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HARMONIOUS MOVEMENT AS A DETERMINER OF ARCHITECTURAL
FORM ILLUSTRATED IN A PHYSICAL PLANT ADMINISTRATION
FACILITY FOR MONTANA STATE UNIVERSITY IN
BOZEMAN, MONTANA

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Mandana State University
BOLEMAN

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ILLUSTRATED IN
A PHYSICAL PLANT ADMINISTRATION FACILITY
FOR
MONTANA STATE UNIVERSITY
IN
BOZEMAN, MONTANA

by
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Submitted to the School of Architecture
as partial fulfillment of the requirements
for the degree of Bachelor of Architecture

AT
MONTANA STATE UNIVERSITY
BOZEMAN, MONTANA

June 1974

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PROPOSAL

The subject of my thesis is the development of a new Physical Plant Administration Facility for Montana State University. This subject is chosen in view of the need of the present Physical Plant Administration to become better organized and more efficient. Over the years the present Physical Plant has acquired additional responsibility and staff without a proportional increase in the size of the present facility. This has lead to a dispersment of personnel and authority throughout the campus thus making the administration of the Physical Plant inefficient.

The thesis that I am presenting is that harmonious movement is a determiner of architectural form. Movement, as it is used in the preceding statement, can happen at various scales. As an example the movement of vehicles versus the movement of pedestrians versus the movement of people within a given space. This movement can also happen at various levels of abstraction. This can happen at the concrete level of actual physical movement of goods or individuals or at the abstract level of implied visual movement through the use of various forms and textures. To illustrate how the various scales of movement can be utilized to arrive at a form, not necessarily architectural, I will develop a campus plan in conjunction with my Physical Plant Administration Facility.

For a faculty advisor on my thesis I have chosen Professor Hugo Eck. My choice of Professor Eck is based on his familiarity with the Montana State University, its Physical Plant and the Physical Plant personnel. It is from the personnel of the Physical Plant that I will draw my resource people. These resource people will include: Martin F. Whalen, Director of Physical Plant; E. Gordon Kelly, Physical Plant Engineer; Rob Harrison, Physical Plant Architect; A. A. van Teylingen, University Architect; and members of the secretarial staff and the crafts composing the service shops. Information obtained from the resource people will include; written material relevant to the operation of the facility and criticism of my

designs and conclusions.

The method that I will use to arrive at a solution to this problem is as follows: first I will collect written and verbal information on campus planning, analyze this information for its relevance to my problem, synthesize a schematic solution to the problem and present a design for the campus that will function efficiently and achieve an order. Second, and happening roughly simultaneously, I will collect written and verbal information on the present facility, on what the facility wants to be and on other existing examples. This information I will then analyze for its validity to my solution, apply this information to synthesize a schematic solution and finally design the facility. The method that I will use to present my solution will be both verbal and graphic. The graphics will be in a two dimensional form of diagrams, plans, sections, elevations, details and three dimensional forms in models. I am counting on my graphics to be concise enough so as to require a minimum of verbal presentation.

The schedule that I propose to follow includes the collection of information for both the facility and the campus plan and development of a campus plan depicting how movement of vehicles, services and pedestrians can be applied to arrive at a logical and orderly campus during the first quarter. During the second quarter the information gathered in the previous quarter on the facility will be put into concrete form or design. I am scheduling meetings with my advisor to fall anytime on Monday afternoons and the thesis meeting scheduled weekly on wednesday afternoon. For a more concise breakdown of the quarters devoted to my thesis see the calenders at the end of this proposal.

My final presentation will include two dimensional, three dimensional and verbal presentation. The campus plan portion of my thesis will be presented both verbally and two dimensionally

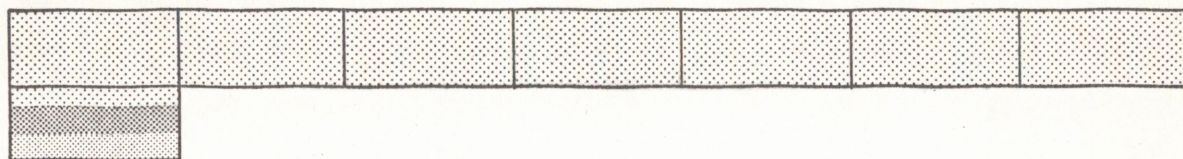
in the form of plans, sections, details and diagrams. The Physical Plant Administration Facility portion of my thesis will be presented verbally, two dimensionally in the form of plans, sections, details, diagrams and elevations and three dimensionally in the form of a finished model and any relevant study models. These portions of my presentation will be done in a manner suitable for photographing and inclusion into a book that will include relevant research material to be held in the Montana State University School of Architecture Library.

At the end of the first quarter of my thesis I will be presenting the data that I collect in the form of diagrams and written display for the facility and presentation of the data collected for the campus plan in the form of diagrams, plans and written display. In addition to these graphic displays I will have portions of my thesis book ready for presentation with exception of the final solution.

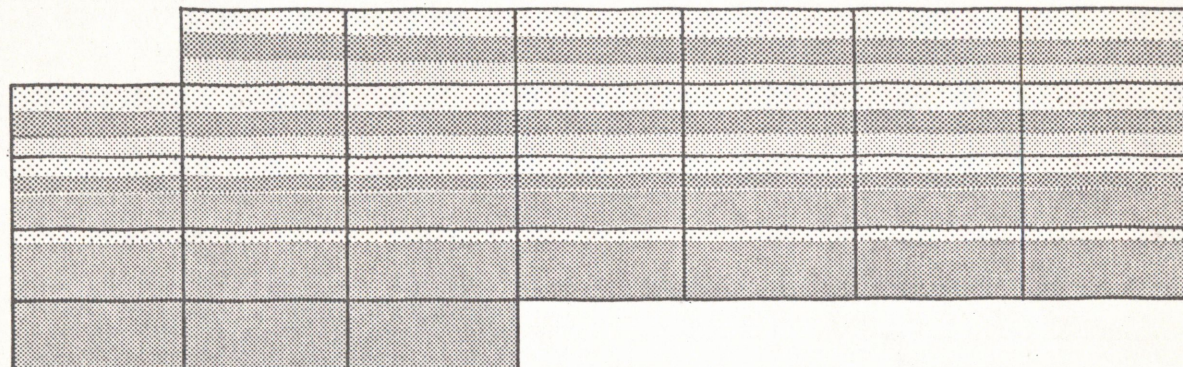
SPRING

1974

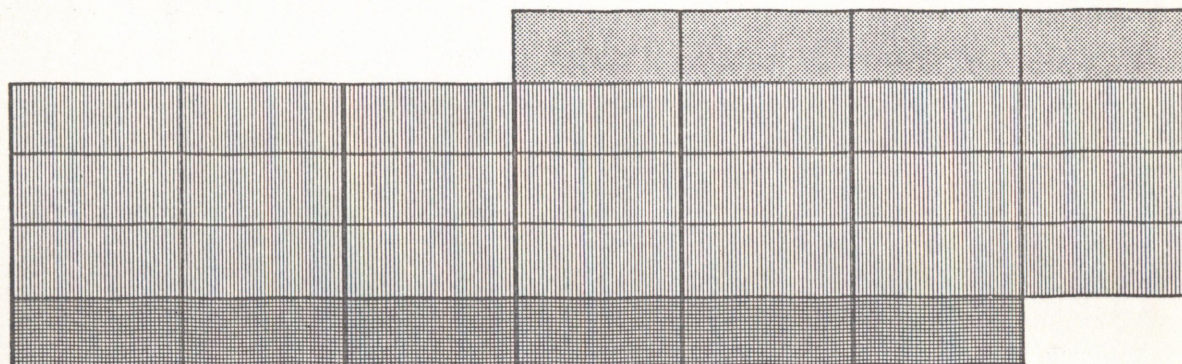
MARCH



APRIL



MAY



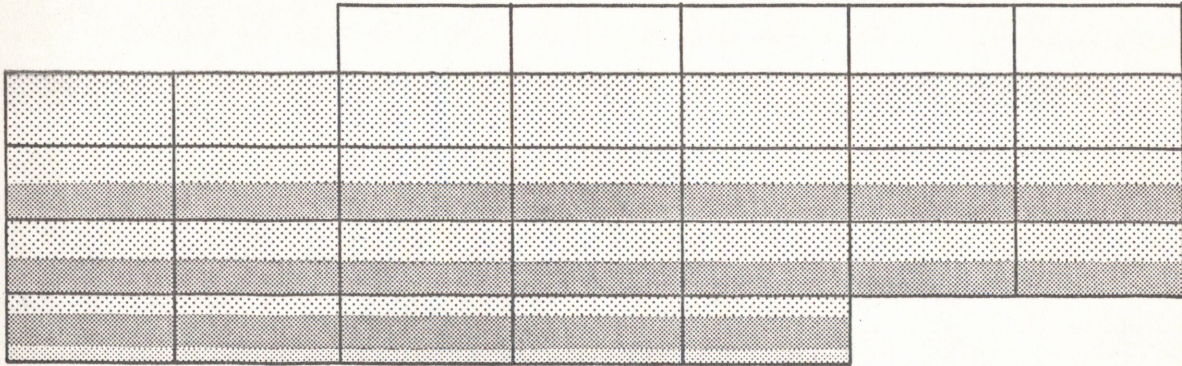
LEGEND

	PLAN
	SECTION
	ELEVATION
	DETAIL
	PREPARATION
	PRESENTATION

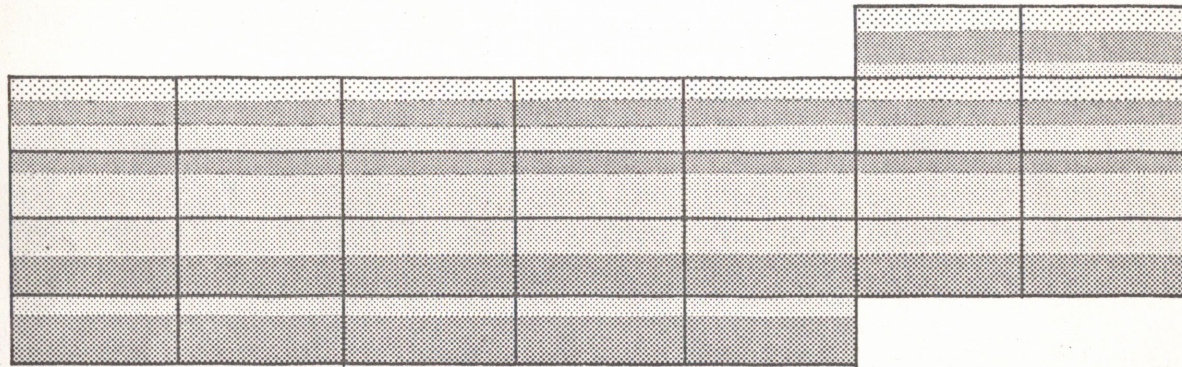
WINTER

1974

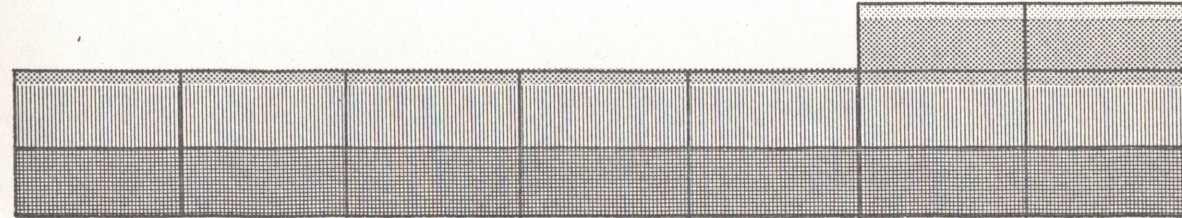
JANUARY



FEBRUARY



MARCH



LEGEND

- CAMPUS PLAN RESEARCH
- CAMPUS PLAN SYNTHESIS
- FACILITY RESEARCH
- FACILITY SYNTHESIS (PROGRAM)
- PREPARATION
- PRESENTATION

THESIS

As I have stated in my proposal, the thesis that I am presenting is that harmonious movement is a determiner of architectural form. In actual fact movement is the determiner of nearly all forms not solely architectural form. I believe that movement is a primary force in the determination of form because it is a universal characteristic of we as humans. Practically everything that we use or are effected by is either a direct product of movement or a refinement of an existing entity due to movement. As an example of a form being the direct product of movement is the case of a sidewalk taking on a certain shape as a direct response to the pattern of traffic flow. As an example of an existing form being refined by movement is the instance of the location of furniture within a space being changed as a result of various stimuli including traffic movement.

My thesis is directed at more than just random movement. It is directed at harmonious movement. Harmonious, as it is used here, is what the dictionary refers to as agreement in action or forming a pleasing consistent whole. The first part of the definition that I have just cited has to do in part to the making of a space or form of functional value. The second part of the definition has to do with the functional concerns and also with appearance or aesthetics of the space or form. This second part of the definition is of greater significance to us as architects and people.

As is stated in my proposal, movement can happen at various scales. At each scale there is a different design problem and solution required. To exemplify what I mean by different problems and solutions at different scales are such things as space capsules, roads, building location and buildings themselves. The example of the space capsule has two of the extremes of scale. At the one extreme there is the exterior design of the capsule based on the movement over large distances and at great speeds. At the other pole is the design

of the interior which is based on the movement of a man or men essentially confined to a sitting position. At a smaller scale occurs the design problems and solutions of roadways. In this instance there are two aspects of movement that are generally considered, these being the velocity of the movement and any obstacles to movement that might exist. From these considerations comes the location of the roadway and the shape the surface takes, whether straight or curved, level or banked. The location of buildings occurs as still a lower, slower, scale. Buildings are located with respect to how people through various movement systems arrive at and leave a building. There are a couple of scales that effect the design decision of where a building is located. These scales are the movement of city traffic, private vehicle and delivery vehicle, and the movement of pedestrians. The design of buildings in themselves is on the lower end of the movement scale, depending on the function of the building. The movement involved here is the flow of the process and people necessary to maintain this process of the function housed in a particular building. This movement is slower than pedestrian movement due to the restrictions placed on it by walls and furniture. At even a lesser scale within a building is the design of furniture which is also based on movement into and out of a piece of furniture and adjustment of position while on the piece of furniture.

Movement can also happen at different levels of abstraction. It can happen for instance at the level of actual physical change of position from place to place of people or products and it can also happen at an emotional or implied level such as visual stimuli. When the actual movement of people and products is considered then such things as street and sidewalk layouts are involved, location of structures determined and building plans are made. If designs were based on this actual movement alone, the designs might be related well in plan but not necessarily in the myriad other aspects of

architectural design. For this reason it is also necessary to consider the implied movement that can be accomplished through the use of visual stimuli. This implied movement can be achieved through the use of structure, material, fenestration, level change and other similar considerations. By the application of implied or visual movement a structure can be made to be visually pleasing while at the same time give cues to points of importance such as entries or special functions.

Of the various scales and levels of abstraction that movement can take in the determination of form the ones that are of greatest influence on architects are those that deal with the siting of buildings, the functional design of the buildings and the aesthetics of the building. Ideally, however, an architect should be able to grasp the concepts of the various scales and levels of abstraction in movement and be able to work with them and thus be involved with the many levels of design.

CONDITIONS CREATING A NEED

1. CAMPUS
2. FACILITY

The campus of Montana State University is located in the rich Gallatin Valley of southwestern Montana. The natural surroundings, the city of Bozeman in which the campus is located and the campus are all visually pleasing in general. There are, however, several existing conditions that do create a need for a change in the existing campus structure. Among these conditions can be listed: the lack of a good concise development plan which has led to the seeming randomness of building location, the relation of major points of access to the campus to the major portion of vehicular storage areas and the conflict that arises between the various types of traffic within the campus.

The condition creating the apparent randomness of building location, the absence of a concise campus development plan, is not as drastic as it sounds. Over the years the campus has been developed under the influence of various development plans. Among the various plans was one that took into consideration the designation of Bozeman as the capitol city of Montana and the campus being utilized as the capitol complex partially. From this plan came the development of South Eight Avenue as a boulevard and primary entrance to the campus, the appearance of the curved sidewalks such as the one from Ried Hall around in front of Romney Gymnasium to the back of the library. Over the years this developed plan has been gradually changed to the extent that the portion of the plan that occurred to the north of Montana Hall has been totally obliterated. This area north of Montana Hall, is the area in which the seeming arbitrary placement of new buildings has been the most noticeable. Another campus plan variation was based on the plan of the University of Virginia. To develop the campus in a plan similar to the University of Virginia's was grand as far as the image of the campus was concerned but it wasn't suited very well to the colder climate of a high mountain Montana valley. As can be seen, the campus has had directions it has followed in its development but there has been no recognizable thread of consistency pulling the various

development plans together. Because of this lack of consistency over the years as new structures were built they seemed random in placement on the campus. A condition of greater impact as far as actual problem is the relation of the access to the campus to the areas designated for use as parking for transient students and staff. A study that was made of the campus traffic and parking conditions indicated that the major portion of the vehicular traffic access to the campus occurs from the north and east while the major portion of the parking areas are on the south and west portions of the campus. To enable the vehicular traffic that has reached the campus to get to a parking lot it is now necessary to provide lanes in the form of streets to pass through the campus. This creates a bad condition when it is coupled with the major accesses to and within the campus which are from the west and east as indicated in the same study.

From the preceding condition, that of the relation of campus access to campus parking, arises the most irritating and most apparent problem on the campus creating a need for change or improvement. That condition is the conflict between the various forms of traffic that at present occur within the campus. These forms are private vehicular access traffic, delivery vehicle access traffic, service vehicle traffic within the campus, bicycle traffic and pedestrian traffic. The major portion of the problems occur between the drastically dissimilar modes of traffic, the motorized traffic and the self propelled traffic.

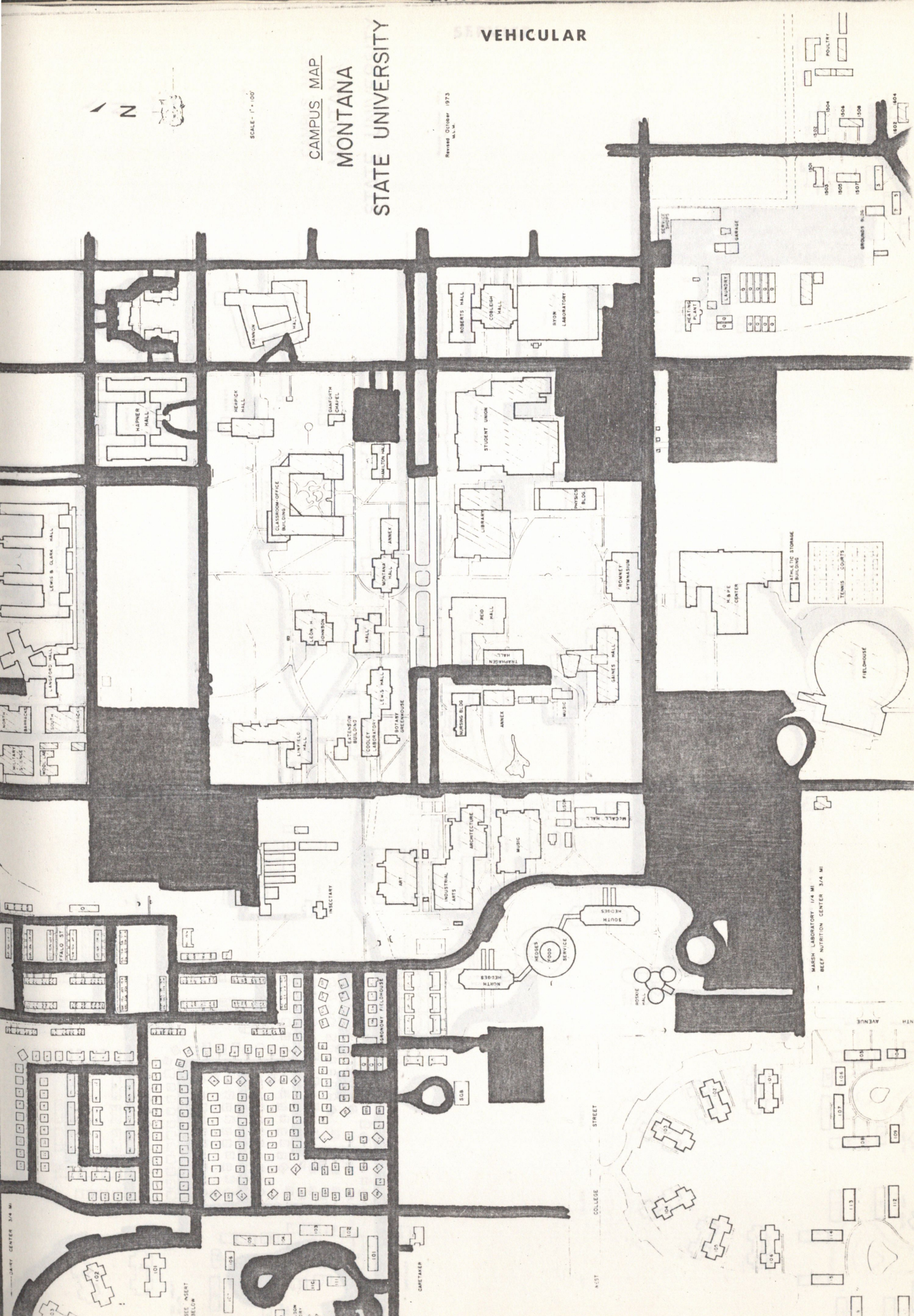
The conditions that are here listed are the major glaring deficiencies in the existing campus. By applying my thesis, as I have stated it earlier, of harmonious movement as a determiner of architectural form, in this particular instance not architectural form but form in general, the condition should be eliminated and the additional aspect of logic and order given to the campus.

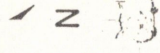


CAMPUS MAP
MONTANA
STATE UNIVERSITY

Revised October 1973

VEHICULAR



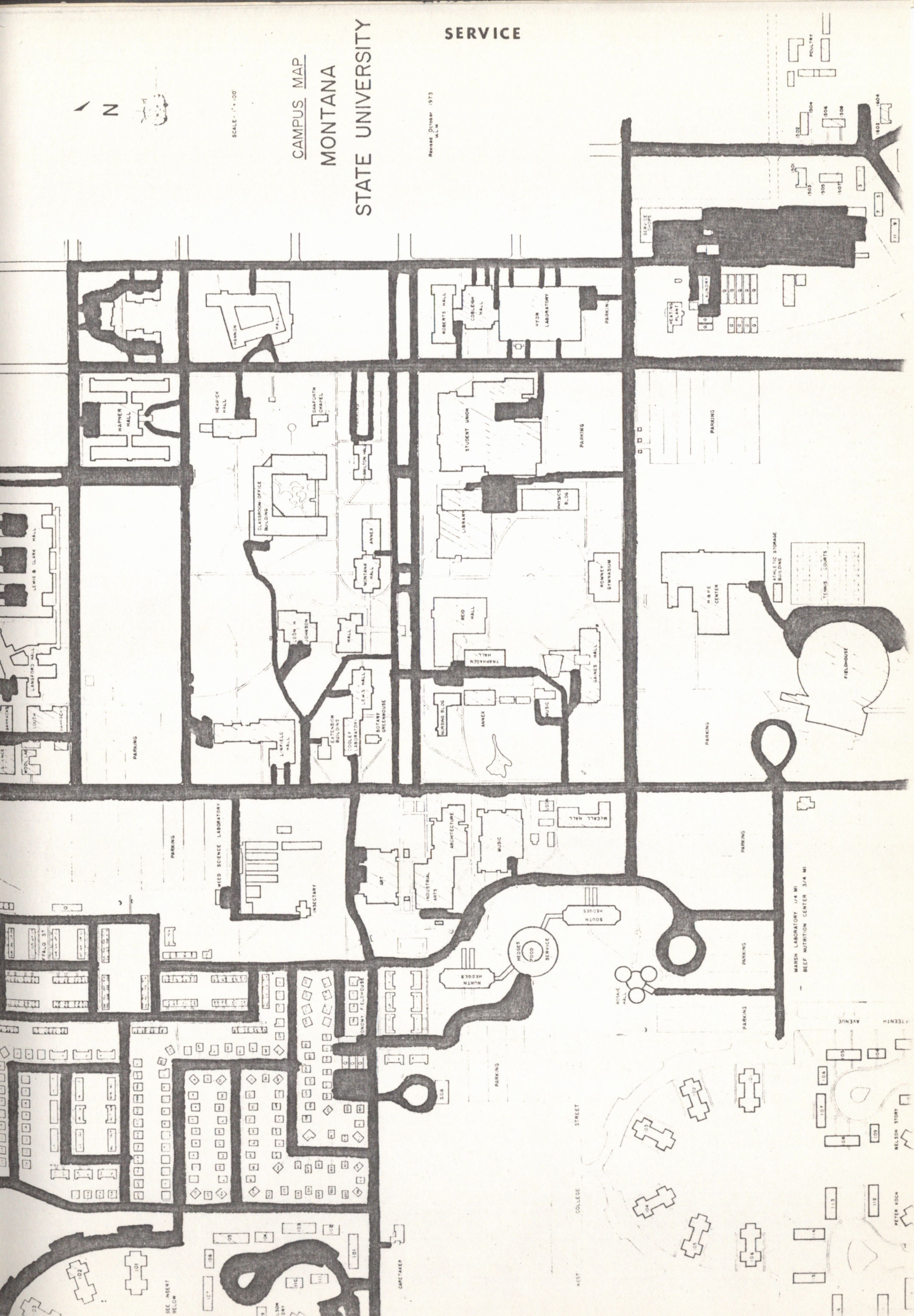


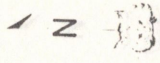
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CAMPUS MAP
MONTANA
STATE UNIVERSITY

Revised December 1973
M.S.M.

SERVICE



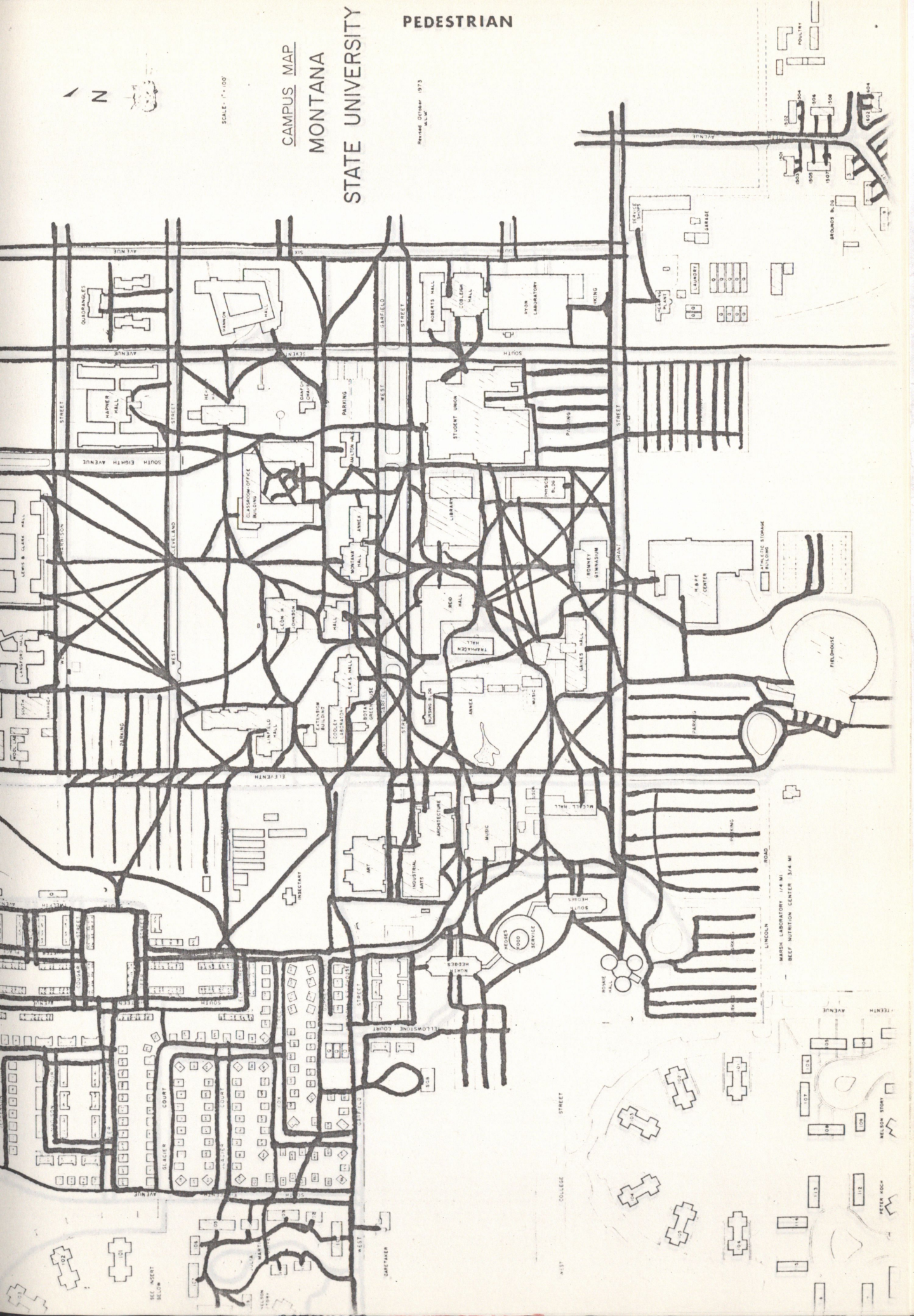


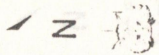
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CAMPUS MAP
MONTANA
STATE UNIVERSITY

PEDESTRIAN

Revised October 1973



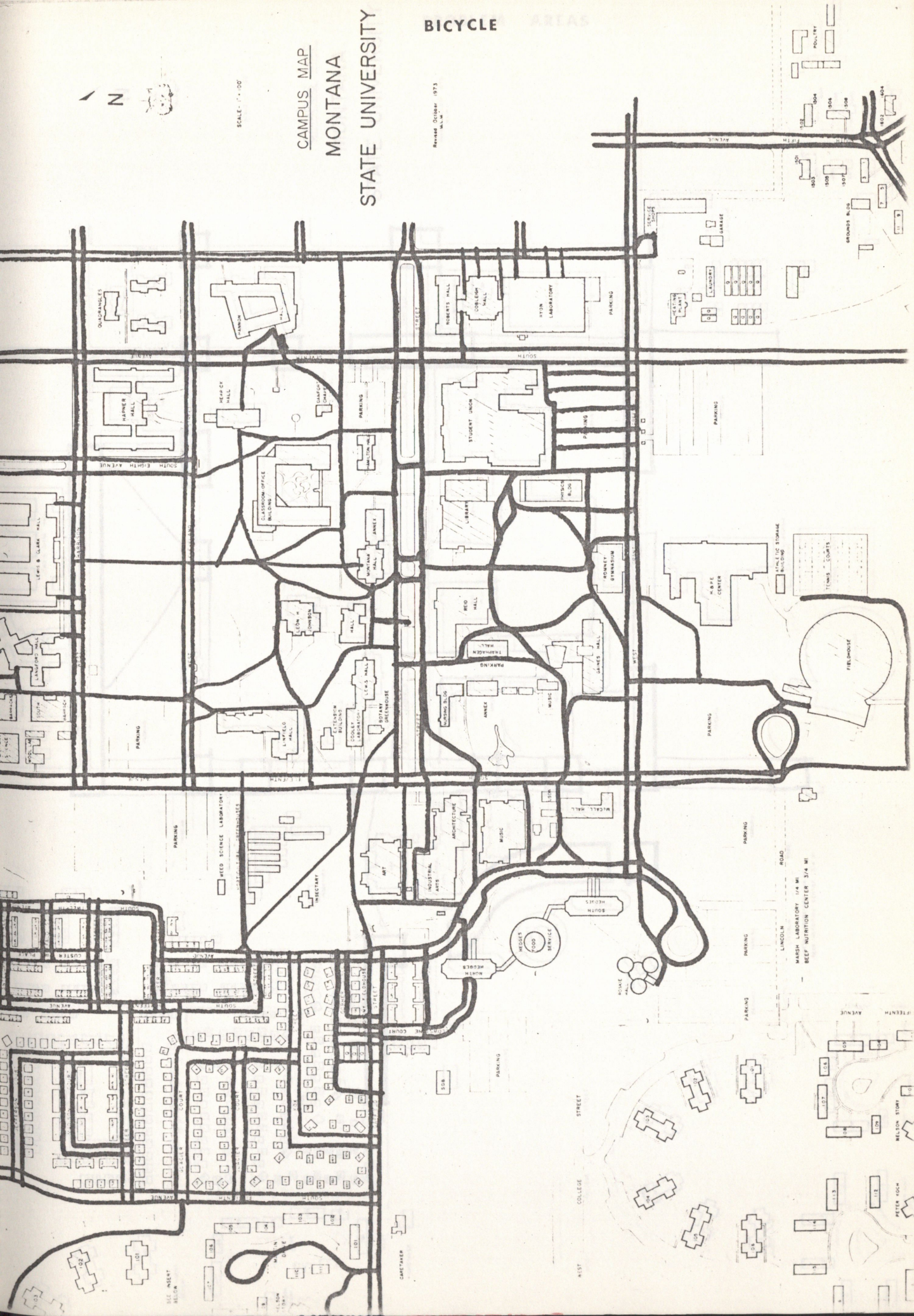


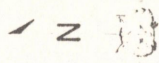
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CAMPUS MAP
MONTANA
STATE UNIVERSITY

Revised October 1973
M.S.M.

BICYCLE
PATHS



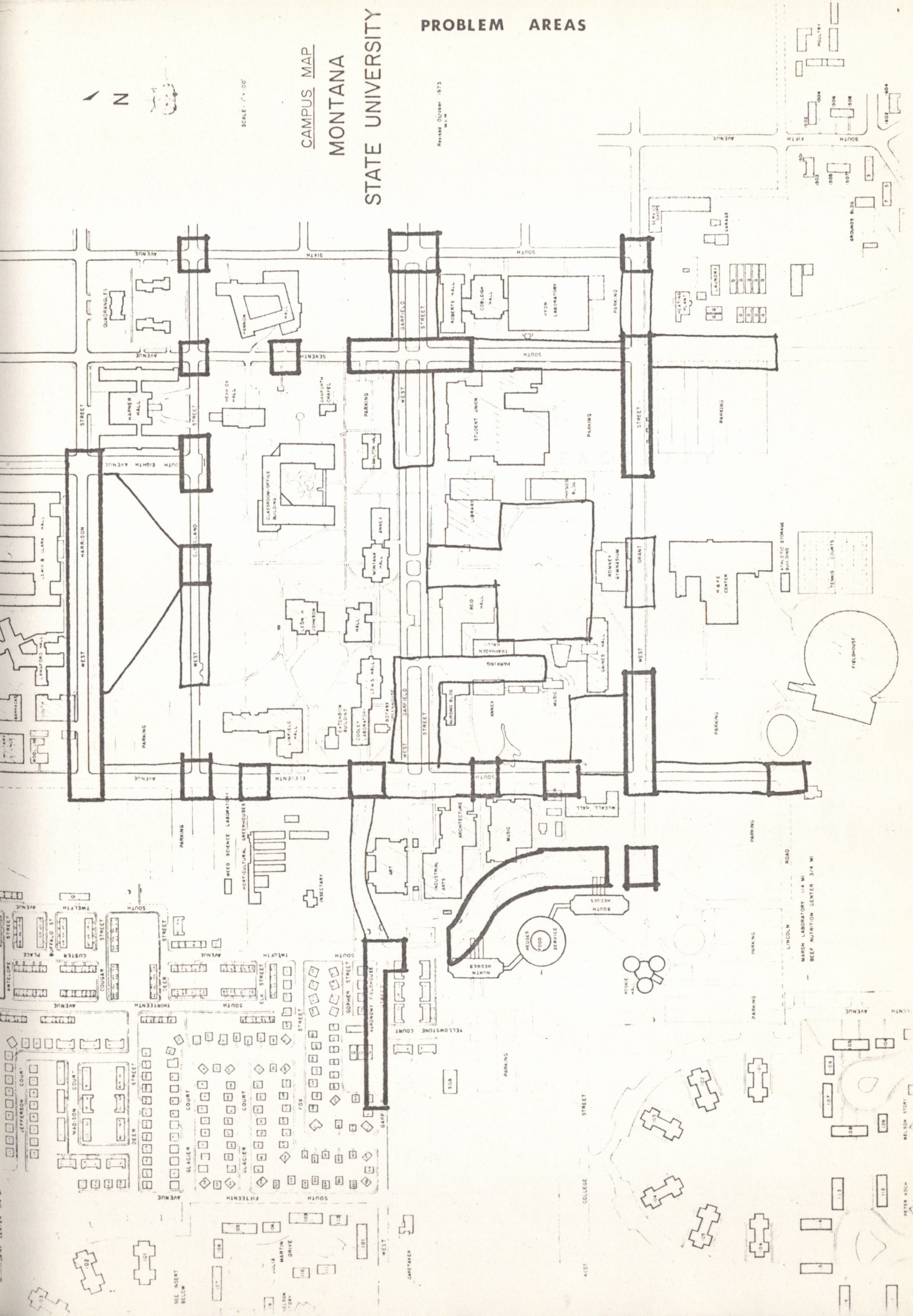


SCALE - 1" = 100'

CAMPUS MAP
MONTANA
STATE UNIVERSITY

PROBLEM AREAS

Revised October 1973



FACILITY

There are two major condition that create a need for a new Physical Plant Administration Facility. These conditions are an increase in the size of physical plant that must be administered to and the increase in the number of employees necessary for this administration. Both of these conditions have their basis in lack of space. This lack of space was evident even at the time the existing facility was built. This early lack of space was due to the lag in time between the design of the existing facility and its construction. The existing facility was designed by the architect Fred Wilson, also architect for the campus heating plant adjacent to the existing facility, in 1929. As is sometimes the case with architecture that is done with the state as a client, the funds for the design of a facility may be appropriated by the legislature without, any provision made for construction funds. Such was the case with the present Physical Plant Administration Facility. After its design in 1929 the facility was tabled until 1952 when it was finally completed and moved into by the staff of the service shops and physical plant administration.

As a result of this lapse of time between design and construction of the existing facility the facility wasn't large enough to handle the duties imposed on it by the increase in the actual physical plant of the university. As can be seen in the physical plant growth map at the end of this section, the physical plant of the campus alone has grown tremendously. The existing facility, at the time it was designed, was adequate to handle the physical plant at that time, consisting of at least eleven buildings which are still in existence and several others now removed from the campus. In the time between design and construction the growth of the physical plant was rather sluggish with respect to permanent structures but was quite rapid when all of the temporary structures that were moved onto the campus are considered. Many of those temporary have either been removed or are soon to be removed. The problem of growth of the physical plant is not eliminated by the

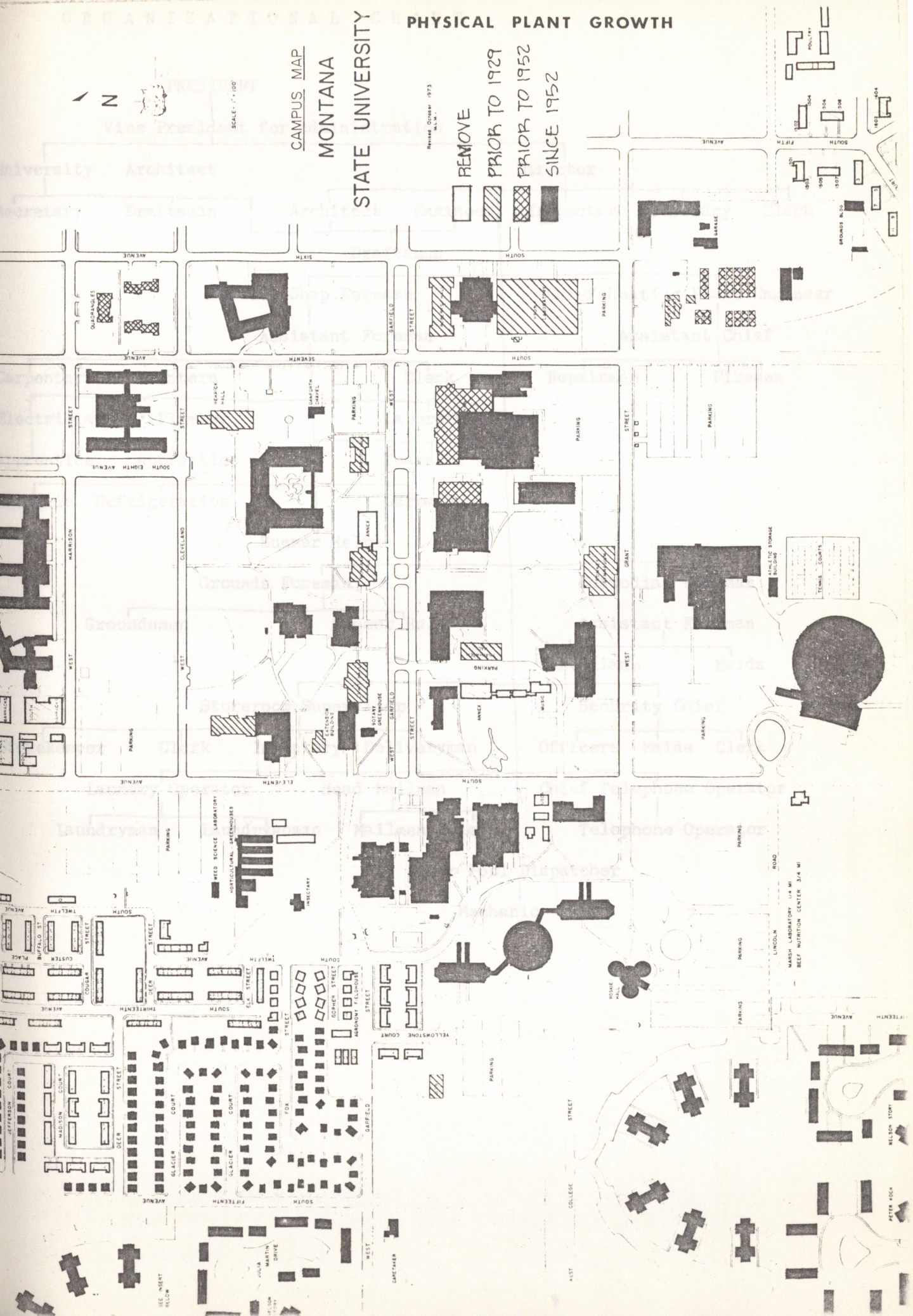
removal of the temporary structures as the number of permanent structures built on the campus has grown markedly since the existing facility's construction in 1952.

The number of employees needed to administer to the increased physical plant has grown also over the years. When the existing Physical Plant Administration Facility was designed it was designed for the use of a staff five in number. The staff consisted of a foreman-supervisor whose job it was to coordinate the demands of the campus and transmit the requests to the craftsmen of the service shops, a carpenter-locksmith, an electrician-plumber, a day laborer and a secretary. Since the staff of five was used as design criteria for the existing facility in 1929 the staff has increased a little over twelve fold as can be seen by the organizational chart at the end of this section and in a publication by the Association of Physical Plant Administrators of Universities and Colleges. It should be here noted that the increase of twelve fold does not include the employees in the custodial services and the employees in the heating plant or the members of the University Architect's staff who are now housed in the physical plant facility.

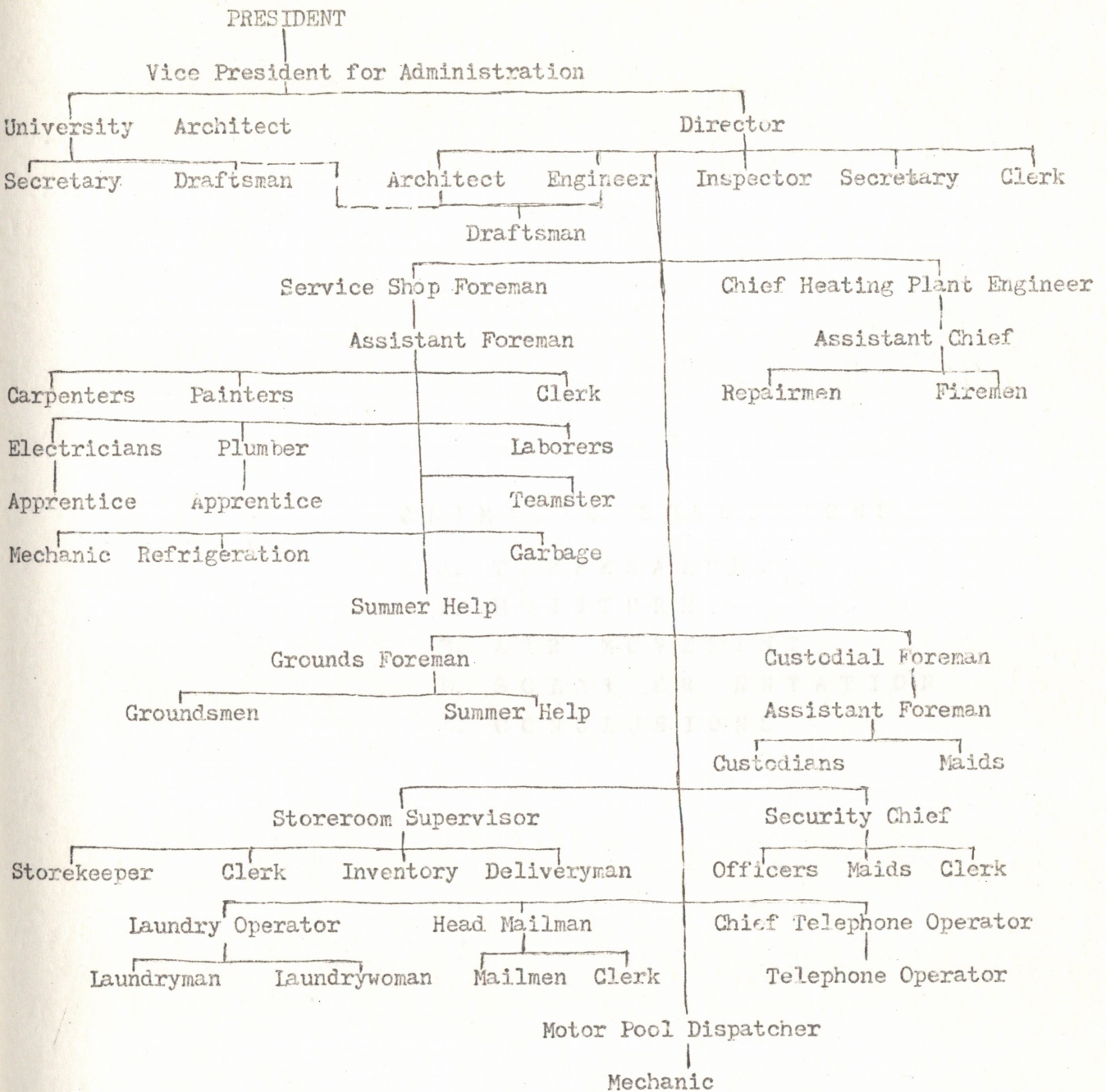
The increase in size of the physical plant and staff without a proportional increase in the size of the existing facility creates a very real need for a new or additional facility just to house this growth. A secondary need that is inferred by the need to increase the size of the existing facility is the need to provide a system that can be easily changed to meet the demands of any future changes in the function of the facility or size of that function.

CAMPUS MAP
MONTANA
STATE UNIVERSITY

REMOVE
PRIOR TO 1929
PRIOR TO 1952
SINCE 1952



ORGANIZATIONAL CHART



CLIMATIC CONDITIONS

1. TEMPERATURE
2. MOISTURE
3. AIR MOVEMENT
4. SOLAR ORIENTATION
5. CONCLUSIONS

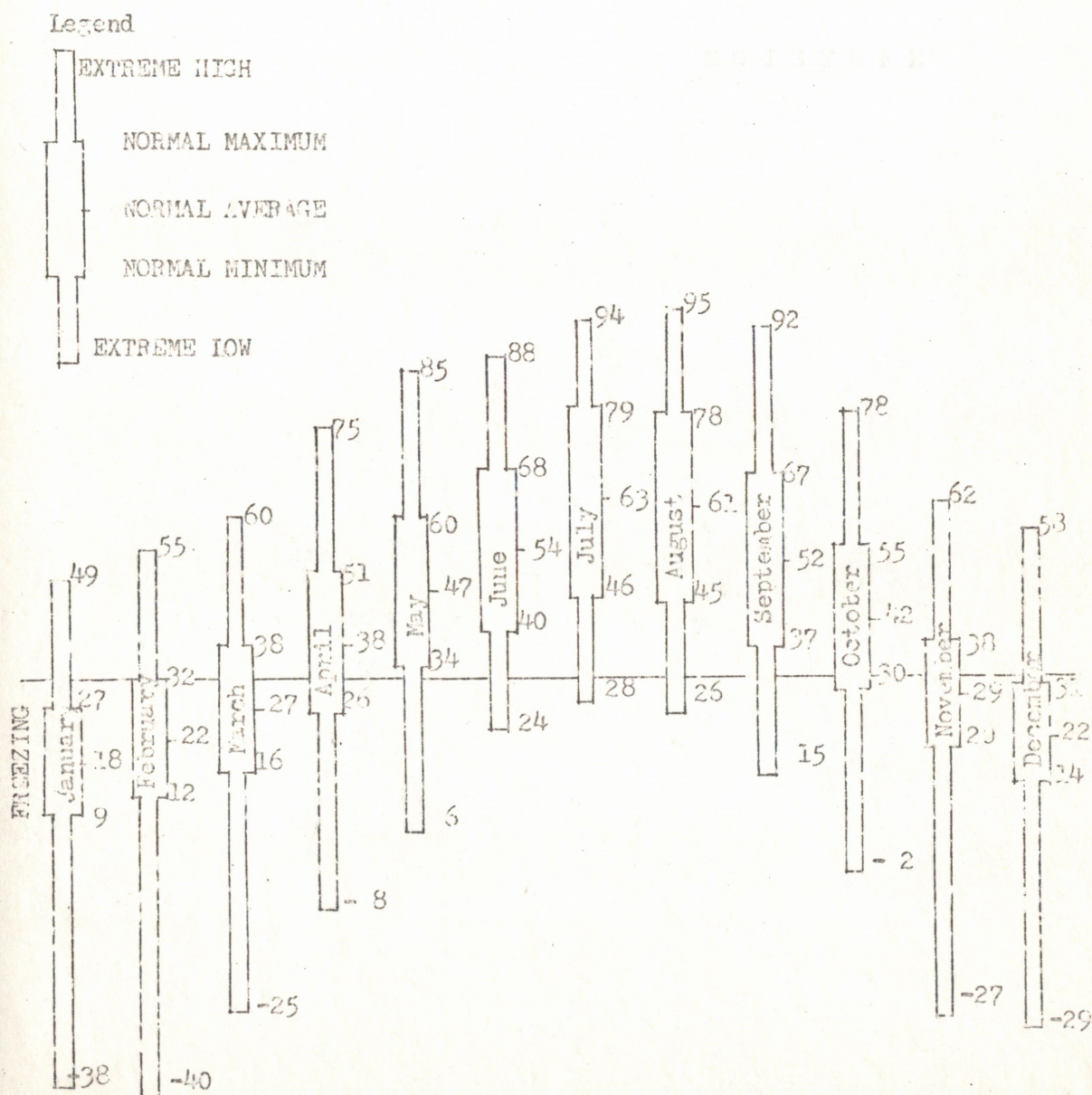
Consideration of climatic conditions has always played a part in the design of structures for man and his possessions to varying degrees depending on the function of the structure and its place in time. When man first started providing shelter for himself it was based almost intirely on response to the climate of the area he was in at the time. As man progressed culturally and socially his architecture became less and less a response to climatic conditions and more and more an attempt to advertize his social and cultural advancement. Due to this desire to advertize culture man has been producing architecture that has been wasteful of natural resources in order to acclimatize the spaces within the structure, in other words, man's architecture has become anti-climatic while being climactic.

In this day and age, what with the gradual dwindling of our natural resources and the energy situation being considerably restricted, our architectural emphasis should be in the direction of energy conservation and ulitization of wasted energy. Energy can be conserved or utilized effectively by having the design of any structure being responsive to the climatic condition as it exists in the area. The conditions that are of the greatest importance to the comfort of human occupants within a space are the conditions of temperature, moisture, air movement and solar orientation. When these aspects of the climate of an area are applied to a design of a structure within that area then the energy necessary to acclimatize that structure can begin to be minimized and the use of natural energy, such as solar radiation, can be maximized.

The following sections will illustrate what can be inferred from the consideration of climatic conditions in the area of energy conservation and utilization.

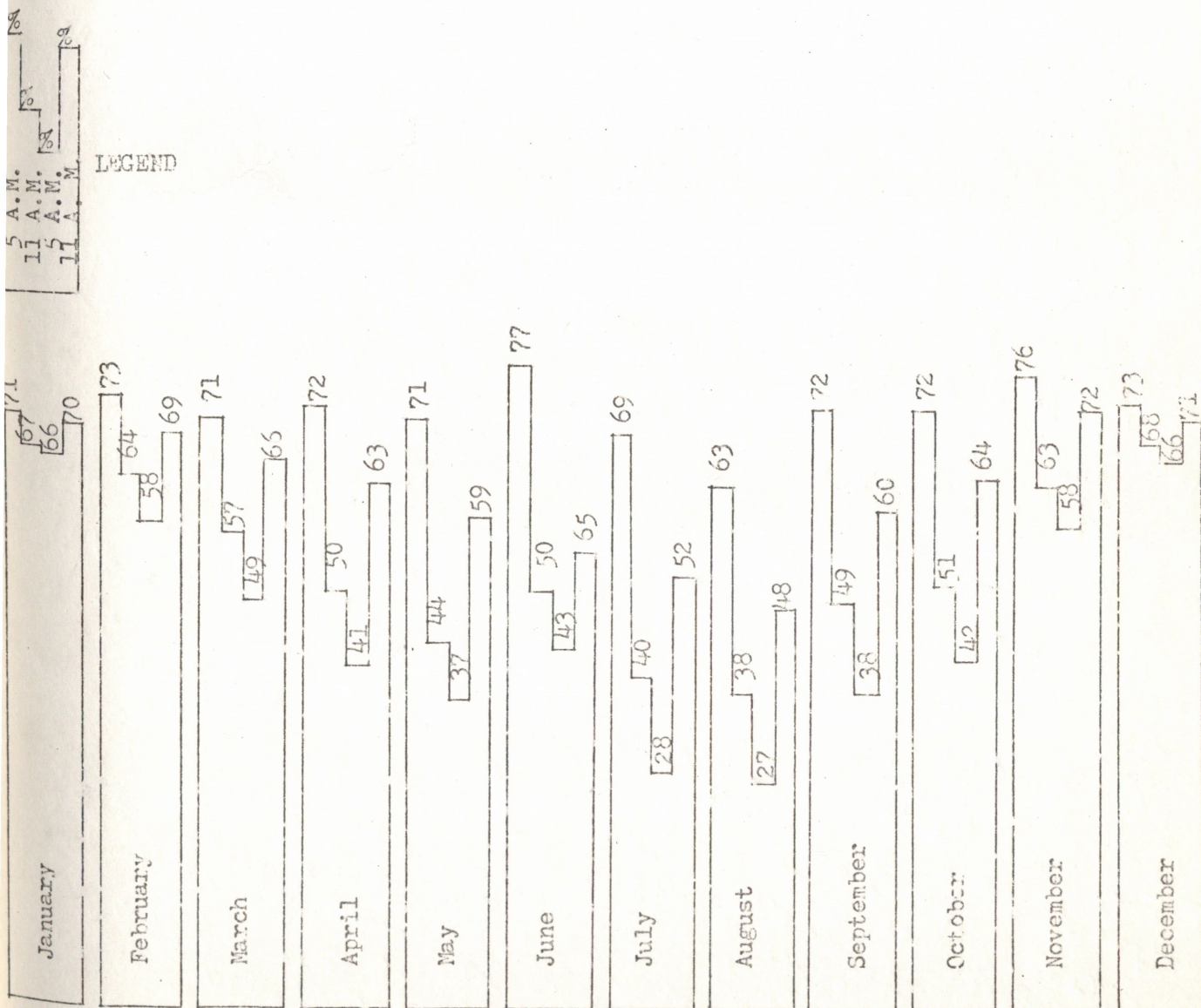
TEMPERATURE

The temperatures within the Bozeman area are as a rule quite moderate throughout the year. The average temperature varies from the high teens to the low sixties with the normal low and high temperatures ranging from nine degrees to the high seventies. In a years time the temperature may vary even more than what is normal. As a rule the extreme high temperatures never exceed one hundred degrees but do approach that mark closely. The extreme temperatures that pose the greatest design problems are those at the cold end of the scale. These temperatures can get as low as forty below zero and stay that cold for extended periods.



MOISTURE

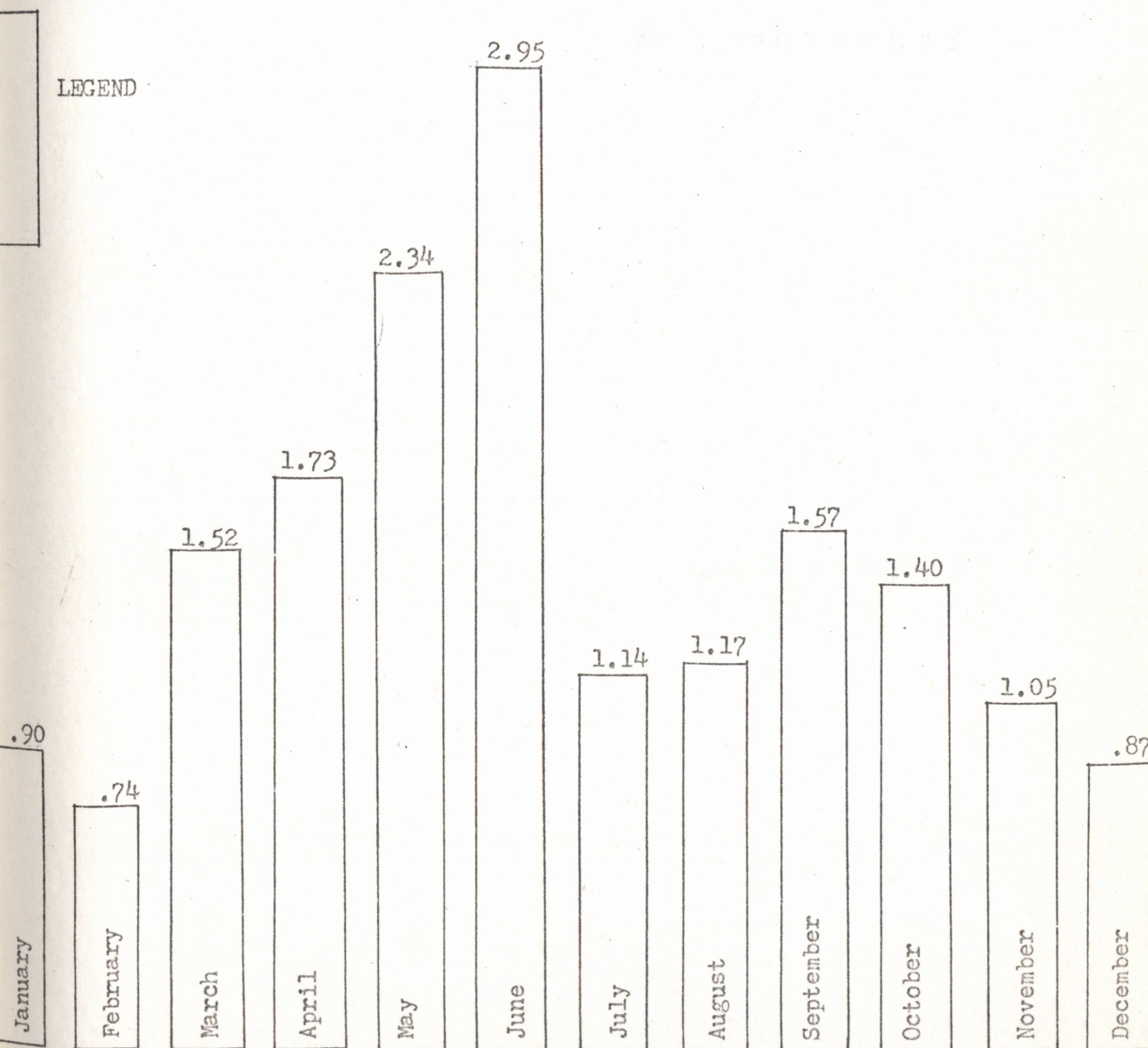
The moisture conditions that effect the comfort of individuals are the relative humidity and precipitation. The relative humidity of an area varies with the time of day. In the hours after dark the relative humidity rises to its greatest level of concentration with the highest level attained just before sunrise. During the daylight hours the relative humidity level drops off gradually until it reaches its lowest level just before sunset. As can be seen by the following graph the relative humidity of the Pozeman area follows the pattern mentioned above with the added indication that the relative humidity varies throughout the year with respect to the precipitation and length and temperature of the days.



The relative humidity during a certain period may vary from the averages shown in the preceeding graph due to the effect of precipitation. The area right around bozeman gets a considerable amount of precipitation in the form of rain or snow depending on the time of year. The area right around Bozeman is not, however, indicative of the whole area. Due to Bozeman's location, at the end of the Gallatin Valley with a range of high mountains packeting the city, it will be experiencing precipitation while just a few miles down the road to the west there will be no trace of that precipitation.

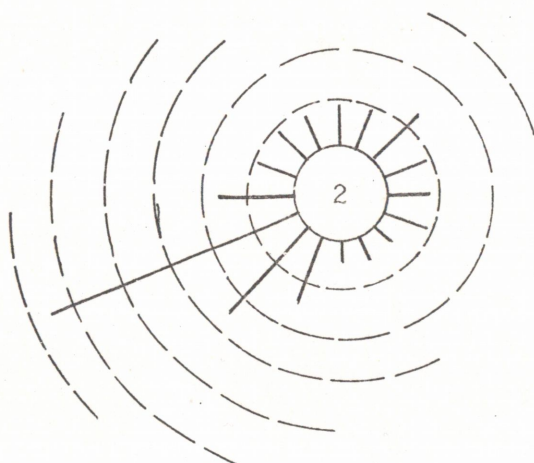
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LEGEND



AIR MOVEMENT

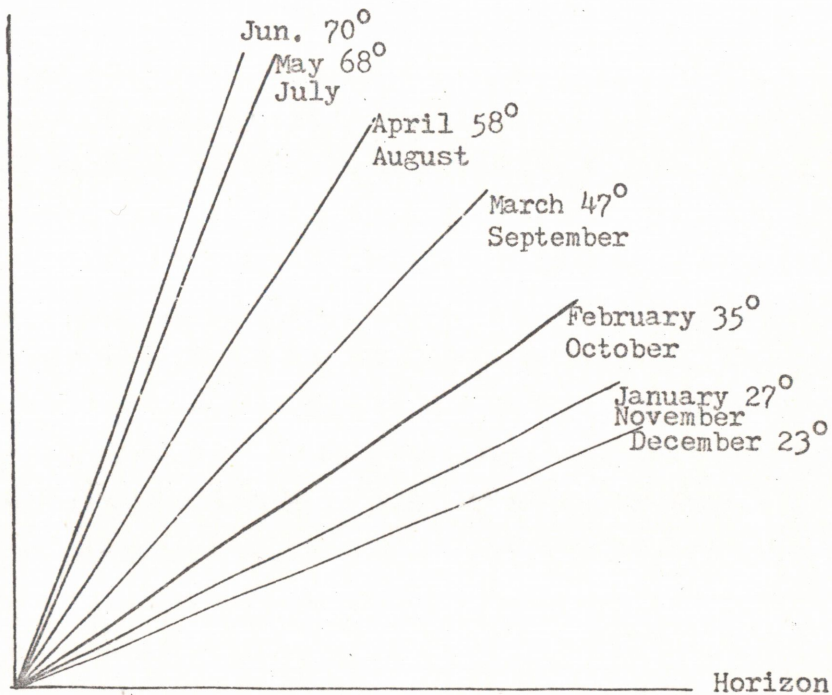
The natural movement of air in the form of winds and breezes is another of the climatic conditions that can be used to advantage in the conservation and utilization of energy. In the Bozeman area the prevailing wind is from the southwest. The wind comes primarily from the direction as a result of being channelled from the Continental Divide down the Gallatin Canyon. During the winter months the wind occasionally emanates from the northwest, bringing with it the winter snow storms and from the east. This east wind is the one responsible for bringing in the harshly cold sub-zero temperatures of the winter and as such is an important design factor.



1.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
7	16	14	14	12	12	11	11	12	14	16	17
W	WSW	SW	SW	WSW	WSW	WSW	WSW	SW	WSW	WSW	WSW

SOLAR ORIENTATION

The orientation of the sun at various times of the year can be either beneficial or detrimental. In the summer months the sun is high in the heavens and shines for the major part of the day. This relationship allows the sun to heat up the earth and the structures that people inhabit and work in during the day. In the winter just the opposite is the case. The sun makes a low arc in the sky and shines for just a few short hours. The length of time that the sun shines is not sufficient to cause overheating of structures. The information on the following charts illustrates the approximate solar conditions and orientation for the Bozeman area.



	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
AM	6:45AM	6:00AM	5:15AM	4:45AM	4:30AM	4:45AM	5:15AM	6:00AM	6:45AM	7:30AM	7:45AM
PM	5:15PM	6:00PM	6:30PM	7:15PM	7:30PM	7:15PM	6:30PM	6:00PM	5:15PM	4:30PM	4:15PM

All of the preceding information is useful as far as the design of the building is concerned, but it is not sufficient to enable the designer to make a final decision on the design of the building. If, however, a good logical design for the general comfort of the inhabitants of a structure is desired, all of the preceding information must be correlated with the physiological needs of the inhabitants. This can be accomplished by applying the information to the bioclimatic chart and the climatic needs as it is described by Pigeon.

The bioclimatic chart provides the means of applying the data for temperature and relative humidity together in relation to a zone of comfort. A zone of comfort is established as a zone in which a person can live without any special clothing or special protection. In the middle of each month, a temperature-humidity curve can be determined. From this curve, the general requirements for a typical day as far as heat, humidity, shade, wind, and moisture are concerned can be determined. At the end of this section, the curves that are shown are not true representations of the actual mid-month day condition. Due to the lack of availability of more accurate information the temperatures shown at the end of the curves were the average temperatures for the entire month rather than typical mid-month day. As a result of this condition the curves do not extend as high or as low as they should thus not indicating an actual and realistic need for air movement to have the temperature-humidity curve fall within the comfort zone.

Upon completion of the bioclimatic chart the information presented there can be further transformed into a more useful form in the timetable of climatic needs. This chart places the requirements illustrated on the bioclimatic chart into relationship with time of day and time that the sun is above the horizon. From this chart it more easily determined what

CONCLUSIONS

All of the preceeding information is useful as far as the possible design of details aimed at solving the problem caused by that particular condition. If, however, a good logical design for the general comfort of the inhabitants of a structure is desired, all of the preceeding information must be correlated to the physiological needs of the inhabitants. This can be accomplished by applying the information to the bioclimatic chart and the timetable of climatic need as it is described by Victor Olgyay.

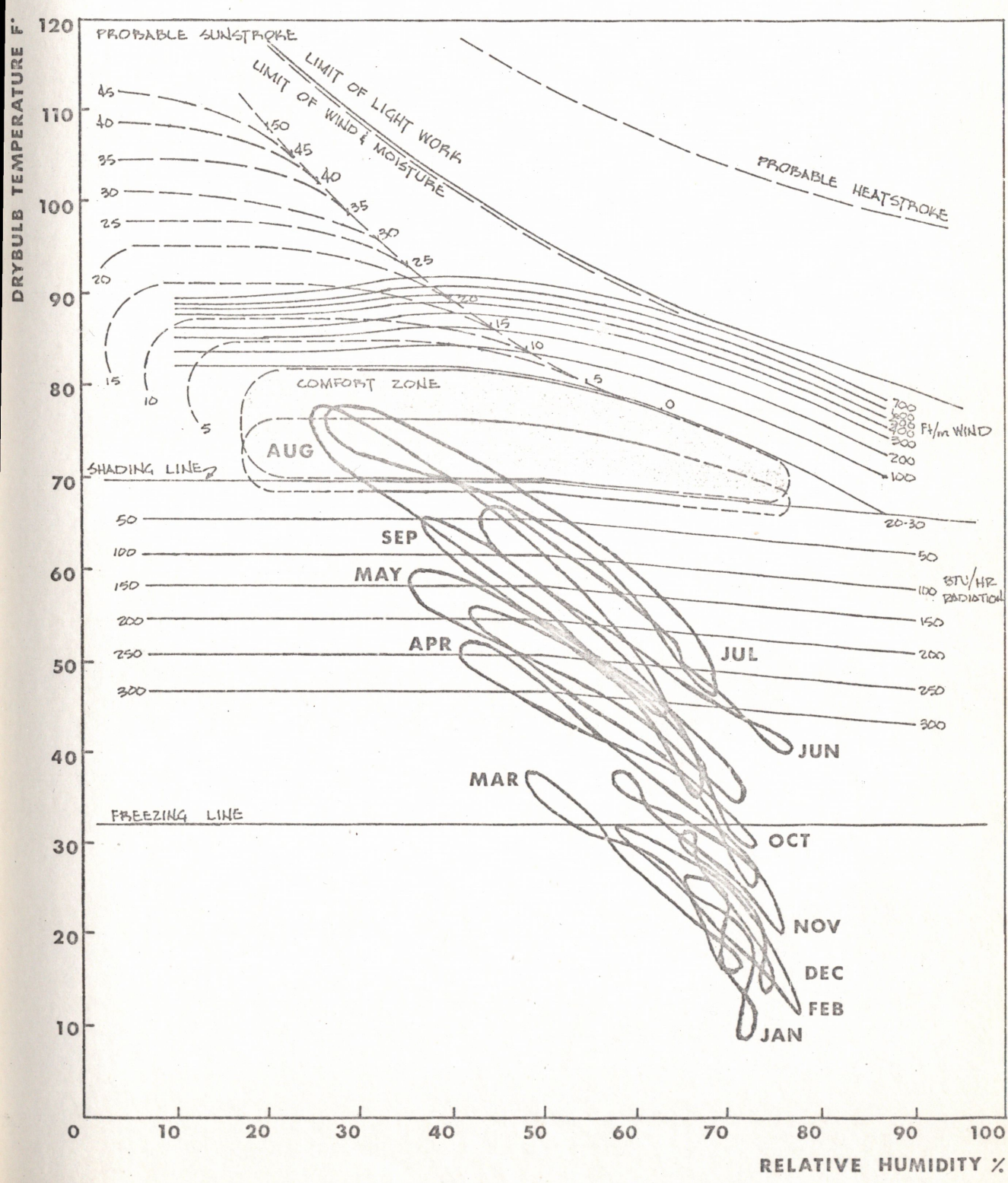
The bioclimatic chart provides the means of applying the data for temperature and relative humidity together in relation to a zone that has been established as a zone in which humans feel most at ease called the comfort zone. By applying the relative humidity and dry bulb temperature for a day in the middle of each month, a continuous closed curve can be generated. From this curves location on the bioclimatic chart it can be determined the general requirement for a typical day as far as heat required, shade, wind and moisture to make the daily climatic chart at the end of this section; the curves that are shown are not true representations of the actual mid-month day condition. Due to the lack of availability of more accurate information the temperatures used to arrive at the close curve were the average temperatures for the entire month rather than typical mid-month day. As a result of this condition the curves do not extend as high or as low as they should thus not indicating an actual and realizable need for air movement to have the temperature-relative humidity curve fall within the comfort zone.

Upon completion of the bioclimatic chart the information presented there can be further transformed into a more useful form in the timetable of climatic needs. This chart places the requirements illustrated on the bioclimatic chart into relationship with time of day and times that the sun is above the horizon. From this chart is more easily determined what

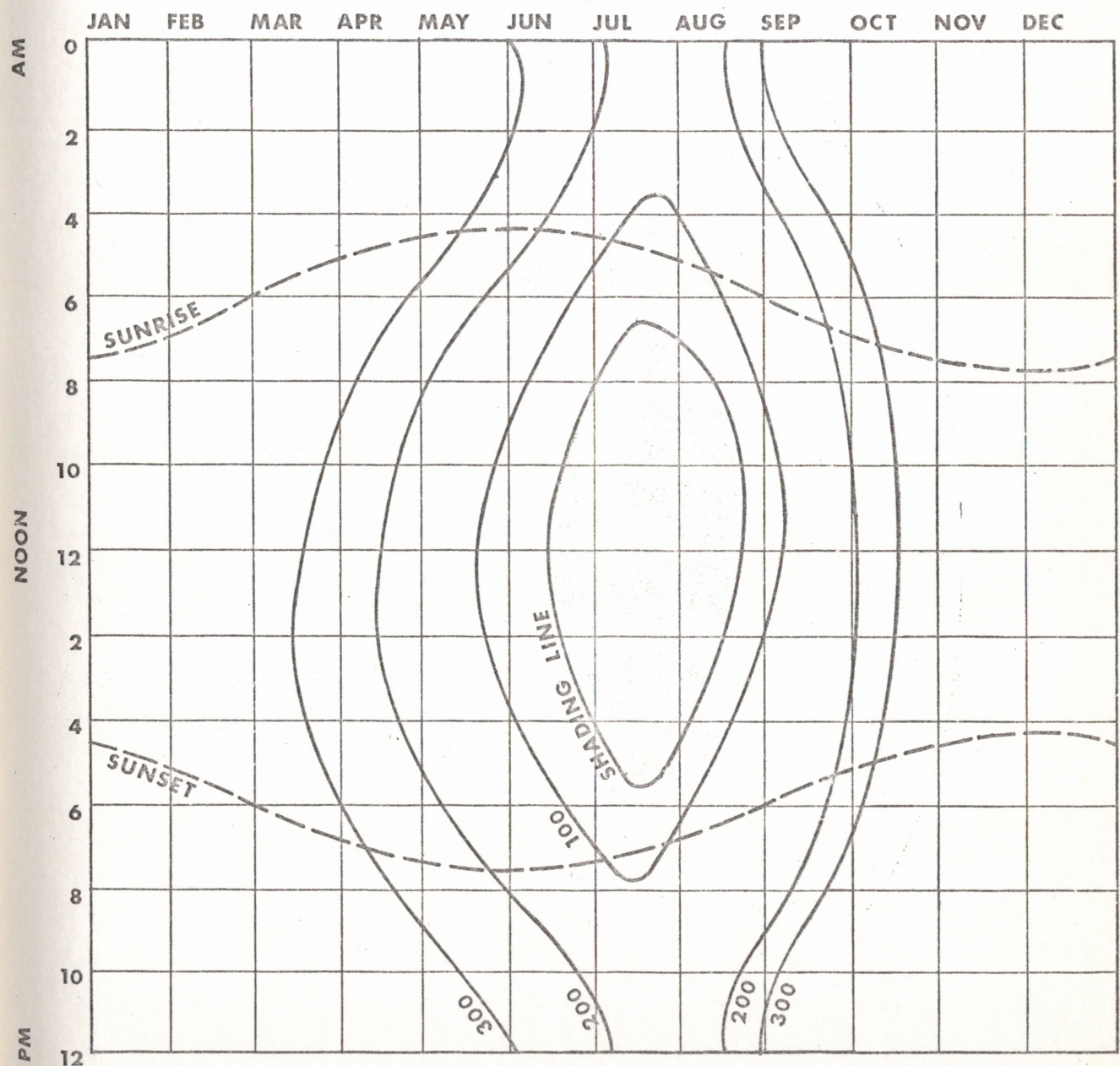
conditions, heat added, shade provided, and such considerations, should be applied to the monthly conditions to have it fall within the zone of comfort. Again it should be here noted that due to the lack of precise information the timetable of climatic needs should actually show a need for some sort of air movement somewhere within the area calling for shade.

Through the use of the raw climatic data and the information garnered from the bioclimatic chart and the timetable of climatic needs, the climate of any area can be used to minimize the consumption of natural resources for the acclimatization of the spaces in which we humans find ourselves living and working within everyday.

BIOCLIMATIC CHART



TIMETABLE OF CLIMATIC NEEDS



EXISTING CAMPUS CONDITION

1. ADJACENT ENVIRONMENT
2. ORIENTATION
3. TRAFFIC
4. TOPOGRAPHY & VEGETATION
5. VIEWS

ADJACENT ENVIRONMENT

The campus of Montana State University is located on the southwest edge of the city of Bozeman, Montana. As a result of this location and the nature of the land holdings in this area the campus has a variety of environments that are in close proximity to the campus. The ownership of the adjacent property about the campus ranges from private ownership to publicly owned land, and the types of environments encountered varies from agricultural through residential to commercial. These variations happen roughly in the major campus orientations and as such have an effect on the nature of the campus.

The north edge of the campus, the area along west College Street, is privately owned and for the most part of a commercial nature. The commercial uses of the adjacent property to the north is concentrated in a strip along west College Street between south Eighth Avenue and south Eleventh Avenue. On either end of this strip occurs residential use of the property and is privately owned. This occurrence is from south Sixth Avenue to south Eighth Avenue and from south Eleventh Avenue to south Nineteenth Avenue. As a result of the commercial development along west College Street the campus in this area has developed a back facade that is seemingly meant as a barrier to such a development. Along the portions of west College Street, where the campus meets privately owned residential, another type of back facade has developed. This facade is aimed at defining the edge of the campus but at the same time it is not as formidable as the back facade that is adjacent to the commercial development. The fact that the commercial and residential developments occur as they do is not the only determinants of the facade composition previously noted. As can be seen in the existing land use map at the end of this section, another reason for the change in character of facade is not only reaction to outer stimuli but also a condition created by the function of the facilities in that area of the campus. As the land use within the campus changes from academic to residential so changes the

scale of the structures and thus the formidable feeling of the facade, use within the campus. The use ranges from residential to graduate and the scale is of a larger nature.

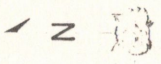
The west edge of the campus faces on land that is publicly owned by the university and used primarily for agricultural purposes. As a result of the land use conditions along this edge, residential on the campus side and agricultural on the non-campus side, the environment encountered here is one of openness and small scale where built structures do occur. This relationship has a marked influence of other conditions within the campus such as traffic flow and growth potential.

The environment along the south edge of the campus has all of the possible conditions previously mentioned, public and private ownership, and commercial, residential and agricultural land use. The west end of the non-campus side of this edge is primarily privately owned residential. A small portion towards the mid-point of this edge is privately owned commercial and the remainder, to the east edge of the campus is all of an agricultural use nature owned privately and publicly. The residential portion of this environment is not of a high density and as such adds relatively little to the campus condition aside from a physical-legal barrier to campus growth and expansion in this area. The major portion of the campus side of this edge is devoted to the automobile in the form of parking lots. Some of the immediate and adjacent portion of the campus side of this edge are utilized by residential and recreational uses. The scale of these uses is rather large, but due to their orientation and separation this facade, unlike the north facade, is open and inviting and more of a frontal facade than a back facade.

The environment along the east edge, although fully developed is one of compatibility. The non-campus side is wholly residential and fairly well established as far as landscape is concerned. This is one of the reasons for the seeming compatibility of the environment created in this area. Another

reason for the compatability of this environment is the nature of the land use within the campus. The use ranges from residential to academic and the scale is of a larger nature. The condition that makes for compatability between the larger campus scale and the subdued non-campus scale is the effect of the buildings being oriented with sides facing the edge rather than backs. In cases where backs of buildings are facing the edge the condition is minimized by the facade treatment or landscaping.

As can be seen from the descriptions of the various adjacent environmental conditions, the campus has a wide variety of effects and impressions available to it to either strengthen or diminish as is desired in promoting an image for the campus.

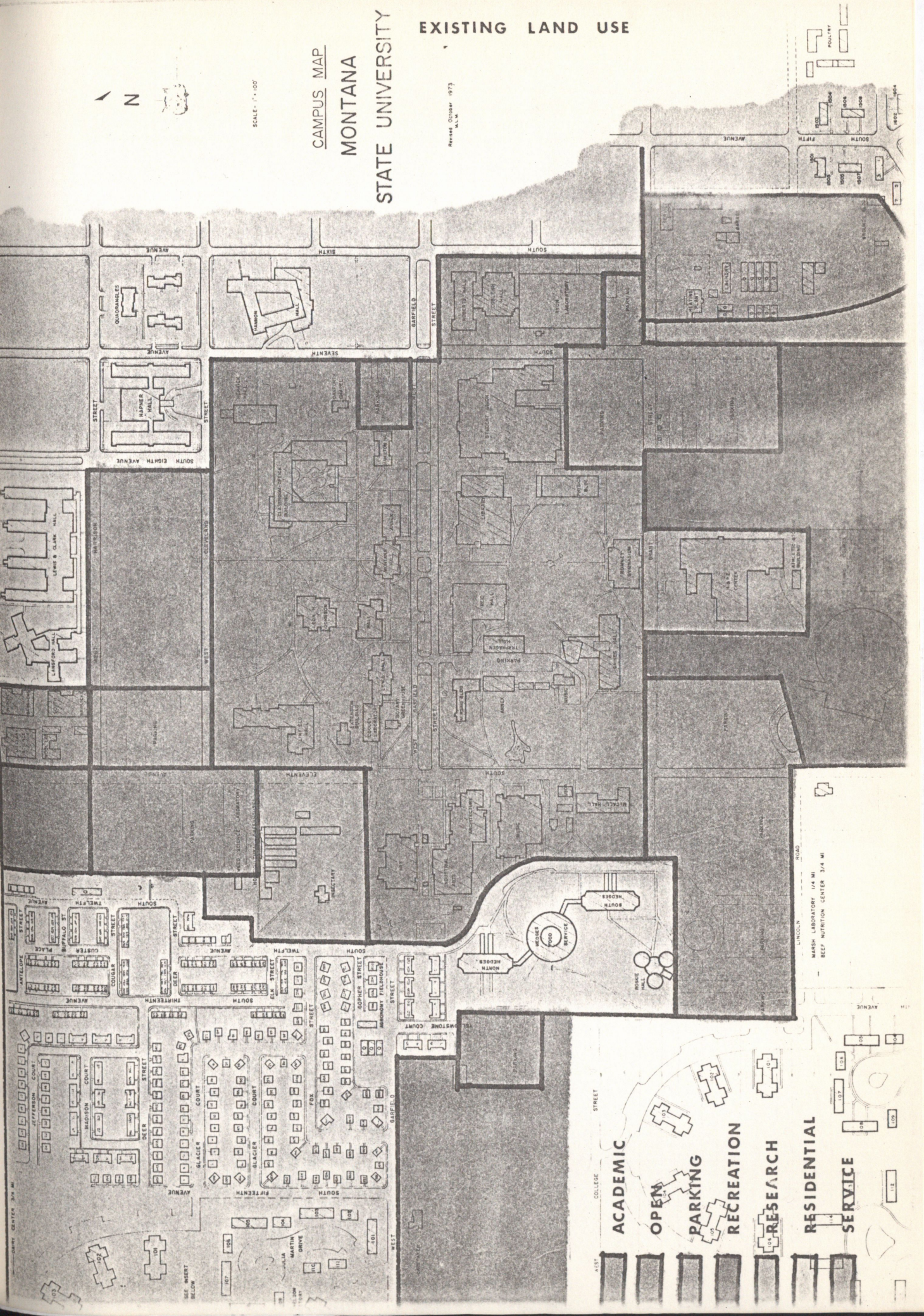


SCALE - 1" = 100'

CAMPUS MAP
MONTANA
STATE UNIVERSITY

EXISTING LAND USE

Revised October 1973
M.S.M.



COLLEGE STREET

ACADEMIC

OPEN

PARKING

RECREATION

RESEARCH

RESIDENTIAL

SERVICE

ROAD
LINCOLN
MARCH LABORATORY 1/4 M
BEEF NUTRITION CENTER 3/4 M

ORIENTATION

As has been mentioned in the previous section, Adjacent Environment, the campus of Montana State University is located on the southwest edge of Bozeman, Montana. This location is at the high point of the terrain on which the city is located. This affords the campus the amenity of having splendid, uninterrupted views and vistas. These considerations however, are not what should be envisioned as orientation. Orientation should be defined as the way that a function or entity relates to the functions and systems of the greater cosmos that surrounds it, whether that cosmos be landscape, other buildings, cities, or larger forms of environment. The relationships that are of prime importance are the entry-exit functions and the focal point functions.

The entry-exit functions has to do with the traffic approaches to the campus from the city. As a result of the location of the campus the major portion of the entry-exit traffic comes from the north and east with some traffic from the west as a result of the growth of the city. These major approaches are cut right through the heart of residential districts. This condition is not the most optimum for several reasons including conflict between the quitness desirable in a residential area and the parking condition that is perpetuated by such a function. The location of the major entry-exit routes are illustrated by dashed lines on the intra-city map at the end of this section.

The other function that is of major importance is the location of focal points. There are two predominant points of focus that should be considered. These points are: for the person driving the motor vehicle, where the places to park are, and, for the person who has just parked his motor vehicle, where the places he wants to go are. On this campus a conflict evolves out of the former, parking space, condition. As noted the majority of entry-exit traffic is from the north and east. The problem occurs when it is understood that the majority of parking spaces occur on the south and west sides of the campus.

The individual that is new to the campus can understandably suffer confusion trying to find a place in which to park his car particularly if he would like to be in the proximity of the facility he is interested in getting to for his business. This relationship of entry to parking can be seen in the existing land-use map at the end of the previous section. The second part of the relationship, that of the relation of parking places to buildings where the individuals are interested in going, also provides a conflict of sorts. The places that have the highest desirability as far as access by people from outside the campus and not necessarily connected with the campus are for the most part hard to find in relation to entry and parking. Such locations, such as the Student Union Building and the Fieldhouse have much the same orientation to the entry-exit points of the campus as do the parking spaces, they are located in the south portion of the campus. The Student Union Building, which has perhaps the greatest interest to people not necessarily affiliated with the campus, has the added disadvantage of being somewhat internalized within the campus thus creating a problem of discovery by the person looking for the building.

As a result of the major portions of the entry-exit function happening on the north and east edges of the campus and the focal points for people using these spots of entry-exit being on the south and west edges of the campus, it is evident that at least one problem can arise out of this situation. This conflict between entry-exit and parking facility location is one of the situations that must be dealt with in any campus plan proposal.

T R A F F I C

In this section the actual traffic pattern that exist will be discussed as compared to the traffic discussed in the previous section, Orientation, which was a generalization of the effect of the actual traffic patterns. Of primary interest will be the traffic conditions that exist and are created by the various forms of traffic and conflicts that may arise as a result of the intersecting of any two or more forms of traffic. The forms of traffic that now exist are those of private vehicular, automobile and motorcycle etc., service vehicular, service shop vehicles and delivery vehicles from the city, bicycles and pedestrian.

The private vehicular traffic can be divided into two catagories that of actual traffic patterns to the campus and the actual traffic patterns within the campus. In regards to the private vehicular traffic to the campus from the city it can be seen as discussed earlier and shown on the intra city map at the end of the privious section in dashed lines, that there now exist four major avenues of traffic from north of the campus and two major avenues of traffic from the east, one of which countinues on and is the traffic avenue from the west. The major routes from the north are south Nineteenth Avenue, south Eleventh Avenue, south Eighth Avenue and south Willson Avenue. Of these routes the ones that carry the greatest number of vehicles are south Willson Avenue and south Eleventh Avenue. These two predominate over the other two because they either pass directly through the campus, as is the case with south Eleventh Avenue, or connected to direct routes to the campus from the east, as is the case with south Willson Avenue. The other two, south Eighth and Nineteenth Avenues, are rather heavily trafficed as a result of being through streets, having all adjoining streets required to come to a stop. The major east-west traffic routes are west College Street and west Grant Street. Both of these streets receive heavy traffic with west Grant Street being slightly heavier due to its proximity to parking spaces. West College Street also carries

the traffic from the west end of the city and traffic generated by south Nineteenth Avenue to the campus. There are several streets between west College and Grant Streets that carry a higher volume of traffic from the east to the campus because of their being through streets. These streets are not major routes however as they do not have a continuous links to parking spaces or other traffic routes.

Once this private vehicular traffic reaches the campus its course is altered in some way as a result of either change in speed or change in direction due to the termination of the route. The result is that a second network of streets and avenues become the major traffic routes. These routes are, in the north-south direction, south Eleventh Avenue and south Seventh Avenue, and, in the east-west direction, west Grant Street, west Cleveland Street and not as extensively but still importantly west Garfield Street. All of these routes are positioned within the campus and as such begin to segregate portions of it from one another. These inner campus routes can be seen on the vehicular traffic map at the end of this section.

The service vehicular traffic, which consists of vehicles that bring supplies and goods to the campus along with the service shop vehicles which service the campus and are not allowed to leave the campus for any great distance, uses the same traffic routes that the private vehicular traffic uses. This is the case as the service vehicular traffic is composed of basically the same type of vehicles with the difference being in size and use. The difference in traffic pattern of the two forms of traffic lies in the areas that are open to service vehicles and not private vehicles. The areas that are open to the service vehicles are the areas necessary to service the various buildings on campus. These include such areas as service drives, Johnson Memorial Court and Garfield Mall. These additional traffic routes along with the ones used by the private

vehicular traffic can be seen on the service traffic map at the end of this section. The problems that arise from this situation are primarily those with private vehicular traffic and pedestrian traffic. The problem with private vehicular traffic arises through conflicts at intersections, which also occurs between private vehicles, and the occasional difference in speed of the two forms of traffic. The problem arising with pedestrians is one of location as in the instance when a service vehicle, while servicing a building, must park in an area designated for pedestrians, such as Johnson Memorial Court or Garfield Mall.

The pedestrian traffic on the campus comes from all directions for various reasons. The pedestrian traffic from the north is generated by the dormitories located along West College Street and to a lesser degree by the residential development to the north of them. This traffic is periodically quite heavy and crosses a couple of the more heavily traveled vehicular routes. From the west a great deal of traffic is generated by the three highrise dormitories, married student housing and the transient parking spaces in the southwest corner of the campus. This traffic which is very heavy has to cross the heavily trafficked vehicular traffic route of South Eleventh Avenue which causes a major problem periodically. The area on the south of the campus generates pedestrian traffic from the parking spaces provided for the driver of the private vehicle and to some extent from the academic facilities that lie across the major vehicular traffic route from east to west. The relation of the parking and academic activity to the major vehicular traffic route, West Grant Street, to the campus academic core causes conflict in the instances when the two forms of traffic occur simultaneously, which is the way it usually occurs. A major portion of the pedestrian traffic to the campus is generated from east of the campus. A large number of the people involved with the campus are housed within walking distance of the campus in this area. The number

and types of conflicts that occur between pedestrian traffic and other forms of traffic in this area are minimal compared to the other areas of pedestrian traffic. This low frequency of conflict is due to the nature of the other forms of traffic which run parallel to the paths taken by pedestrians. The major routes of pedestrian traffic are depicted on the pedestrian traffic map at the end of this section. Emphasis should be placed on the idea of major routes being shown on this map as the pedestrian, being human, has the ability to change his mind and direction at a moments notice and create his own path.

The last major form of traffic is that of the bicycle. The bicycle is a scavenger vehicle. It can use just about any route used by vehicular and pedestrian traffic for its route and usually does as can be seen on the bicycle traffic map at the end of this section. The conflicts that arise with the bicycle and vehicles are similar to those that arise with the pedestrian, and vehicles, that being one of varigated velocity. The conflicts arising with pedestrians and bicycles are also based upon differential speeds fo involvement which, due to the velocities involved, are not as drastic as the conflicts between bicycle and motorized vehicle.

When these various modes of movement are compared one to the other, as in the overlaying of the various traffic maps at the end of this section, a picture is formed that shows areas where serious problems exist due to the nature and number of conflicts between these movement modes. By this comparison the intensity of conflict can be discerned and depicted. As can be seen in the problem areas map at the end of this section, the comparison of the various traffic patterns produces a pattern of conflict from intense to mild. By this method of comparison a starting point may be istablished on which any proposal can be based.

The topography of the region is characterized by a series of low, rolling hills and valleys. The highest point is the summit of the mountain, which is covered by a dense forest. The terrain is generally flat, with a few small hills and valleys. The climate is temperate, with a range of temperatures from 50 to 80 degrees Fahrenheit. The precipitation is moderate, with an average of 40 inches per year. The vegetation is primarily deciduous forest, with a few evergreen trees scattered throughout. The soil is fertile and well-drained, with a high content of organic matter. The water resources are abundant, with a number of rivers and streams flowing through the region. The overall impression is of a peaceful and scenic landscape.

TOPOGRAPHY & VEGETATION

The topography of the region is characterized by a series of low, rolling hills and valleys. The highest point is the summit of the mountain, which is covered by a dense forest. The terrain is generally flat, with a few small hills and valleys. The climate is temperate, with a range of temperatures from 50 to 80 degrees Fahrenheit. The precipitation is moderate, with an average of 40 inches per year. The vegetation is primarily deciduous forest, with a few evergreen trees scattered throughout. The soil is fertile and well-drained, with a high content of organic matter. The water resources are abundant, with a number of rivers and streams flowing through the region. The overall impression is of a peaceful and scenic landscape.

With the exception of the mountain, the terrain is generally flat, with a few small hills and valleys. The climate is temperate, with a range of temperatures from 50 to 80 degrees Fahrenheit. The precipitation is moderate, with an average of 40 inches per year. The vegetation is primarily deciduous forest, with a few evergreen trees scattered throughout. The soil is fertile and well-drained, with a high content of organic matter. The water resources are abundant, with a number of rivers and streams flowing through the region. The overall impression is of a peaceful and scenic landscape.

The topography of Bozeman is flat to gradually sloping to sloping rather steeply as the city nestles into the foothills of the mountains that terminate the east, northeast and south edges of the Gallatin Valley. It is on such a gradually and steeply sloping topography that the campus of Montana State University is situated with the north and west edges of the campus are on a nearly flat but gradually sloping terrain that slopes up toward the main academic core of the campus. The academic core is situated on the steeply sloped terrain that rises to the top of a hill on which is located the rest of the academic core. This puts the major portion of the campus on a north slope condition which, at certain times of the winter creates problems with snow and ice conditions.

The vegetation of the Gallatin Valley area is somewhat limited in variety due to the severity of the cold winter months which takes its toll on the unhearty varieties of vegetation. Of the types of vegetation that do prosper in this area there is a choice available between deciduous or coniferous vegetation in sizes and shapes running from crawling shrubs to tall majestic trees. The vegetation that does survive the cold, harsh winters of the area do quite well during the growing season in the immediate Bozeman area due to the large amounts of moisture, compared to the rest of the Gallatin Valley, that are bestowed upon it due to the topography of the adjacent land which wrings out the most moisture available in the atmosphere as it passes over the mountains.

With the use of the topography and the available types of vegetation any campus, whether it be private yard, university campus or city, can be planned and appointed pleasantly and in a way that can utilize the forms and shapes that are natural.

VIEWS

The fact that Montana State University's campus is situated on the top of a hill is an extreme advantage in the area of views available to individuals. Being nestled at the terminus of a large valley is also an advantage in that the terrain on which the hill is located is elevated above the bottom of the valley thus giving long unobstructed vistas. The views that are available are tremendous. To the north and east the valley ends in the majestic Bridger Range. The north portion of these magnificent mountains are evident down the Gallatin Valley to the west gradually diminishing into the Horseshoe Hills and finally into the valley itself. To the west, the view is of the Tobacco Root Mountains. These mountains provide the termination point of the west end of the valley and are a stepping stone to the Continental Divide a little farther west. The views to the south are dominated by the Spanish Peaks as part of the Madison Range and Highlight Peaks which is part of the Gallatin Range. The view in this direction is particularly impressive when the morning sun first illuminates these rocky crags when they are snow covered.

As has just been described, the view from the campus of Montana State University is superb in all directions. This begins to indicate that any planning and building construction should take place with an alert effort to augment or in the least, not destroy these views.

PROPOSED CAMPUS CONDITION

1. ADJACENT ENVIRONMENT
2. ORIENTATION
3. TRAFFIC
4. TOPOGRAPHY, VEGETATION
AND VIEWS

ORIENTATION

The campus of Montana State University, as covered in the Orientation section of the Existing Campus Conditions, has its major entry-exit functions on the north and east sides of the campus with its parking functions oriented on the opposite sides of the campus. Also the orientation of traffic within the campus is toward the use of the automobile. Both of these orientation conditions are not the best and as such should be corrected or at least improved. The orientation of the internal traffic of the campus being vehicular should be changed for several reasons, among them being economy, safety and order. The change here proposed is from an automobile oriented campus traffic to a pedestrian-bicycle oriented campus. The economic aspect of this change has subliminal effects. As has been made apparent to us recently through the vehicle of the energy crisis, we are going to have to sacrifice some of our dependence on the automobile as a means of getting from one point to another. As a means of developing this shift in dependence from the automobile as students at this campus is to learn to be pedestrians. A more manifest advantage of shifting from a vehicular to a pedestrian campus is the increase safety to the individual on the campus. No longer will the individual be taking his life in his hands when he comes to a crosswalk, if indeed that individual elects to utilize the designated crosswalks. Yet another advantage of changing the campus orientation from vehicular to pedestrian is an increase in the order of the relationships within the campus. The major effect that will increase the order of the campus is that of making the velocities of motion more uniform and slower. Another condition giving support to a pedestrian rather than vehicular campus is the growth of the academic core over the years. As the number of buildings necessary to house the academic pursuits increased it became necessary to expand to areas that demanded the crossing of several major vehicular traffic routes thus creating a hazard.

The orientation of the campus, with its north side relatively

closed to any major changes and the parking being oriented on the south and west sides of the campus, can not change too extensively due to the development of the campus. The change that can and must take place in order to achieve a pedestrian campus is the shifting of the entry-exit function from its present location on the north and east sides of the campus to a location farther south and closer to the parking functions thus shifting all of the automobile functions to the south.

With the shift of the major entry to and exit from the campus to the south the campus can become free of the confusion promoted by the automobile thus creating an order of sorts and a pedestrian campus. The effect of this orientation of the campus to pedestrian will have a tendency to make the campus more human and with the entry being oriented to the south will make the campus more open and receptive to the sun's warming rays in the cold winter months were the major portion of population inhabits the campus.

in the adjacent areas... to the extent... the nature of the... with the ef-... Any consid-... environment... of the... of environ-... and... and... is... along... held... of

ADJACENT ENVIRONMENT

... the nature of the... commercial, ... facilities being developed. ... adjacent areas, ... will have to be considered...

Of a type of development... the effect of the adjacent environment... of this consideration... development within the campus and the nature of the campus and the city. The nature of any... along the per-... to be sympathetic... rather than... poli-... areas of the city. ... already been said it is necessary to consider the form and texture of the... involved to the existing...

If consideration is given to the nature of the adjacent areas based upon use and future development and if the treatment of

In any proposal that is made as far as changes to the existing campus are concerned, the effect of these changes on the adjacent environment should be considered along with the effect of the adjacent environment on the campus. Any consideration of how changes will effect the adjacent environment should be based in part on the nature of that environment, ownership and use. As was mentioned in the Adjacent Environment section of the Existing Campus Conditions just preceeding, the ownership of the land surrounding the campus is predominantly private in the areas that are developed along the north, south and east edges with some privately held undeveloped areas along the south edge. The remainder of the holdings are public and held by the University as agricultural production experimentation. As previously noted, also, the use of these adjacent areas are not solely residential. Along the north and south edges occurs numerous commercial uses with the prospect of some possible future commercial, residential and research use facilities being developed. Due to the nature of these adjacent areas, certain peripheral amenities, such as access, will have to be considered in a positive manner.

Of a greater visual impact will be the effect of the adjacent environment on the campus. Within the scope of this consideration fall such aspect as future development within the campus and the meeting of the campus and the city. The nature of any future development that occurs along the peripheral edges of the campus should make an attempt to be sympathetic to the existing adjacent conditions rather than being just a bold statement proclaiming the greater political power of the University over the adjacent areas of the city. In places where such a statement has already been made it is necessary to provide the proper amount, form and texture of transition from the adjacent environments involved to the existing campus fabric.

If consideration is given to the nature of the adjacent areas based upon use and future development and if the treatment of

future peripheral development and the transitional elements are arrived at in a sympathetic manner then the effect of the campus will be one of kind compassion rather than stern dominance.

The purposals made herein for the various forms of traffic that will occur within or on the periphery of the campus, private vehicular, service vehicular, pedestrian and bicycle, are made with the orientation of the campus as being pedestrian. Also included within the service traffic considerations is the movement of the utility services about the campus. At this stage of the campus plan development is where my thesis, movement as the determiner of form, is applied. My thesis can be applied to the form a particular traffic mode takes to various extents depending upon the nature of the areas around it. The nature of the development in the areas bounding the traffic routes that are used as approaches to the campus is an example how the area around the traffic route determines the extent to which my thesis can be applied. As discussed earlier, there do exist several major routes for the handling of private vehicular traffic to and from the campus. These routes are located within residential development and as such can not change their form appreciably due to the movement of the traffic. In this case the velocity and amount of movement associated with this access traffic determines its location in the existing system rather than leading to a new or revised form.

The new routes that are proposed for the access of the private vehicular traffic to the campus are similar to the routes that are in existence at the present with the omission of some and the addition and emphasis of others. Of the four major routes proposed three are the same as exist at the present. These three routes are south Nineteenth Avenue, south Willson Avenue and west College Street. The new route proposed is the one made by the east-west oriented streets to the south of the campus, Kagy Boulevard and Lincoln Road. The choice of using south Willson Avenue is based upon its existing nature, that being of ample width to handle the increased traffic created by the elimination of some of the existing north-south routes and the through traffic nature of the route. South Nineteenth Avenue is chosen because it, at the present time, is not developed so extensively that the

areas it passes through couldn't be planned for accomodating a major traffic route. West College Street remains a major traffic route to the campus as a result of the commercial development at the north edge of the campus, and the fact that it is a feeder from both the east and west that is continuous. The choise of the Kagy Boulevard-Lincoln Road route to the south of the campus is made, aside from its location, considering the existing condition. This route will be the major route for access to the parking areas of the campus. Future plans for this route include the completion and improvement of it from south Willson Avenue and south Nineteenth Avenue thus completing the full circuit around the campus.

As has been alluded to earlier in the Orientation portion of this section, the campus proposal that I am making calls for making the campus pedestrian oriented. This proposal requires that the vehicular movement of campus be altered. As can be seen by the proposed campus plan at the end of this section the alterations that are made to the existing campus vehicular system are largely the exclusion of vehicular traffic from within the campus. This can be justified as far as traffic to, from and past the campus is concerned by the use of the alternate major traffic routes described above. Also, since the major portion of the parking areas are on the periphery of the campus it would seem that the traffic to these areas should also be on the periphery.

There are some instances, however, where vehicular traffic must be allowed to occur within the edge of the campus. These instances that happen are related to the activities of certain departments on campus. These departments or functions that require an encroachment of vehicular traffic on the campus are the Student Union and the campus postal and security services. The Student Union requires an incroachment because of the nature of the buildings use. The Student Union

is the hub of most of the activities that occur on the campus, both university oriented and non-university oriented. Due to the non-university use of the Student Union it is of great importance that access to it be clear and easy to find so that as much confusion as possible be eliminated. The vehicular access to the security and postal services, located in Hamilton Hall, should be maintained in order that these functions can in the case of the postal services, receive deliveries from off campus and, in the case of the security services as well as the postal services, maintain access for the vehicles, that are an integral part of these operations, from Hamilton Hall to the campus.

Another aspect of public vehicular traffic on the campus is the proposal for the inclusion of a mass transit system, at present more than likely a bus system, into the proposed vehicular traffic system. This mass transit system would utilize the vehicular traffic circuit described earlier in this section with terminal points located at the end of public traffic routes into the campus as is shown on the Proposed Campus Plan at the end of this section. These terminals are located on the edge of a theoretical ten minute circle that can be inscribed on the campus using Montana Hall as its center. This recognition of the existence of such an ordering device as the ten minute circle begins to tie the existing campus with the proposal set forth herein there by creating an order between old and new. The terminals are also located in a position that can have the largest number of people served by each one. These locations are based on such considerations as proximity to living units, dormitories, and publicly oriented spaces.

The other major form of vehicular traffic associated with the proposed campus is that of the service and delivery traffic. Also included in the area of service traffic is the utility runs to the various buildings. The movement pattern that helps in the derivation of the form of the

service traffic routes is the type of movement system that the existing campus is organized around. That system is a typical rectangular grid usually associated with an urban street and avenue network. By using the grid, as it exists or as it should be modified to accommodate such things as slope of the terrain or existing structures, as the service vehicle and utility network several benefits are derived. One such benefit is that when the private vehicular traffic is banned from the interior of the campus the existing streets are no longer needed for that purpose and as such can be removed or phased out. Upon the removal of these abandoned streets the new service grid can be located and at the same time a utility tunnel system that would carry these services to the various structures on campus. The form of these service drive grids would be that of a widened sidewalk that could accommodate both pedestrian and service vehicles simultaneously. To help distinguish between routes on which a pedestrian would or would not be confronted with a service vehicle a change in materials or texture could be employed to give a visual or tactile cue. A second benefit derived from the use of a grid as a service network is that a logical pattern for future buildings, if any be required, is established. This same rationale of logical location for any future structures can also be applied to structures in existence that seem to have been located on the campus in an arbitrary manner. The third and possibly most important benefit to the campus with respect to a pedestrian campus is the effect of the grid upon pedestrian traffic patterns. The grid establishes certain constants that can begin order and organize the random pedestrian movement patterns.

The movement of pedestrians can create interesting forms. By nature, the pedestrian, being a human and having a mind that can change thoughts and desires, is notoriously random in his direction of movement. As a general rule he will take the most direct route from one point to another, depending on

taken a marked upsurge in popularity. This form of traffic when considered with well planned vehicular and pedestrian

convenience or directness, and quite often change direction of movement as he remember or thinks of something he has to do or some other place he has to go. Taking this aspect of pedestrian movement into consideration, the logical way to supply surfaces for the pedestrian to travel on would be to have a continuous all encompassing surface, say of concrete or brick, etc. This method of accommodating pedestrian traffic would do a great deal as far as saving any turf that is heavily trafficked on even though it would be brutal. The brutality of such a system would be too extensive for the nature of the campus, especially in the lush Gallatin Valley. As such it is the intent of this proposal to provide both walking surfaces and preserve the vegetation as much as possible. To achieve this proposal the surfaces that are to be allocated to hard material pedestrian traffic ways will be located on the lines of traffic that show the greatest amount of desirability of traffic. There are many instances, however, when these major movement lines would be detrimental to some other function if they were treated with a hard surface. In such instances other methods can be used to determine the form of pedestrian traffic. These methods have their basis in the simple concept of making it more difficult to travel the direction desired than an alternate route. Or in other words, making it more desirable to travel in an alternate route will eliminate the need to provide a hard surface in an area that might function better with a soft or turfy surface. This can be accomplished by the use of vegetation, such as hedges, shrubs and trees, or by employing a change in elevation, creating a noticeable rise or depression in the terrain. The Proposed Campus Plan at the end of this section illustrates the idea of providing hard surfaces where the greatest desire for movement is noted and also where vegetation can be used to effect a change in desire.

The final major form of traffic that will be necessary to consider is that created by the bicycle which recently has taken a marked upsurge in popularity. This form of traffic when considered with well planned vehicular and pedestrian

ways does not necessarily prescribe special routes. The bicycler, somewhat like the pedestrian, will seek out the most direct route from point to point. The difference between a bicycler and a pedestrian is that, due to greater velocity attainable by a bicycler, the bicycler will more readily take on longer alternate route than the pedestrian. As a result of taking the most direct route the bicycle traffic is somewhat like a scavenger. It will use any existing traffic route so long as it is not too inconvenient as far as steepness or sharpness of direction changes. In order to accommodate the bicycle then the proposal is made to incorporate it within the pedestrian routes by the use of wider sidewalks that can accommodate both pedestrian and bicycle and at the same time keep it out of the way of the hazardous vehicular traffic.

As can be seen by the Proposed Campus Plan and the preceding discussion on traffic, movement, in its various forms, scales and character, can be applied to a situation and manipulated to fit any existing natural or man made conditions to arrive at a form that is workable and considerate of basic desires.

TOPOGRAPHY, VEGITATION & VIEWS

Also as previously mentioned, vegetation can be directed by the use of any material, therefore becomes critical that the choice of material, color, height, and shape and logical placement in relation to circulation, climate and use of space is of great importance. There are two other reasons for directing vegetation, one is the ability of this vegetation to act as a screen of the specific area. With the proper type of vegetation and placement of them on the campus they can serve as a screen for the views discussed earlier there by supplementing the variety of experiences perceived on the campus, or even acting as a barrier to objectionable views. Aside from framing a distant view the proper selection and placement of foliage can be a focal

As has been described in the Existing Campus Condition views section the views from the campus of Montana State University are magnificent. Because the views are so great, the effect of any future structure development on the view described should be considered carefully. There are a couple of ways that this consideration can be given. The first way is to develop buildings that are not of such a height that they could block the views or the second consideration would be to situate and design any buildings that would be tall enough to block views in a way that would augment the views.

The general topography of the campus, that of slope and level, should not be altered drastically there by destroying the character of the campus. The topography of particular areas of the campus can, however, be changed slightly as described in the Traffic section preceeding this section. The change would not be so drastic that it would alter the face of the campus extensively thus altering the character that exists. These changes would be of the magnitude of around three feet at the most and at that magnitude not continuous. This change in elevation would be around the edge of green open spaces as a form of deterrent to the thoughtless or misdirected pedestrian traffic.

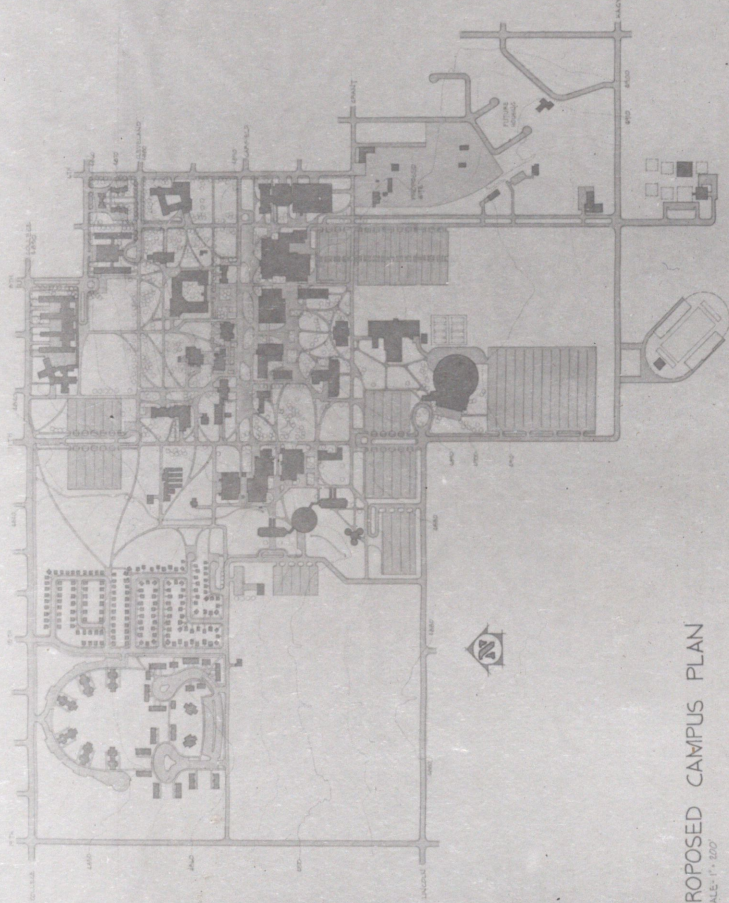
Also as previously mentioned, pedestrian traffic can be directed by the use of vegetation. It therefore becomes critical that the siting of trees, bushes and shrubs have a definite and logical placement in relation to circulation, climate and use of space in which they are planted. There are two other reasons for careful selection of sites for the planting of this vegetation and for proper selection of the species used. With the proper types of vegetation and placement of them on the campus they can serve as frames for the views discussed earlier there by augmenting the vareity of experiences perceived on the campus or even acting as a barrier to objectionable views. Aside from framing a distant view the proper selection and placement of foliage can be a focal

point in itself. By sensitive coordination of this aspect there can develop areas of the campus with varying degrees of intimacy and openness.

With the careful and sensitive treatment of topography, vegetation and view, the campus of Montana State University can begin to become a campus where smooth transitions can be made between the man-made and natural environments and the individual can feel at ease in the spaces provided no matter what type of activity he is participating in at a given instant.



PHYSICAL PLANT FACILITY
MONTANA STATE UNIVERSITY
THESIS BY MARTIN MATISKAINEN



PROPOSED CAMPUS PLAN
SCALE: 1" = 100'

FACILITY SITE SELECTION

The selection of a site for the new facility, both with respect to the existing campus and with respect to the proposed campus, can be determined by the use of my thesis, movement as a determiner of architectural form. In both instances there are two types of movement involved. These types of movement are, the movement of goods, services and people to and from the site, and the movement of existing facilities and their relation to other facilities.

When the movement of goods, services and people is considered several sites are suggested. The primary sites for consideration are one that would be centrally located within the campus thus making the movement of goods and services from a physical plant administration facility to the campus the easiest. The other primary site for selection is that that now houses the existing physical plant administration facility. This site is of prime consideration because of its ease of movement of goods and service to the site from the city.

Of the two sites mentioned, the one that I have chosen is the one that houses the existing facilities. This site is chosen over the other site mentioned above for the reasons set forth by my thesis, movement. This site is on the edge of the campus and as such has a more direct access for goods, services and people who might have business with the administrative or service staff from outside the campus. This consideration is of great importance when the all pedestrian campus is proposed and also when the method of delivery is taken into account. The development of the campus into a pedestrian oriented campus cuts off all of the major unobstructed vehicular routes to the interior of the campus. This factor is of great significance in the choice of the existing site over a more centrally located site. The other aspect of movement that indicates the existing site to be the best is the movement of vehicles and equipment, that are an integral part of the operation of such a facility, within the site. A great deal of

space is required for the movement of some of the service shop equipment, such as motor patrols and rollers, and some of the delivery vehicles that are associated with the facility, occasionally sixty foot long semi-trailer and tractor units. Also a large space is needed, which is not available within the interior of the campus, for the large number of smaller service units such as the service shops pickup fleet. Another consideration that prompted the selection of the existing site over the other is the possible future use of the railroad as a means of getting goods to the campus and service shops. When this is taken into account the existing site is suggested strongly because of the fact that the railroad at one time had a spur into the campus, for delivery of coal to the heating plant, that terminates in this area. By selection of this site no further grading would be required in order to re-accommodate railway service.

The other major movement factor involved in the selection of this site over a more centrally located site is the effect on the coordination of the work of the various parts of the physical plant administration if the administration portion of the physical plant administration were removed to a separate site. As a result of desiring to keep all of these related activities, heating plant, service shops, grounds and administration, together it is more logical to maintain and improve the existing site.

A final factor that made the existing site more desirable than a more centrally located site is the inclusion of the state motor pool into the campus and as such the traffic movement associated with this function. With the inclusion of the motor pool it becomes critical that the location of this facility which has a direct link to the automotive portion of the service shops, be as easy to get to as possible. This desire for ease of access again dictates the choice of the existing site.

EXISTING SITE CONDITIONS

The site for the new facility, the existing site, is located on the southeast edge of the campus. It has university oriented facilities on the south and west edges of the site and privately owned residences on the north and east edges of the site. As a result of the site being located between south Seventh Avenue on the west and private residential on the east, the site has had to expand to the south, when expansion is necessary, from the north, which is bounded by west Grant Street. This elongation in the north-south direction has placed emphasis on this axis so that the focus of the site is to the north where the entry has developed.

The traffic associated with the site can be separated into on site and off site vehicular and pedestrian. The vehicular traffic that must leave the site to make deliveries or service calls are confronted with the traffic conditions as described in the Existing Campus Condition-Traffic section. Having the entry and exit to the site, for both service vehicles to the campus and delivery vehicles to the site from the city, on the north edge of the site creates the problem of integrating the two forms of traffic, private vehicular and service vehicle. The pedestrian traffic to and from the site is fairly easily achievable on the present system of sidewalks. The major problem that the pedestrian has to the site focus is the realization that the Physical Plant Administration Facility is not in fact housed within the Heating Plant building. This problem is one that must be solved in order to avoid as much confusion as possible.

The traffic within the site, both vehicular and pedestrian, is of great concern to the planning of the site. At the present time, vehicular traffic on the site is of a random nature. By random it is meant that although the major emphasis of the traffic is either north or south, depending on the time of day, the paths that are selected for these movements are numerous. The great number of routes used in this traffic

movement is due primarily to the location of auxiliary structures, such as the automotive repair garage and the gas and oil storage building, which are right in the midst of the service shops yard. The great number of vehicular traffic routes causes a bad situation, that of having a larger number of places where a conflict, such as a collision, can occur. This conflict can occur between a motorized vehicle and another motorized vehicle or between a motorized vehicle and a pedestrian.

The conflict that occurs between the pedestrian and a motorized vehicle has several prime reasons for occurring. These reasons are one of a matter of scale of the traffic difference, another is a matter of difference in velocity and the last being the conditions creating the need for pedestrians in the service yards in the first place. The difference in scale is rather obvious, that being the difference in size between a pickup truck, which weighs in the range of a half to three quarter ton capacity, and a craftsman, who may weigh in the range of a couple hundred pounds. The thing that makes this situation so hazardous is that not only is there a difference in size physically but the craftsman pedestrian often times take a route that intertwines him among parked vehicles where he is somewhat hard to see and along the blind sides of buildings, popping out from behind them at any instant.

The differences in velocity between the two forms of traffic, pedestrian and vehicular, has been described in a previous section and as such needs only passing notice at this point. The difference in velocity, besides being a difference in miles per hour traveled, has the added dimension of a load carried by the vehicles thus creating a greater difficulty in slowing or stopping of the vehicles in the case of an emergency.

The seat of the problem of the pedestrian and the vehicle is the diffusion of the activities of the service shops and the materials storage facilities. Due to the lack of adequate

space within the existing facility some of the crafts within the service shops have had to locate their work areas in the auxiliary buildings in other parts of the yard. Among these crafts are the painting and the refrigeration work areas. Also due to the lack of space the various materials stored and dispensed by the store room are stored in various structures throughout the yard thus making that operation poorly organized and creating pedestrian traffic as well as vehicular traffic that just adds to the problems of traffic already discussed.

Another problem area that at present does not exist but in the foreseeable future will be of major consequence to the traffic movement situation in the site is the inclusion of the vehicles of the state motor pool. Not only will there be traffic, both pedestrian and vehicular, to the area designated as motor pool vehicular storage to pick up a vehicle for a specific use, there will also be the traffic generated by state motor pool vehicles from other locations than the university arriving at the motor pool for services to the vehicles and departing on the rest of their journey.

The site itself is practically level with approximately four feet of rise in six hundred feet of horizontal run. What slope there is in the terrain is oriented to the north in the direction of the existing facility. The levelness of the site has been achieved over the years by the gradual working of the terrain into a surface that is able to be black topped, which for the most part it has been, at the expense of vegetation. The major areas where vegetating occurs are on the edges of the yard as a screening device and to a great extent around the Heating Plant.

This site is related to the campus, as far as views are concerned, in the same manner that the campus is related to the city. That relationship is that the site is at the top of the hill that dominates the campus and as such provides spectacular panoramas in all directions. To the north are the impressive

Bridger Mountains, to the south are the peaks around Hylite Reservoir and the Spanish Peaks a little farther west.

As can be seen by the previous discussion, the site has several shortcomings in its existing configuration, poor movement paths, poor auxiliary structure location, lack of space for new activities and limited use of vegetation. A majority of these problems can be solved by the application of my thesis to the existing situation and coming up with a solution. Any solution that is arrived at should be sensitive to the natural beauty of the area.



PROPOSED SITE CONDITIONS

The site, as it is proposed herein, will have, as a result of the restrictions described in the previous section, the location of existing streets and residential development, its major axis in a north-south direction. As such the location of the entry and the exit to and from the site will be in approximately the same location as it is now with some adjustments made to accommodate the new circulation patterns created by the new facility. These adjustments will help to ease the entry onto west Grant Street by the use of grassy buffer strips between car parking spaces in front of the facility and the street. This along with the restriction of parking on the street in this area, will increase visibility at this intersection thus easing a bad situation.

The access to the site for both vehicle and pedestrian will remain somewhat the same as described in the previous section, Existing Site Conditions. The most noticeable change to these movement systems will be the addition of visual elements that will begin to make the tie between the Heating Plant and the new facility thus proclaiming the identity of the Physical Plant Building as being separate yet related to the entire complex. The visual elements that are considered in this proposal are the use of vegetation such as hedge materials to form a link of natural materials within the site.

The movement of vehicles and pedestrians within the site will be altered greatly by the increase in size of the existing facility and the location of the actual physical addition on the site. Other factors that will alter the movement within the site are the removal of the shop functions formerly housed in the auxiliary buildings into the new facility and the replacement of some of these structures with new facilities to house different functions. By the removal of the existing automotive repair garage and the oil and lumber storage building from the center of lines of movement within the site a major portion of the conflict between motorized vehicles and other motorized vehicles will be eliminated as a result of

clearer lines of site for the drivers of these vehicles. Some of the conflict that occurs between motorized vehicles and pedestrians will be eliminated by the removal of these buildings as there will be fewer obstacles for a pedestrian to appear from behind and take a driver of a vehicle unaware. The majority of the remaining conflict between pedestrian and motorized vehicle will be eliminated by the inclusion of the work and storage areas described as being in the auxiliary buildings in the previous section into the new facility. This will eliminate the need for any craftsman to walk across the service yard to get to his work station.

The desire to keep the vehicular movement areas as open and uncluttered as possible led to the placement of the new facility on one side of the yard along with other considerations that will be discussed in the following section. This desire to make the movement of the service vehicles and large delivery vehicles, such as semi-trailer and tractor units as easy as possible led to the location of the new auxiliary buildings on the edges of the yard, these structures being the equipment storage building and the vehicle storage building and automotive service garage. The shape of the new facility is also partially determined, in the set back portion, by the need to keep the delivery vehicles out of the movement paths of the service vehicles when the delivery vehicles are unloading materials.

The new traffic that will be imposed on the site, as described in the previous section, is that of the motor pool. The amount of traffic movement generated by this facility is extensive and by logic it can be seen that such a large amount of traffic would cause a great deal of conflict with service vehicle movement if it is incorporated with the service traffic. For this reason the access to the motor pool vehicle storage and service areas are made separate from the service shops access. This separation can only be accomplished by the increase in

size of the service yard itself. This expansion can only be achieved by moving onto the university property now occupied by temporary faculty housing to the south and east of the existing service yards up to the limits imposed by south Fifth Avenue and Faculty Court. By making this expansion, an area is established to the east of the Grounds Building to south Fifth Avenue. The access for this area is off of south Fifth Avenue onto what is left of Lincoln Road after its closure for the construction of the Fieldhouse. Within the area provided for the motor pool there is sufficient space for the storage of vehicles assigned to the Bozeman motor pool when they are not in use and there is also space available for the temporary storage of private vehicles in this area while the owner is using a motor pool vehicle. These two areas are separated so that the motor pool vehicle storage area can be secured and leave the temporary storage area open so motor pool vehicles can be returned at any time. This feature eliminates the need to maintain a twentyfour hour surveillance.

In connection with the motor pool service activities and the service shops vehicle service activities the location of the vehicle maintenance garages are determined. Both facilities, motor pool and service shops, need vehicle maintenance facilities. Since the facilities are identical in function it seems logical to have them adjacent to one another, even if they would probably not be the same space due to security precautions. By being adjacent they can begin to share facilities such as storage of various component parts, tires batteries, lubricants, etc., and fuel storage tanks there by lessening the expense of having duplicate separate facilities.

The slope of the existing site shall be maintained as close as possible to the existing condition with the occasional alteration to accept an area drain or something of that nature to eliminate any water that may be on the site due to precipitation or some catastrophe such as a broken water main.

The major change in the configuration of the yard, aside from the planting of new structures and removal of old ones is the inclusion of areas around the new facility that are to be planted with small trees such as lilacs and shrubs. These areas will serve several uses. One use will be the softening of the large expanses of asphalt that are encurred in the service yard and softening the transition from horizontal to vertical surfaces. Another use of the trees, especially those of a deciduous nature is that they can alter the micro-climate of the new facility. In the summer months they will provide shade to the west exposure windows there by cutting down on the heat gain through them. In the winter months, on the other hand, when the leaves of these trees have fallen off these same windows can accept the west sun and its inherent warmth.

In respect to the views that are available, as described in the previous section, the new portion of the facility is P S located at the spot it is so as not to block the views afforded to the south from the upper level windows. The location of the new portion of the facility is not made entirely upon the consideration of views but are considered.

By the above discussion and the site plan at the end of the book it can be seen that by the application of my thesis is made in order to come up with an site plan that works well within the context of that thesis.

The physical plant administration can be sub-divided into four major categories, due to a change in location of the motor plant, a few examples. The central categories are: Administrative services, maintenance, general service, and

There are many other functions that are perhaps the most important. The physical plant is the Director of the physical plant, the physical plant architect, whose responsibility is to be controlled by the Director of the physical plant. The physical plant is different from the physical plant. The physical plant is the ones that are directly associated with the public, public and private. The physical plant is the staff. It is

PROPOSED FACILITY

1. FUNCTION
2. AREA REQUIRED
3. PLAN RELATIONSHIPS
4. STRUCTURE
5. ELEVATION

The physical plant may contain a wide variety of functions. Included within this category are the campus store room, the security, the physical plant and the various crafts of the service. The physical plant functions listed the postal and security. The physical plant is more public oriented than the others and, therefore, the physical plant are of such a nature that they are not directly related to the physical plant. If they were incorporated into the physical plant, as such have not been considered in the physical plant, the physical plant are aimed at the provision of other materials is the campus of finished products from the physical plant.

The operation function of the physical plant administration is that that is concerned with the supply of the heat to the

The physical plant administration can be sub-divided into four major categories and, due to a change in location of the motor pool, a fifth category. The general categories are: administration, service, operation, maintenance and general service.

The administration covers the areas that are perhaps the most publicly oriented. Within its structure are the Director of the Physical Plant and the University Architect, whose responsibilities are not controlled by the Director of the Physical Plant as they are of equal authority in different realms of responsibility. These two individuals are the ones that are the most directly associated with the public, public meaning primarily non-physical plant campus staff. It is under them that the rest of the staff of the administration work directly. This is not to say that these staff members do not have first hand contact with the public for they do. The remainder of the administrative staff consists of secretaries, various levels of professional employees and draftsmen. It is the responsibility of these individuals to communicate the desires of the campus either to the service shops or to the public for bids. In effect the administration acts as the liaison between the desires of the campus populace and the finished product.

The service category covers a wide variety of functions. Included within this category are the campus store room, the security and postal services and the various crafts of the service shops. Of the service functions listed the postal and security services are more public oriented than the others and, as has been discussed earlier, are of such a nature that they would not function effectively if they were incorporated into the new facility and as such have not been considered in the design. As an entity these functions are aimed at the provision of either materials to the campus or finished products from such materials.

The operation function of the physical plant administration is that that is concerned with the supply of the heat to the

campus and as such is comprised of the heating plant staff. This function was not considered in the design of the new facility as it already is housed adequately and even if expansion were needed its requirements are such that it would not function well being a part of a physical plant administration facility.

Maintenance, as part of the physical plant administration consists of the services that are required for the interiors and exteriors of the campus. These functions are the custodial service and the grounds maintenance staff. Of these functions only the custodial is considered in the new facility as there is a great deal of material that is stored under the indirect control of the campus storage function and as such proximity is desirable. As far as the grounds staff is concerned, they were not considered due to the nature of their operation. They are, at present, located fairly well with the addition of storage space vacated by campus storage for the storage of some of the equipment and supplies used by this function and the increase in the ground area that is usable for shrubbery growth as transplants.

The general service function, that of the state motor pool, is not directly connected to the physical plant administration. The closest connection between the two functions is something along the lines of a tenant-landlord relationship. This facility functions as a service to both the campus and the outside state system.

the requirement of grades
 and the design was checked to
 be adequate for the

	AREA (square feet)	TOTAL (square feet)
Office		150
...		150
...		150

AREA REQUIRED

...	150
...	150
...	100
Office	100
Drafting	400
Storage	100
...	150
Storage	250
Plant	100
Food	100
Office	300
Current	150
Project	150
Basin	200
Total	3000

...		
Capacity		
...	300/man	2500
...	250/man	1000
...	250/man	250
Plant		
Planting	250/man	1000

The following tabulation is a general requirement of spaces needed compared to what the original design was expected to house and what is generally accepted as adequate for the indicated functions.

<u>DESCRIPTION OF SPACE</u>	<u>REQUIREMENT</u> (square feet)	<u>TOTAL</u> (square feet)
<u>I Administrative</u>		
Office (Director)		150
Office (University Architect)		150
Office (Physical Plant Engineer)		150
Office (Physical Plant Architect)		150
Office (Inspector)		150
Office (Bookkeeper)		150
Office (Secretary)		100
Office (Receptionist)		100
Drafting Room		400
Equipment Room		100
Blue Print Room		150
Storeroom (Vault)		250
Files		100
Product Literature		100
Conference Room		300
Current Projects Area		150
Project Records Area		150
Restroom Facilities		<u>200</u>
Total		3000
<u>II Service Shops</u>		
Carpentry Work Area		
Cabinet Making	500/man	2500
Rough Carpentry	250/man	1000
Locksmithing	250/man	250
Plumbing Work Area		
Plumbing	250/man	1000

<u>DESCRIPTION OF SPACE</u>	<u>REQUIREMENT</u> (square feet)	<u>TOTAL</u> (square feet)
Refrigeration	500/man	500
Electrician Work Area	150/man	750
Paint Work Area	200/man	1000
Mechanic Work Area	1000/man	2000
Office (Shop Administration)		400
Office (Custodial)		100
Locker Area		500
Restroom Facilities		<u>250</u>
Total		10250

III Storage

Carpentry Storage	4100
Plumbing Storage	400
Electrical Storage	400
Painting Storage	250
Custodial Supply Storage	1500
Office Supply Storage	5200
Receiving Area	400
Customer Service Area	150
Office (Storage Records)	<u>500</u>
Total	12900
Mechanical Room	<u>550</u>
Grand Total	26700

In the existing facility there is approximately nine thousand square feet of re-usable space. When this is applied to the grand total needed the total square footage needed in new construction is 17700 square feet.

The plan of the new and revised facility is determined almost purely by letting movement determine the form. The New Physical Plant Administration Facility can be sub-divided into two distinct orientations, those being public and what can be called in-house. As such, those functions that are mostly public oriented, administration, office supply storage and the custodial services office, are located closest to the access to the site in the existing building. The functions that are more oriented toward in-house activities, the service shops, the service shops storage and custodial supply storage, are located farther from the public in the new facility yet with access still available.

PLAN RELATIONSHIPS

As far as the plan within the existing building, the functions that were at one time housed on one floor of this wing are now housed on two levels. This can be accomplished by the relocation of the office supply storage into the space previously occupied by the service shops. Once this space is made available then the spaces of the facility can be located within the wing according to movement patterns. There are two types of movement that are apparent. These types are primary and secondary. The primary movement consists of the movement of the public to the areas designated for the use of the Physical Plant Director, the area for the University Architect and the Physical Plant University Accountant. As such these functions are located on the first level along with the conference room that is frequently used by both the director and architect. The secondary movement is the movement of the public, usually tradesmen, to the areas designated for the professional staff and draftsmen. These areas, including their ancillary areas, are located on the upper level, easily accessible by the public yet separated from the primary movement systems.

The other public oriented area is that of the office supply storage. This area is not as obviously accessible from the parking area in front of the existing facility but, none the

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The other public oriented area is that of the office supply storage. This area is not as obviously accessible from the parking area in front of the existing facility but, none the

less, access is available from this area.

The access to the service shops area from the administration area is achieved by use of a corridor along the west face of the south wing of the existing facility. This serves as a protected movement system that should get moderately heavy traffic. This traffic will be generated by the need of a craftsman of one of the crafts of the service shops to obtain information about some aspect of a certain project with the assistance of a member of the administration a professional staff. This corridor can also act as a transition space for the transfer of materials from a delivery vehicle to the proper area for storage.

STRUCTURE

The relationship of the shop storage to the service shops is one of linear movement. This movement occurs in a manner that has the raw materials for a certain craft, say carpentry, being stored in the storage area in the same general area as the shop. From here, upon request by a carpenter, a piece of wood needed for a project can be moved in a straight line to a work station where it can be fabricated into an article. This article is then transported in a straight line to the loading dock where it is then loaded onto a truck and delivered to its final destination on the campus. This straight line relationship exists for all of the craft functions of the service shops.

By the above discussion it is evident that movement can be used effectively to determine the shape and relationship of the parts of a plan, one to another. The production of a plan is only one phase of architecture. Additional proof will be established in succeeding sections.

By choice, movement, can be applied to the selection of a structural system for this facility in addition to the generation of the plan as described in the previous section. The selection of a system can be based on several movement levels. On one level there is the desire to make the space that the structural system is enclosing as flexible as possible. By flexible is meant that the space created will be column free. It is of great importance when alteration of the interior spaces is possible.

Another level of movement that can be applied to a structural system is that dictated by the shape of the system. With this aspect of the design to maintain as flexible a space as possible, the structural system shown is a concrete structural system which is a concrete folded plate system. Its very configuration implies a movement, even to the point of suggesting the natural movement of air within the space. This system can also provide a space that is free to accept any type of movement as it can clear-span the total distance from exterior wall to exterior wall without any intermediate supports.

STRUCTURE

Movement can not really be used as a determinant for the materials used in the structure, but the structure arrived at with respect to movement may begin to dictate or indicate a material or number of materials. This is the case with this facility. As a result of the structural requirements of a concrete folded plate, that being that end panels must be incorporated with continuous reinforcing, concrete becomes one of the structural materials dictated. The other structural material that is used is masonry, in the form of brick and concrete block. These two materials are not structural in the same way. The concrete structural members are symbolic of the strong inviolate members that are meant to be impenetrable. The masonry structural members are more or less pseudo structural members. They do not actually serve as support for any other members other than their own weight. These

My thesis, movement, can be applied to the selection of a structural system for this facility in addition to the generation of the plan as described in the previous section. The selection of a system can be based on several movement levels. On one level there is the desire to make the space that the structural system is enclosing as flexible as possible. By flexible it is meant that the space created will be column free. This is of great importance when alteration of the interior spaces is possible.

Another level of movement that can be applied to a structural system is that implied by the shape of the system. With this aspect and the desire to maintain as flexible a space as possible the structural system chosen is a concrete structural system chosen is a concrete folded plate system. Its very configuration implies a movement, even to the point of augmenting the natural movement of air within the space. This system can also provide a space that is free to accept any type of movement as it can clear-span the total distance from exterior wall to exterior wall without any intermediate supports.

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members are symbolic of the areas in the structure where the structure may be penetrated, whether by window or doorway.

As has been illustrated in the above discussion and can be seen in the photographs at the end of this section, a structural system can be chosen with respect to the movement desired within the space that is enclosed by that structure. It can also be seen that the structural system itself can imply motion.

ELEVATION

The previous two sections have dealt with how movement can be applied to a situation to derive a relationship of the various parts, in architectural terms to arrive at a plan, and choose a structural system in which to house that relationship. This section will deal with how movement can be used to derive a logical order for the facade of a building. Movement may be applied to the selection of forms in the facade and also to the manipulation of fenestration.

The forms that are selected for the facade of this particular project are selected on a basis of being active rather than passive forms. One factor is the shape of the roof line which drives a square form for the structural system. **ELEVATION** earlier. This form, due to the angular inclination, is a rather active shape. The panels that are utilized in the concrete facade are active, aside from attempting to tie the heating plant in visually with the new facility, as a result of wishing to incorporate active forms into the facade. As such, the active form is more active than than a rectangle or the like.

The application of movement to the fenestration creates some interesting window patterns. By the dropping of a panel of glass below the level of the rest of the window begins to cause the eye to move in that direction. This, aside from being a result of the application of my thesis, begins to serve a functional purpose. That purpose is the indication of such entities as doors and passages.

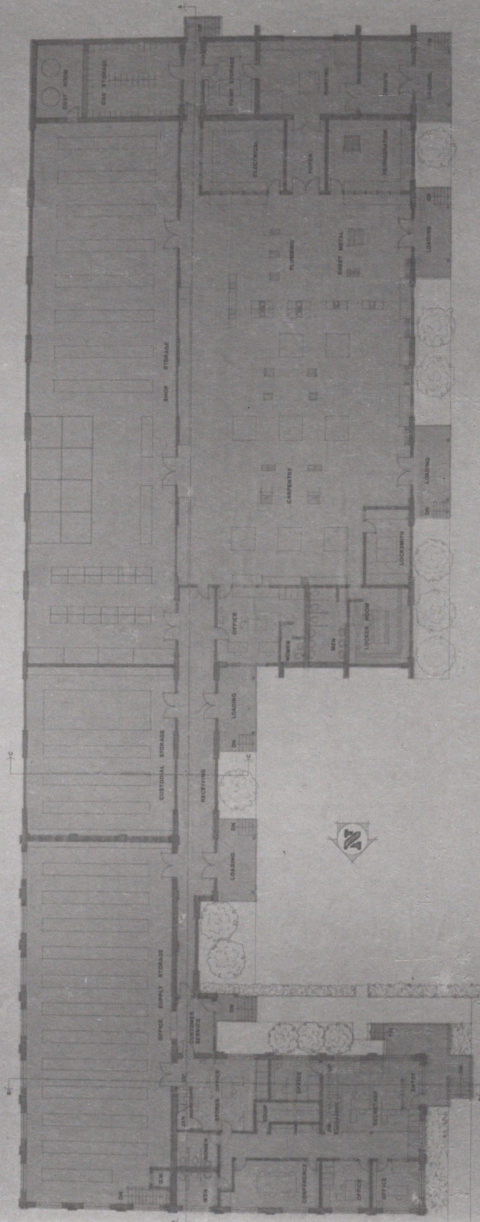
In the manner discussed above the facade of buildings can be made to be rational and visually pleasing. With this discussion culminates the examples of how movement can be used to determine architectural form. These are but a few of the aspects of movement as a determinant of architectural form.

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The forms that are selected for the facade of this particular project are selected on a basis of being active rather than passive forms. One form is the shape of the roof line which drives its shape from the structural system as described earlier. This form, due to its angular inclination, is a rather active shape. The panels that are infilled in the concrete facade are arched, aside from attempting to tie the Heating Plant in visually with the new facility, as a result of wishing to incorporate active forms into the facade. As such, an arched form is more active than a rectangle or the like.

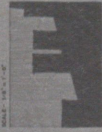
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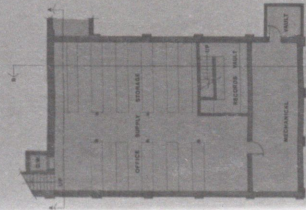
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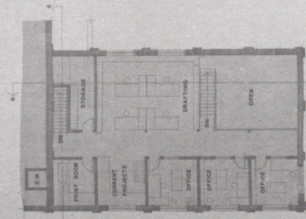
MAIN LEVEL
PLAN

PHYSICAL PLANT FACILITY
MONTANA STATE UNIVERSITY
THESIS BY MARTIN MATISKAINEN

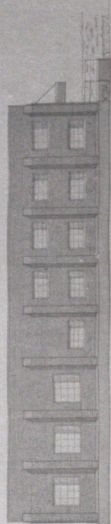




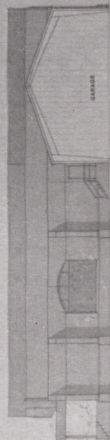
LOWER
LEVEL
PLAN



UPPER
LEVEL
PLAN



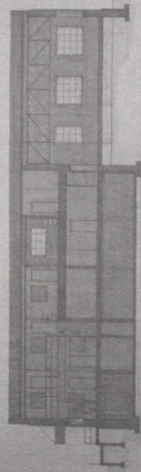
NORTH ELEVATION



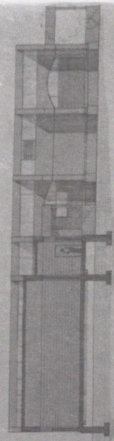
SOUTH ELEVATION



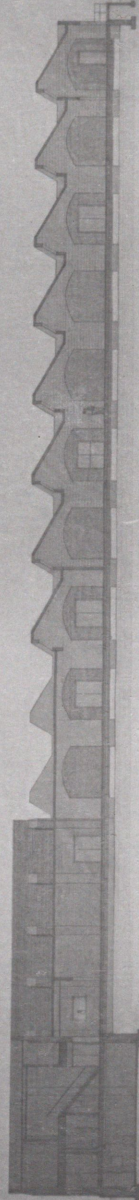
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SECTION B-B



SECTION C-C

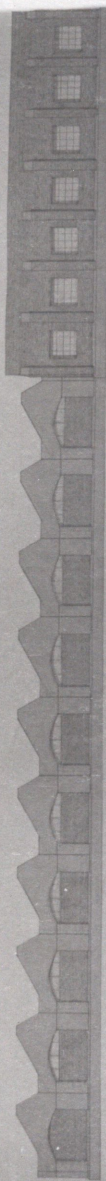


SECTION A-A

PHYSICAL PLANT FACILITY
MONTANA STATE UNIVERSITY
THESIS BY MARTIN MATISKAINEN

1944-45, C-C
All drawings 1/8" = 1'-0"





EAST ELEVATION

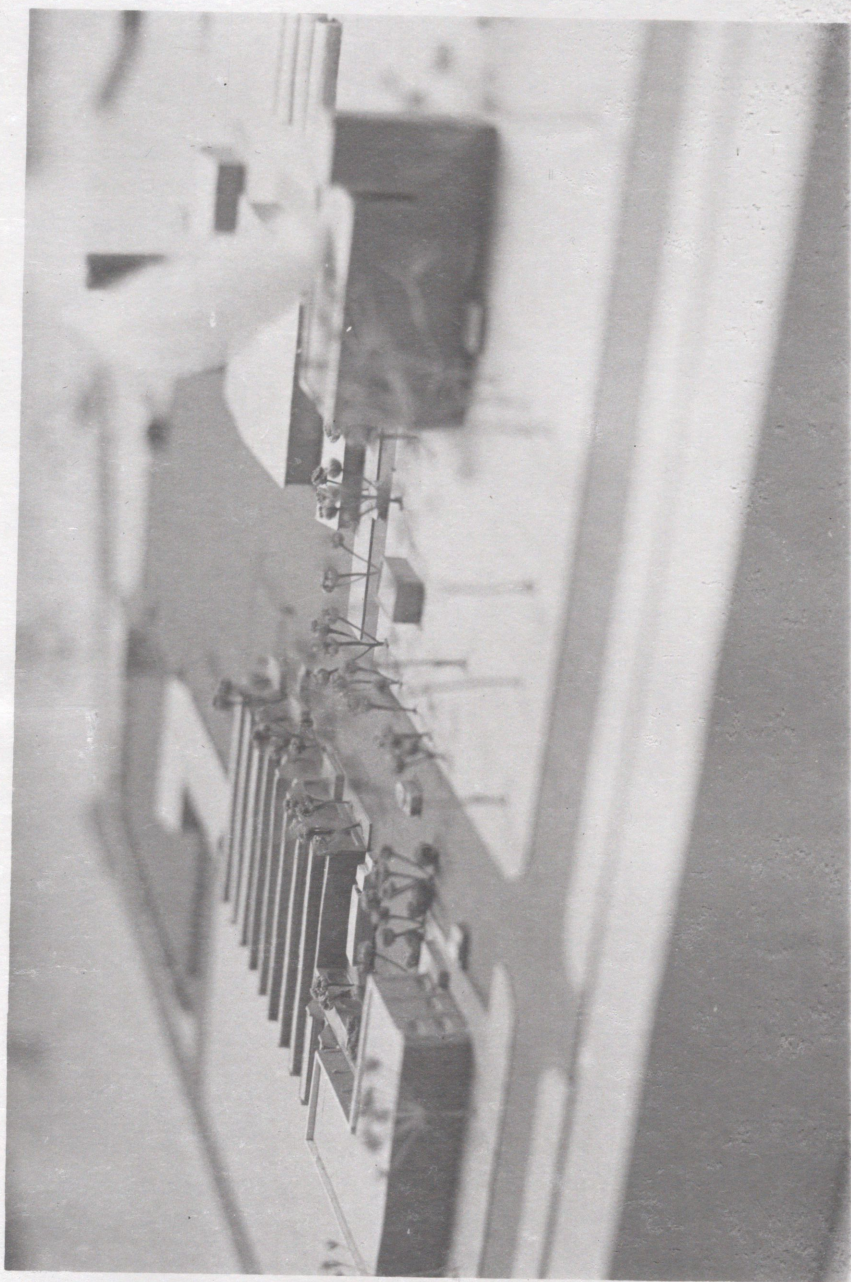


WEST ELEVATION

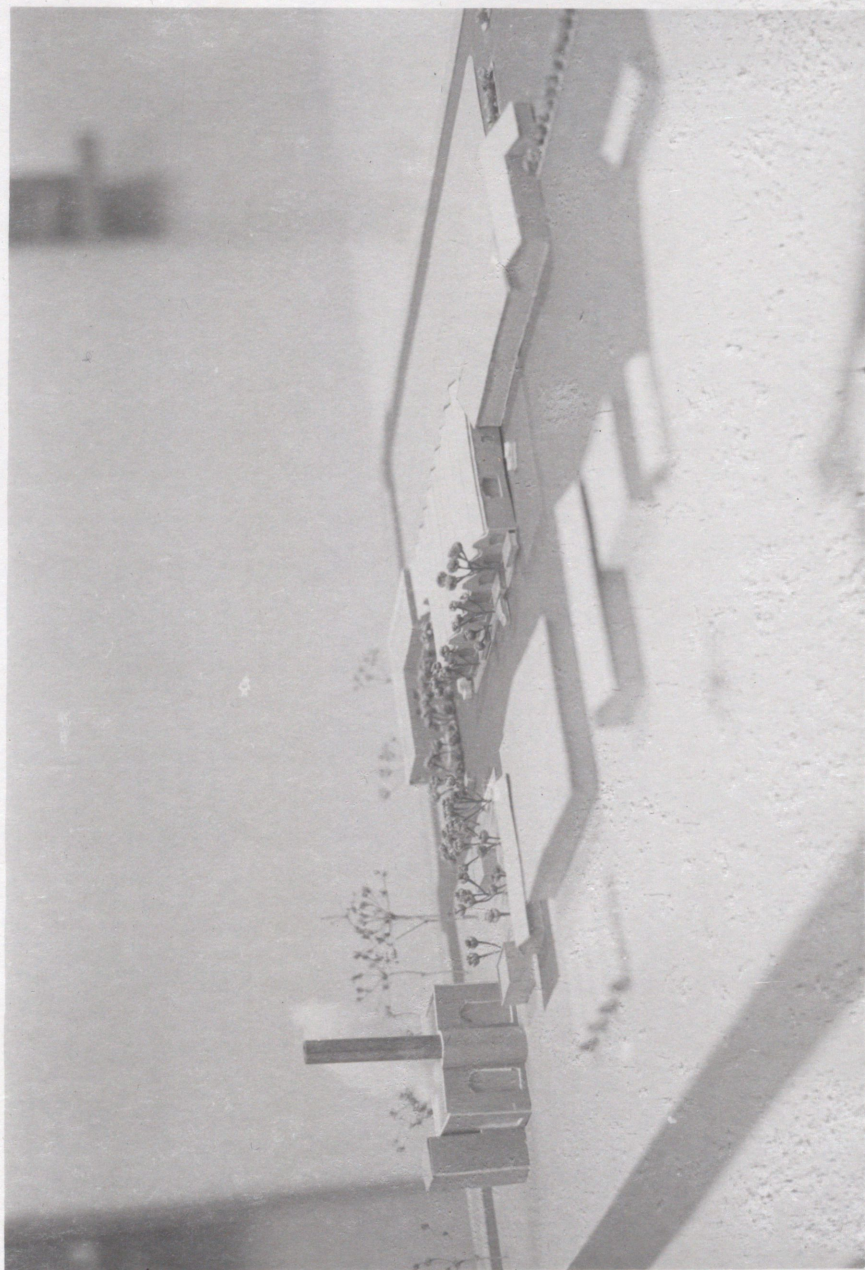
PHYSICAL PLANT FACILITY
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1954-55
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