquisition: abstraction, or the isolation of the general case. Abstraction serves to isolate general principles upon which elaboration can take place.[13] Once again we must refer back to a specific contextual arrangement within which materials are used because it is within a context that materials do come to have particular applications. This exemplifies the idea of a general principle because materials do come to have general types of uses, or applications, within a particular area. It is from this point that elaboration may occur in the general case, to promote new meanings through a new and different application, or in the elaboration of a present use.

The final form, and most sophisticated, involved in acquisition relies on the interrelationship of parts, or--construction. Construction in language acquisition is analogous to construction using materials as both a system of symbols and when considering them in their physical state as defined by their characteristic properties because construction is a process that relies on the relationships of parts (materials) to each other to create meaning. No elaboration is required to explain this principle because through combinations and contrasts of materials in construction, they do come to facilitate design ideas and thus elicit responses.

The preceding principles of acquisition were presented in the order of their complexity so that an understanding of the heirarchial process involved could be clearly defined. In itself, acquisition is a process that is dependent on these definitions, and as one principle is expanded upon and pressed to its limit, the next highest principle must be employed to achieve understanding. Thus, for the highest form of acquisition to exist meaningfully it must employ all prior forms. Also, for the built environment to be realized as a symbol system, at the highest level of acquisition -- construction, one must understand the process whereby a material attains a symbolic nature, within a particular contextual application.

Use:

From acquisition we are led to explore the ways in which materials are employed to convey ideas. They may be used in a variety of ways limited only by their physical properties as a product of the imagination of the designer. Thus there exists the possibility of an endless number of meanings, or ideas, to be conveyed. However, when addressing materials as a symbol system, where a material acts as a sign, or a symbol, in any application there are only two ways in which a material, acting as a sign, or symbol, can suggest meanings. The following section employs the definitions of signs which have been applied, in a general sense, to materials taken as a system of symbols to show how materials can be used to convey ideas.

The first means by which a material may be used like a symbol is as a sign itself (signer).[14] This simply means that a sign is used to represent itself and to the observer there is no change in the meaning that is conveyed through its application, regardless of the type of symbol system that is addressed. Looking to materials as such a system means that a material takes on an application which it is most suited to in accordance with its inherent physical characteristics, and is one that has been commonly accepted within a contextual realm. Another means of expressing this might be to say that a material is to be used in a manner that is most appropriate to its nature and most commonly accepted within a specific area. For example, brick is a material which can best be employed as a sheathing, and in compression. Symbolically, it may have come to represent solidarity and security within a specific area. If used as a signer, brick would thus be found in an application in this area where these characteristics, both physical and symbolic would be conveyed.

The second means by which a material may be used like a symbol is in reference to something else, something to which a sign refers to, (signified).[15] This approach allows a sign to come to represent other signs or ideas through applications in which such a sign is normally not encountered. To apply this idea to materials, as a system of symbols, simply allows a material to suggest new meanings through differing applications. Looking to the example of the brick may clarify this use. If a brick is not employed as a sheathing or in compression, or in any other

application in accordance with its physical characteristics, it may not convey the ideas of security and solidarity through its use. But rather, through a new application, not commonly found within a particular contextual situation, the brick may come to symbolically represent another type of material or action. Acting as a symbol, which signifies, may allow the use of a material in a variety of applications which might elicit new and different responses, and new meanings.

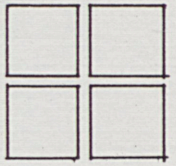
Limitations:

While there may exist endless possibilities for the meanings which may be suggested through the use of materials, there are limitations that are encountered. These limitations are ones which we ourselves come to impose upon a material and its use, and are relative only to the context within which materials come to be employed. We often see materials as having only particular uses, normally these are ones that have commonly been encountered. This occurs where the application of a material is consistent over time within a certain area, the one in which we live, or are most familiar with. Many times we loose the ability to see beyond these contextual uses, beyond the restrictions that have been contextually established by social groups and cultural norms.

Another limitation that is apparent once a person can remove themselves from their contextual situation and look to another, is that the use of materials from place to place may greatly differ so that the meanings suggested through the use of a material may not be consistent. This is something which is commonly encountered, but is something which we may not consciously be aware of because of the learned conditions and attitudes which are associated with specific places. It may be difficult to understand why the use of a material may have a different meaning in another context, we blind ourselves to this fact through our ethnocentrism. This works in two ways. First, a material use may be the same within different contextual situations, and different ideas and meanings may be suggested in their like applications; or, a material may differ in use in different contexts, but with much the same meaning conveyed. In either case it is the realization that meanings and uses can differ between places which is important.

What then is gained from the investigation of the physical and symbolic nature of materials, and those contextual parameters that come to influence their use? The reasons for why materials come to have particular uses and how through their use they suggest meanings has been addressed to promote an awareness for these ideas. Materials are the vocabulary of the built environment, they are the means by which man builds our building blocks. From this we must look to a specific contextual arrangement to discover these same qualities of an area and how through the use of materials, design ideas have been conveyed. By examining specific buildings within an area, and the ways in which materials contextually respond, we can make these same observations, considering a contextual situation more fully.

TWO CASES



The following case studies are provided to examine the ways in which other architects have used materials to help facilitate design ideas. They also illustrate the meanings these buildings have acquired regardless of the architect's intentions through the use of materials. I have chosen to review two existing buildings which respond to their contextual situation through the use of materials. They are also buildings which relate in some way to research, which is similar in function to the building which will be the outcome of this thesis. At no time is the assumption to be made that these are complete building analyses. In each case, the discussion is restricted to materials, their use, and how they may suggest ideas through their specific applications.

The National Center for Atmospheric Research
Boulder, Colorado
I.M. Pei, Architect

I.M. Pei's National Center for Atmospheric Research would be a difficult design to understand if it were removed from its setting on a mountainside near Boulder, Colorado. The arrangement of the building on its site is clearly the key concept, and the building's sense of fitness to the landscape was precisely what Pei set out to achieve, and successfully obtained. He intended that the building grow out of the Mesa and surrounding slopes -- an organic conception of form. The building was meant to meld into its surroundings through the use of form and materials indigenous to the area.

An inspiration for the NCAR were the indigenous masonry towers of the Anasazi Indians thirteenth century ruins at the canyon cliffs of Mesa Verde National Park in southwestern Colorado. To Pei, they were not intimidated by the gigantic scale of their surroundings, which in many respects was analogous to the future site of the NCAR. From this observation a seed was planted for his concept for the shape, color, and texture of the NCAR towers. Pei sought to reinterpret the principles of Mesa Verde's architecture by using the best available concrete technology to duplicate surrounding natural materials. The materials then, their color, texture, and scale employed in the NCAR were a key element in the expression of these principles.

The use of concrete allowed Pei to express the highly sculptural qualities of the towers, concrete being a material to Pei that permitted one to express volumes. He intended then to exemplify and emulate what he had seen at Canyon Cliffs and the ancient Indian towers. The materials that were to emphasize these volumes were then a critical part of the design concept. The use of indigenous materials, a special aggregate for the concrete, of local pinkish-brown limestone, from a quarry some twenty miles away, bush hammered and sandblasted in its application to the surface of the volumes brought out its distinctive color. The color was like the rocks behind the NCAR, and the surrounding environment. All this was contrived to make the center read as a positive occurrence in the countryside, one which had its own identity and self confidence, but which did not seek to intrude impertinently upon the grandeur of its mesa setting.

The Boyce Thompson Institute for Plant Research
New York State College of Agriculture and Life Sciences, Cornell University
Ithaca, New York
Ulrich Franzen, Architect

The Boyce Institute for Plant Research at Cornell University by Ulrich Franzen is a successful attempt at providing a university building on a strict budget, that has a functional order, is highly articulated and which relates the structure to existing building around it. Franzen calls this "context architecture" which is his way of describing both this process and the results it yields. A building is shaped by a specific set of programmatic and environmental circumstances and respects the limits these circumstances impose.[16] This is the exact philosophy which Franzen strives to work with in all his buildings, and is successfully employed in the design of the Boyce Institute.

The Boyce Institute sits in and amongst many other campus buildings at Cornell University, some previously designed by Franzen himself. According to Franzen's philosophy, the building must respect and respond to the contextual circumstances. This applies to aspects of the site and surrounding structures which a new building must respond to. In response to this, forms, shapes, materials, textures, and color are employed to integrate a building into a particular contextual arrangement. The choice of materials then is one means by which this can be achieved in combina-

tion with other conditions, and Franzen has some interesting thoughts on the use of brick in this structure.

When asked why he has used the material he says that originally it was never a conscious choice, since he never had any well-to-do clients. Brick is one of the least expensive exterior finishes and is virtually self-maintaining, two reasons why architects as well as clients find it very acceptable.[17] This probably was an overriding condition in the use of brick in the Boyce Institute and in the buildings surrounding it, but for this reason the Institute does respond to its surrounding environment. Regardless, the building is an integral part of this contextual arrangement because of the consistent use of materials in accordance with the surrounding architecture.

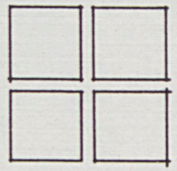
Now that the dual nature of materials, the physical and the symbolic, have been explored these general ideas need to be applied to a specific place to understand how materials have come to be used and the meanings conveyed as a result of their consistent use. From these realizations as a designer, I might come to design in a more sensitive manner to this place, using materials to convey certain design ideas. This involves the use of all that has been explored about materials and their properties, their dual nature, so that they can best be understood in the terms of the contextual situation of which they are a part. This should allow the designer to look at particular applications of materials within a specific place and draw from observation of the total context, ideas, or meanings, conveyed through their use. From this, when a new form is proposed to become a part of such an environment, these aspects of materials can be examined within contextual circumstances to make for a structure more responsive to its location and site. In doing so, materials might come to act as a means by which to convey meanings and intent within a specific application in response to surrounding contextual circumstances.

The specific place, or contextual arrangement under study, focuses on the city of Bozeman, Montana, yet also includes the local and region circumstances that act as contributing forces in its establishment. This ensures a fuller definition of its contextual influences. The site for the design culminating this thesis will eventually be chosen somewhere within Bozeman, or the surrounding area. Working from a broader definition of context, in this case the Northwestern Plains and Rocky Mountain Region, better enables an understanding for particular contextual influences within Bozeman. Here, this study is concerned with the nature of materials, so meanings suggested through the use of materials may have drawn from this broader view of context.

Bozeman, Montana was chosen as the area of study for a number of reasons. The major consideration in its selection is that it is easily accessible to this author for observation on a day to day basis, observation being the most useful tool in the study of materials in this area. From observation one can see what materials have been used and the varying applications in which they have come to be employed. This allows for speculations and deductions to be drawn on my part as to the meanings conveyed through their existing uses.

Another consideration for the choice of this area to study is because it is the most familiar contextual arrangement to the author. Being a native Montanan and living in the state and traveling primarily within the surrounding area, I feel somewhat an understanding for the area and a strong appreciation for it. Bozeman has been home for me for the past five years, so it is in this frame of mind that I chose to begin. In this light, the application of materials within the contextual realm of Bozeman and the meanings conveyed as a result of their use will be important considerations throughout the progress of this thesis. From this I expect to apply this knowledge to a specific building type within Bozeman and use materials in a manner which come to convey meaning and intent. The following is the documentation from my observations within the Bozeman area of the use of materials categorically, and some of the implied ideas through their application in specific building types, both past and present.

MATERIALS: THE CONTEXTUAL NATURE



"Good Building depends on a familiarity with materials that comes with long observation, as if they were the character traits of a marriage partner."

Sibyl Moholy-Nagy
"Native Genius in Anonymous Architecture"

Wood

Because Bozeman, and the surrounding area, to include much of the Northwestern Plains and Rocky Mountain Region, had highly forested mountainous regions nearby, area residents probably saw wood as the first widely used building material. It was, and still is, a material readily available to the region. At one time it was indigenous to many areas, and still is. Originally, all that was required to obtain wood products was to fell a tree and extract from it what was necessary for construction. Today, because of vast distribution systems within the United States, a greater variety of wood products are available to all areas.

Wood's biological characteristics, its limited heat conductivity, its kinship with man and living nature, the pleasant sensation to the touch it gives, as well as the possibilities of various types of surface treatment it offers, have all secured it in a dominant position in architectural applications everywhere.[18] It does have drawbacks though, flammability and the need for upkeep, but these have not discouraged its use, but rather have come to facilitate other uses for this material.

The contextual conditions that define parameters for the use of the material in this area were such that wood came to be highly used in a variety of applications. Though climatic conditions vary in extremes, wood was still widely used. If protected and treated to resist and withstand moisture in its exterior applications, the material was found to respond very well to changing conditions. As previously mentioned, wood was, and still is, readily available which continues to make it an economic means of construction. Technologically, what was required to build with wood was easily mastered, or passed on from person to person. The case is the same even today. For these reasons, in addition to many

ical and nostalgic use of wood by ambitious businessmen. The attitude that does not accept wood in many commercial uses would be considered a contextual limitation. It is described as such because it is spawned from the attitudes of those in the area who have come to accept its uses based on the repetition of its use over time in particular applications. This is not to say that wood cannot be used in other ways in the Bozeman area, but that these are the traditionally accepted uses and meanings conveyed through its use.

Brick

Brick is a man-made ceramic and is suited for a variety of applications because of the characteristic properties of a ceramic: hardness, strength, imperviousness to heat, resistance to chemical attack and brittleness.[19] These properties have contributed to brick, and the many variations of brick products, to becoming a Montana vernacular.

In the Bozeman area brick was employed in response to the contextual parameters of the area. It is a material that can withstand the extreme climatic fluctuations, although some care in construction is required to provide for expansion, and insulation must be used for this material to be effectively employed. After World War II brick became a readily available material with the existence of a local brick plant. Until this time it was not available to the area on this basis, or widely used because it was not economically feasible to import the material. Today this is not the case. Brick is readily available for a variety of uses at costs which make it economically desirable for construction. Technologically, the labor force within the area is skilled in the use of brick. For these reasons brick has come to be used in ways that may be considered traditional and to have acquired particular meanings through its applications.

Traditionally, brick has been used in buildings of either a commercial or institutional nature. Many wooden commercial structures in the downtown area, after being either burned down or torn down, were replaced with brick, or some type of stone. Sometimes due to the gained wealth of a business, a structure was intentionally torn down and re-erected in brick, a material of considerable more expense than wood, which also came to reflect the prosperity of a business. Often when a businessman had acquired some amount of wealth he chose to build in brick, as an accepted sign of his status and his business' solidarity. Though today this is not the case, it being a fairly inexpensive building material by current standards, brick can be found in a variety of buldings of this same type. Examples of these can be seen on the campus of Montana State University, the downtown hotels, the Baxter and the Bozeman, and many commercial and institutional buildings in the area. These can then be considered the traditional uses for the material.

From the use of brick in these commercial and institutional applications by those who could afford the material it came to suggest security, solidarity, wealth, integrity, and power, to name only a few. Many municiple buildings were also of brick which helps to reinforce those general meanings conveyed by the use of the material in this institutional type of application. These associations that existed because of the use of brick in particular types of structures carried over into another application -- well-to-do residential.

The brick house, or mansion, came to transcend the wooden house of the common man and stood as a symbol of status in many neighborhoods. Because brick was a material that was more expensive than wood, it could only be employed by those who could afford it -- the well-to-do. The material then came to suggest the same meanings through its residential use as had been established earlier by commercial, or buildings of an institutional nature. Those would be wealth, solidarity, integrity, etc. Many examples of its residential application can be found on Willson and Grand Avenues, as well as throughout other parts of town. Brick can also be found in a variety of applications other than those previously mentioned, in walkways, walls, and in many colors, sizes, shapes, and textures. However, it is those traditional uses that have given rise to particular meanings that have been suggested through its use. Turning now to those points from the symbolic aspects of the nature of materials these ideas and suggested meanings may be explained.

Brick has come to suggest security, solidarity, wealth, integrity, and power because of the consistent and repetitious use of the material over time in the aforementioned applications. People in the area, unconsciously aware of the consistency of its use throughout time, came to accept its application in these ways. They "learned" this to be the use of the material, and this is also why it is not found in some applications. From these original uses, an elaboration on this general principle was successfully attempted by carrying its use over into residential structures and becoming an acceptable material in these types of applications. It also suggested those same meanings as were found in commercial, municiple, and residential types of buildings. That is not to say there are not other uses for brick in this area, though these are the commonly accepted uses which have formed the contextual limitations for the use of the material.

Concrete

Concrete is a man-made material and is suited for a variety of applications because of its characteristic properties: hardness, strength, imperviousness to heat, resistance to chemical attack, and brittleness, which makes it comparatively easy to shape the material of chipping it.[20] Concrete is suitable for a number of applications, but until recently has not found much use as a total building material in the Bozeman area. It has come to be used primarily because of its characteristics of strength, durability, workability and economy.

Concrete has been found in a limited number and types of applications in this area, but in keeping with the contextual conditions that define the parameters of use. In response to the extreme climatic conditions encountered in the area there are some problems involved with the use of concrete. Often times cracking will occur due to contraction and expansion of the material with temperature fluctuations, but this can normally be remedied through the use of reinforcing steel. It is a material however that is readily and locally available, although the variability of costs, which appear to be rising, do have an affect on its use. Of course the cost will vary, as it will with other materials, depending upon the amount and the type employed. Additional costs are encured as a result of wood or metal formwork that is required. The technology necessary to work with concrete is known by the labor force within the area, but primarily only for those applications in which it is normally encountered. There are many techniques that are not known by local laborers that would permit them to use the material in other applications. It is these conditions that have contributed to the traditional and commonly accepted uses of the material in the Bozeman area.

As a building material, concrete has commonly been used in limited applications in this area. As a structural system it has been employed with other materials sheathing it, or it has been left exposed and a contrasting material used as infill. In these instances, concrete is not recognized as the primary material in construction because of the extensive use of another material. However, there are exceptions to this in the Bozeman area, particularly by the architect Fred Willson. Many of his older institutional types of structures such as schools and munici-

pal buildings were constructed primarily of concrete and display a monumental character. Today there can be seen a slow revival of the use of concrete in this type of way, although this is not the commonly accepted use for the material.

There exists an overriding application for concrete in the Bozeman area for utilitarian types of uses, and this is normally how it is encountered. In almost all recent construction it has been used for footings, foundations, slabs on grade, retaining walls, steps, sidewalks, and for innumerable other things. At one time block and stone were used in this capacity, but this is not as commonly seen anymore. Concrete does not require the skills needed to lay block or stone for such applications and it doesn't take the hours that these other materials do to achieve the same ends. Block and stone however imply an older form of a foundation wall, or walkway. They come to be replaced by the new material, concrete, and because it was fast, and required less work than stone or block it was highly used instead. Just because it was new, or involved a newer technology did not make it a better material than the two previously used, and it certainly did not have that natural quality about it that block or stone did. Rather, there was something very "civilizing" or urbanized about the material in these applications, something a building would be elevated upon. There is not a natural feeling to it. When concrete is utilized as an entire building material, it is commonly exposed as in those buildings that are more utilitarian in nature, such as warehouses or garages. Recalling those points discussed concerning the symbolic aspects of materials these ideas and common suggested meanings may be explained.

Concrete has come to be used in particular applications because of the parameters imposed on its use by the attitudinal restrictions established by people within the area. Because it has been utilized for many years in utilitarian types of applications, it has been thought of in a utilitarian manner with implied deconnotations of "ugly" surfacing when it is described, or thought about. It is through this consistent and repetitious use of the material in these ways that has encouraged those who encounter it to think of it in this manner. The buildings by Fred Willson however are considered an exception because the material is not recognized as dull, gray, concrete. He elevated the use of the material, an extreme form of the elaboration of a general principle in the use of

the material. A general principle refers to the commonly accepted way of use, or way of thinking. This extreme form of elaboration might also suggest that as a symbol, concrete was used in the form of the "signified," calling to reference some other idea, or material. The possibilities for the use of concrete in this area however may be changing when people begin to think of it as a material to be used in other ways. This requires an attitudinal change among those of the Bozeman area, but there are signs that some attitudes are changing among those of the Bozeman area, as is the use of concrete.

Concrete Block

Concrete block is also known as cement, or cinder block, but it is a man-made ceramic material and is suited for a variety of applications because of the characteristic properties of a ceramic: hardness, strength, imperviousness to heat, resistance to chemical attack, and brittleness.[21] It is a material that is becoming more widely used in this area for a variety of applications. These applications however are determined by the contextual conditions which form and define the parameters of use in this area.

Concrete block is readily and locally available in a variety of block types, textures, and colors. Due to an efficient distribution system, what is not locally available can be easily imported. The ease in accessibility of the material for construction purposes is another reason why it has a high degree of use. It is also very economical to use. The technology involved, and the labor required for the use of block is minimal in comparison to other building materials, and the labor force in the Bozeman area is skilled enough to handle most, if not all, applications of the material. With ease of construction follows reduced labor costs which adds to the economic feasibility involved in this material's use. Concrete block is also responsive to the changing climatic conditions of Bozeman when proper measures are taken to ensure proper expansion for the materials. These conditions have all contributed to the use of concrete block in this area and have inspired customary applications for it.

Traditionally concrete block has been thought of as a "cheap" material, and in all respects this is due to the applications in which it is normally encountered, and the response as a result of these applications. In a foundation, or basement, it is not the same as concrete, it is a cheaper version. Under a gable roof it becomes a warehouse, or some other industrial application, or a "cheap" commercial building. Its use in these types of buildings involves the economy of the material -- it is cheap, thus it produces a "cheap" structure. Usually these structures do not stand in social significance within a community so reasoning dictates that they need not be elaborate, rather just serve their purpose. This says, build them as cheaply as possible, function

and utility are of the utmost and aesthetics are often disregarded. However, there are other applications for this material, primarily where it is used as a structural wall, and then faced by another material. Sometimes it is employed as an infill between a structural system. Though a variety of textures are available in concrete block, they are seldom utilized in this area because it is not always readily available, and it is often more expensive. Therefore, the uses and the meanings conveyed through the use of concrete block in the Bozeman area are somewhat limited, and labeled as "cheap" and utilitarian because of the response resulting from its particular applications. Looking to the symbolic aspects of the nature of materials may provide explanations for these descriptions.

As previously mentioned, concrete block has been traditionally thought of by people in this area as a "cheap" material used for utilitarian purposes. This is an example of a limitation imposed upon the use of a material by a social group who is not able to see beyond their contextual circumstances to other ways in which it may be employed. Because of the consistent and repetitious use of concrete block in specific applications, people have acknowledged and accepted these uses, and do not transcend this thinking. Since there have not been any other predominant uses for the material in this area, people will continue to think of concrete block to be used in this fashion. This does not mean however that concrete block cannot successfully be employed in other applications. It will require time for the evoluation of its use to occur, and become accepted within this contextual arrangement.

Stone

There are many types of stone to be found in the Bozeman area, which give rise to the many applications that it may take on due to its properties. Stone has innate biological characteristics that cannot be changed; such as stratification, grain, density, responses to load, temperature, moisture, and aging. It is a ceramic, and possesses those characteristic properties of a ceramic: hardness, strength, imperviousness to heat, resistance to chemical attack, and brittleness, which makes it comparitively easy to shape the material by chipping it.[22] These characteristics define and describe many types of stone which are identified by the shape and the finish treatment of the surface of the stone in a natural state. From the natural state stone can be fashioned in any of the following ways for a number of uses: dimensioned (cut stone), rubblestone (ashlar type), flagstone, or crushed stone. Examples of all of these are found in the Bozeman area, but are very limited in their use.

Stone, though readily available in this area has come to have limited applications because of the extensive processing required to prepare it for construction purposes. Economically, the material is no longer feasible to use when compared to other materials, so when it is utilized, it is usually in smaller applications. Finding the craftsmen who can handle the material with a measure of success in this area is a difficult task, they are rare men. Consequently, the cost of labor is very high because laying stone is often treated as a lost art. Most masons will lay stone in smaller types of applications such as walks, walls, and chimneys. Climatically however the material responds well to changing environmental conditions, although in any type of building application insulation is normally required. These factors then have contributed to the limited uses of stone as a building material in this area.

Stone has come to have very limited applications in the Bozeman area and is normally employed in smaller scale types of projects simply because of the expense involved with its use. It is used in such things as walls, walkways, and footpaths, patio floors, older foundations, and fireplaces, and it also can be found in agarian types of use, such as for walls or rip-rap. There are some examples in the Bozeman area of stone employed as the entire building material, but this occurs primarily

in much older buildings such as earlier houses and a few churches. It is in these applications that stone has come to convey a monumental character, with a feeling of permanence to the building, in addition to its natural feeling conveyed through its use. Stone is a natural material, of the earth, and in this area there can be seen many applications where this feeling for its natural qualities are sought. It may be these same qualities which are tried to be emulated through the use of imitation stone, or false rock in the Bozeman area.

Imitation stone, or fake rock, is becoming more widely used and accepted in the Bozeman area in a variety of applications. It is most commonly encountered with metal building systems, such as large warehouses, farm buildings, and in commercial applications where the natural tendencies of stone are sought and have hopefully softened and "naturalized" the metal structure. Recalling some of the aspects of the symbolic nature of materials we shall try and understand the meanings conveyed through its use, and why it has come to be used in particular applications.

Traditional uses and meanings that have come to be conveyed as a result of these applications can be found within the Bozeman area. There remains some confusion however when examining the use of fake rock, or imitation stone. Natural stone has come to convey ideas of monumentality and permanence within larger structures because it was in those buildings of the past which sought to stand in solidarity, churches and residences in which we find it employed. In smaller scale applications it adds a softening characteristic of many natural materials when unaltered for use in construction. In both scales of application however stone displays its natural characteristics, which may have been the reason for its use. Its naturalness is also a link to the surrounding landscape, because it is a material of the earth, perhaps it was sought because of that. These meanings we accept as being conveyed ideas through the use of a material exist because of the consistent and repetitious use of a material over time that has come to be accepted within its contextual realm. It may be that these same ideas are hoped to be conveyed through the use of fake rock, but only time will tell in this instance. Though it appears that the use of natural stone may be dwindling, the use of fake rock products is on the incline possibly to emulate those properties of natural stone. This then contributing

further still to the vocabulary of materials that has become the vernacular of this area.

Metals

Metals are opaque, lustrous, and comparatively heavy. They are strong, but they can be rolled or hammered into shape and be alloyed and welded. They are good conductors of heat and electricity.[23] Because of their diverse abilities as a building material, they may come to be used in both structural or non-structural capacities. Both of these types of applications are encountered in the Bozeman area. Many different types of metals exist, the ferrous metals which contain iron, steel, stainless steel, and cast and wrought iron, and the non-ferrous metals, aluminum, copper, brass, bronze, and zinc. Though there are examples for the use of all these types of metals throughout the area, this study will focus on a discussion of metals in general terms in both their structural and non-structural applications.

Though limited by the contextual conditions of Bozeman and the surrounding area, metals in both structural and non-structural applications, have come to be highly employed. In its structural applications the most commonly encountered of all metal products is steel. Normally it is found to be faced or sheathed by another type of material so that it is not recognized as the material of which the building is made. In these types of applications there need not be much concern for its response to climatic conditions, but it is when the material becomes exposed in a structural capacity that the steel should be protected by some type of agent to prevent oxidation. The availability of structural metals does vary because they must be imported from outside sources, which dictates what may be used in this area. Economically, the structural metals are becoming widely used because in terms of costs they are favorably comparable to other materials, and this is to include expenses for shipping and handling to import it. The technology required for the erection of a structural steel system has been mastered by the labor force in the area, so that problems are minimized in construction. Looking to the traditional uses of structural steel in the area, primarily it has been employed only in the capacity for which it was designed, as a structural system. However, the use of non-structural metals, those which are the observable, exterior building skin are of more concern to this study because it is from these that we form images of metal building types.

A variety of metal building systems are locally and readily available for use in the Bozeman area. The metal building system has rapidly come to be called a western vernacular because of its large use in a number of applications. Due to its availability, if a special system is required to meet a particular need, it can be quickly and easily provided, which is a large reason for their wide spread use. But, the overriding explanation for the use of these systems is due to costs. They can provide a structure for about the lowest cost in comparison to other materials, so it is an economically feasible building system to employ. With availability and economics a plus for these systems, there is also little to know about their assembly. Just about anyone can assemble a system quickly and efficiently, except in some larger applications where a skilled labor force may be required. This tends to keep costs of construction down when a labor force need not be employed. In addition to all of these factors, metal building systems have also come to be used because they weather well in response to fluctuating climatic conditions. Originally, problems were encountered in these systems, but once treated to resist and retard the effects of weather, they became even more acceptable as a building system. It is for all these reasons that have contributed to the success of metal buildings in this area and for why they have so quickly become a western vernacular.

In Bozeman, and throughout many parts of Montana, metal building systems have been employed in a variety of applications, but particularly where costs have been a determining condition, and oftentimes where a large building is required. This usually has come to include structures for agrarian uses, such as barns, silos, and garages, in industrial and warehouse applications, for commercial operations where additional storage space is required, and even in backyards of local residents as garages or storage sheds. Primarily though these systems have been employed in structures of a utilitarian nature and are used rather than more expensive materials, to cut costs for a building of this type. It could be said that metal building systems have become the common man's material to parallel, or equal, that of wood. For the same reasons that wood was once so widely used (and still is) metal building systems have found significant use within the building vocabulary of this area.

Originally these systems were employed for agrarian types of uses. Remnants of many of these structures can be seen all over Montana in the

form of silos, haybarns, and sheds. When the economy of these systems was discovered, people began to consider it a feasible means of construction for other building types. Later, metal siding for residential use became an accepted means of sheathing, as an offshoot of these same types of metal building systems. Some very elegant examples of metal sidings can be found in the Bozeman area, the Gallatin County Airport to cite just one. From these metal building systems came another application of the material -- metal roofs. Though this has not caught on its popularity like metal sidings have in this area, this author predicts that they will come to have a high use in the future. Time is needed for people to accept this idea of a roofing system. Recalling those points from the symbolic aspects of the nature of materials, we can examine and hopefully explain the traditional meanings conveyed through the use of these systems within this contextual arrangement.

Looking to the traditional uses of metal building systems we find that they have commonly been employed in utilitarian types of applications, so that this is the association that is called to mind in other uses. Through the consistent and repetitious use of metal building systems over time in these types of applications, people have accepted this to be the kind of structure these systems are suited for. Based on past experience with the material, this has become the established way of thinking about its proper application. Although this may be considered a limitation that is attitudinally imposed upon the use of the material, that is not to say that this will not change. For purely economic reasons people have been turning more and more to metal building systems as a viable means of construction. This expresses the idea of an elaboration on a general principle, and examples of this are beginning to be seen throughout the surrounding area. The use of these systems has rapidly caught on in this area for a variety of reasons, and it is assured that new and different uses for this vernacular product will be seen.

Glass

Glass is a ceramic, made from organic materials. Its properties are like that of a ceramic: hardness, strength, and brittleness, but in its most common forms its characteristics distinguish it from other ceramics. Though there exists an endless variety and types of glass available in this area, only two types will specifically be examined, translucent and transparent glass. Transparent glass includes window, heavy sheet, plate, insulating, and tempered, while translucent glass applies to such products as patterned, corrugated and glass block. Though in this area it is as of yet considered a building or construction material, it is significantly used within many types of structures, so that some observations should be presented on its uses.

The most common use of glass is for windows that protect openings in structures from climatic conditions. They allow in heat and light, and open portions of a building up to views, while at the same time functioning as a skin, or membrane, between interior and exterior environments. Glass for this purpose must be carefully employed, or it can easily fail in its application. Due to changing climatic conditions of the area it is imperative that glass be wisely used with considerations for energy conservation to be given highest priority as its use as an insulating membrane. Orientation and the amount of glass area used are critical decisions to be made. When considering a southern exposure in this area, the solar gain experienced has led to the use of glass in this manner to heat interior spaces. It has also spawned the use of glass in another way, in the form of a solar greenhouse, specifically employing a southern exposure to benefit from solar gain. Many examples of this type of use are beginning to be seen in the Bozeman area.

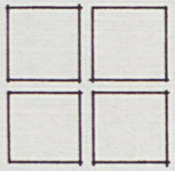
Glass is a material that is locally and readily available, and if something of a special nature is required it can easily be imported from an outside source. It is relatively economic in its applications, although this is dependent upon the type and amount of glass employed. Installation and labor charges are normally accepted by those wishing to use the material, and there are those in the area who are competent in handling and installing glass products.

The applications of glass, though quite apparent in the Bozeman area have been observed and noted as have other materials because of its high degree of use in a variety of applications. At this point the author wishes to draw no conclusions as to the meanings or ideas conveyed through its use, because the functional nature of glass.

The preceding section specifically addressed those groups of materials which are commonly found to be used in Bozeman and the surrounding area. Based on carefree observation I have investigated materials, and how through their use, their role in architecture, they come to convey and suggest meanings so that I might better and more effectively design within contextual parameters. My attempts have been through exploration, to gain an understanding of the fundamentals of materials, such that their application in specific, may lead to a more complete realization of intent.

With such an understanding gained, the test of this knowledge comes through its application. At this point, I turn to a regional center for archaeological research. Through this vehicle I hope to apply this new found knowledge of materials. The following thoughts are an attempt to clarify and understand my ideas of such a research center. They have come to guide the design as well as the comprehension of the thesis, and stand as a measure for my intentions.

THE PROJECT



Concepts

A regional center for archaeological research, by its nature, is a place of research and study of archaeological materials and remains specific to a particular region. More than simply a building, it is a tool for man to seek knowledge, as it is a step within the continuous and ongoing process of the study of archaeology. As it is a place where questions are answered, so too does it prompt man to ask more of himself and the ways of his past, and the past of a specific region on this earth.

It is not a static, or idle place, but rather a gathering point for those involved and interested in the archaeology of a region to come together, to examine, and process artifacts and remains, and determine and question their significance. It is a coordinating facility which interacts with many other institutions within the region and allows for a transfer of materials and ideas to occur between. Found here are the opportunities for questioning and research, yet there is always the freedom to interpret. It is a place, among many within a process, that promotes an understanding for the past, present, and allows for predictions of the future to be made.

This place is in many ways introverted of itself. Because it houses a majority of the archaeological remains of a region, there is continuous and intense ongoing research which often times turns the focus inwards to these efforts. And at other times, the regional research center is open, extroverted, looking out to the region and inviting in those with fresh ideas and interpretations, as well as to the possibility of new found archaeological remains.

A regional center for archaeological research is also a link between the actuality of found archaeological remains within a region, and the speculation which evolves from the study of those remains. Such a place also points out the limitations that man may have for truly understanding the particular past of a region.

In all, a regional center for archaeological research is a place that will accommodate those who seek to understand the past of a region through research and exploration.

Site

A site for a regional center for archaeological research requires the coordination of a number of important variables necessary to its operation. The contextual situation within which a regional center must respond to and come to represent is the first point of consideration that must be addressed. If this center for research is to represent the characteristics of a region, then there must be considerations made for materials and their applications and associations within the region, the concern of this thesis, in addition to other variables which such a center must reflect, or represent in some manner. It must also somewhat signify the center for archaeological research within the area through its proper geographic location in relation to coordinating facilities and services it must employ within the region. In order for these conditions to be met, an understanding must be had for those determining conditions and parameters that define the region which is represented by such a research facility. This requires an examination of the region in the most general case, gradually determining the specific, which eventually will represent the site for such a center.

The region which this research center for archaeology will come to represent is known as the Rocky Mountain and Northwestern Plains Region. The boundaries of this area are roughly defined, but it includes the majority of Idaho, Montana, the northern half of Wyoming, and into parts of North and South Dakota. It is but one of many regions that are distinguished for the pursuit and study of archaeology in the United States.

(See map of U.S. indicating the region, p. 50)

With the boundaries of the region defined it becomes necessary to select a site that is representational of the region, as a center for archaeological research. The geographical location of such a site should acknowledge and consider the coordinating activities which are necessary to the operation of such a center, and their present locations within the region. Selecting a site near most of these services may provide for a more complete and efficient method of processing archaeological remains. Fortunately, there does exist such a place within the Rocky Mountain and

Northwestern Plains Region -- Bozeman, Montana. It currently is the center for archaeological research within the region and many of the coordinating facilities required for such research are also located here. However, it lacks the organization between coordinating facilities that such a regional research center would provide.

(See map of region indicating Bozeman and surrounding area, p. 51)

Bozeman is a city of 25,000 people located in southwestern Montana just east of the continental divide. Geographically, it is somewhat centrally located in the Rocky Mountain and Northwestern Plains Region, which could make it an appropriate location for such a research center, but more importantly it has been the major center for the research and processing of archaeological materials in the past. The reason for this stems from the fact that the necessary coordinating facilities and activities are for the most part located and performed in the Bozeman area. These activities have been primarily carried out by two state institutions, Montana State University and the Museum of the Rockies.

(See map of Bozeman indicating state institutions, p. 52)

Montana State University, with an enrollment of just over 10,000 students, is a multi-purpose institution offering a widely diversified curricula. Due to its multi-disciplinary nature, the university is involved with the processing of archaeological data and remains amongst many departments, through the somewhat structured archaeology program offered at the university. This program is a part of the Anthropology Department, but has limited accommodations to carry on its research. It currently exists in a few rooms throughout Wilson Hall with the processing of materials occurring throughout different departments on campus. There is a need for a separate place, somewhere on the campus, which the Archaeology Department could solely occupy, hence the need for such a center, which would in turn expand the current program, and offer greater opportunities for research.

The Museum of the Rockies is the other state institution that can be considered a major coordinating facility involved in the processing and research of archaeological data in the region. Here is where a majority of the storage space for processed materials and remains is housed.

There are also areas which are involved in the replication process of artifacts and remains. Most importantly though, it provides gallery space for the purpose of display of such articles to the public. The Museum is also involved with newsletters published through the year by the Montana Archaeological Society.

The Museum of the Rockies and the services of other disciplines on the campus of Montana State University are presently the coordinating facilities that exist, and are involved in the processing of archaeological remains for the Rocky Mountains and the Northwestern Plains Region. What is missing is this process, and which there exists a need fore, is a center where incoming, processing, and research of archaeological remains could be housed within one facility, rather than being scattered throughout many different facilities. This would be the purpose of such a regional center. The task now is to select a site that could best afford such a center the greatest opportunity for the successful undertaking of archaeological research to occur in conjunction with existing activities in the Bozeman area. The following is an analytical attempt to consider a variety of factors which could contribute to the selection of such a site.

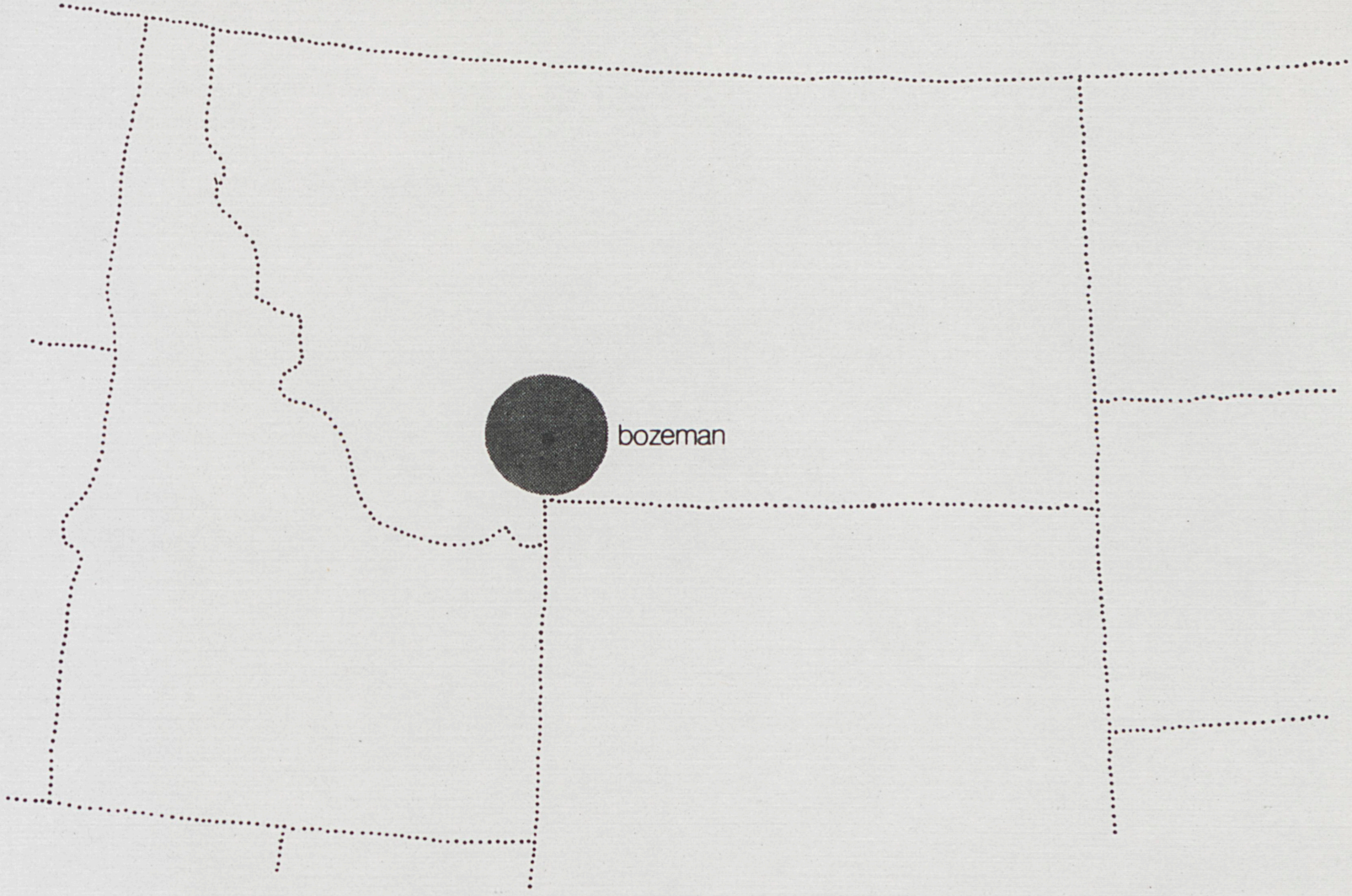
Six sites were examined to consider which might best be suited to the needs of the regional center, and which would best respond to the impact of it. All of the sites are located within the general proximity of the campus of Montana State University and the Museum of the Rockies to better coordinate the center with existing facilities involved in such work. The following matrix points out a number of varying considerations which might aid in the selection of a site. These considerations are not clearly rated and don't carry equal weight, but from the top of the scale on down they do decline in importance.

(See map of campus indicating sites, p. 53)
(See site matrix, p. 54)

The site selected for the regional center for archaeological research, site A, is on the campus of Montana State University. The specific site location came out of availability, practicality, and the consideration of such a center's operation. It came to be located within the main body of campus because here it is most accessible to those who may use the building, and the nearby coordinating facilities, while at the same time it is

within walking distance of the Museum of the Rockies.

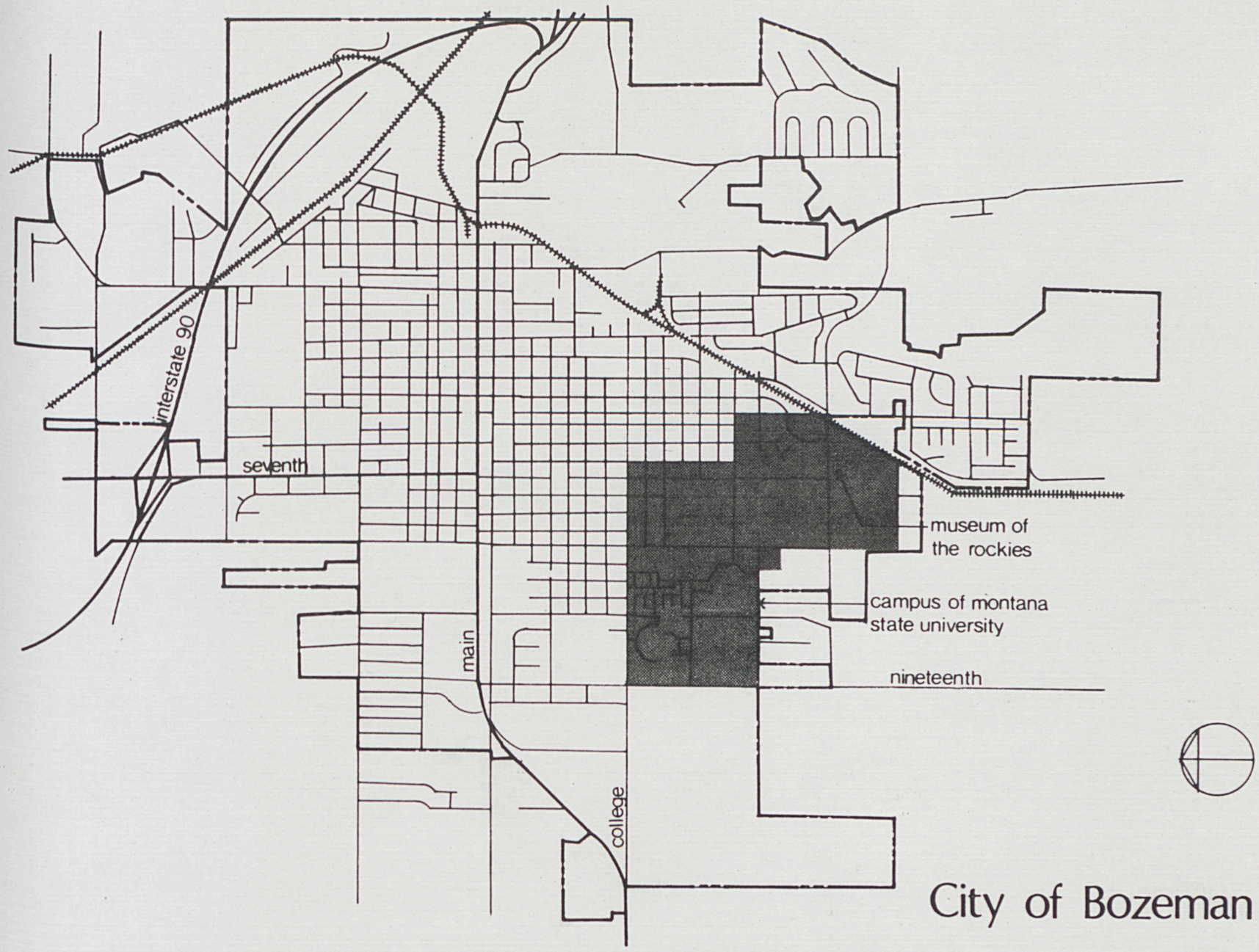
The site occupies a corner lot, bounded on the south and west by Grant Avenue and Eleventh Street, and is near the southwestern edge of the main body of campus. This area can easily accommodate such a center without disrupting the existing campus structures or activities surrounding the site, or the vegetation and heavily forested portions of the site. This area also provides a contextual situation which may be highly responsive to existing applications of materials, a concern of this thesis. A framework is therefore provided within such a center might react and respond to.



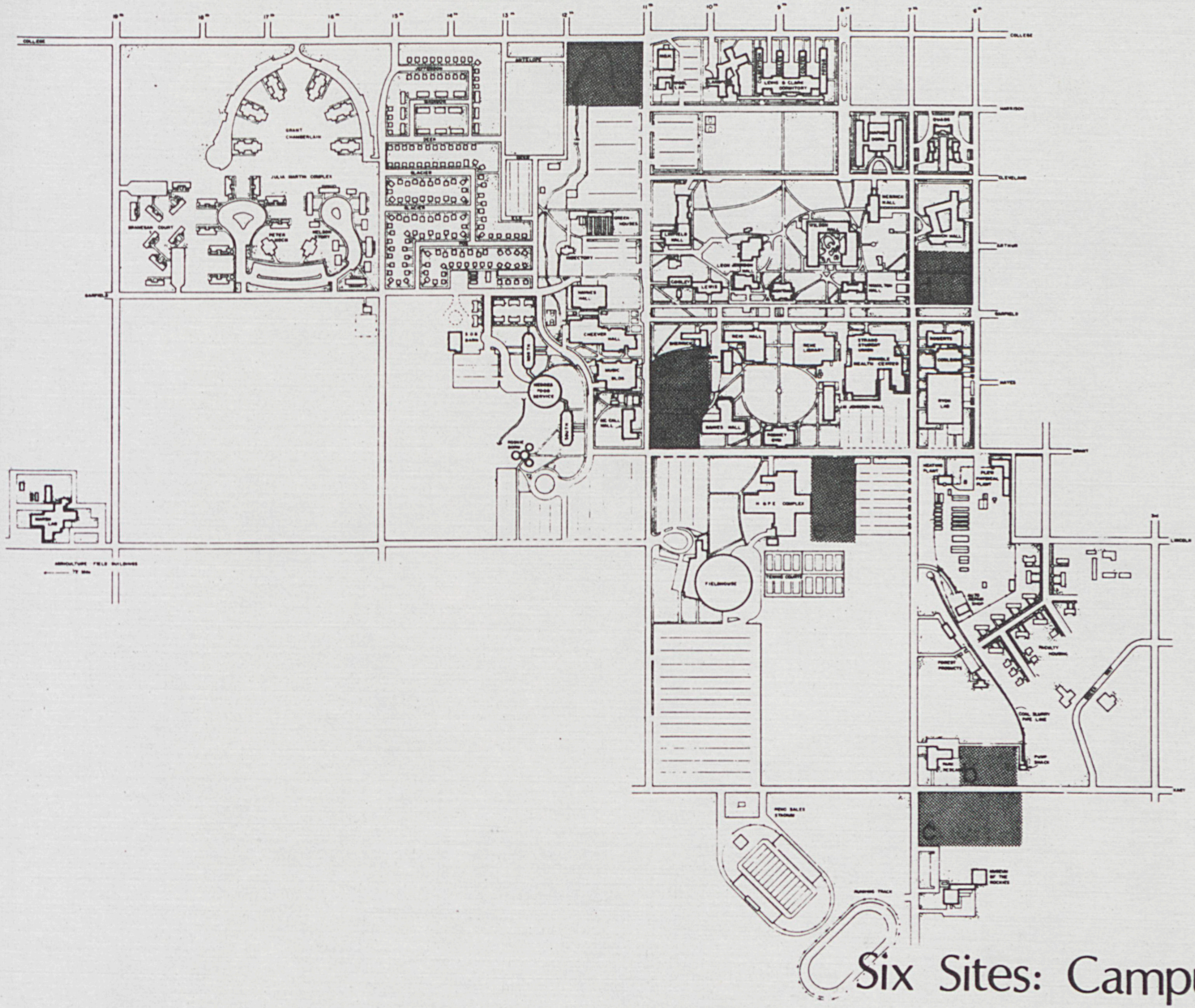
The Area



The Region



City of Bozeman

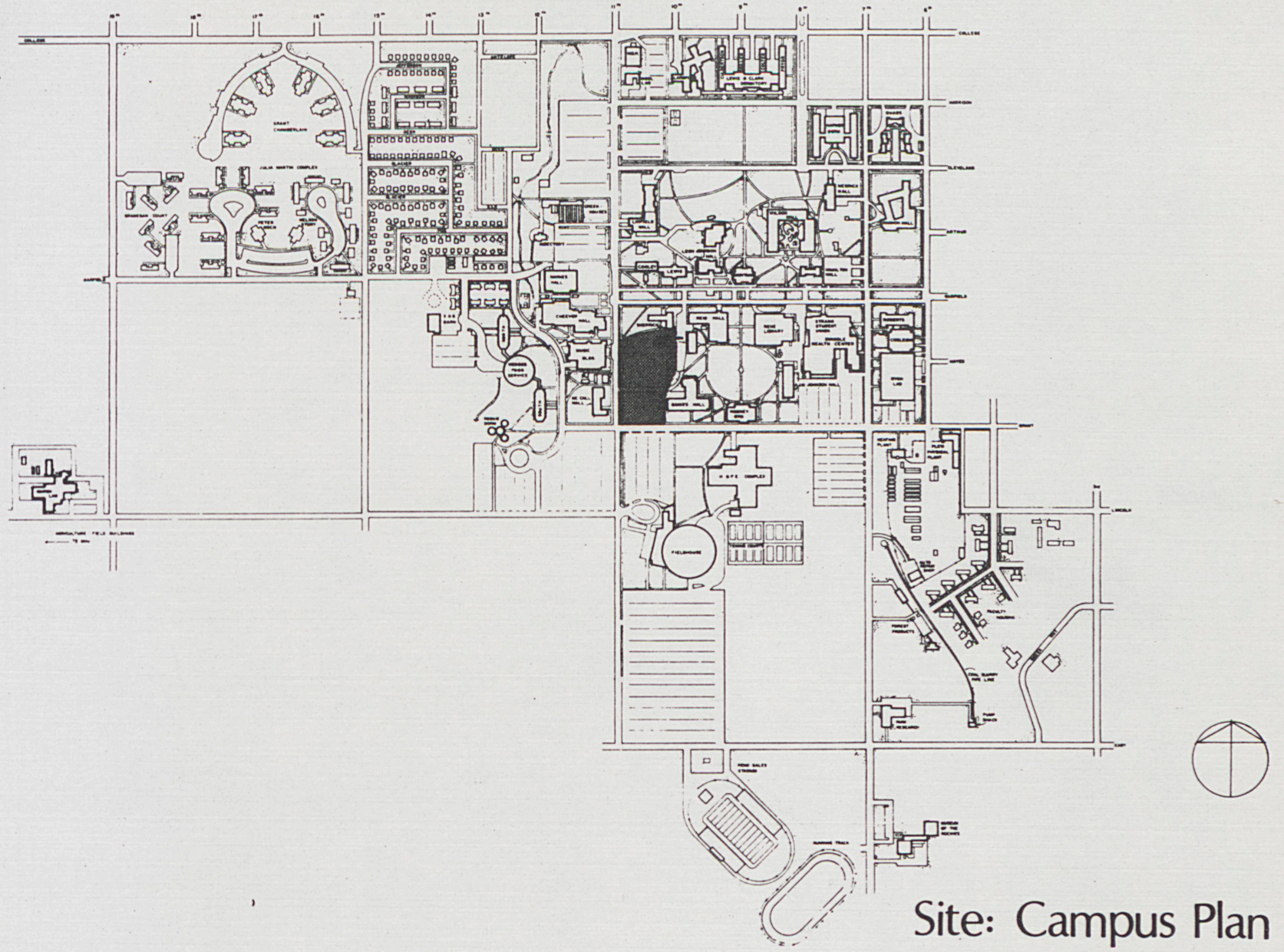


Six Sites: Campus Plan

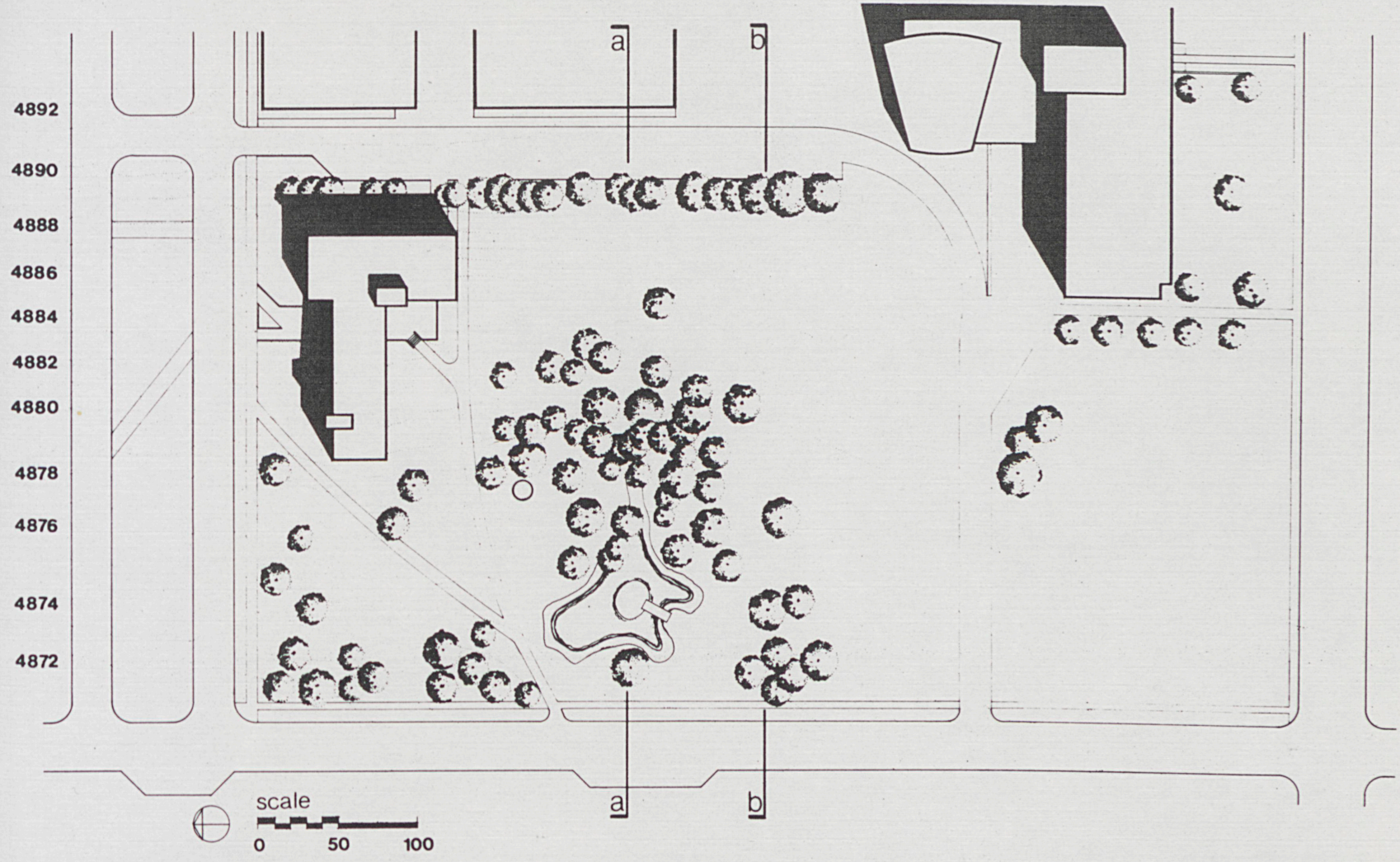
	considerations	site a	site b	site c	site d	site e	site f
1.	in response to the materials of a larger context: local/ regional	●	●	●	●	●	●
2.	in response to the surrounding material applications	●	○	○	●	○	●
3.	in close proximity to coordinating facilities	●	●	○	●	●	●
4.	in close proximity to campus	●	●	○	●	●	●
5.	in close proximity to the museum of the rockies	●	●	●	○	●	○
6.	in response to the materials of the museum of the rockies	○	●	●	○	●	○
7.	on campus	●	○	○	●	●	●
8.	within walking distance of campus	●	○	○	●	●	●
9.	easy vehicular access for services	●	●	●	●	●	●
10	parking nearby	●	●	●	●	●	●
11.	accessible to the public	●	●	●	●	●	●
12.	off campus proper	○	●	●	○	○	●
13.	to define a campus boundary	●	○	○	●	●	●
14.	large site compared to building area	●	●	●	○	●	●

legend: high: ● medium: ● low: ○

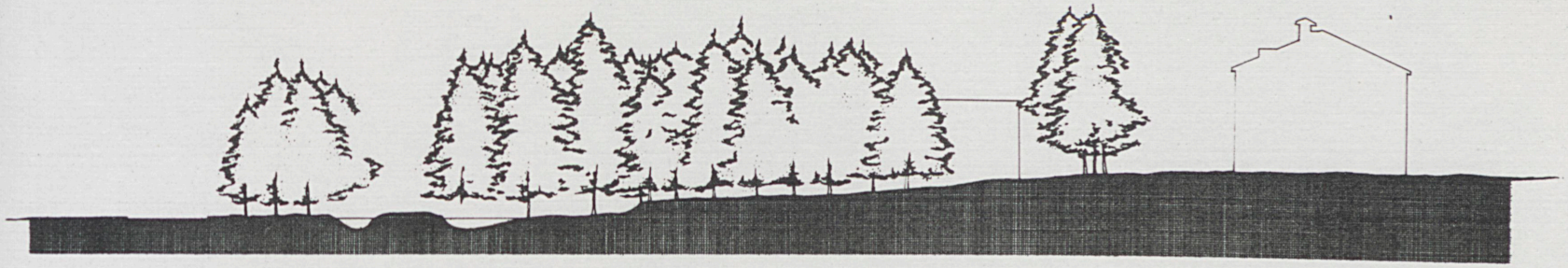
Site Matrix



Site: Campus Plan



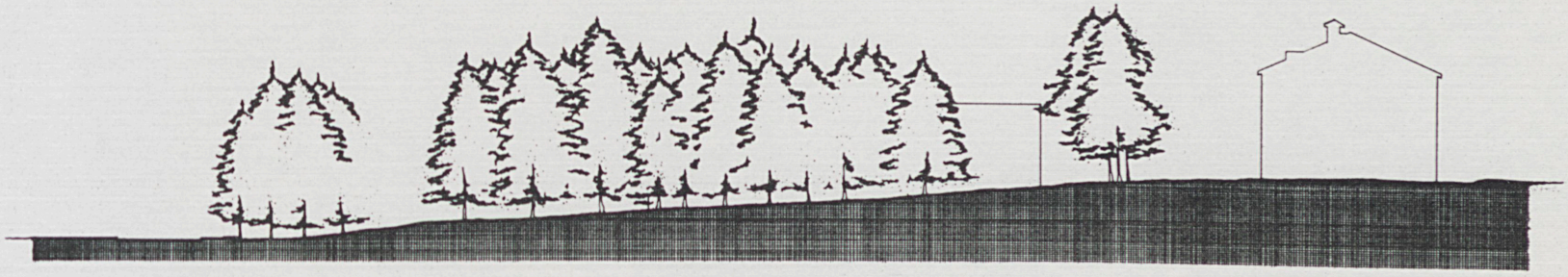
Existing Site



scale

0 50 100

profile a



scale

0 50 100

profile b

Site Profiles

Site Analysis

The corner of Grant Avenue and Eleventh Street, bounded to the north by Sherrick Hall, the nursing building, to the east by Gaines Hall, the chemistry building, and to the west by existing coniferous trees, on the campus of Montana State University.

I. Soils

a. Type of soil -- large amounts of fill on site, so conditions vary, but considered to primarily consist of Bozeman silty loam.

b. Any unusual amount of fill required -- this will vary depending upon final location of building due to large amounts of fill on site.

c. Is soil bad enough to warrant a mat foundation -- no.

d. Is soil bad enough to warrant use of a pier (caison) foundation -- yes.

II. Hydrology

a. Any water problems -- no, some rising of water table in spring due to snow melt resulting in marshy conditions around area of frog pond, well, and natural spring.

b. Location of water table -- varies across site.

*c. Any bodies of water on site or nearby -- yes, a frog pond, natural spring, and a well.

*indicates graphic supplement

d. Any irrigation easements or ditches -- no.

*e. Drainage patterns -- flows from east to west down the site, with water flowing into the natural drainages of the frog pond and existing spring.

f. Any natural drainage problems -- no.

III. Utilities

*a. Septic -- city sewer hook up.

*b. Availability of services.

1. Gas -- OK
2. Phone -- OK
3. Electricity -- OK
4. Water or Well -- OK
5. Steam and Return -- OK
6. T.V. Cable -- OK

IV. Climatic Conditions

a. Temperature range -- +100° F to -36° F.

*b. Prevailing Winds.

1. Storm (winter) wind -- from 90° west of south to 22° east of south.
2. Summer wind -- from 90° west of south to 135° east of south.

*c. Wind velocity -- 5 m.p.h. to 10 m.p.h. normally, with higher gusts occurring throughout the year.

d. Precipitation.

1. Rainfall

a. Annual average -- 14 inches.
b. Annual extremes -- 8 inches to 29 inches.

2. Snowfall

a. Annual average -- 24 inches.
b. Annual extremes -- 37 inches to 12 inches.

e. Humidity

1. Winter -- averages 70%.
2. Summer -- averages 30%.

f. Frostline -- four feet below grade.

g. Tornado or hurricane area -- does not apply.

h. Unusual local conditions -- no.

i. Lightening protection -- does not apply.

V. Solar Orientation

*a. Solar angles -- see graphic supplement.

b. Differential expansion -- possibilities if masonry used.

c. General direct light exposure -- excellent.

d. General exposure intensities.

1. North -- fair (partial obstruction from surrounding vegetation consisting of tall coniferous trees).
2. South -- excellent.
3. East -- moderate (shadows cast by structures in the morning hours).
4. West -- moderate (partial obstruction from surrounding vegetation consisting of tall coniferous trees over western portion of site).

e. Shadows/any structure blocking sunlight to site? -- no, existing structures, Sherrick & Gaines Hall, do not cast shadows across site.

VI. Vegetation/Landscape

a. Trees -- northwestern portion of site is covered with a variety of tall coniferous trees, with many other species randomly occurring across the site.

b. Hedges -- established growth near Sherrick and Gaines Halls.

c. Plants -- nothing of special interest.

d. Grasses -- site is currently covered with grass, type not significant.

VII. Views

*a. North -- to existing vegetation, Sherrick Hall, and mountains beyond.

*b. South -- to mountains.

*c. East -- to campus buildings.

*d. West -- to existing vegetation, to campus buildings, and mountains beyond.

*e. Other -- see graphic supplement.

VIII. Sensory Stimulus

a. Offactory -- nothing special.

b. Tactile -- nothing special.

c. Gastotory -- nothing special.

d. Auditory -- nothing special.

e. Visual -- see VII.

IX. Adjacent Structures

a. North -- Sherrick Hall, the nursing building.

b. South -- none.

c. East -- Gaines Hall, the chemistry building.

d. West -- none.

e. Any basement in existing buildings -- yes (in both Sherrick and Gaines Halls), also some existing foundations on eastern portion of site.

f. Any underground structures in the area -- no.

g. Will driving of piles adversely affect or damage adjacent structures -- no.

h. Any tall buildings in the area -- no, four story maximum.

i. Will surrounding buildings affect wind loading -- no.

j. Noise control necessary -- area is within campus proper, but should not warrant noise control system.

X. Prevailing Architectural Vocabulary

a. Rural -- to a limited degree.

b. Urban -- yes, within a rural context.

1. Predominant style -- not clearly defined, but is characterized by the general campus vernacular.
2. Strong design considerations -- the use of materials, in this instance brick, which consideration must be given.

XI. Character of Adjacent Environment

a. Natural -- yes, many tall coniferous trees and existing natural spring.

b. Artificial -- yes, due to surrounding buildings and their support entities.

c. Dilapidated -- no.

d. Growing/Changing -- yes, due to the nature of the campus as a state institution with plans for future expansion.

e. Stagnant -- no.

f. Renewable -- yes, if required or needed.

XII. Unmentioned Site Characteristics

a. None.

XIII. Movement/Circulation

*a. Vehicular

1. Circulation.

a. Primary -- around site, on Eleventh Street, Grant Avenue, and Garfield Avenue.
b. Secondary -- currently up service drives to Gaines Hall, and above site on eastern edge adjacent to Traphagen Hall.

2. Parking -- currently above site on eastern edge adjacent to Traphagen Hall, across Grant Street in the Field House parking lot, or in Hedges dormitory parking lot.

3. Unusual craft/vehicle conditions -- possible large trucks, or carry-alls may enter the site to unload remains and significant archaeological data.

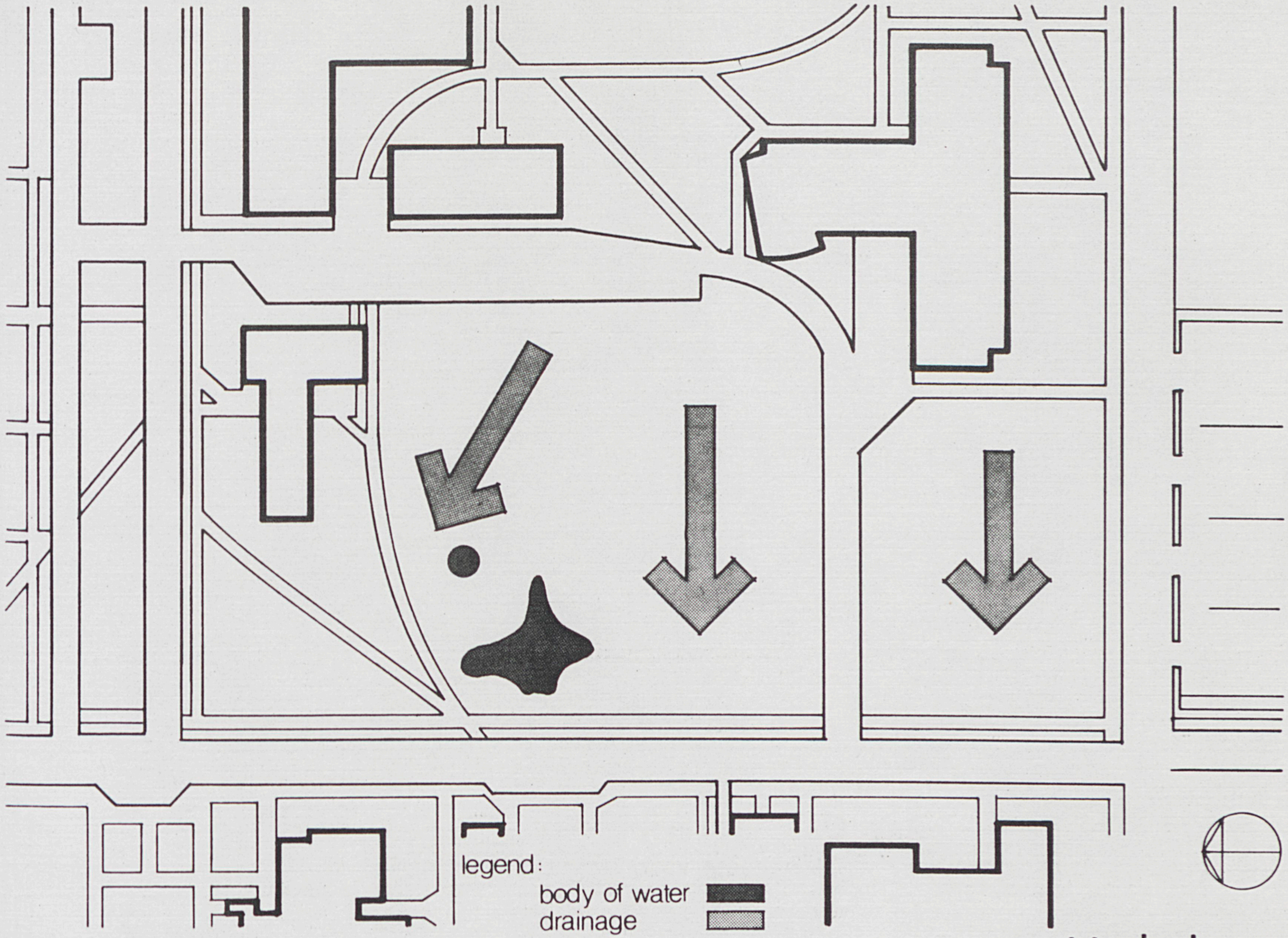
*b. Pedestrian

1. Circulation

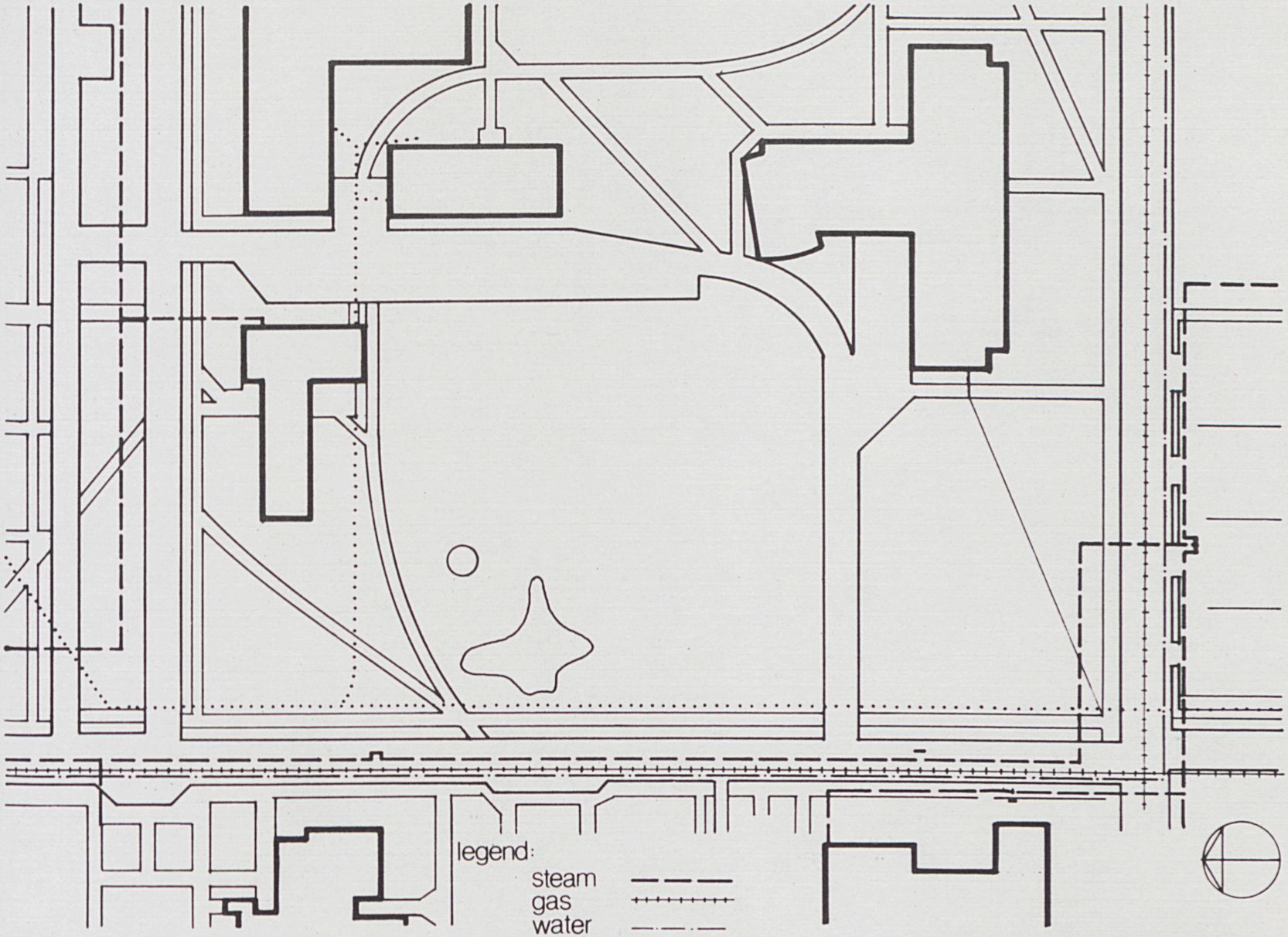
a. Primary -- sidewalks around the site, and through the site behind Sherrick Hall, also use of service drives by pedestrians.
b. Secondary -- established footpaths between sidewalks, and across the site.
c. Random -- people, primarily students, wander across the site often ignoring established primary and secondary routes.

c. Other considerations

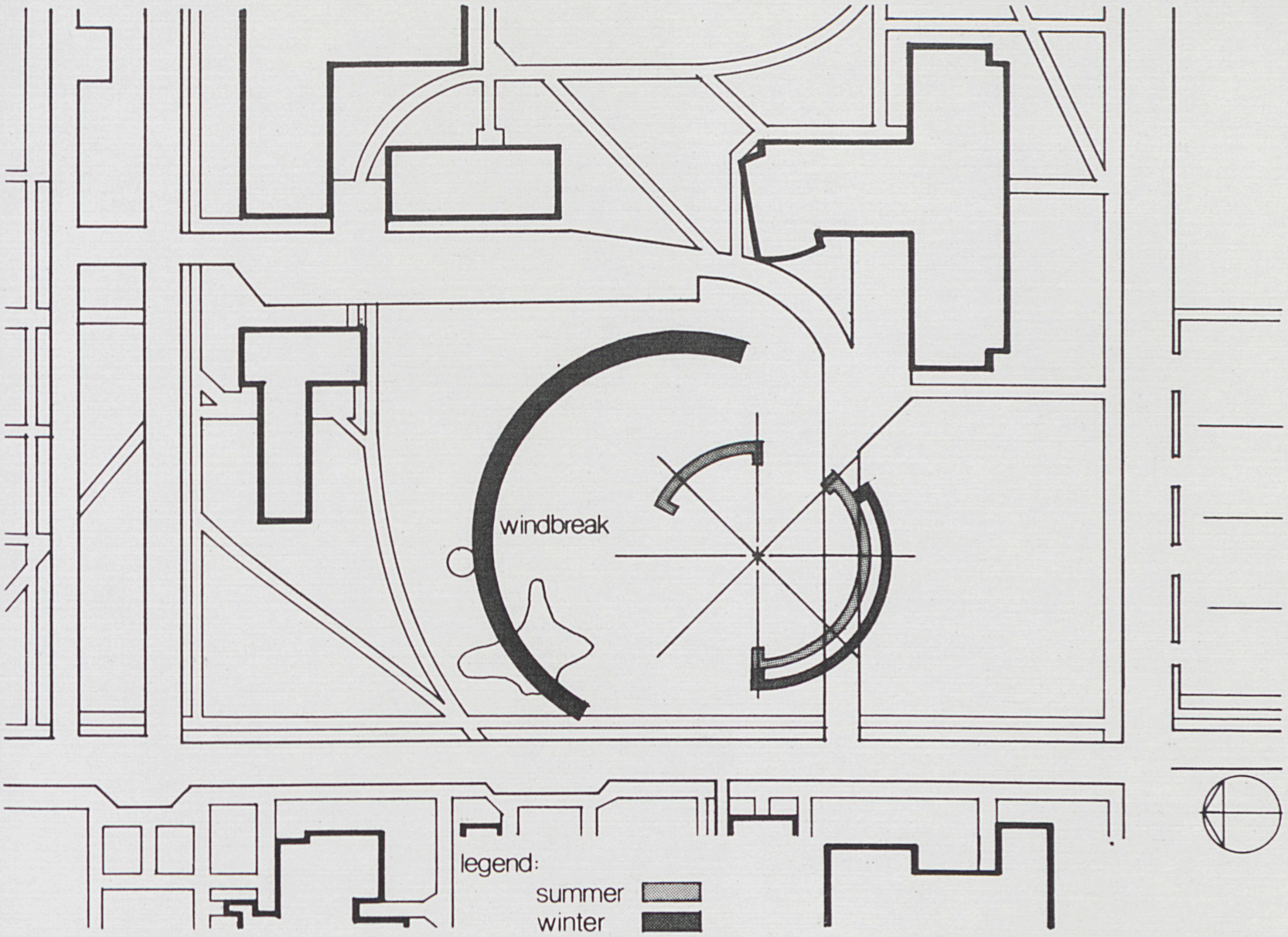
1. Bicycles -- travel along vehicular paths for the most part, parking all around the site.



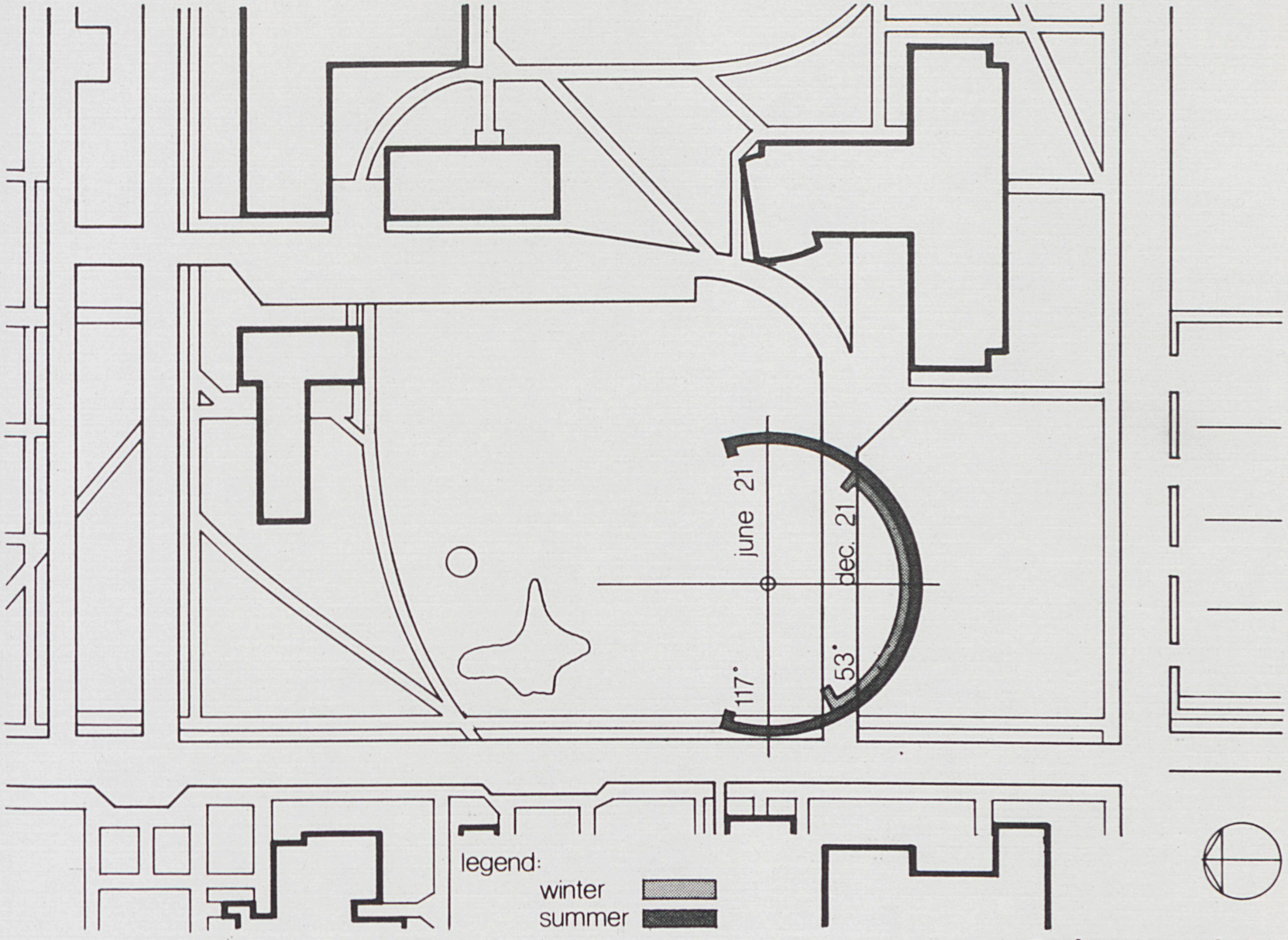
Hydrology



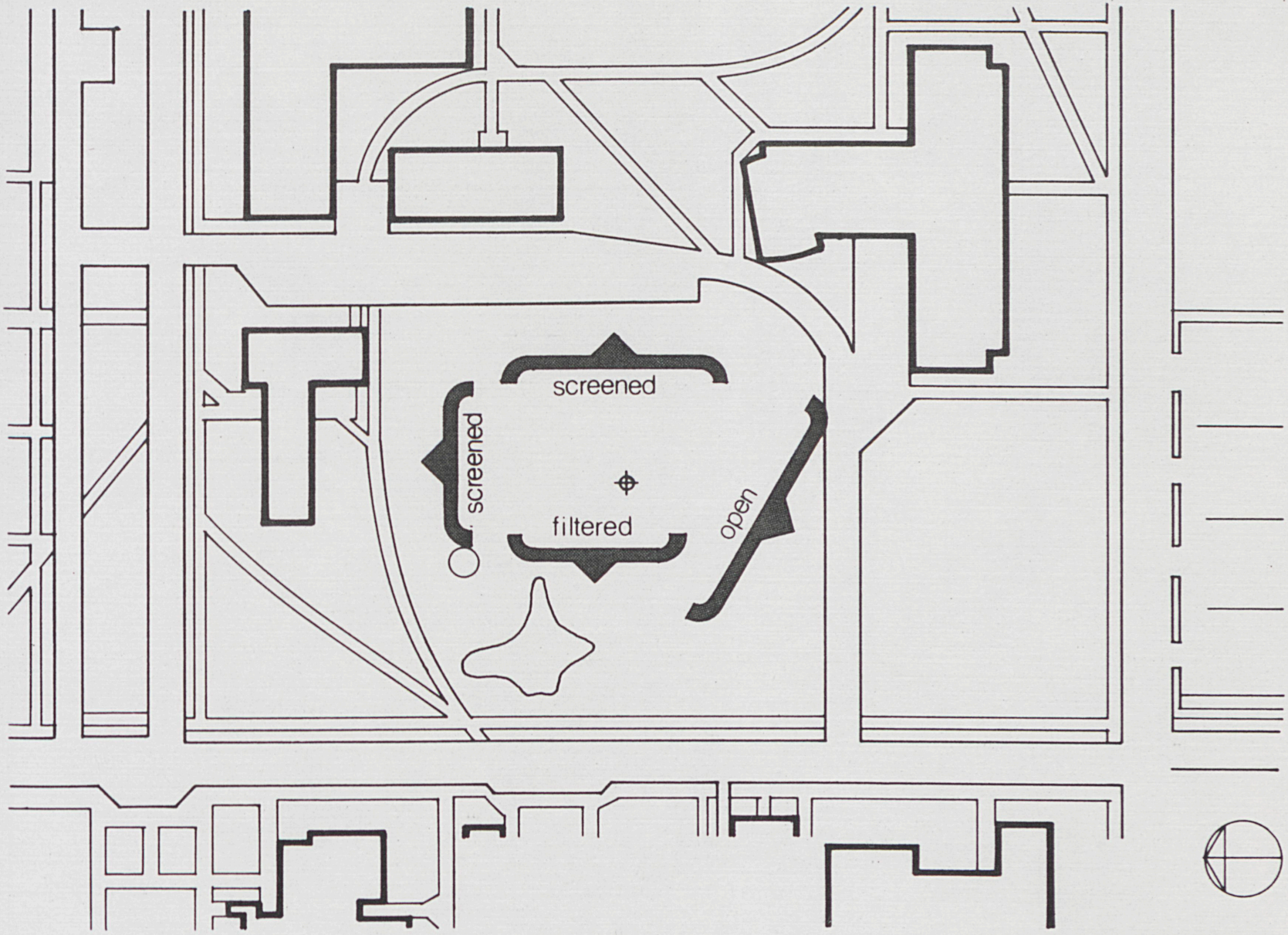
Existing Utilities

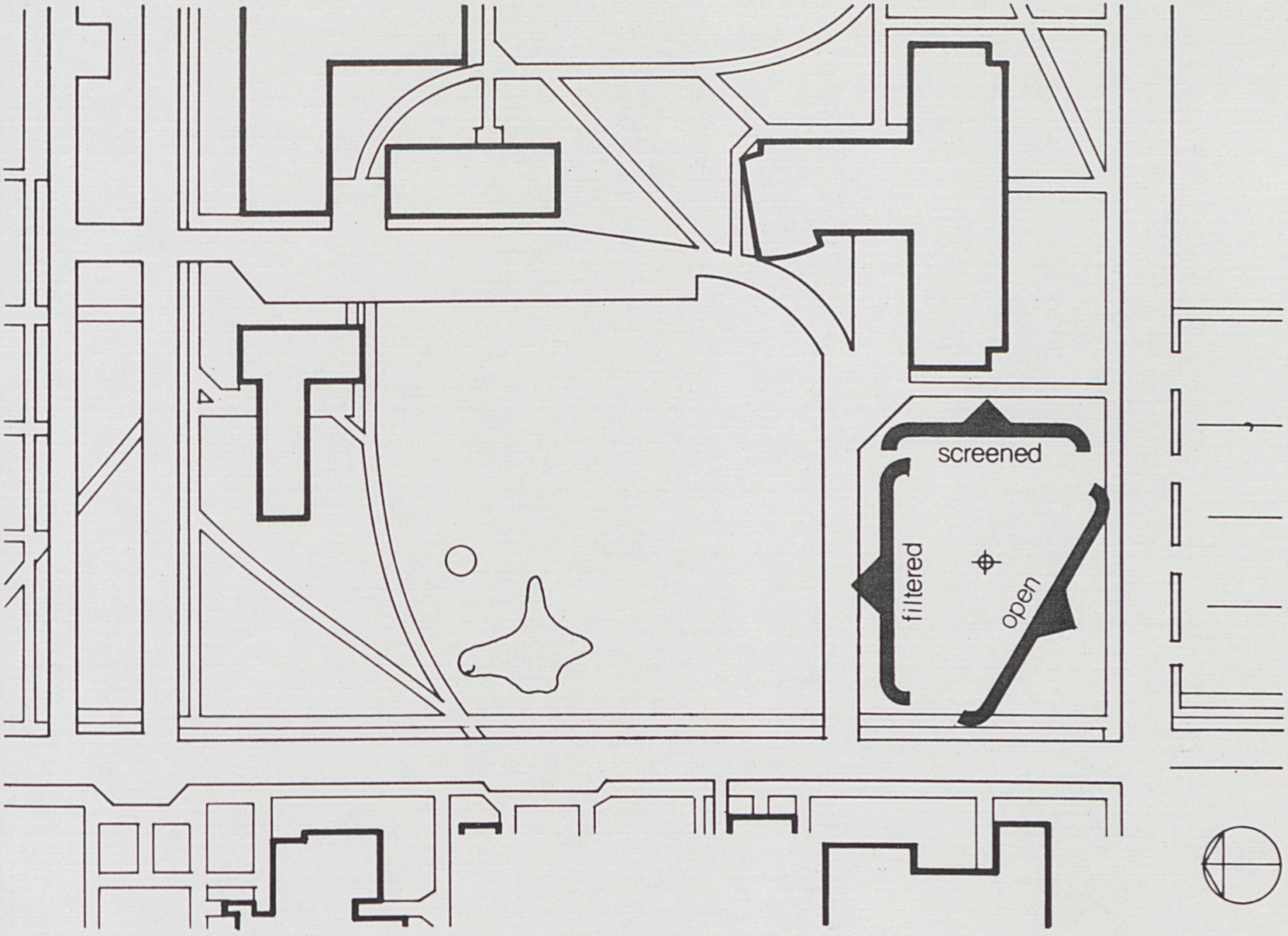


Prevailing Winds

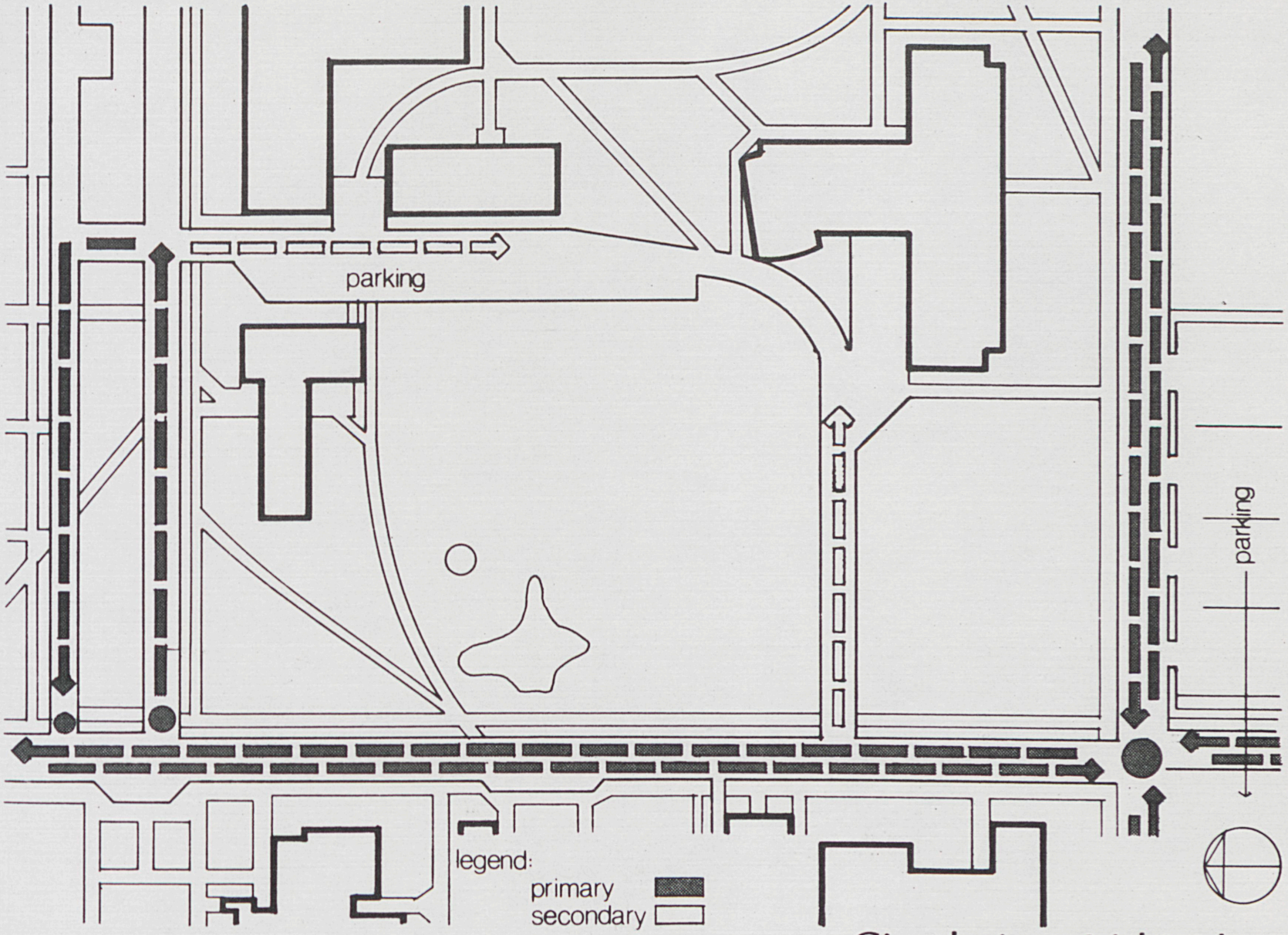


Solar Angles

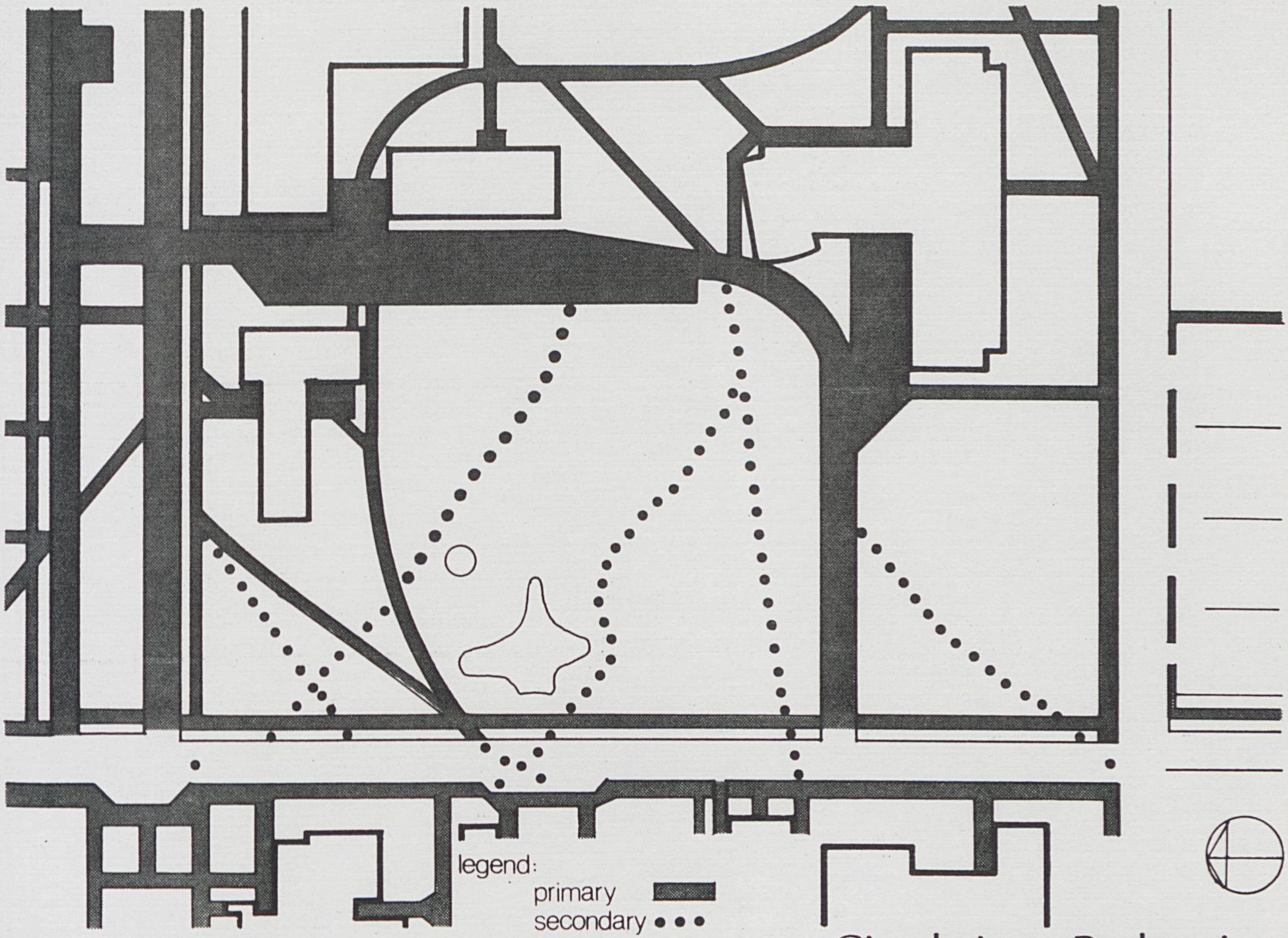

screened
screened
filtered
open
View Axis



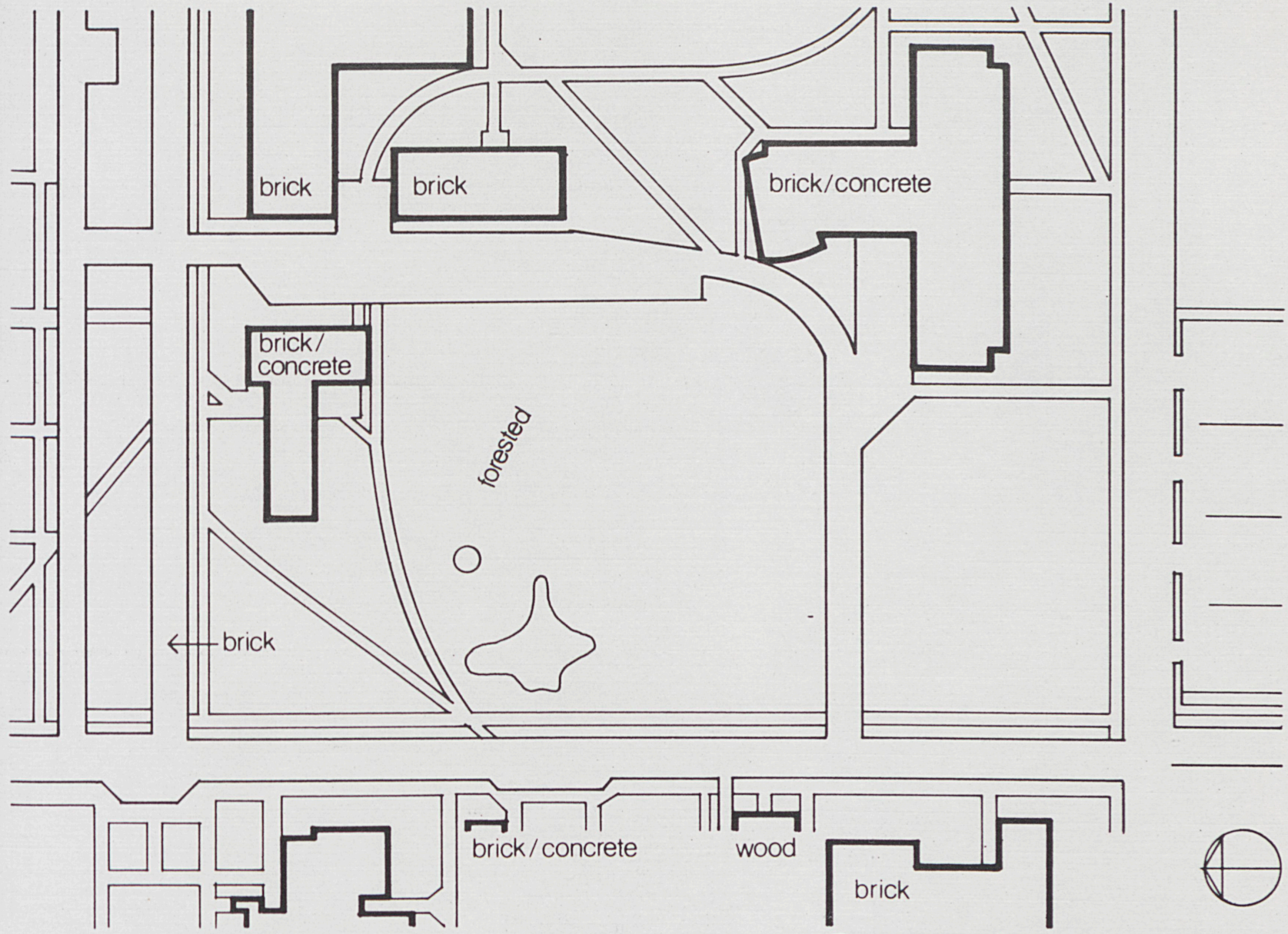
View Axis



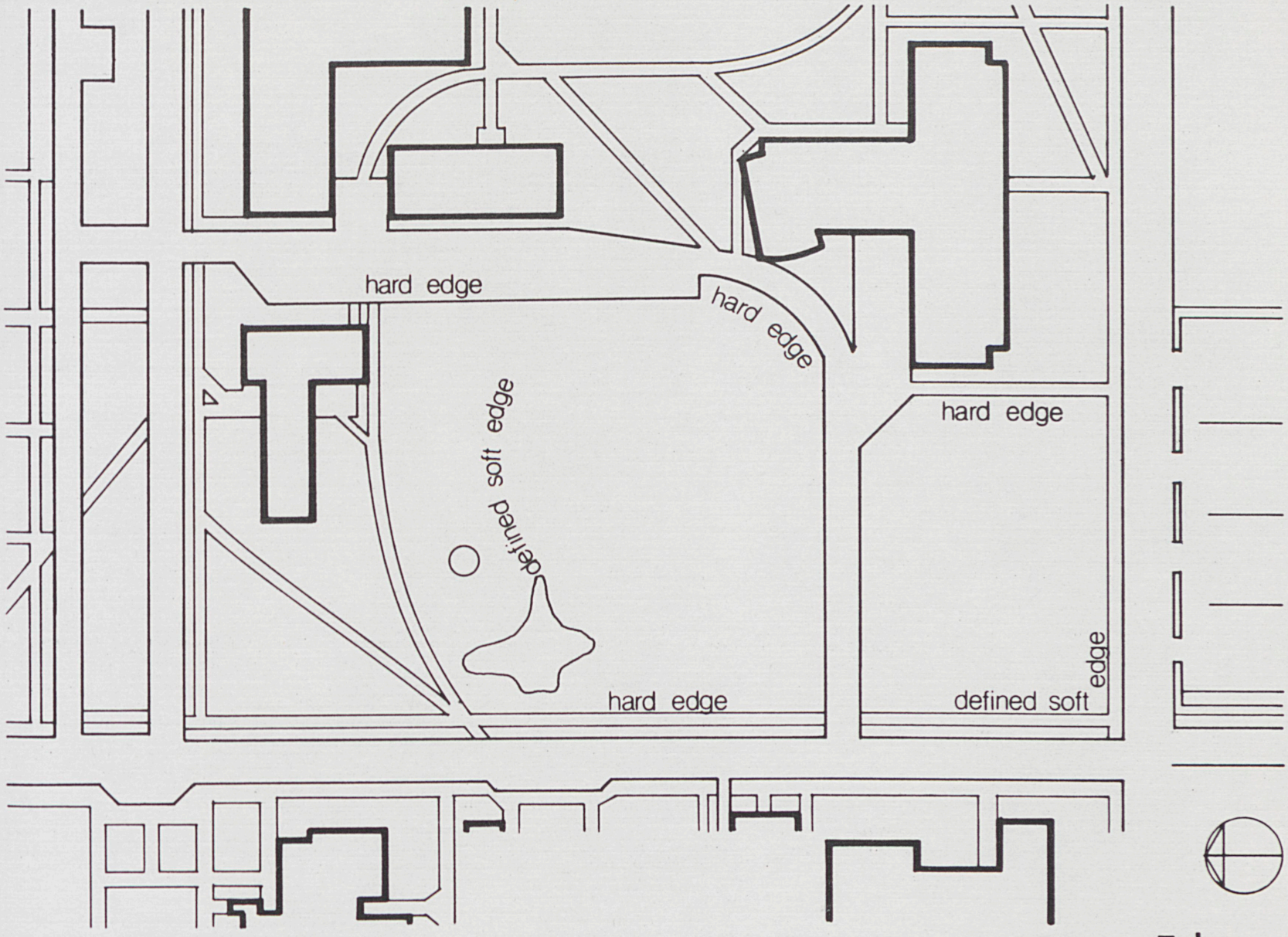
Circulation: Vehicular



Circulation: Pedestrian



Surrounding Materials


hard edge
hard edge
hard edge
defined soft edge
hard edge
defined soft edge

Edges

Program

A regional center for archaeological research is a facility which is a specialized center at a university that requires a continuing commitment of facilities and services, and of faculty time and effort, as well as financial support from external agencies and foundations. The decision to initiate such an integrated laboratory must therefore be supported by strong evidence that the sum is greater than the individual parts, with direct benefits accruing to each participant: the univeristy, external funding agencies, and the participating faculty. Advantages evident from the university's perspective are several, including the following:

1. The opportunity to forge new frontiers of research through concentration of efforts in one research field.

2. The opportunity to create new bonds of interdisciplinary cooperation, which have traditionally remained separate disciplines.

3. The provision of research experience and training opportunities to graduate students.

4. Economics in the construction, equipping, and use of facilities through emphasis on their joint use.

5. The extensive laboratory facilities envisioned would permit the university to function as a regional center for archaeological research. It is probable that researchers from other institutions would be attracted to the laboratory during summers or research semesters to utilize the facilities. Thus, the existence of the facility would strengthen archaeological research in the region.

A generalized regional center should physically include (1) office space, (2) laboratory space, (3) a research library, (4) a records center, (5) a conference center, (6) temporary storage for collections, (7) permament storage for collections, (8) a system of transportation between these units to facilitate the easy movement of specimens, (9) a typing and duplications center, (1) equipment storage, and (11) room to expand.

Functions to be performed within the center include: (1) basic archaeological laboratory analyses, (2) report writing, (3) specialized laboratory analyses, (4) typing, (5) photography of specimens, (6) care and restoration of specimens, (7) cataloging of specimens, (8) storage of specimens, (9) photoduplication of records, (10) drafting, (11) computerization of data, (12) data retrieval, (13) research publication and distribution, and (14) hosting of conferences or symposia. No single institution in the United States is currently equipped to carry out these functions utilizing the technology that is available within our society. The regional center design is conceptualized as a facility wherein all of these functions may be carried out by a full-time professional staff focusing on regional research problems.

Inasmuch as the specific research needs within separate regions vary and there already exist certain institutions within these regions, it is assumed that each regional center would vary in size, range of facilities required, and to some degree in scope of work. Therefore this regional design will be couched in general terms as follows:

A. Lobby

This space is provided as an introductional and orientational space to the functioning aspects of the building. It receives people, most importantly the general public, and invites them into the facility.

Required Area: 400 sq. ft.

B. Gallery

This space is provided for the display of archaeological materials to inform and educate those interested. Displays or exhibits may also be coordinated with such activities at the Museum of the Rockies.

Required Area: 600 sq. ft.

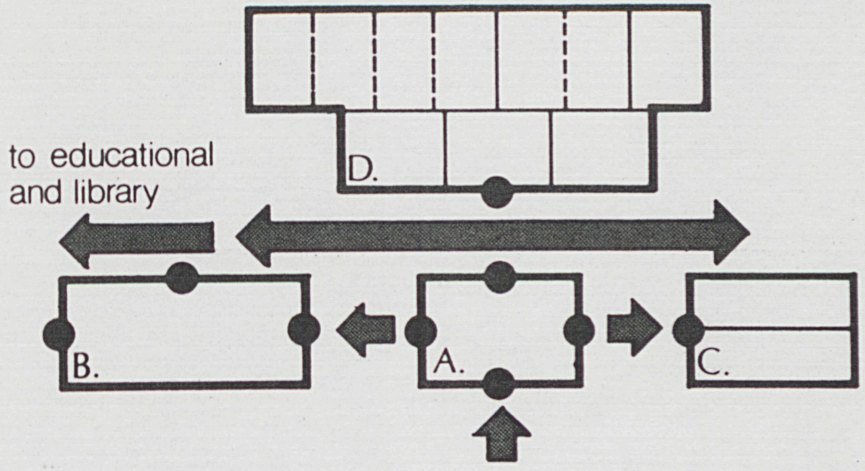
C. Rest Rooms

Required Area: A minimum of 2 at 200 sq. ft. = 400 sq. ft. per floor

D. Administration

This area accommodates those functions necessary to the basic operation of such a facility within the campus institution. The following lists the minimum required spaces within this area:

Reception/Secretarial:		200 sq. ft.
Equipment & Storage:		200 sq. ft.
Director's Office:		200 sq. ft.
Associate's Office:	2 @ 150 sq. ft. =	300 sq. ft.
Open Office Space/carrell space for visiting personnel and their typists:	4 @ 150 sq. ft. =	600 sq. ft.
Internal Conference Area:		200 sq. ft.
Required Area:		1,700 sq. ft.

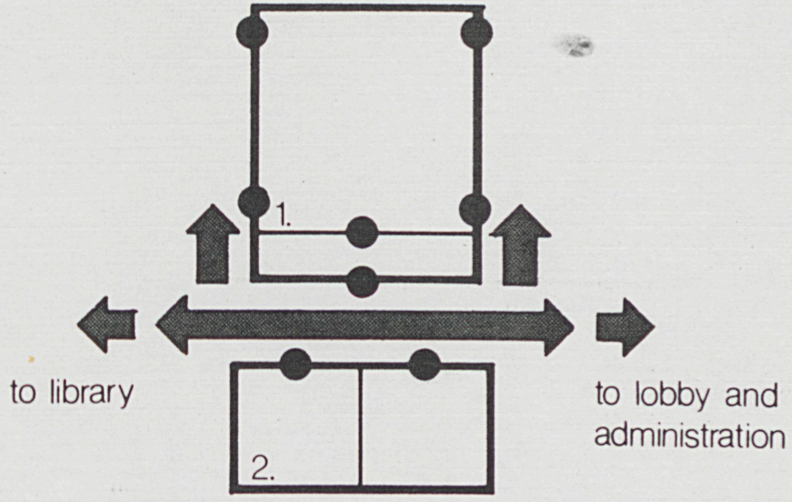


A. Lobby
B. Gallery
C. Rest Rooms
D. Administration

E. Educational/ Conference

This area is a support facility and is intended to fill two needs within this research center. Here are classrooms and an auditorium for educational purposes, as well as to accommodate those involved in conference or symposia activities. It must be somewhat a flexible area to support the needs of these two user groups. The following lists the required spaces within this area:

Classrooms:	2 @ 400 sq. ft. = 800 sq. ft.
Auditorium/maximum occupancy of 150 persons:	1,200 sq. ft.
Required Area:	2,000 sq. ft.

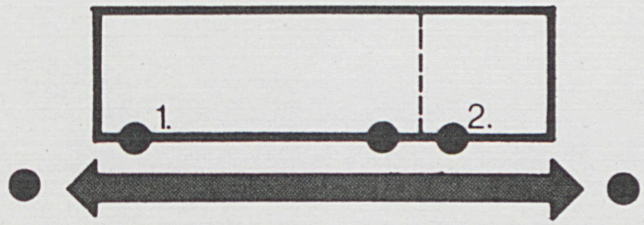


E. Educational/Conference
1. auditorium
2. classrooms

F. Storage

This area accomodates both the permanent, dead, storage of archaeological materials in addition to some temporary storage. The following lists the required spaces in this area.

Permanent Storage:	1,000 sq. ft.
Temporary Storage:	400 sq. ft.
Required Area	1,400 sq. ft.



to garage

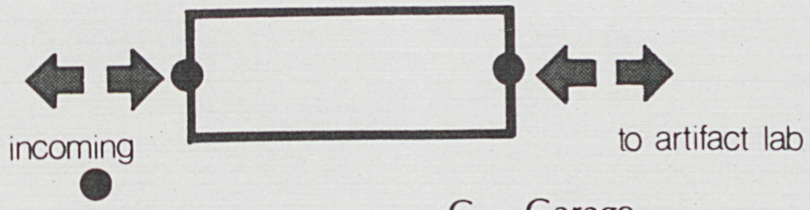
to artifact lab

F. Storage
1. permanent storage
2. temporary storage

G. Garage

This area within the research center is an area that houses the equipment necessary for the successful undertaking of the archaeological dig. This comes to include one back hoe-front end loader, one-one and one half ton truck, two-three quarter ton trucks, plus storage space for equipment such as screens and shovels. The following lists the required spaces within this area:

Garage Space:	600 sq. ft.
Equipment Storage:	200 sq. ft.
Locker & Personnel Area:	200 sq. ft.
Required Area:	1,000 sq. ft.



G. Garage

Laboratories

These areas accommodate the majority of research activities that occur within this research center. Each lab has a specific function which aids in the total processing of archaeological materials.

H. Statistics Laboratory and Library

The statistics laboratory and library is not intended to function as a research lab, but more as a central information area for the building. Its primary function, as a support facility, is to provide a means of reference for both written and sample materials to those who require them in their research efforts.

Two areas are required in this area. The first is the library area which houses much of the written data within this research facility. Here also is where reference sections are provided to aid persons in the search for materials. Tables and seating are provided so that research and analysis might also be carried out here.

The second part of this information area houses data retrieval systems, some which are directly related to the storage system of the research facility. Here catalog and file systems are provided to aid in the location of particular specimens for study. These will take the form of card files and computer programs, since computer terminals will also be located in this area to provide information as to the location of study collections for data retrieval. Other equipment incorporated into this statistical laboratory will include calculators and typewriters.

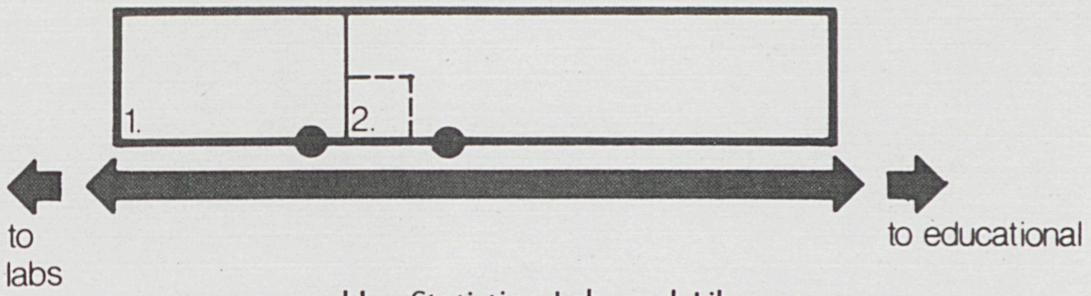
Library

Librarian's Office:	100 sq. ft.
Circulation Area:	60 sq. ft.
Catalogs & Files:	40 sq. ft.
Tables & Seating:	500 sq. ft.
Bookstacks:	800 sq. ft.
Required Area:	1,500 sq. ft.

Statistical Laboratory

Required Area:	700 sq. ft.

Total Required Area: 2,000 sq. ft.



H. Statistics Lab and Library

1. statistics lab
2. library

I. Artifact Laboratory

The artifact laboratory is designed primarily for the processing of artifacts. Initial requirements are thus for facilities for washing, labeling, classification, and primary analysis, and finally storage, both prior to the initial processing and later after it has been completed.

Three areas are required in the artifact laboratory. The first is an area for incoming and receiving of artifacts. This area should be somewhat self-contained because it is here that most archaeological material is received and contamination to other parts of the lab should be kept to a minimum. Here is where material is sorted and stored prior to examination. Receiving occurs by two means, within the building itself, or by an exterior causeway which allows trucks and equipment transporting materials to come directly into the building from the garage and equipment area.

The second part is to be used as an archaeological reference area and its function basically is that of reference. This is a relatively small area, but it allows for cross referencing to be carried out between found data and existing, recorded samples.

The third section is a large area for mechanical analysis of specimens. Here is where artifactual analysis is carried out and where a further event of study often goes on. Artifacts may be irradiated, then sectioned, examined under low power magnification to identify wear patterns, examined under extreme magnification for evidence of manufacturing stress or alteration in the chemical lattice, photographed through the microscope, subjected to X-ray diffraction, etc. These techniques provide insight into cultural data through already-established procedures and, as well, provide opportunities for the development of new research techniques.

Storage Area:	500 sq. ft.
Reference Area:	500 sq. ft.
Mechanical Analysis:	1,500 sq. ft.
Required Area:	2,500 sq. ft.

J. Lithic Laboratory

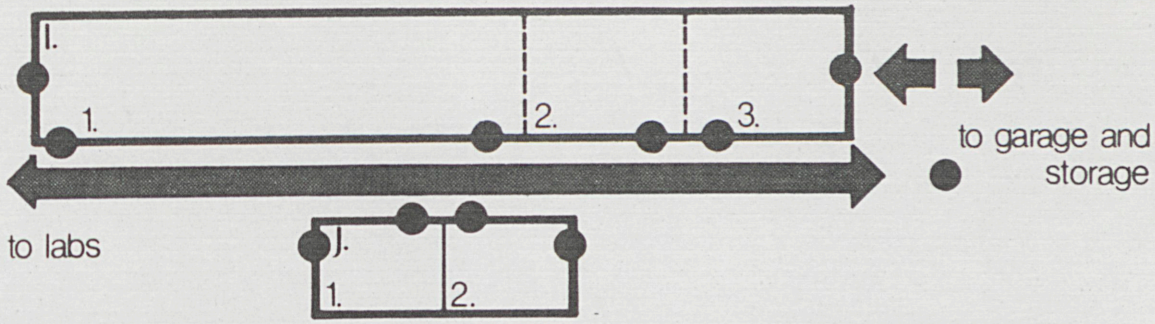
A lithic lab can be incorporated into a well equipped artifact lab, but in this instance a separate laboratory is provided because of the special function of operations involved.

There are three areas of concern within this laboratory and the first is devoted to obsidian hydration dating. The technique of hydration measurement is relatively quick and simple. A thin-section of obsidian is cut from the artifact or flake at right angles to the surface to be measured. After grinding this section down to extreme thinness and placing it on a microscope slide, the hydration layer can be observed with a microscope. Other operations may also go on within this lab such as the processing of charcoal and bones.

A second major research interest concerns the identification of stone tool sources. Samples of stone from sites and quarries are thin-sectioned and then identified through the use of a petrographic microscope.

The third area of concern requires a room for lithic replication. Here tools and artifacts are cast and reproduced in plaster for display and study. This area should provide for a large workspace with seating all around for this process.

Dating Area:	300 sq. ft.
Replication Area:	300 sq. ft.
Required Area:	600 sq. ft.



I. Artifact Laboratory

1. mechanical analysis
2. reference area
3. incoming storage

J. Lithic Laboratory

1. dating area
2. replication room

K. Photolaboratory

The archaeological photolaboratory is designed as a support facility with two primary functions: (1) the taking of publication quality photographs of research specimens and (2) the processing and printing of negatives either taken in the field or in the photo studio. This laboratory is not intended to function as a research laboratory. Research needs or objectives that might require photogrammetric techniques and specialized equipment are primarily within the realm of aerial photography and interpretation, which are considered as part of the cartographic laboratory.

The photolaboratory needed for the routine processing of film is viewed as requiring four connecting rooms: a camera room or studio, a negative storage room, a printing room or darkroom, and a print drying room. The functions of these rooms is fairly standard, so no elaboration is provided here. Neither color nor movie film processing are considered necessary.

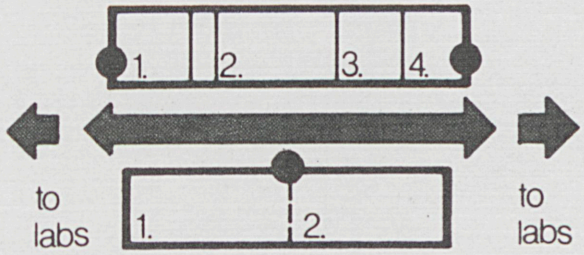
Camera Room:	150 sq. ft.
Darkroom:	200 sq. ft.
Print Drying Room:	100 sq. ft.
Negative Storage Room:	150 sq. ft.
Required Area:	600 sq. ft.

L. Cartographic Laboratory

The cartographic laboratory is viewed as fulfilling two functions: mapmaking as part of archaeological recording, and mapmaking as a research technique. Routine archaeological record-keeping requires the construction of maps and profiles in the field. In the laboratory these illustrations must be drafted in a form suitable for research and publication. Research conducted within such a laboratory would depend upon aerial photographs as primary sources of archaeological data. These data must be

identified, interpreted, and then transferred to maps of a size and quality suitable for publication. Current interest in the survey of archaeological remains over large areas prepatory to investigations in the field makes aerial photo interpretation a major program within the envisioned laboratory.

Drafting Room:	300 sq. ft.
Map Making Room:	300 sq. ft.
Required Area:	600 sq. ft.



K. Photolaboratory

1. camera room
2. darkroom
3 print drying room
4. negative storage

L. Cartographic Lab

1. drafting room
2. map making

M. Environmental Laboratory

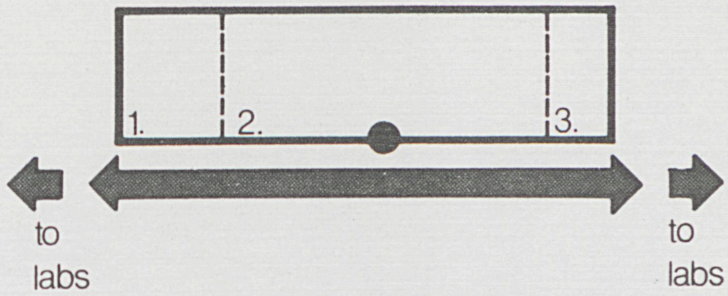
Environmental studies in archaeology have become increasingly important in recent years. Archaeological research provides a wealth of remains indicative of past environmental conditions. Each specimen recovered may be assigned provenience data identifying its locus, depth, age, and associations. The data may themselves be studied as to the role they play in man's adaptive response to his habitat, and they provide important information for the reconstruction of past environments, as well. The basic operational aspects of the laboratory include the washing, screening, separating, and weighing of site matrix components; all primary processes. Once so processed, certain remains are identified as to species or are sent out to identifying specialists, usually within the campus.

Three rooms are required in the environmental laboratory. The first is a laboratory for the scientific analysis of soil samples; it should be complete in itself; contamination must be avoided at all costs to protect both the samples and the equipment. It also should be self-contained in that all the chemicals, glassware, and equipment are stored here.

The second part is the archaeological sampling and storage room. Here bulk samples are processed for environmental data and some collections are stored. The equipment for this room consists primarily of large working tables and storage equipment.

The third section is the processing room in which the samples are washed, dried, and sieved. Ideally, the room should be separate from the other functions of the lab to avoid contamination.

Soil Samples Analysis:	500 sq. ft.
Samples Storage Room:	200 sq. ft.
Processing Room:	300 sq. ft.
Required Area:	1,000 sq. ft.



M. Environmental Lab

1. soil samples analysis
2. samples storage room
3. processing room

Building Area:	14,800 sq. ft.
Mechanical Area: (10% of building area)	1,480 sq.
Circulation: (20% of building area)	3,250 sq. ft.
Outdoor Areas:	limited, but as required
Total Building Area:	19,500 sq. ft.

Code Analysis

Codes Employed:

Uniform Building Code, 1979 Edition
National Handicap Code
Zoning Ordinance of the City of Bozeman

A. OCCUPANCY GROUP

Group B, Division 2

B. TYPE OF CONSTRUCTION

Type I F.R.
Type II F.R.

Types of Construction--Fire-Resistive Requirements
(in hours)

Building Element	Type I F.R.	Type II F.R.
	Noncombustible	
Exterior Bearing Walls	4 Hour Sec. 1803 (a)	4 Hour see Sec. 1903 (a)
Interior Bearing Walls	3 Hour	2 Hour
Exterior Non-Bearing Walls	4 Hour Sec. 1803 (a)	4 Hour see Sec. 1903 (a)
Structural Frame	steel or iron, see Chapter 27, reinforced concrete, see Chapter 26, reinforced masonry, see Chapter 24. 3 Hour	steel or iron, see Chapter 27, reinforced concrete, see Chapter 26, reinforced masonry, see Chapter 24. 2 Hour
Partitions--Permanent	1 Hour	1 Hour
Shaft Enclosures	2 Hour	2 Hour
Floors	2 Hour	2 Hour
Roofs	2 Hour see Sec. 1806	1 Hour see Sec. 1906, but specified as in Sec. 1806.

Types of Construction--Fire - Resistive Requirements
(in hours)

Building Element	Type I F.R.	Type II F.R.
	Noncombustible	
Exterior Doors & Windows	See Sec. 1803 (b), to comply with Section 504, and shall be protected by a fire assembly having a 3/4 Hour fire protection rating.	See Section 1903 (b), to comply with Section 504. Same as for Type I F.R.
Parapets Required	does not apply	yes, not less than 30 inches above the point where the roof surface and the wall intersect and having the same degree of fire resistance required for the wall upon which they are erected.
Projections From Building	shall be of non-combustible materials. See Section 504 (b)	Same as Type I F.R.

C. LOCATION ON PROPERTY

Buildings housing Group A Occupancies shall front directly upon or have access to a public street not less than 20 feet in width. The access to the public street shall be a minimum 20 foot wide right-of-way, unobstructed and maintained only as access to the public street. The main entrance to the building shall be located on the public street or on the access way.

See Section 603.

ZONED DISTRICT	PLI--Public Lands & Institutions.
LOT AREA & WIDTH	No requirement.
LOT COVERAGE	The entire lot, exclusive of required yards and parking, may be occupied by the principal and accessory buildings.
YARDS	No requirements.
SETBACKS	No requirements.

Light, Ventilation and Sanitation: See Section 605

All enclosed portions of Group A Occupancies customarily used by human beings and all dressing rooms shall be provided with natural light by means of exterior glazed openings with an area not less than one-tenth of the total floor area, and natural ventilation by means of openable exterior openings with an area of not less than one-twentieth of the total floor area or shall be provided with artificial light and a mechanically operated ventilating system. The mechanically operated ventilating system shall supply a minimum of 5 cubic feet per minute of outside air with a total circulated of not less than 15 cubic feet per minute per occupant in all portions of the building and such system shall be kept continuously in operation during such time as the building is occupied. If the velocity of the air at the register exceeds 10 feet per second, the register shall be placed more than 8 feet above the floor directly beneath.

Exit lighting in portions of buildings other than the stage shall be on a separate circuit from that of the stage. Such exit lighting shall be controlled from the box office or other approved central control center located in a portion of the building other than the stage. All lights in corridors, exit courts and exit passageways shall be protected by a wire cage.

All registers or vents supplying air backstage shall be equipped with automatic closing devices with fusible links. Such closing devices shall be located where the vents or ducts pass through the proscenium walls and shall be operated by fusible links located on both sides of the proscenium wall and both inside of and outside of the vent or duct.

There shall be provided in an approved location at least one lavatory for each two water closets for each sex, and at least one drinking fountain for each floor level.

For other requirements on water closets, see Section 1711.

Special Hazards: See Section 608

Stages shall be equipped with automatic ventilators as required in Section 3901.

Chimneys and heating apparatus shall conform to the requirements of Chapter 37 of this code and the Mechanical Code.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Proscenium curtains shall conform to the requirements set forth in U.B.C. Standard No. 6-1.

Flammable liquids shall not be placed or stored in any Group A Occupancy.

All exterior openings in a boiler room or room containing central heating equipment if located below openings in another story or if less than 10 feet from other doors or windows of the same building shall be protected by a fire assembly having a three-fourths-hour fire-protection rating. Such fire assemblies shall be fixed, automatic or self-closing. Every room containing a boiler or central heating plant shall be separated from the rest of the building by not less than a one-hour fire-resistive occupancy separation.

EXCEPTION: Boilers or central heating plants where the largest piece of fuel equipment does not exceed 400,000 Btu per hour input.

Fire Protection System

See Chapter 38--pending
Systems to be considered:

Standpipe System
Fire Department Hose Connection
Automatic Fire Extinguishing System (sprinkler)

Exceptions and Deviations

pending

D. ALLOWABLE FLOOR AREAS

	Types of Construction	
	Type I F.R.	Type II F.R.
Allowable Area (one floor)	unlimited	29,900 sq. ft.
Increase for Separation on 2 Sides	increased at a rate of 1¼ percent for each foot by which the minimum width exceeds 20 feet, not to exceed 50 percent.	same as for Type I F.R.
Increase for Separation on 3 3 Sides	increased at a rate of 2½ percent for each foot by which the minimum width exceeds 20 feet, not to exceed 100 percent.	same as for Type I F.R.
Increase for Separation on All Sides	increased at a rate of 5 percent for each foot by which the minimum width exceeds 20 feet, not to exceed 100 percent.	same as for Type I F.R.
Increase for Fire Extinguis-ing Systems	area tripled in one story buildings and doubled in buildings of more than one story.	same as for Type I F.R.

ALLOWABLE FLOOR AREA (cont.)

	Types of Construction	
	Type I F.R.	Type II F.R.
Increase for Multi-Story	area shall not exceed twice the area allowed for one-story buildings. Basements need not be included in the total allowable area, provided such basement does not qualify as a story nor exceed the area permitted for a one-story building (unlimited)	same as for Type I F.R.
Total Allowable Area (one floor)	unlimited	59,800 sq. ft.
Total Allowable Building Area	unlimited	59,800 sq. ft.

Total Area of Proposed Building: 19,500 sq. ft.

E. HEIGHT AND NUMBER OF STORIES

	Types of Construction	
	Type I F.R.	Type II F.R.
Stories	unlimited	12
Feet	unlimited	160 feet
Increase for Fire Extinquishing System (see Section 507)	unlimited	13 stories
Allowable Increases based on the installation of an approved automatic fire-extinguishing system	one story	one story

E. OCCUPANT LOAD: See Chapter 33

USE	AREA	SQ. FT./ OCCUPANT	NO. OCCUPANTS	EXITS REQUIRED	EXITS SUGGESTED
Lobby	400 S.F.	15	26	1	2
Public Gallery	1,600 S.F.	15	106	2	2
Restrooms	400 S.F.	--	--	1	1
Administrative	1,700 S.F.	100	8	1	1
Auditorium	1,200 S.F.	8	150	2	4
2 Classrooms	400 S.F.	20	20	1	2
Storage	1,400 S.F.	300	4	1	2
Garage	1,000 S.F.	200	5	1	2
Laboratories					
Statistics & Library	2,000 S.F.	50	40	1	1
Artifact	2,500 S.F.	100	25	1	1
Lithic	600 S.F.	100	6	1	1
Photolaboratory	600 S.F.	100	6	1	1
Cartographic	600 S.F.	100	6	1	1
Environmental	1,000 S.F.	100	10	1	1
Mechanical Areas	1,480 S.F.	300	5	1	2
		Total Occupants	437		

Number of Exits Required: a minimum of two (2)
See Section 3302 (a) and Section 3315

Width of Exits: $(\frac{\text{occupant load}}{50}) = \frac{437}{50} = 8.75$ feet

Distance to Exits: Exits shall be at least a distance apart equal to not less than one-half of the height of the maximum overall diagonal dimension of the length of the maximum overall diagonal dimension of the building or area to be served measured in a straight line between exits.
See Section 3302 (d)

Exits shall not exceed 150 feet or 200 feet in a building equipped with an automatic sprinkler system throughout.

Exit Doors

Width & Height: Exit doors shall be not less than three (3) feet in width, and not less than six feet eight inches in height.
See Section 3303 (e)

Swing: Exit doors shall swing in the direction of exit travel when serving any hazardous area or when serving an occupant load of 50 or more.
See Sections 3303 (b) & (e)

Exit Corridors: See Section 3304

Width & Height: Exit corridors shall not be less in width than 44 inches and this width shall not be obstructed.

Exit corridors shall have a clear height of not less than seven feet, (7'-0"), measured to the lowest projection from the ceiling.

Dead End: Not to exceed twenty, (20), feet in length.

Fire Resistance: Walls of corridors serving an occupant load of 30 or more shall be of not less than one-hour fire-resistive construction and the ceilings shall be not less than that required for a one-hour fire-resistive floor or roof system.

Exit Corridors (cont.)

Openings: See Section 3304 (h)

Stairways: See Section 3305

Width: Stairways serving an occupant load of more than 50 shall be not less in width than 44 inches.

Landings: Landings shall have a dimension measured in the direction of travel equal to the width of the stairway.
See Section 3305 (g), (h), (i).

Rise & Run: Rise shall be not less than 4 inches nor greater than 7½ inches.

Run shall be not less than 10 inches.

See Section 3305 (c).

Stairway to Roof: Does not apply.

Exit Enclosures: Enclosure walls shall be not less than one-hour fire-resistive construction.
See Section 3308.

Smoke Proof Enclosures: See Section 3309.

Other Requirements

Aisles: See Section 3313.

Width: Every aisle shall be not less than three feet wide if serving only one side, and not less than three feet six inches if serving both sides.
See Section 3313 (b)

Distances to Nearest Exit: The line of travel to an exit door by an aisle shall be not more than 150 feet. Such travel distance may be increased to 200 feet if the building is provided with an approved automatic sprinkler system.
See Section 3313 (c).

Exit Corridors (cont.)

Openings: See Section 3304 (h)

Stairways: See Section 3305

Width: Stairways serving an occupant load of more than 50 shall be not less in width than 44 inches.

Landings: Landings shall have a dimension measured in the direction of travel equal to the width of the stairway.
See Section 3305 (g), (h), (i).

Rise & Run: Rise shall be not less than 4 inches nor greater than 7½ inches.

Run shall be not less than 10 inches.

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Stairway to Roof: Does not apply.

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Other Requirements

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See Section 3313 (c).

Other Requirements (cont.)

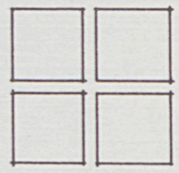
Slope: The slope portion of aisles shall not exceed 1 foot tall in 8 feet, except as permitted in Section 3306 (c).
See Section 3313 (g).

Steps: No single step or riser shall be used in any aisle, but where they are used they shall extend across the full width of the aisle and shall be illuminated.
See Section 3313 (h).

Seat Spacing: See Section 3314.

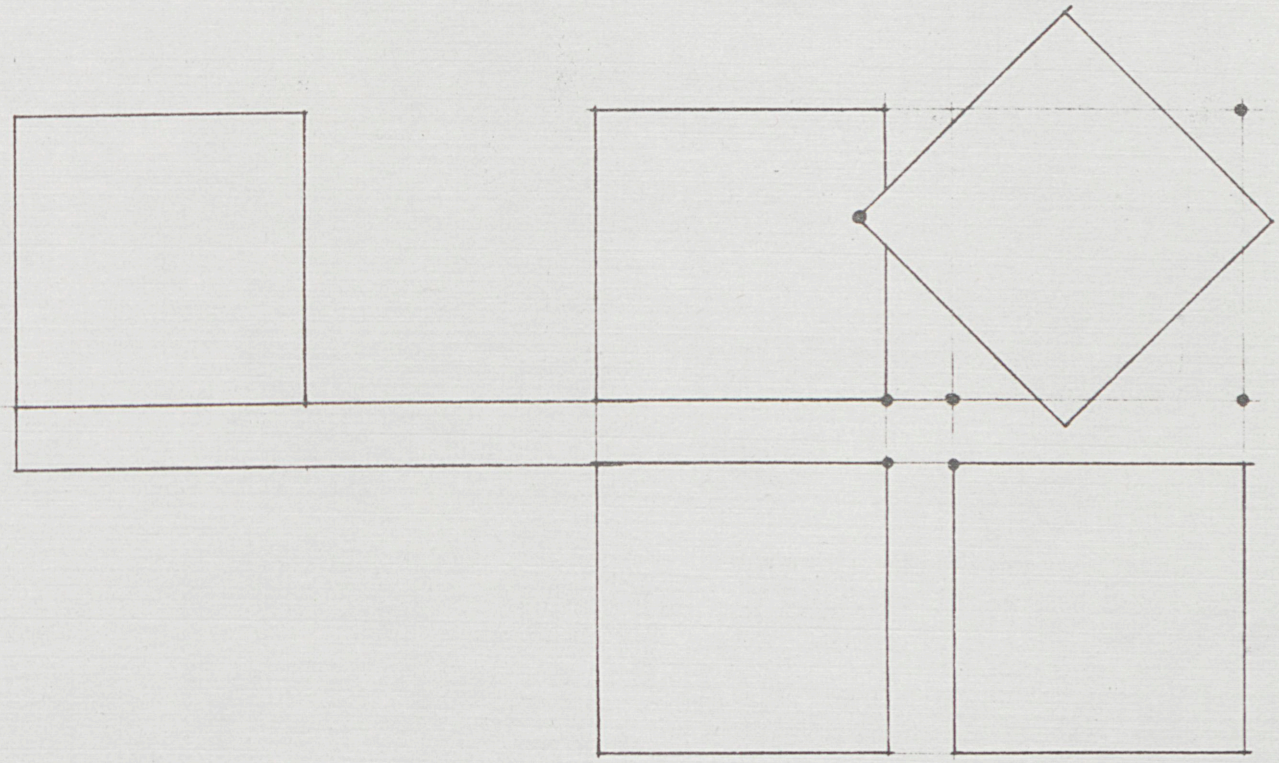
Other Conditions: Pending.

DESIGN DEVELOPMENT

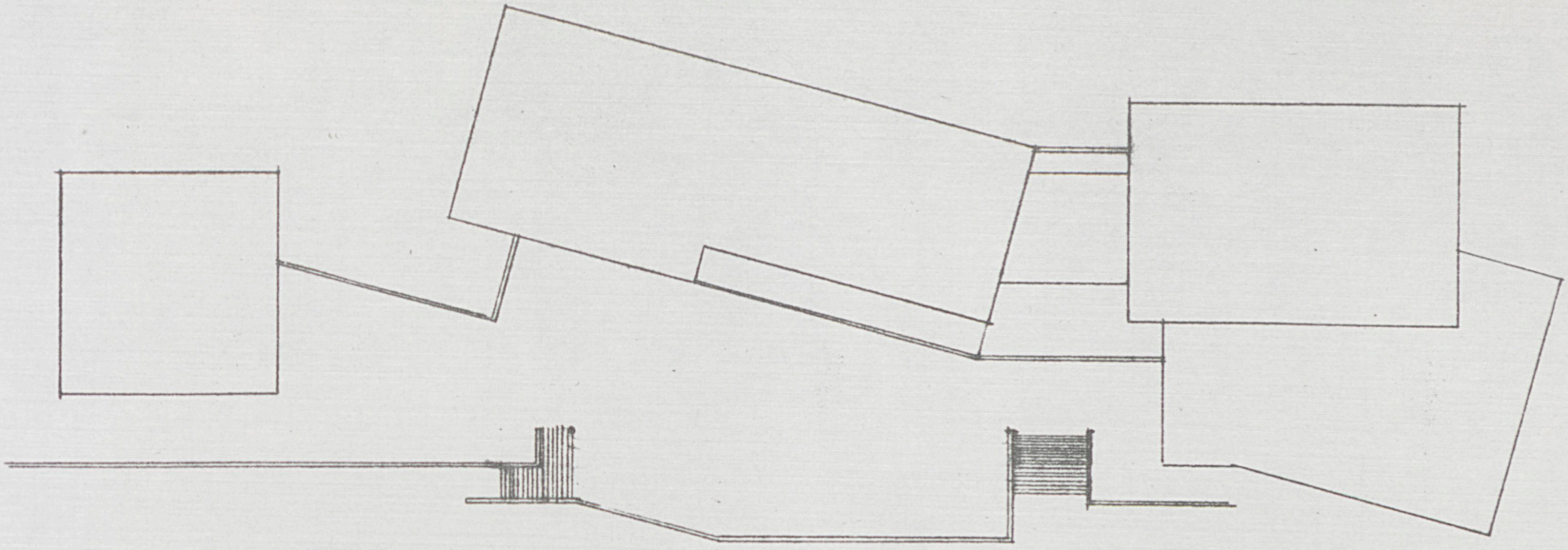


Tools

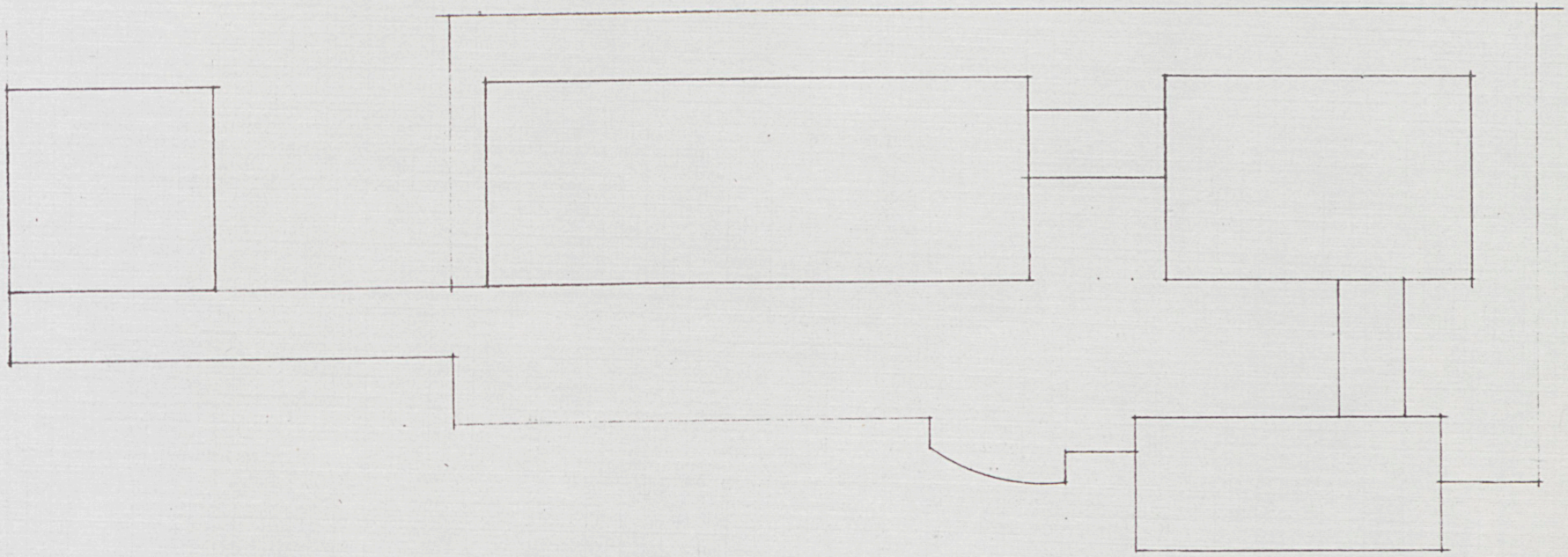
The following section provides a graphic representation of the design process from the formative stages of conceptual thought up through and including the final conceptual idea employed. By no means are the following total design concepts, but rather sketches which put forth concepts in part and images that I felt would evolve to an appropriate and complete design solution. Many of these graphic thoughts are my attempt for a greater understanding of the formal considerations of such a center, and how form plays an integral role in the establishment of an image. It is from this point that the use of materials becomes important because as form modifiers, rather than form determinants, they also act to resolve formal decisions into a complete image and solution for such a center. These ideas will be further expanded upon in the next section, Materials. The following graphic process is an attempt to explore the evolution of the design and to understand the outcome as based upon this process.

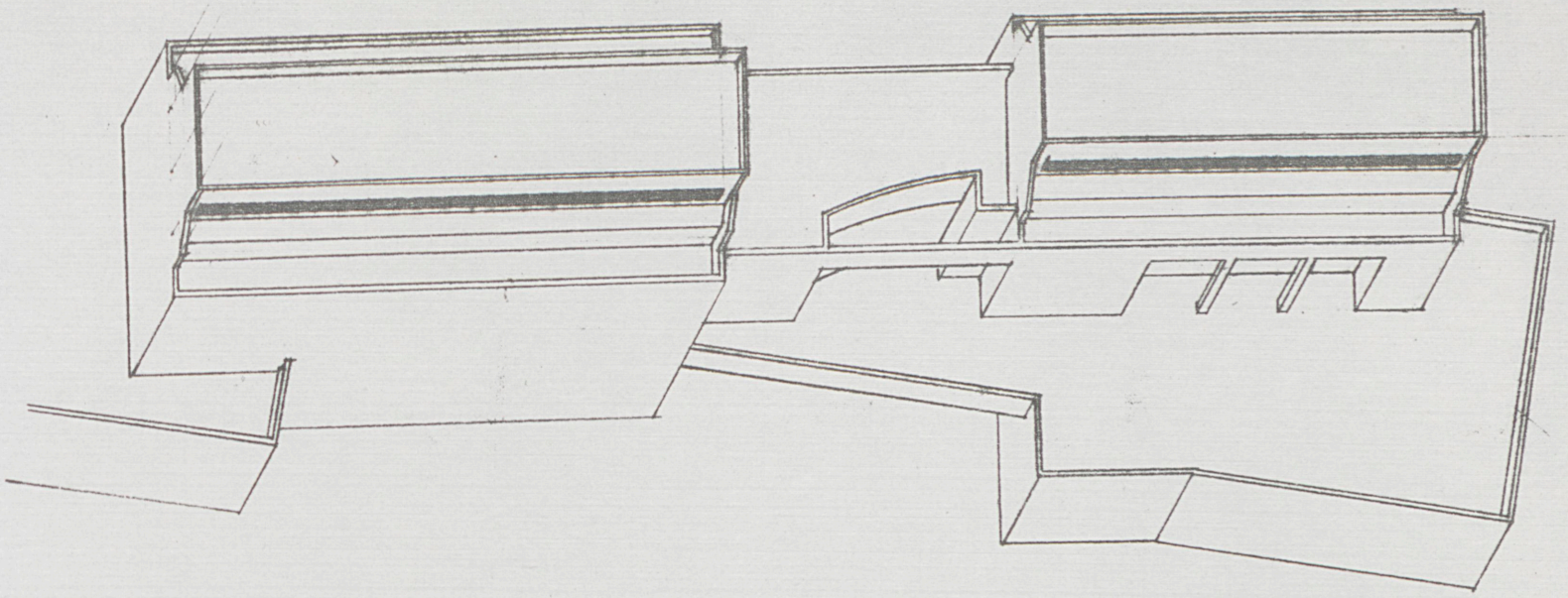


EARLY IMAGES MAY 1980

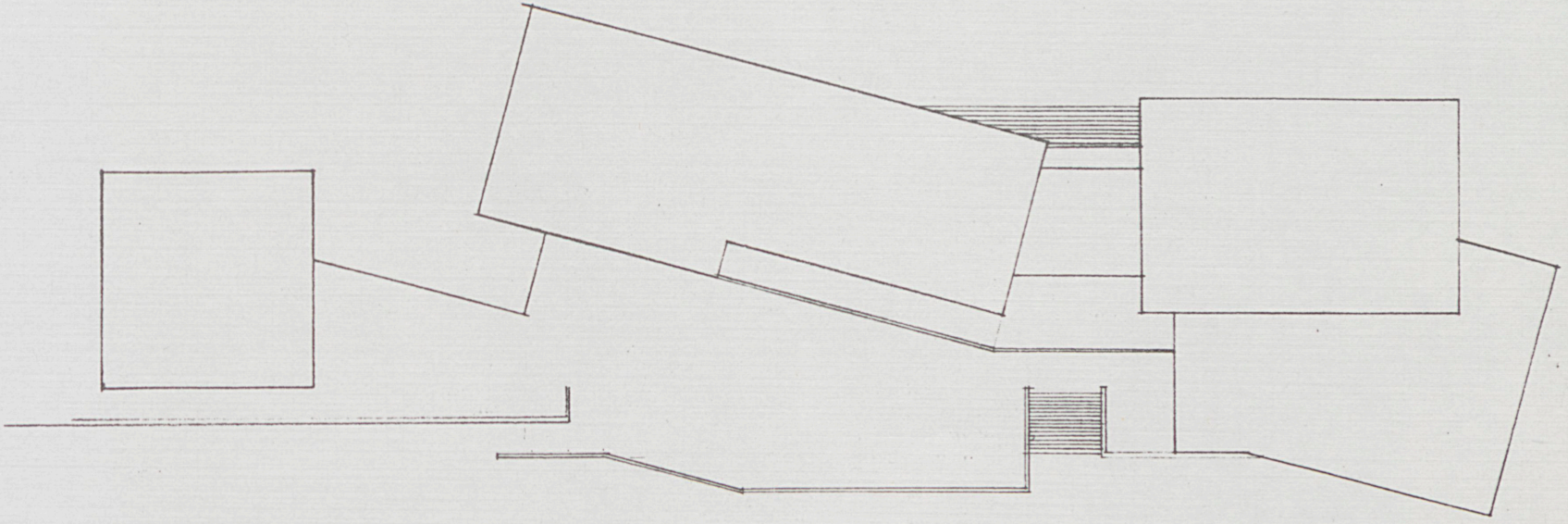


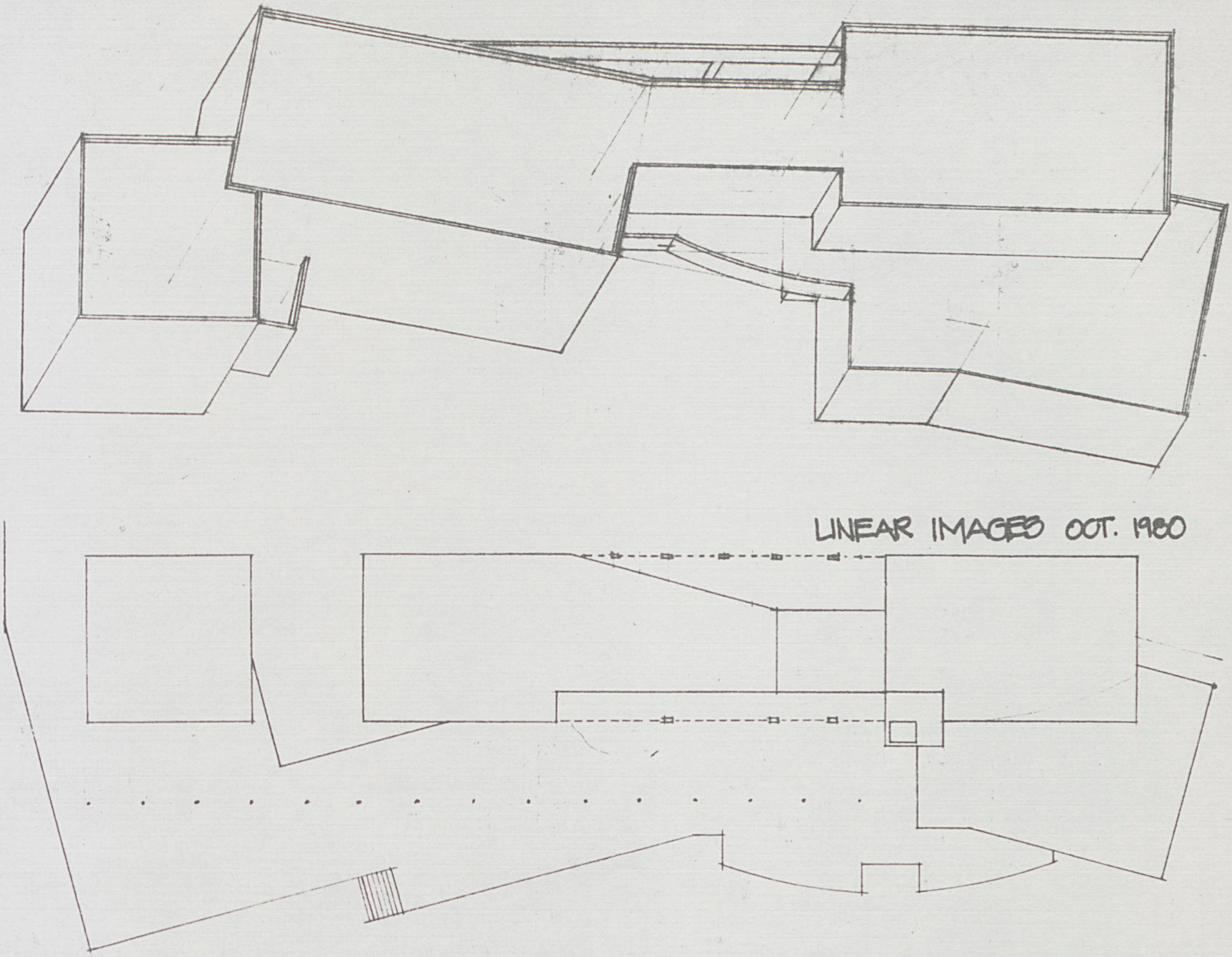
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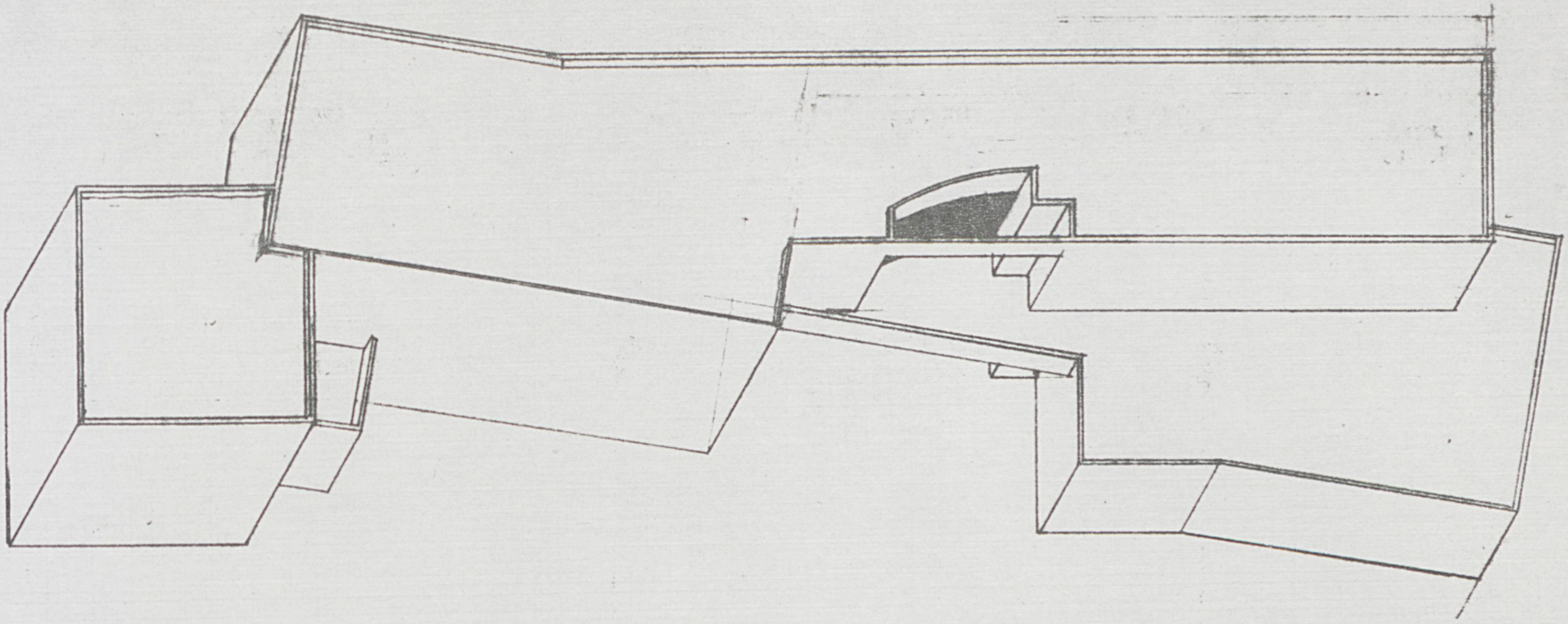




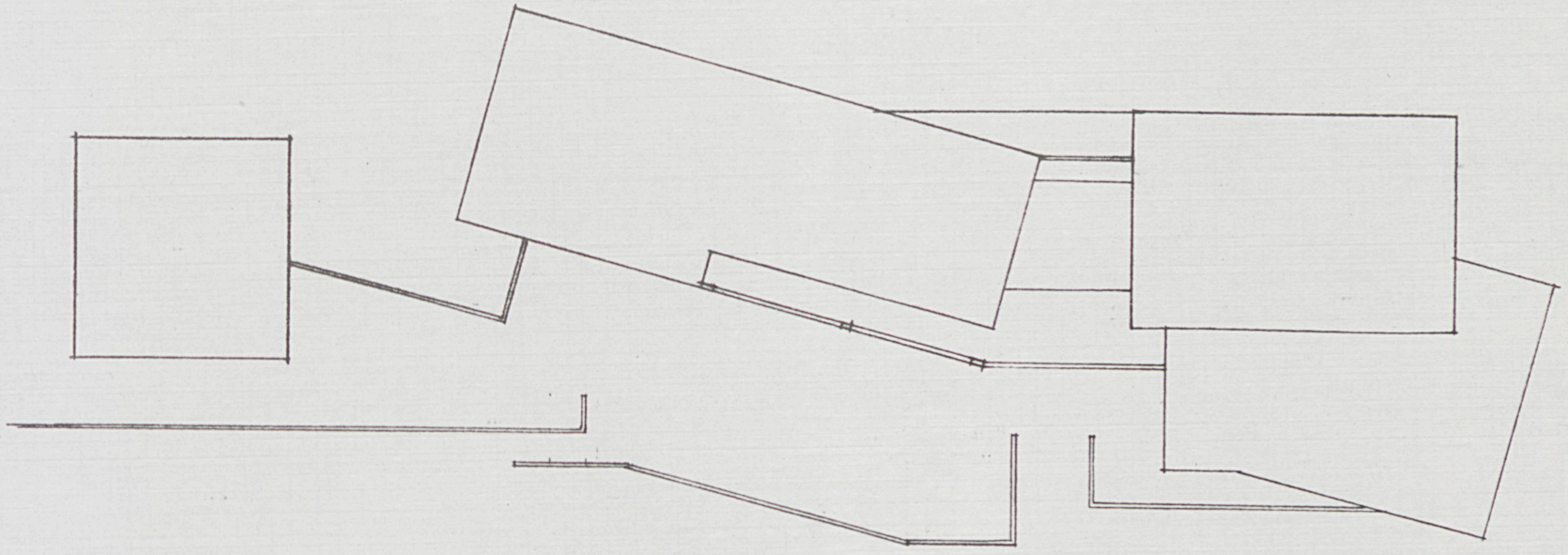
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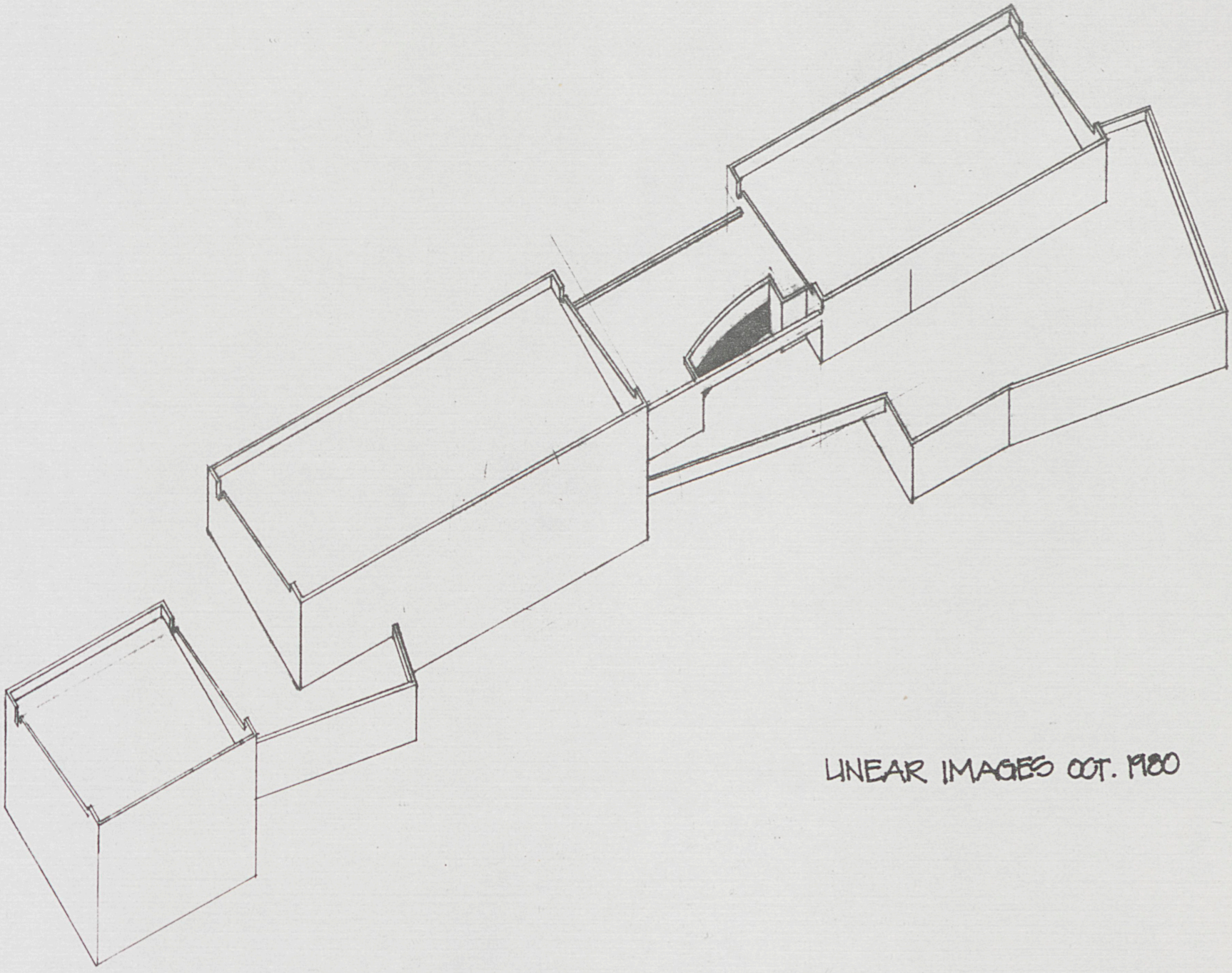



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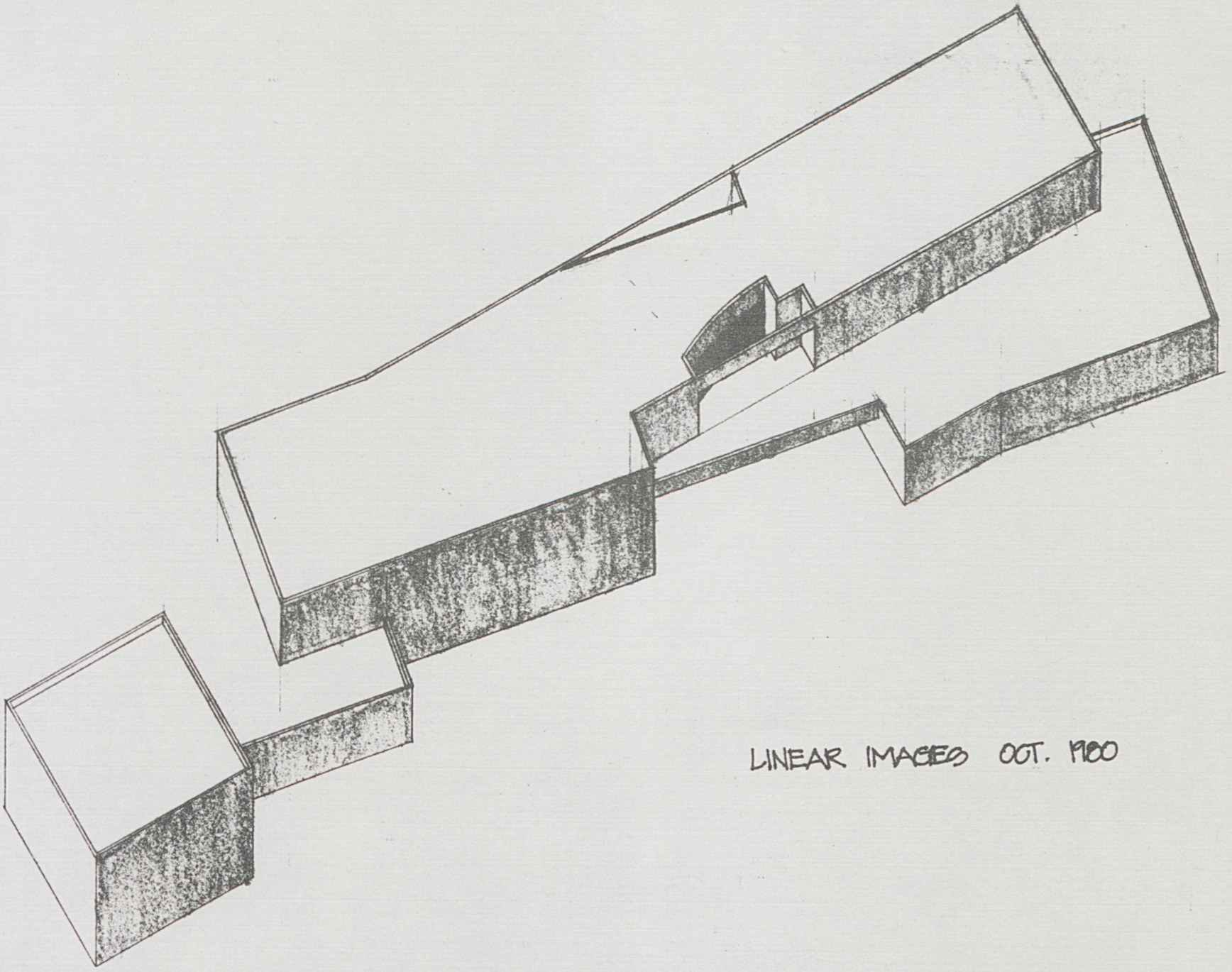


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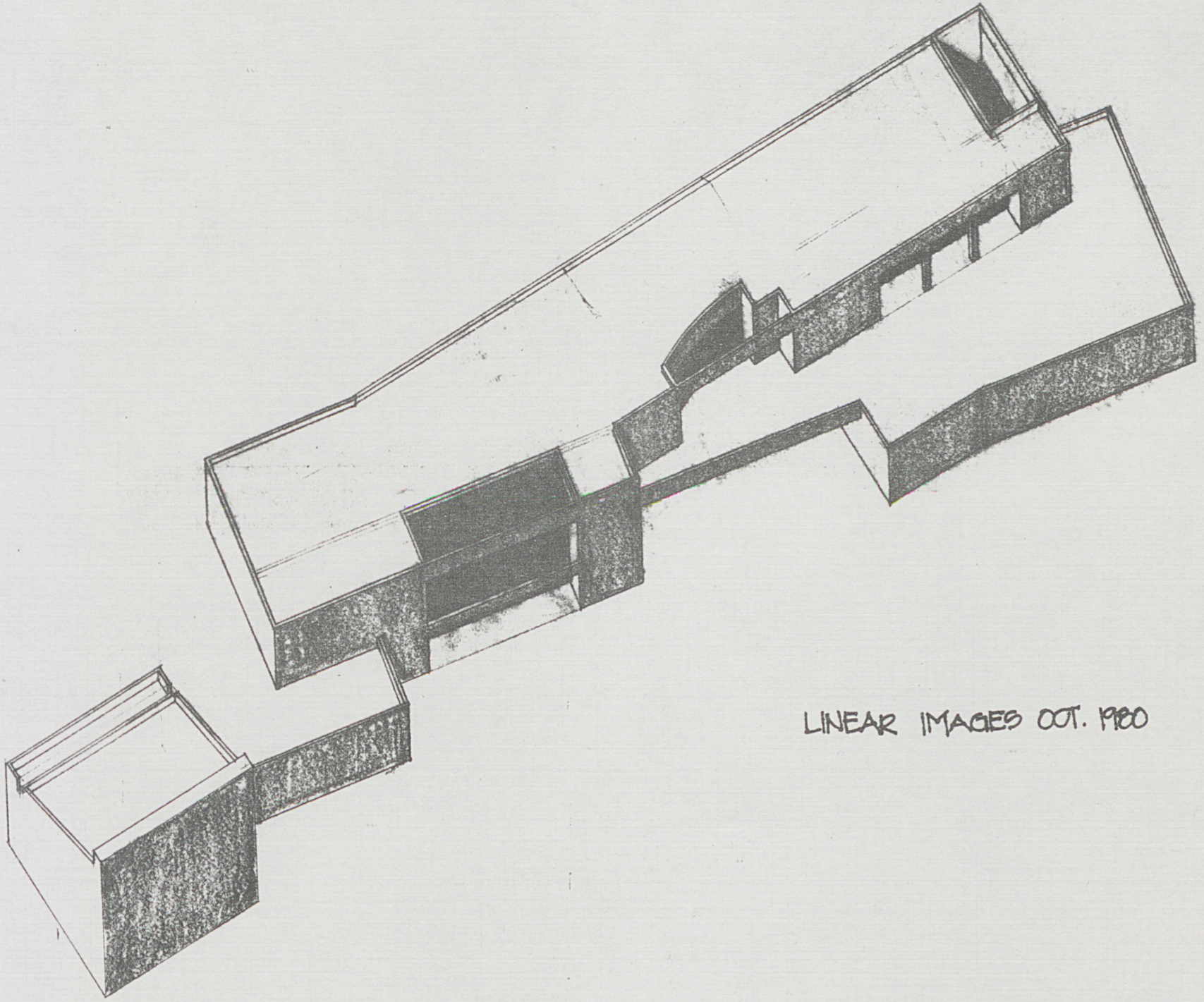




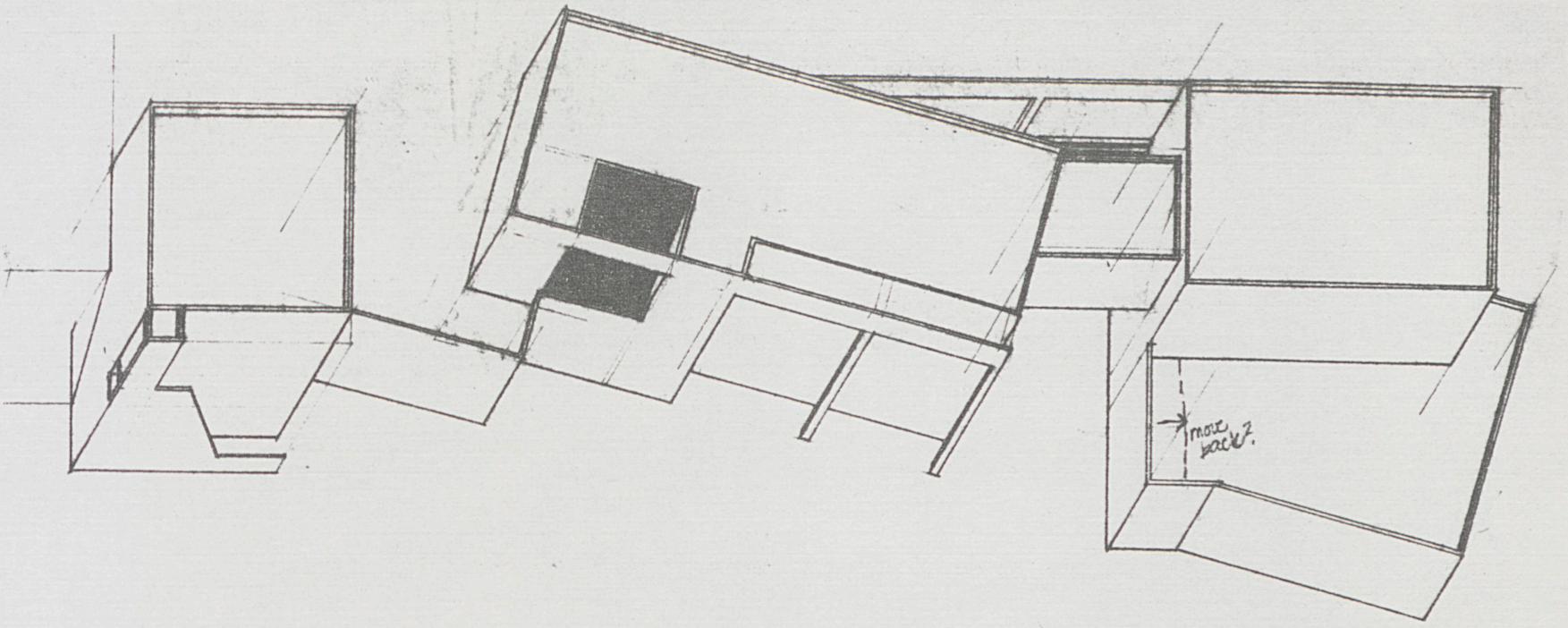
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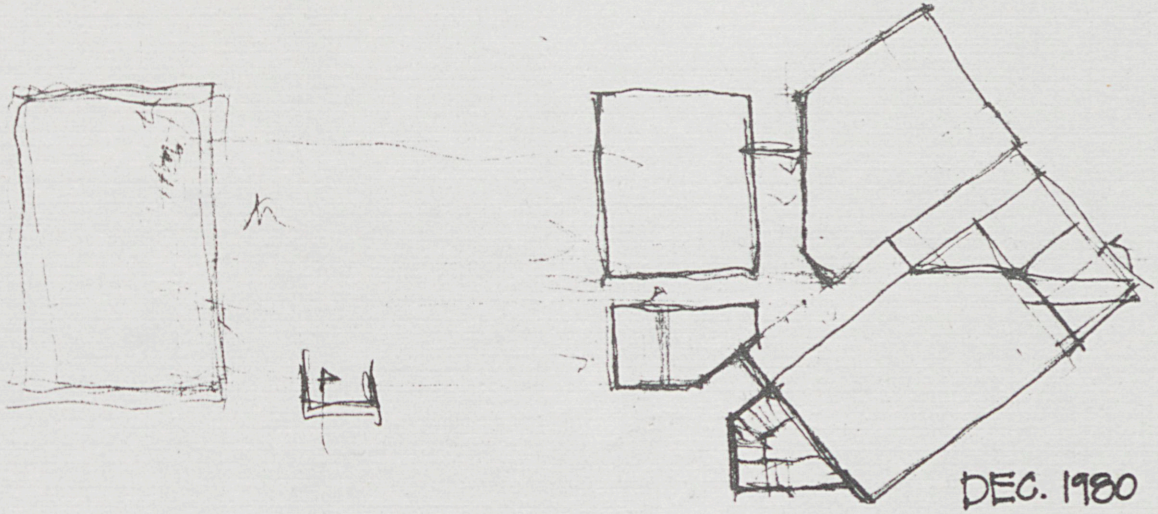
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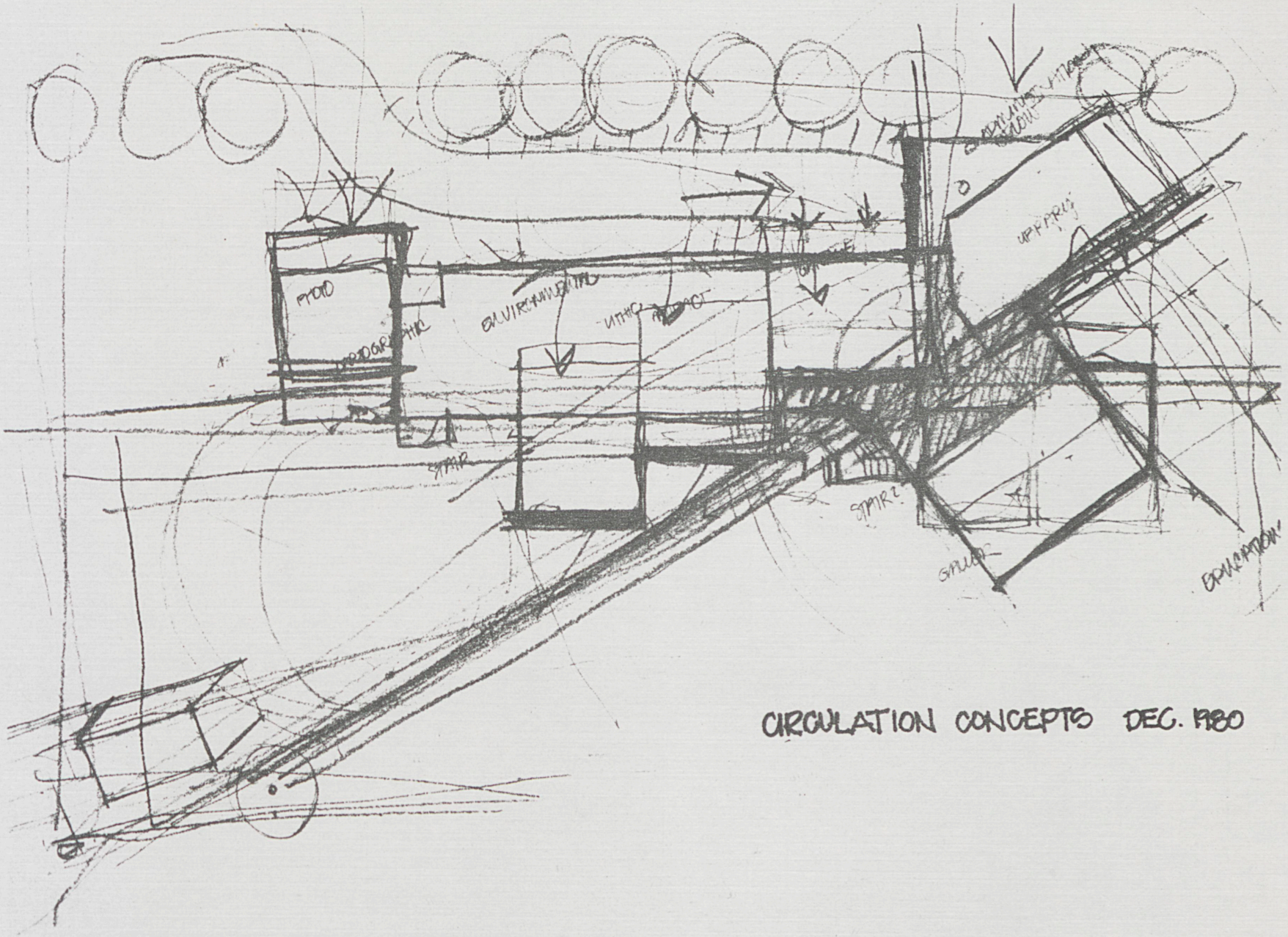
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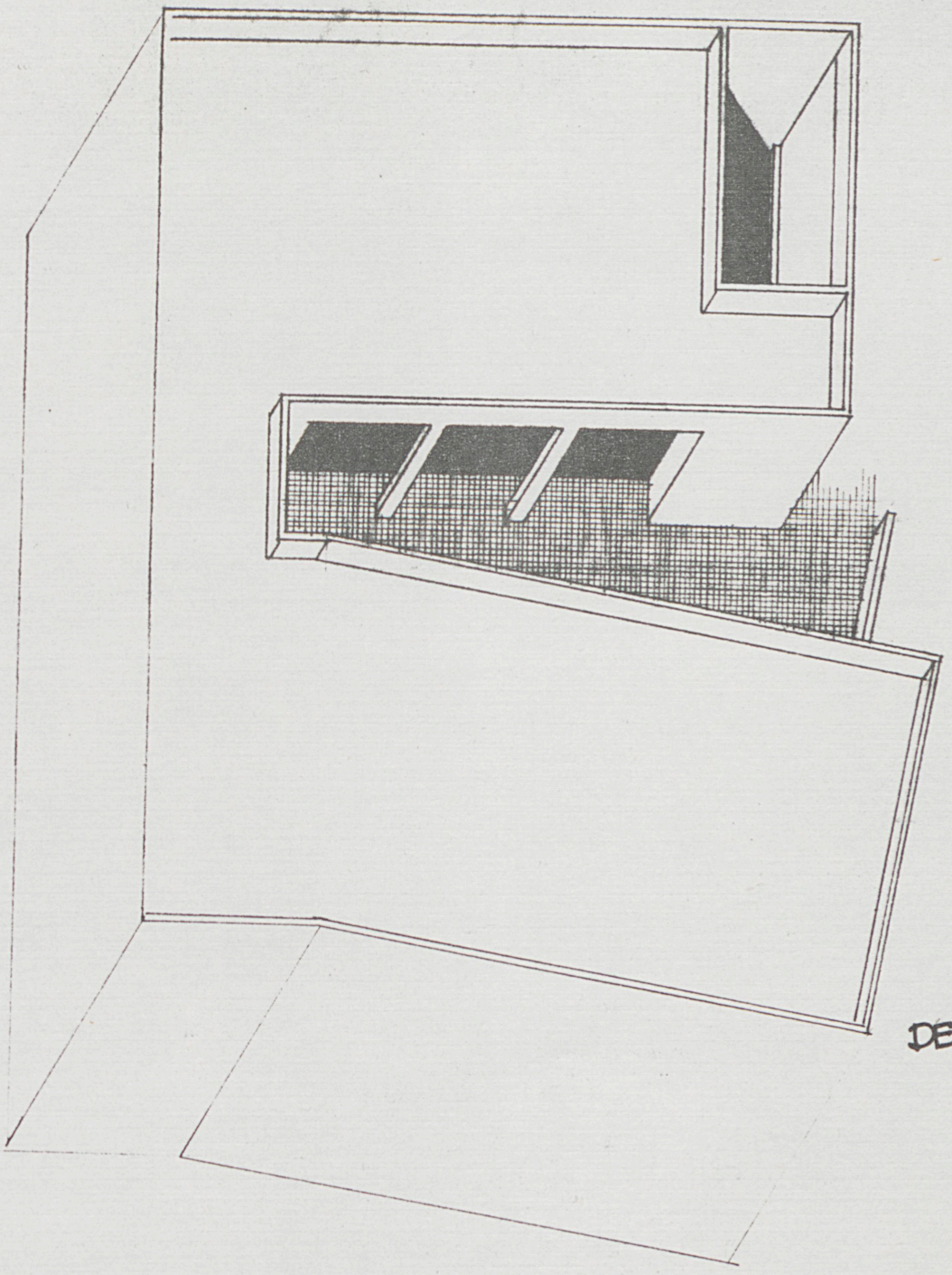
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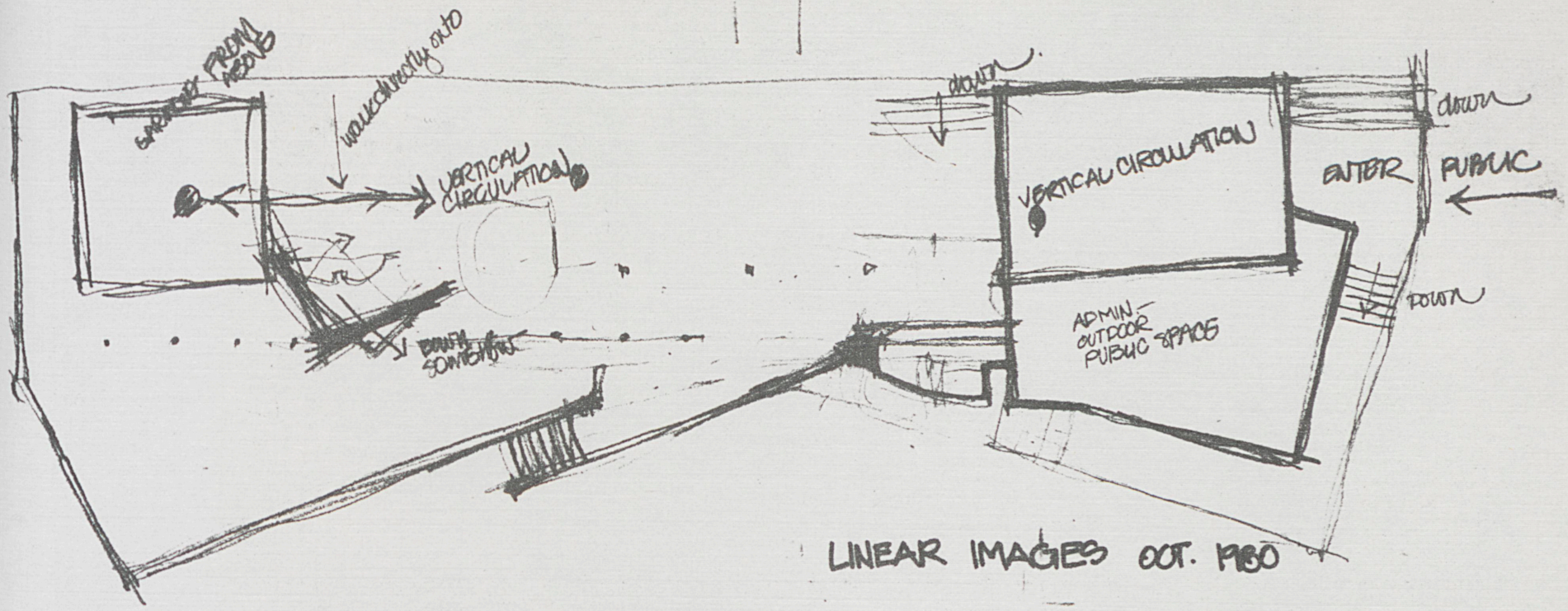
DEC. 1980



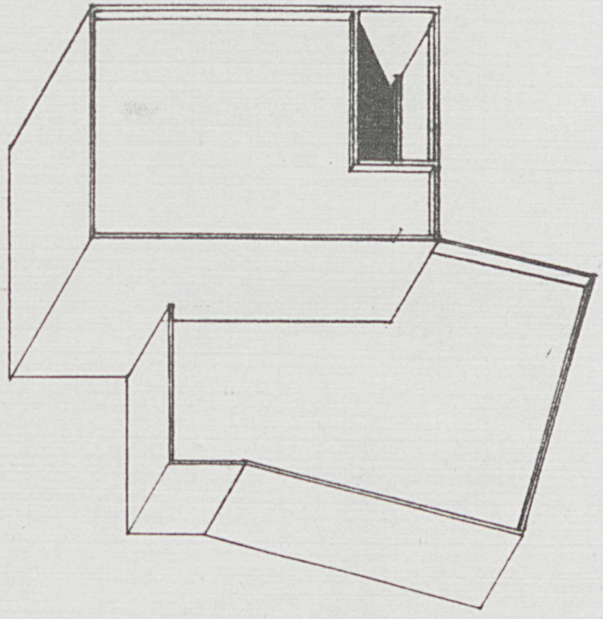
CIRCULATION CONCEPTS DEC. 1980

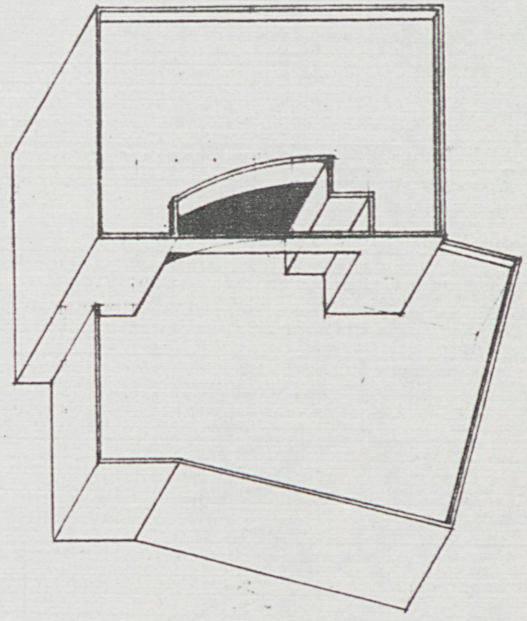


DETAILS
OCT. 1980

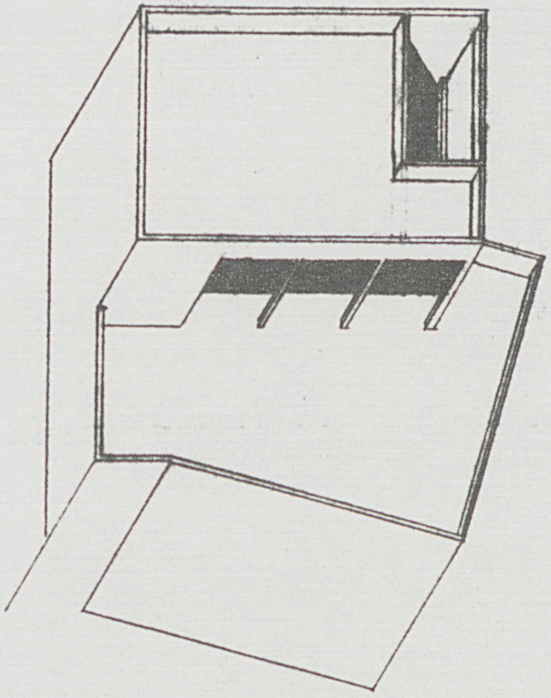


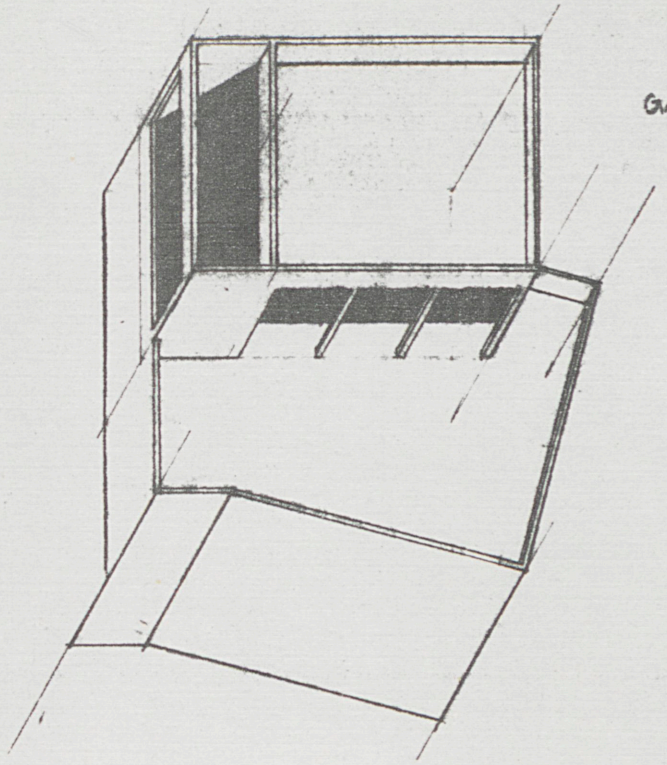
LINEAR IMAGES OCT. 1980





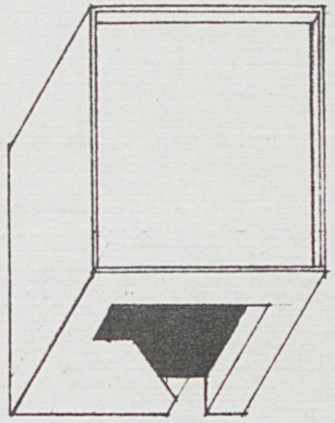
DETAILS OCT. 1980





GALLERY / ADMIN.

CLASSROOM
AUDITORIUM



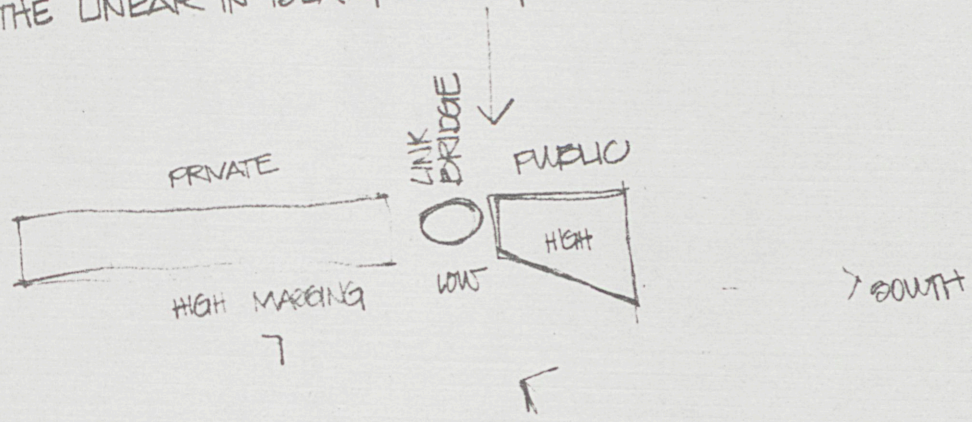
DETAILS OCT. 1980

THE CONCEPT

LINEAR ORGANIZATION OF LABS → CIRCULATION THRU TO BREAK DOWN LINE
CLEAR ORDERING OF PROCESS — MASSING OF LINE
UPPER LEVEL PAPER PROCESSING
LOWER LEVEL MATERIALS PROCESSING

SEPARATION BTWN LABS/ADMIN & PUBLIC SPACES
CIRCULATION
A LINK
A BRIDGE

AN ENDING POINT
TERMINATION OF THE LINEAR IN IDEA & FORM & MASSING
SOUTH SIDE OF SITE
PUBLIC AREAS



FORESTED BUFFER

CIRCULATION

Materials

The nature of materials, together with the physical and the symbolic, and how they convey meaning and intent through their use within a specific contextual arrangement has been the concern of this thesis. This idea must be addressed a last time to establish conclusions, if any, and to put forth observations concerned with the use of materials uncovered throughout the thesis process. I began by examining the nature of materials, their physical and symbolic aspects, and the ever present interaction between the two perspectives. From here context, or the total environment, in which materials were employed in particular ways was explored as an idea, and then the study focused on a specific environment and the ways in which materials come to be used. The specific environment, or region, surveyed was an area designated as the Northwestern Plains and Rocky Mountain Region, an archaeological division. In particular, my study focused on Bozeman, Montana and the surrounding area as the center geographically, and representively of the region. Here I drew general conclusions about the meanings particular materials conveyed through their application in the Bozeman area. A consistent pattern emerged through these observations, and I was seeking regularities to base future predictions on. I found that a material came to convey a meaning, or response, to people when used in a certain manner over a period of time. Repetition suggested sameness in both the use and the meanings conveyed as a result of that use. Though I could draw generalizations about a group of materials, in some instances this formula method did not provide me with explanations. It did, however, allow me to understand general patterns that emerged in acknowledging the past and present uses of materials, and the meanings conveyed in these examples, but it could only be employed as a guide for future predictions. It couldn't provide any future insight for materials in later applications. Though it led me to no predictions, I could infer some ideas about the future use of materials. There was, however, no way in which to account for changes within the contextual arrangement, so such forecasts could only be seen as speculation. In drawing general conclusions, or understanding the meanings conveyed, from the observations of the use of materials within an environment I could not regard this method as an absolute, but merely a guideline for predicting what may happen in future applications. Past and present uses

of materials and the meanings conveyed as a result of their use are therefore best considered as influencing forces in establishing the ideas conveyed by material in future roles.

I began this thesis anticipating that from careful observation and analysis of the use of materials within a specified context I could find consistent regularities in the meanings conveyed as a result of their use, and because of their use within a particular environment. My goal then was to apply these discoveries to future architecture to predict the meanings conveyed through the use of materials within this same environment. As previously stated, I had no absolute method for making these kinds of determinations, I could only generalize. However, these observations and generalizations did provide me, the designer, with an awareness for the past and present use of materials particular to Bozeman and the surrounding area. I became more sensitive to the issue of materials, as form modifiers, rather than form determinants and now feel more of an understanding for their application within this same environment. With the notion that such an understanding has been gained, I might better incorporate future architecture into this context through the use of materials in a manner in which my intentions are conveyed and understood. The test of this comes only in analyzing the use of materials within a specific building in the context defined by Bozeman and the surrounding area. I must now turn to this future structure, a regional center for archaeological research.

At the onset of the design process I realized that all my decisions would eventually be tested by the materials chosen to modify, enhance, or possibly contradict each formal decision. Concerned then with a formal conception of the functional requirements I narrowed the approach of the solution to two avenues. The two are polarities, extremes of each other, both in formal conception and material considerations. The first approach is concerned with contrast within its context. This includes contrast between form and materials, in relationship to the immediate site area, and to the context itself on a much larger scale. Every decision made would be an intentional contradiction to the aforementioned concerns. It also provided a definite attitude for the significance of the building and its function to the surrounding contextual arrangement.

The second concept's theme dealt with the idea of integration. This provides for a cohesive interaction between form and materials, for integration of the building to its immediate site area, and to the context itself, at a larger scale. This approach put forth an opposite image, in reference to the first concept of contradiction, in terms of the overall building. Both approaches provided an equal challenge, but the idea of conveying a meaning through the use of materials within the context defined by Bozeman and the surrounding area was the critical force in deciding which approach would more appropriately accomplish this. This is why the second formal concept, of integration, was selected as the course to persue. This means more likely will approach the desired ends of this thesis.

Beginning with the approach of integration, between form and materials, the building to its immediate site and to the context on a larger scale, I formulated images of the center. This had to be reflected as an exterior expression as well as in the interior decisions of the building. The image, or my intentions I sought to convey formally for the center were that of a structure of an institutional character, one that mixed well with the surrounding campus, institutional, architecture. I considered forms that also conveyed the efficiency of the internal functioning of the center's processes, the paper process on the upper level and the mechanical process on the lower, relating to the processing of archaeological data. The separation of public and private aspects of the center also would come to be manipulated formally and through site considerations in contributing further still to the image of the center. Though it is somewhat difficult to understand the creation of an image, turning to the final solution might better describe it through a tangible graphic means.

Though this image was primarily established by formal means, in keeping with the concept of integration, the use of materials played an integral role as form modifiers. They could be used to reinforce the intended image, and as a result of this, the meaning(s) conveyed through their use supported the established image. Though this argument may be circular it is because the use of materials (in this example) reinforces the formal aspects of the building, and in the same light the building form compliments the materials employed. Considering the approach of integration this argument supports and contributes to the concept. There-

fore, in support of the concept I hope to determine which material(s) best will compliment the building's formal and spacial characteristics and employ them as form modifiers in the establishment of the image for the center.

Considering first the sloping nature of the site, I saw the opportunity to physically integrate the building into the site. Access to the center could be gained on the upper level on the side of the site closer to the campus, as well as to the lower level from the opposite area of the site. This presented a means also to separate the two internal processes, paper and mechanical, and to gain access to each in a different manner. The upper level then was devoted to the paper, administrative processes of the center, and was directly accessible at the same level of the rest of the campus. The lower level designated the mechanical process of sorting and examining archaeological data, and was physically separated from the paper process by building level and from the rest of campus because of its proximity on the site. The problem of separation between internal processes was solved simply and efficiently because of considerations due to the nature of the site. The direction and control of the public and access to the center was then addressed, and I discovered that the siting of the building and the discrimination between upper and lower processes could aid in the establishment of entrance to the center. By looking again at the site I found that the more developed an exterior area of the site became, the more attention was drawn to it, and a greater opportunity for entrance to the center was gained. The planning for landscaping then was critical also to the internal processes. By placing more developed exterior areas coincident with interior major circulation and public functions the problem of control could again be solved by the integration of the site and the building concept. The eventual form of the center then was generated by the integration of all of the aforementioned considerations. The center became linear, ordered, and expressed efficiency within and without. Entrance and control of the public were also determined by the integration of building and site. As the expansion on previous commitments to the concept occured, a total design solution emerged, and the concern of this thesis was finally addressed -- materials, and their use as form modifiers to convey meaning and intent.

The decisions for what material(s) would be used had to be based on what the center had become because of the concept employed concerning its integration with the site and the discrimination between internal processes, and on my intentions for the center, and the desired image. Though much of this was already established, the materials employed could now modify, and enhance how the building was viewed. Actually, any material could be used to construct the center, but only a few could appropriately be employed in the establishment of this image. Again the site was addressed to provide some insight for this decision. I was primarily concerned with the natural setting of which the building was an integral part, and its relationship to surrounding campus architecture. Finally, though I formed few impressions from this source, the context at large, the Northwestern Plains and Rocky Mountain Region, was examined. The material chosen for the center was brick because of the images I had formed of the application of the material within the total contextual situation. Its physical characteristics were sufficient to compliment the formal considerations. As a material that evokes a response of warmth and connections to the earth in many applications, I felt it was best suited as a material that could integrate form and site. At the same time it also set the building apart from the site and visually integrated it into the surrounding campus architecture. I then considered the past and present meanings conveyed as a result of its use in the area in forming my decision. The integration of building and site were still critical considerations so that the public landscaping was done with cobblestone, and grassy exposed areas. The cobblestone was carried through into the building in public and major circulation areas as a link to the areas externally that service the same purpose. These natural materials were also chosen because they complimented the brick massing.

These decisions are all based on what I felt would best convey my intentions for a regional center for archaeological research within this context. Though many forces did influence this decision, the formal conception, the integration of building to site, and to surrounding campus architecture, the intention of presenting a building with an institutional character, and the link to the context at large, the choice was mine, the designer's. The past and present uses of brick in Bozeman and the surrounding area, and the meanings conveyed as a result of their use was also an influencing force, though not a predictor for future applications

of this same material. The final test for all of these arguments however, unfortunately comes after the fact, once the building is complete. Only then can the questions be posed by passersby, "what image does the building connotate? What does it look like?" If the impressions formed approximate the designer's intentions then we might conclude that there was a validity to our methods in response to the nature of materials.

Footnotes

[1]Francis D.K. Ching, Architecture: Form-Space and Order, New York: Litton Educational Publishing Inc., 1979, p. 10.

[2]Webster's Third New International Dictionary, 1966 ed., p. 492.

[3]Donald Preziosi, The Semiotics of the Built Environment, London, Indiana University Press, 1979, p. 74.

[4]Charles Jencks and George Baird, Meaning in Architecture, New York, George Braziller, 1960, p. 57.

[5]Francis D.K. Ching, Architecture: Form-Space and Order, New York, Litton Educational Publishing Inc., 1979, p. 50.

[6]Ibid., p. 50.

[7]Ibid., p. 50.

[8]Ibid., p. 50.

[9]Ibid., p. 51.

[10]Ibid., p. 51.

[11]David C. Thompson, Thesis--"Dialogue in Architecture," 1979, p. 7.

[12]Ibid., p. 7.

[13]Ibid., p. 8.

[14]Donald Preziosi, The Semiotics of the Built Environment, London, Indiana University Press, 1979, p. 2.

[15]Ibid., p. 2

[16]Walter F. Wagner Jr., "Franzen: Four Current Projects: Multicategorical & Animal Research Laboratory," Architectural Reocrd, July 1971, p. 114.

[17]Sharon Lee Ryder, "Bravado with Brick," Progressive Architecture, September 1974, Stanford, Conn., Reinhold Pub. Co. Inc., p. 76.

[18]Goran Schildt, trans., Sketches, by Alvar Aalto, Cambridge, Mass., The MIT Press, 1978, p. 142.

[19]Materials, San Francisco, Calif., W.H. Freeman and Co., 1967, p. 55.

[20]Ibid., p. 55

[21]Ibid., p. 55.

[22]Ibid., p. 55.

[23]Ibid., p. 39.

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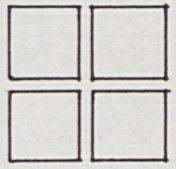
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DESIGN



the nature of materials in architecture

an archaeological research facility

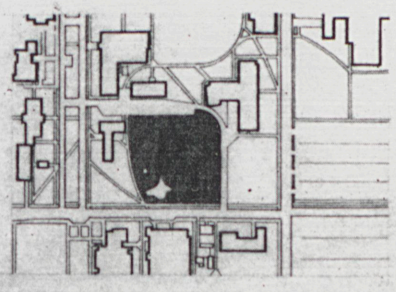
for the northwestern plains and rocky mountain region

bozeman, montana

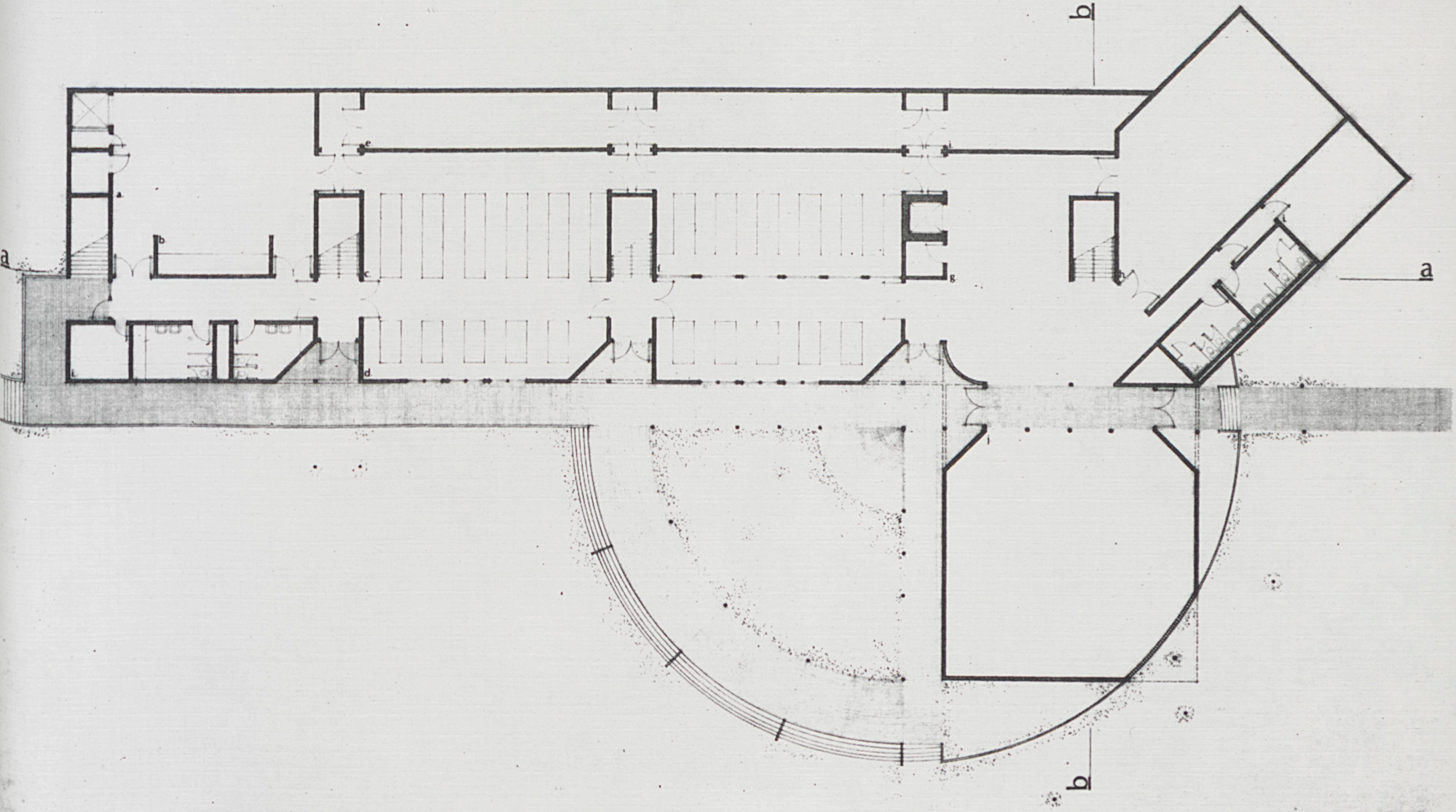
jean m. hecimovich





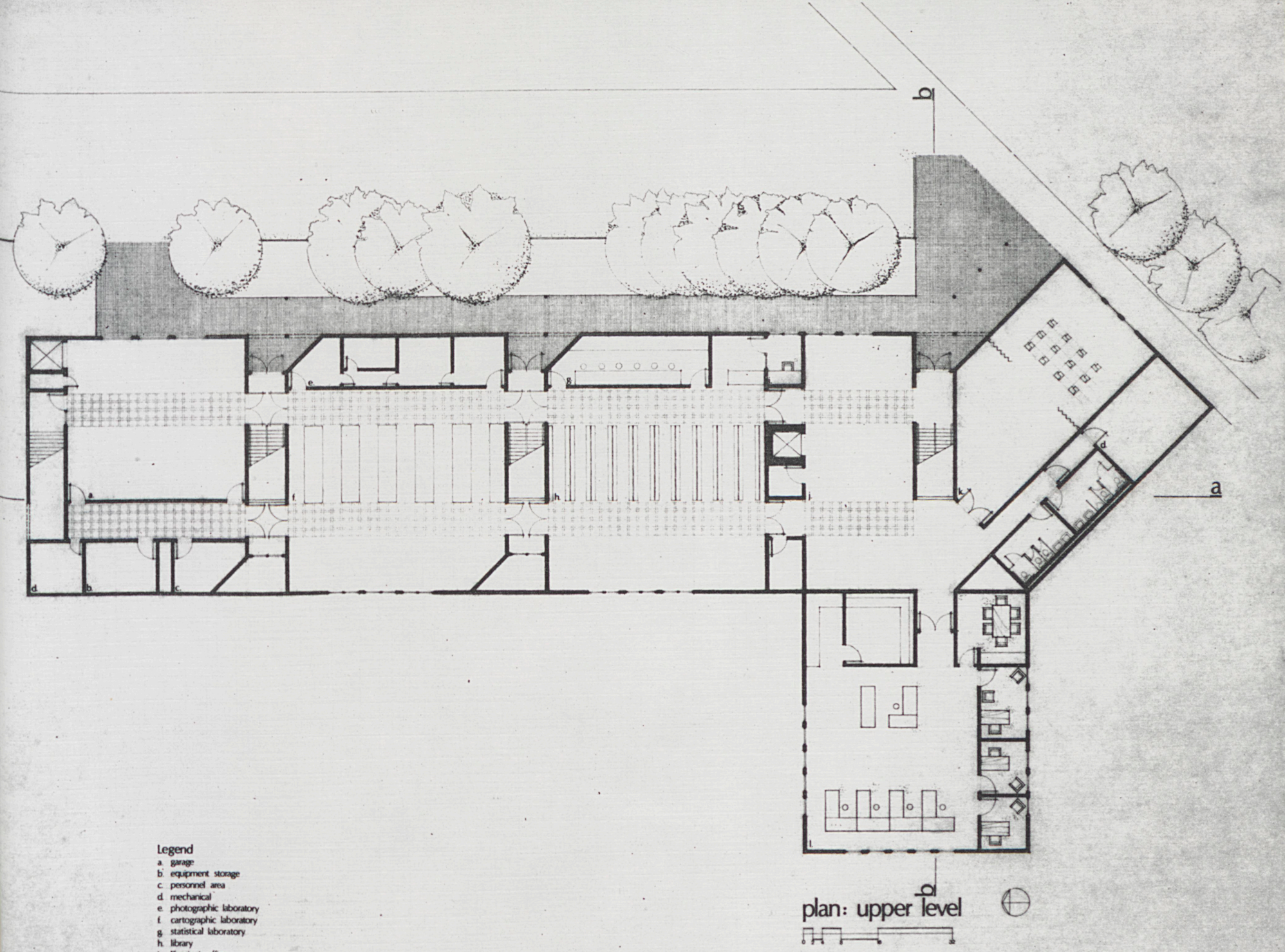


site plan



Legend
artifact laboratory
a. incoming storage
b. reference area
c. mechanical analysis
d. lithic laboratory
e. storage: permanent
f. environmental laboratory
g. lobby
h. conference
i. mechanical
j. gallery

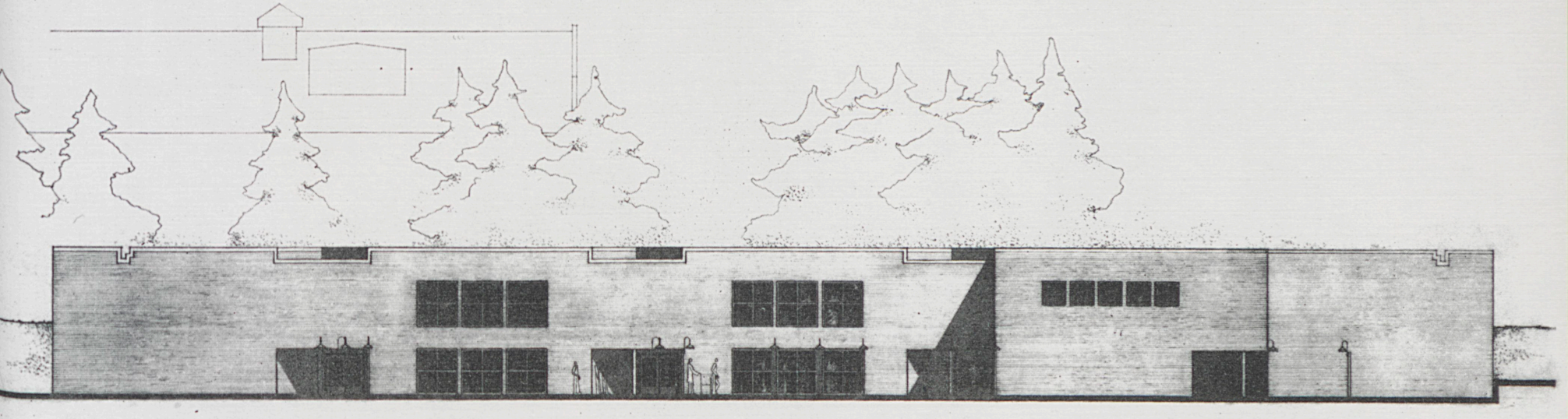
plan: lower level



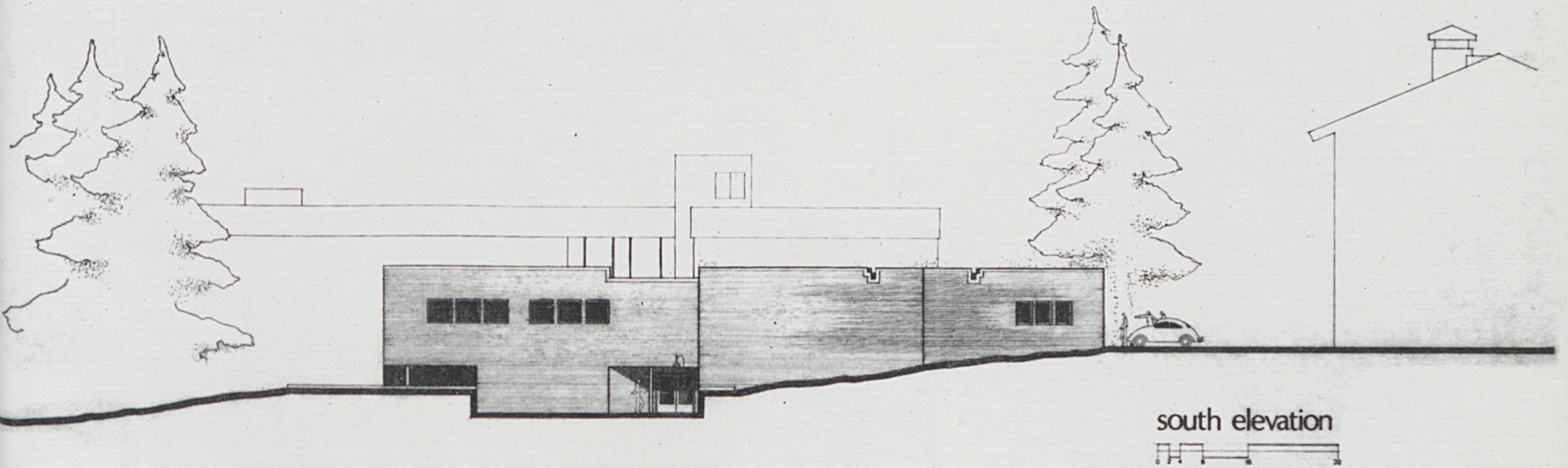
Legend

a. garage
b. equipment storage
c. personnel area
d. mechanical
e. photographic laboratory
f. cartographic laboratory
g. statistical laboratory
h. library
i. librarian's office
j. lobby
k. classroom(s)
l. administration

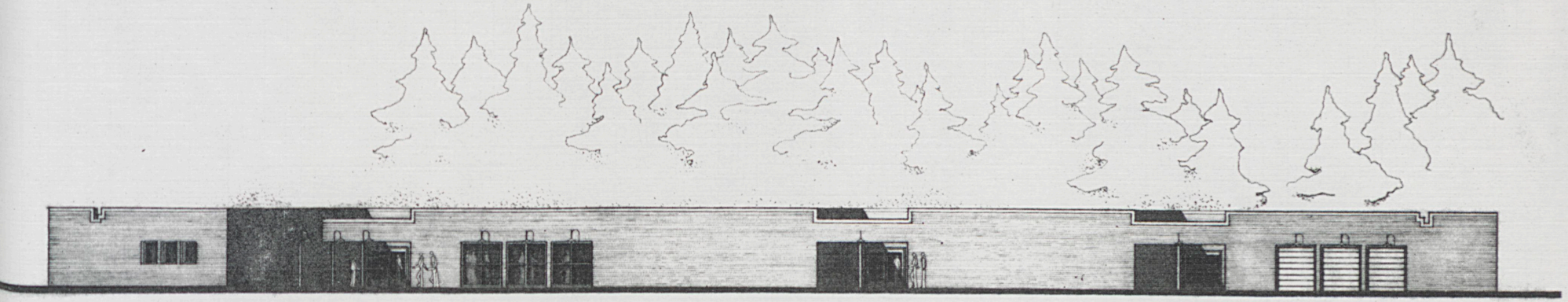
plan: upper level



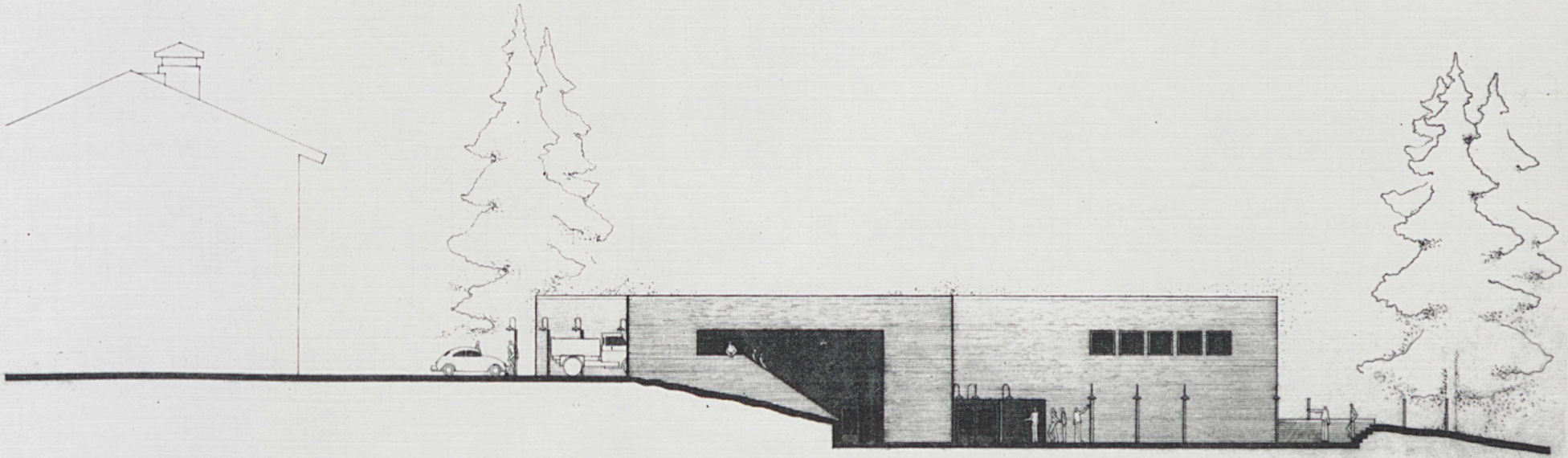
west elevation



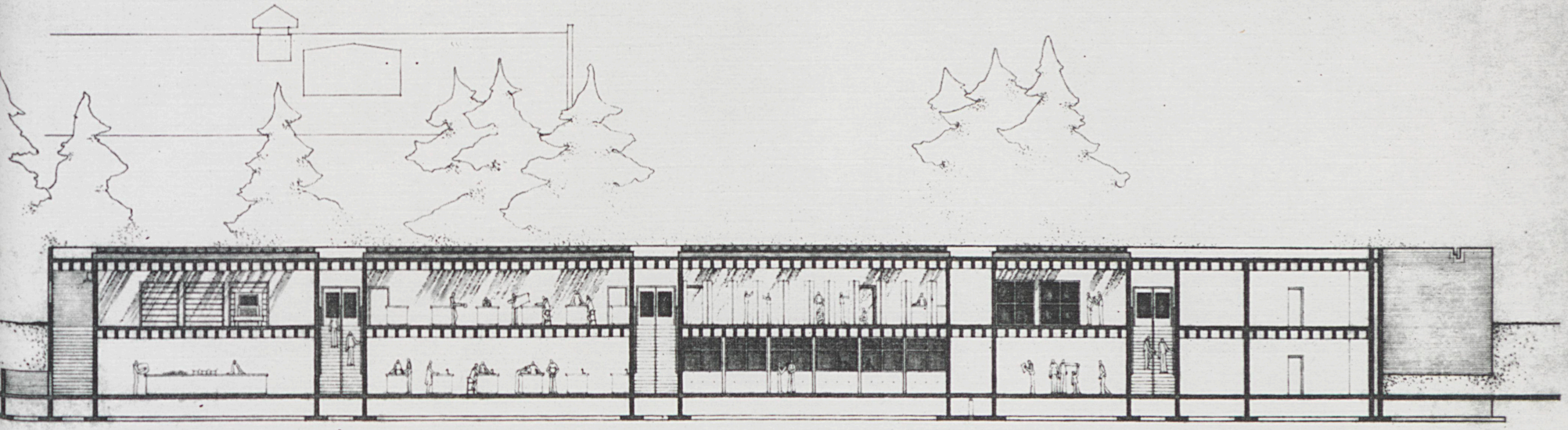
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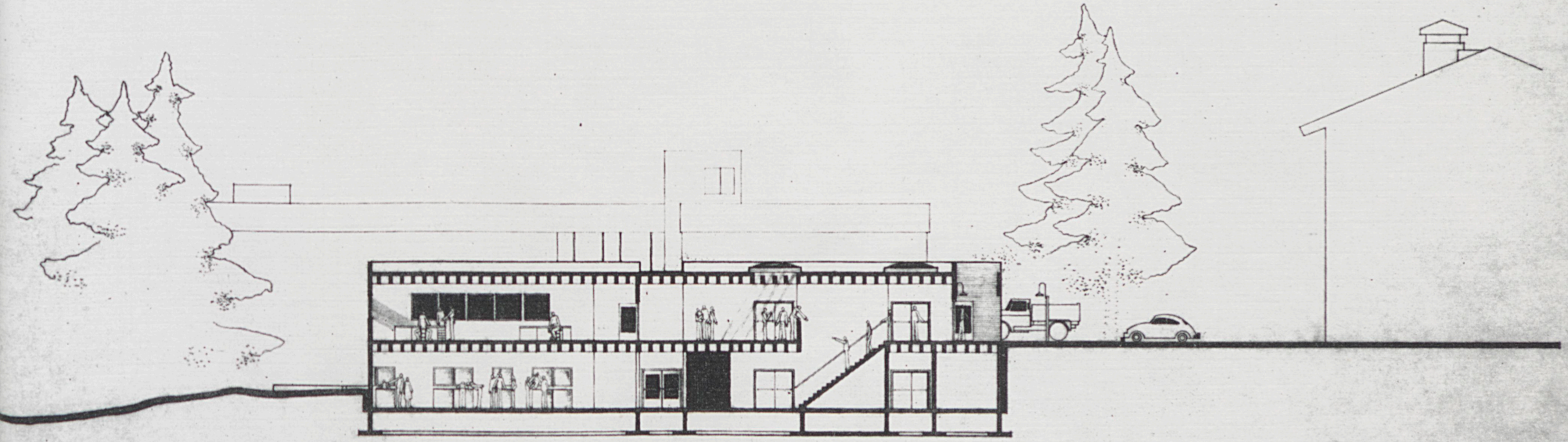
east elevation



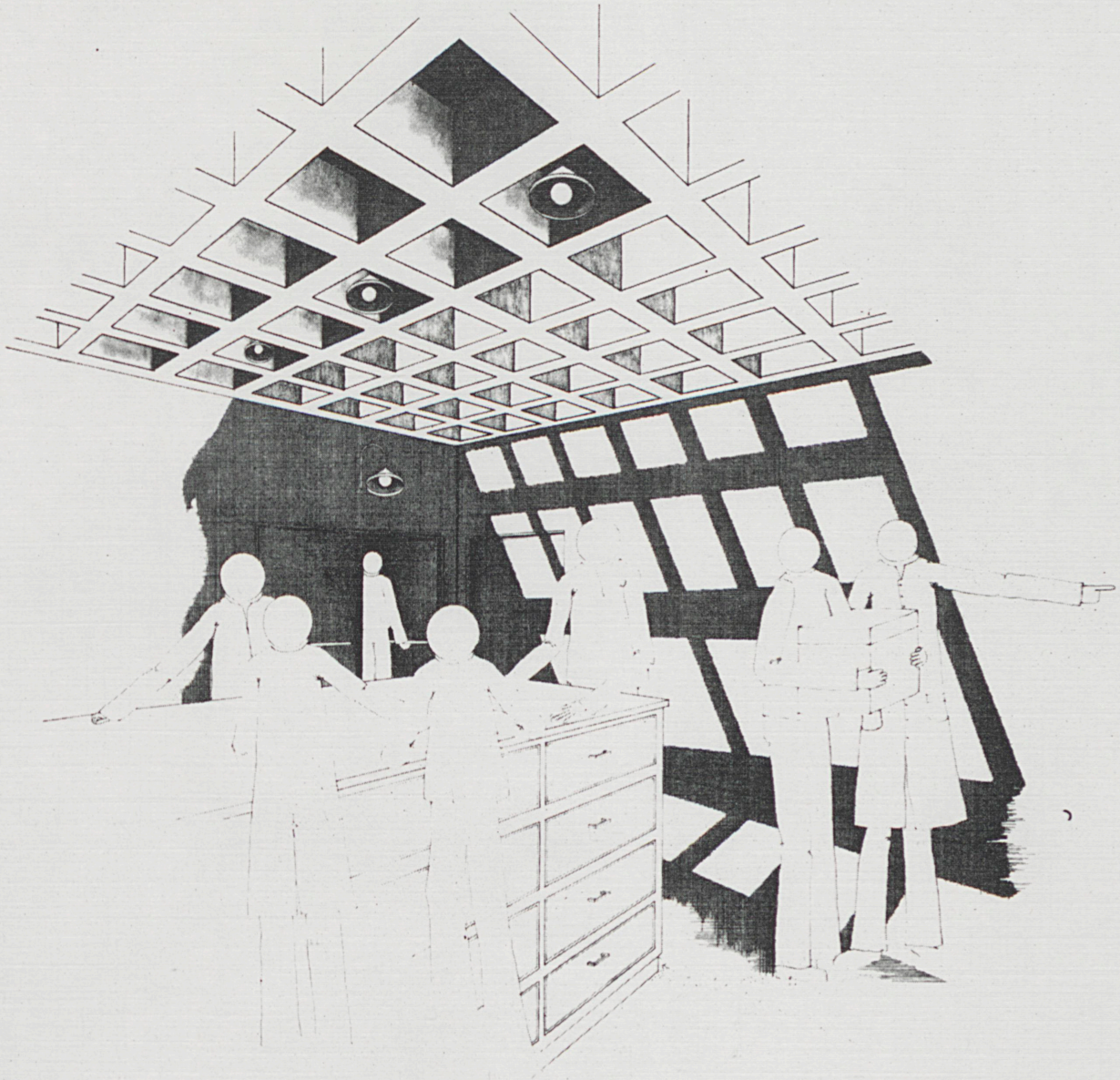
north elevation



section aa



section bb



interior lab skylight

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