A RATIONALE FOR URBAN DESIGN

by

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June 19, 1967

Dean Lawrence B. Anderson
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Dear Dean Anderson;

In partial fulfillment of the requirements for the degree of Master of Architecture I hereby submit this thesis entitled "A Rationale for Urban Design".

Respectfully,

William Robert Gustafson

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Part I: A Philosophy of the City

There is a crisis in the city today. Aside from its present social, economic and physical difficulties which will be discussed later, the city faces an even more pressing dilemma, the lack of direction toward the future. A large knowledge gap exists among the planners as well as city folk. A 19th Century economic philosophy, laissez faire, seems to have saturated this aspect of the city development as well.

Rising out of the smoke and grime of the industrial city of the 19th Century in Western Europe and America, men like Thoreau, Orwell, and Huxley protested the degradation of human life that confronted the average citizen. More ambitious men sought to develop actual communities founded on social principles. Later in the first quarter of the 20th Century Wright, Corbusier and others sought physical solutions to the same pressing problem. Irregardless of the solution, however, the lack of integration of physical and social aspects was typical. Common themes of material abundance, rationality, social participation and manipulation of institutions in social utopias neglected a basic tenet: the need for individuality and freedom, an open ended character. Similarly the physical utopias were limited by a self-consciousness with form and order and an absolute dearth of supporting social order.

With the beginning of interest in planning as a socio-political as well as professional concept the need for a different approach to the utopian scheme is absolute. No longer can these poles of interest remain separated. Planning as it incorporates the need for continuity to the future and a

means of achievement is ripe for shhema which sympathize with both aspects. Unlike the past social shhemes which dabbled with order and form, the new utopian plans must attempt to investigate the manifestations of both socio-economic and physical models integrated as one. Only the interrelationship of means and ends can sufficiently test the validity of various planning schema.

The Classical City is dead. Despite the remnants of the past glory the functional significance of the Classical City has been ebbing for five hundred years. In order to fully understand this demise, it is necessary to elucidate the characteristics of the old city form. Epitomized by the Greek polis or the Gothic cathedral town, the Classic City is a container: for defense, for economic reasons of markets, for a metaphysical unity with life, for political boundaries, and for even health (subsistence). The Medieval concept of religious asceticism was complimented by a physical form rendered in service of God, the church the physical dominant. The city expressed a unity of work, religion, and home. Community space was emphasized, God omnipotent, man reverent. Through his labor the individual sought to express his reverence; penitance was the ultimate satisfaction of life. Similarly in a different metaphysical system the Greeks achieved a balance of community and private life. Their polis, too, evolked the same sense of unity, of a single place, a container, as the Medieval city.

Under the onslaught of science dispelling all the old metaphysical concepts of the central role of the Earth in the solar system, the cubic shape of the planet, and the evolution of man, the Classic City altered form. Later the concepts of infinity, the astronomical experiments of Galileo and the force system of Newton revised the container again. Unlike the notion of centrality which characterized the Greek, Medieval, and Renaissance order, the matrix or grid now expressed the concept of the universe. With the continuing attention to

science thinkers tried to revise their world views in terms of scientific knowledge. The breaking of the deterministic bond of religion actually marked a major breakthrough. In compliment to the economic revolution, the atomization of production, altered another element, time. Under the pressure of the expanding cycle of division of labor, enlarging the size of the market, and increasing productivity, time became a crucial element.

Initially the economic revolution (Industrial Revolution) appeared to enhance the city—container. Only in the city could there exist external economies. That is, the city by its concentration provided external to any atomized units certain qualities which made operation more economical. The market for goods and labor, the functional variety of living and entertainment, a transportation linkage both internal and external, a supply of power (steam and later electric), a natural supply of economic raw materials from farming, mining, and fishing nearby, and space for large scale operations all contributed to a densifying of cities. Conveniently the producer absorbed all these economies and even blatantly perpetrated the diseconomies of pollution, devastation of natural supplies and human slavery. The city was unable to take advantage of its drawing power; it lacked a democratic organization to cope with these brute forces. Thus while the old city flourished, it was really becomming diseased.

Today in the 20th Century we are observing the final demise of this old city form. In religious terms the city has reversed itself. Instead of being the center of religious intensity, it is the secular city. Calvinist Protestentism, which broke

the bondage of labor and religious penitance has led to a faltering of the work-home unity. Previously hard work was a projection of religious intensity (Freud). With the growth of scientific doctrine and humanistic labor practices, however, the slave bonds have been permanently severed. Concentration on present staisfaction (materialism) instead of a life hereafter are manifestations of this same movement.

Economically the Classic City form was based on subsistence. Today the United States economy with 5-10% efficiency could produce enough to live on. Kenneth Boulding has predicted that 1-2% of the world's capacity will be sufficient to produce subsistence in the future. The rise of science is based on hierarchical structures. Similarly economic units have become hierarchies--that is, orgainizations. Unlike the past system of political or landed organizations the present system emphasizes present ability and knowledge--scientific criteria. The freedom resultant from this development has created mobile man--possessor of time and money.

Of the 20th Century scientific theories Einstein is responsible for providing the major breakthrough--the theory of relativity. It has completely revised again our concept of the world. Classic society was based on absolutes. Beauty was not a relationship derived but an absolute quality achieved through discovering laws that existed in Nature. This view itself epitomizes the container nature of Classical thinking. Under Einstein's conception Beauty become relative; existence preceded essence. Notably space and form derived new meaning. Previously a building was a container of box-like space; now

space flowed; forms became positive elements modulating inside and outside relationships. On a larger scale space became relative to time. One could move from Bombay to San Francisco in eight hours. Our notion of space is a function of time. Similarly we now experience a space in a different manner. As a pedestrain one level of perception is apparent. In an auto a space has an entirely different meaning. Space becomes relative to motion. Further we can regulate the direction of our perception. On both a vertical and horizontal coordinate system we can experience space. Thus space, time, and motion have been united in relativistic terms.

The city-container was by nature dependent on face-to-face contacts. In scale the communication was efficient, direct, and two-way. The 20th Century has witnessed an evolution of new communication potential, polar to the container ideal. Electronic transmission is not bounded by walls. Cybernetic innovation has completely disturbed the past labor cycle via automation. The telephone forms a communication matrix across the entire globe. This is not to relagate face-to-face communication to a past termanology. As will be expanded later this form of exchange still has relavance. Importantly though, communication has completely altered the notion of static place, container. Movement of goods as well as people is a product of this web of new communication.

Before leaving the Classic City it may be well to surmise these eulogistic events in abstract form. Initially we began with a container imputing its forces toward a common goal--religious

forgiveness. The city form was a direct translation of this unity of purpose. Centrality, community, planar geometries, integrated function characterized this physically. In the 20th Century only the corpse of the Classic City remains. Nostalgic as some are toward this form of living, it would be a contradiction of scientific reality to attempt to retain this permanently. A new form of living based on relative definitions, heirarchies of structure, knowledge and skill, and matrixes of communication is before us. Technology, the open ended function, has given us the menas. Science has broken the chains of mysticism and superstition. Civilized man possesses freedom unparalleled. Secularism is both a liberator and a challenge to greater personal responsibility. Such responsibility is that of guiding the development of the city. The city becomes relative to the Will.

"We are now passing through a period of transition in the state of man quite as large and as far reaching as the transition from pre-civilized to civilized society. I call this the trasition from civilization to post-civilization. This idea is shocking to many people who still think what is going on in the world today is a simple extension of the movement from pre-civilized to civilized society. In fact, however, we have to recognize that we are moving towards a state of man which is different from civilization as civilization was from the pre-civilized societies which preceded it. This is what we mean by the innocent term "economic development". There is something ironic in the reflection that just at the moment when civilization has, in effect, extended itself over the whole world and when pre-civilized societies exist only in rapidly declining pockets, post-civilization is stalking on the heels of civilization itself and is creating the same kind of disruption and disturbance in civilized societies that civilization produces in pre-civilized societies."

Kenneth E. Boulding
Conference on the City in History
Harvard, 1961

The Classic City produced civilization. Post-civilization must likewise be the product of the new city. Physically the Classic City had walls for defense. The post-civilized city needs no walls; the bomb has outmoded the old concept of defense. The Classic City grew inward, imputed its additions. The new city, however, must cope with population increases unparalleled. It cannot contain; it must learn to grow, to expand and contract, to fluctuate. Classic City was self-centered, its sphere of influence minute, its communication simple. The new city will extend, and enhance communication further; it operates in a world sphere. Instead of the free nation, state or city the post civilization will feature the autonomous man--a creator.

In order to develop the full potence of this change from civilization to post-civilization it would be best to investigate the basic unit, man, initially. The consequence of the civilized city was that man was the porduct. An urban area (the setting) prdduced that man. Ecology, the science of physical settings, is based on the theory that the physical environment moulds man's actions. Without realizing it, the civilized city did just this. But, significantly, the development of psychology altered this emphasis. Not only is the physical environment important but also the individual man is. Possessing certain "needs", man seeks out an environment to satisfy these "needs". This element, though active, has hardly been emphasized in the Classic City. A post-civilized city must balance the environmental aspects and the human "needs".

Perhaps the most natural extension of man is his work. The civilized city was based on a unity of labor and home life.

Once the religious bond between labor and home had been broken, it became contradictory to try to sew them together again. The orgainzation, based on knowldege and acquired skill, replaced the old form. This heirarchy cemented the dichotomy of labor and home life. (Physically the suburb seems to be a product of this movement. Creative artists like painters, sculptors, architects, writers, and poets significantly maintain a close continuity between "work" and home life. In their relams "work" and life become coexistent.)

Having severed the chords of past city existence, it is necessary to immediately explore what a post-civilized "city" will exist for. As previously mentioned the city was the center for labor, markets, communication, entertainment, and transportation. But these external economies which produced the civilized city are destroying it today. The improvement of communication has broken the cities' drawing power. Industry continues to extend, labor is mobile; it moves with industry. Even retail and wholesale establishments are extending; they must retain time-distance relationships with people. Diseconomies resulting from past exploitation by units have polluted air and water, ruined natural habitats and landscape features, and neglected man's most basic needs. Of course taxes and politics amplify this decentralization through parochial policies and inequities for city users. Thus, what is a city for?

Paralleling the growth of scientific information has been the desire and need to learn. In order to deal with this increasingly complex environment man has sought "education" as

a tool. Communication is inextricably tied up in learning. Through one-way learning, television, and radio, man has acquired knowledge previously inaccessible. (Aside from its cultural value, television has supplied man with certain negative habits which bear consideration). Other electronic communicators like telephones similarly increase the range of learning. Now with the initiation of computer learning the potential is astounding. Computers utilized as local, regional, and national storage and dissemination cetners render other forms somewhat obselete. Despite the potential for achieving greater factual information than previously imagined, there remains a basic missing link. A discrepancy exists between the environmental experience and the formal learning center. The information each involves is unrelated to a great degree. At more advanced levels the gap becomes more apparent. In seeking to specialize for a certain vocation, a man becomes isolated from the remainder of his environment. Granting that this man may perform his orgainzational function but he hardly is considered willful in his environment. Perhaps the epitome of this discrepancy occurs when man, having guaranteed (formally) certain rights to others, denies them on practical grounds like race and color. Thus, instead of attempting to integrate types of informational learning and experience, man can separate them. The responsibility of secularism is to integrate them.

On the interpersonal level environment is most prominent. A basic motivation is the need for novelty, mastery, change, and variety. An environment of people couldn't be surpassed for such a need. It is interesting that surburban folk, lacking such a social satisfaction attempt to achieve identity (personal and

group) by projecting this need on to material goods like new automobiles, gadgets, and even new houses. The deprivation which characterizes their remaining physical environments likewise limits their ability to achieve new experience.

With the scale of interaction that will characterize the post-civilization, certain forces exist that will encourage the development of social and environmental integration, or destroy civilization. Population extrapolations which predict seven billion people by 2000 will alter the concept of living. War, potentially ruinous, is the alternative. The destruction of humanity is the stake of the post-civilization.

Aside from the need to enhance communication with environments for exchange, there exist certain other motivations which will affect the new city. The basic needs for food, water, sex, oxygen and other physiological criteria must be satisfied in the new city. Unlike the Classic City which concentrated for these subsistence purposes, the new city is liberated. Granting the need for food, clothing, medical care, transportation and shelter (the compontents of subsistence) at a certain level, the society can produce them with a small percentage of the economy. Further needs like water and power are now supplied in matrix systems throughout the U.S.. (With the development of atomic power large scale centralization may prove sensible. Similarly the fresh water supply of the Great Lakes and the untapped ocean potential will affect large scale centralization or concentration.) However, these requirements specify little about the specific parameters of living, i.e. a limit of population concentration. (The East coast megalopolis seems quite uniform in its ability to supply

water, power, etc., for example.)

Before discussing the relevance of this argument to actual planning shcema, it would be advantageous to consider two extensions of the conecpt of psychological motivations. First, nature itself provides tremendous novelty and variety. Mutation and sheer numbers yield a continuous vitality of interest. Thus, in the concept of the environment as an experience it would be a diseconomy to obliterate nature entirely. Realizing that population growth will tend to infringe and eliminate certain species necessitates retention of areas for natural existence. The suburb cannot be a fusing of real nature and city. Though not excluding nature in the new city entirely, its presence will be limited to plants, parks and controlled growths. The waste of space and land characteristics of today's suburb, if continued, could eliminate the natural experience in the future. Aside from its educational capacity nature as a source of exygen in exchange for CO_2 may limit the extent of man-made growth in the absolute sense.

A second consideration is that of regionalism. Within a system based on intercommunication on a global scale, will we witness a decline of the variety and indiviaualigy of peoples? To me the question is not one of, will this occur, but what the factors of regionalism shall be. Climatic conditions of sun, humidity, percipitation, etc. produce a natural variety of life and should be effective elements of cultural variety. Similarly the major landscape features which differentiate areas contribute to variety. (e.g., the Allegheny mountains should limit the growth of the megalopolis westward and thus retain district qualities.)

Another factor contributing to this regional character is the continuity of histories. Language differences, cultural habits already existing will not disappear suddenly. In that sense the new city can compliment this diversity by recognizing varying life patterns and integrating them. Differences of communicative experiences over such a wide range will further enhance the variety of human beings. I consider this an expanding rather than contracting hierarchy of knowledge.

Furthermore, the more specialized a talent becomes in a certain direction leads to a concentration of talent. For example, in New York City only can the major decisions for XYZ insurance company be made today. Thus, the city will become the intersection of various hierarchies of specialization. Certain cities will initiate new innovations and thus require a concentration of experts. The link of communication to other cities will allow innovation in other cities, a growth of knowledge on a wider scale. Thus the post-civilized city will be based on different criteria than the Classic City. It will exist as a communications center in a totallly new sense. It can be a city of education, creativity, and the autonomous individual. A challenge to responsibility.

Having attempted to broadly investigate the concept of a new city in post-civilized society, it is essential to organize these goals into planning criteria. Basic to this conception is the idea of <u>place</u>. Place may be defined as a location of interaction between people or objects. Previously place was land related, i.e. consistent with the surface of the earth. A place was a square, a backyard, a church interior. With the

liberating effects of technology place is no longer land-based, necessarily. It may be related to land forms (e.g. trees) but gravity and structural members limits are the parameters. Thus place may become a relativistic location united by time, space, and motion on both horizontal and vertical coordinates. Its structure will be dependent on hierarchies of activities, movement and natural conditions. In the city today place is very limited in variety and number.

The second unit of the new city is diversity. Unlike in the Classical City where diversity designated many choices of houses, stores, etc. (a function of income), it is intended to be a social diversity, levels of contact, dependent on various places from community to private. It is a potential for having contacts with many levels of people (formal, informal, haphazard). In the Classic City as it remains today environments tend to either an extreme of community or privacy but not a range of social contact. Even the wealthy who can afford privacy in Manhattan for access to functional diversity do not have social diversity. Naturally, too, the group prejudices and superstitions prevalent are the result of a lack of social diversity, ie. judging a man as an individual. Communication overload is the result of the opposite extreme of community level interaction without privacy.

Density, a land based term, is no longer applicable. Instead of area density, the previous concepts lead to the idea of spatial density. What are the parameters of light, air, sun, and crowding? The potential of receiving an adequate amount of space to insure these essentials is the essence of this type

of density.

A final basic unit of this concept is called interdependence. In the old city form the various functions were mixed. The unity of work, religion, and home necessitated the combination of various functions in the same buildings, e.g. shop and home related vertically. Gradually the forces of population and technology (dirt, smoke) applied to the container upset the balance forcing the separation of functional use types. Industry was segregated from housing, retail, etc.. This dispersion may have succeeded temporarily but the communication strain it caused is apparent. Today's concept of the "tree structured" city is a sub-group of the same development and equally limited in its communicative potential. This is not to suggest the general dispersion of activities anywhere. For example, there are basic relationships between the school and home; they are just not so simple as to be placed in a single hierarchy. The concept of interdependence stresses this kind of relationship. On a smaller scale external economics works here in, e.g., providing customers for a restaurant from a theater. In stating these relationships in formal terms the basic need for both distinctness of certain spaces, or forms as well as the continuity among functional groups is a problem of delicate balance.

Although not a specific goal, technology is a force which underlies the four basic components of the new city. In contrast to the Classic City, which was based on land-centered concepts and fixity of physical structures, the reality of technology presents us with a completely new situation. Even

out of civilization came hints of the potential technology offered. Place could become a function of the stress limits of steel or concrete in a vertical direction. Movement could be on a scale from indiviaual vehicles or escalators to large jets or subways, each implying certain parameters of use. Regretably, at the time of the Industrial Revolution technology was untamed and random. Innovation came so rapidly that it caused fear and distrust. Today, however, one realizes both the potential and the limitations of technology. Aware of the need for both stability and change, technology may now become the tool rather than the brute force behind change.

A post-civilized outlook toward society and science is parallel with the principles of technology. Under this system design will evolve as a relativistic approach, ie., the designer will work toward a solution with the relaization that innogations may alter the framework entirely. That the change can be integrated rather than superimposed (as in the present situation) is important. Thus, design will become open-ended rather than absolute, unchangeable, classic.

Thus, the post-civilized city will encompass a new range of thinking. And the physical forms that compliment this philosophy will reflect the open-ended quality that is the basis of the age.

Part II: A Rationale for Germantown, Maryland

In the beginning of a design project there is a groping. The termination of the same should have brought about a focusing effect. In between the extremes lie many experiments, theories, design principles, dead forms, inappropriate concepts. This paper is an attempt to structure what at times has been chaotic or at least disorderly. Out of it should evolve a clearer picture of what I mean by the role of urban design, its forces and its importance to city building. Whereas, in practice, city planning, urban design and architecture have fluid boundaries, I, as one designer, have sought to develop a differentiation for myself. With this project the city planning aspects have never been particularly emphasized. In beginning with data for Germantown and no real client, the role of planners as interpreters of community groups was lost. On the other hand, urban design as relating to architecture was an even more muddled relationship. Unlike planning which can encompass various disciplines, urban design is dealing with essentially the same tools as architecture. But there is a very basic difference of scale and purpose. In architectural undertakins the object may become a single building or complex of units. The environment created affects a limited number of people, usually those immediate to the client. The expression of the building evolves as a product of client-designer interaction. The life style which guides such a design can be agreed upon. At the scale of urban design the problem is somewhat different. Most important, the environment is total rather than partial in effect. A great fallacy in relating these two fields today is that many presume that the single great designer can perform this monu-

mental task. My basic argument is for an urban design based not on this approach, but instead on an attempt to provide a structure within which many architects can design. Urban design involves the entire or at least, major portions of a city - a CBD, a neighborhood district, a park system, etc. In a democratic society, I cannot conceive of having a man armed with a single value system (his own) charged to design the entire city form.

Urban design, then, is an effort to structure urban sectors for the architect to design in. Unlike the architect who deals with precise forms, materials, structures, the urban designer works at a larger scale; a different force system is involved. In explaining my experience with this Germantown development, it is important to understand the basic forces I have been concerned with, as well as the varying effects they have as the scale of attention shifts from citywide, to use district to project area. At the project level the architect takes over with his materials, structures and forms. He, too, works with larger forces but they are given rather than moldable as with urban design. In this system one can immediately sense the importance of the urban designer being sensitive to the architects' approaches. A poorly conceived urban design, lacking in flexibility to the architects' goals and style, would turn design on the project scale to chaos or anonymity.

In working with the design of a new town I was presented with an opportunity to work on all scales of urban design. As a design method my approach may be termed increasing scale design. This term means that the initial concentration was at the largest scale, the city as a total organism with increasing scale to the city as a use district and finally concluding with the city as a series of projects - enter the architect.

Penetrating this entire process has been a vein of forces which change with each scale of work. The direction of my study can best be described under four groups of urban forces: movement systems, structural systems, form studies and functional (use) studies. At each of the three scales of design these factors were considered with certain ones predominating at each scale.

Before entering into a discussion of the city-as-an-organism scale, I prefer to set the context for the Germantown development. In lieu of the other satellite city development from Washington, D.C., I would expect Germantown to be another low density extension of high-middle class income groups. Location of certain key institutions, the National Bureau of Standards, the A.E.C., plus industry like Fairchild Hiller would provide some impetus to town growth. Two major transportation linkages, the National Highway, 70-S and a proposed mass transit using present railway rights of way would similarly stimulate a high density environment for Germantown for two basic reasons. First, there is a need for an alternative choice in decentralization. At present one is forced to choose either the contact of the city (great Negro concentration in Washington has resulted from many leaving the central city) with its social ills or the tranquility and low key activity of suburban development. In a high density environment I had hoped to establish some of the urban qualities that are lacking in lower density suburbs as well as in central Washington. Secondly, I was unaware of exactly what urban was when I began, but had thought that a high density environment would be more conducive to studying the question. When an environment becomes so sparsely populated as to be totally constructed of single use, single site, one level

constructions, the concepts of urban design are less applicable.

At the largest scale of the design, the city-as-an-organism, the function and movement forces were considered first. In having certain leeway in site selection, I sought to elucidate the forces on the largest scale which would be most conducive to town-city growth. As mentioned, a certain economic stimulus existed. Secondly, the two basic movement systems provided the basis for satellite linkage to Washington. Specifically, with the A.E.C. already located at this intersection of 70-S and 118, this interchange became a key determinant. Also, since 118 intersected the mass transit-freight line 1.25 miles to the south, another key focal generator was possible. With two creeks, Little and Big Senaca, existing, a potential water source for ponds or even lakes was present. However, the high density nature of the development caused me to separate these water sources from the proposed town. I preferred, at the scale of 100,000 people, to retain this lake potential for low keyed recreation.

On the basis of these two basic generators, the intersections and the relation of city development to recreation potential, I decided that the site described was desirable. With the basic location determined, I further investigated the use of the land with relation to the region. To do this, I made a functional-land use study in which all forested areas and forms of large singular property divisions were marked. These areas were considered assets to the region. The land that remained was concentrated along 118. Also noted were the major topographical characteristics, the spinelike form from 70-S to the intersection of 118 and the railroad defined by the creek beds on each side. This relationship seemed to define the basic character of the city growth: two generators of activity and growth linked by a spine with green space paralleling the spine for recreational

potential. The notion of phasing is included in this definition in that the two foci generate the initial growth; a subsistence level is established. Secondly, the two foci merge tofether alon the spine and finally diversification laterally occurs at the 100,000 stage. An ideal form of the city might look as illustrated.

In moving to the city-as-use districts scale, several studies were involved. Whereas movement, landscape qualities, and large-scale growth highlighted the first aspect, I concentrated on use allocation in this second phase. A common means of organizing use in the past was to initially create use districts of a separate character, i.e. retail district, industrial district, etc. However, urban designers have come to realize the limitations of such a simplified approach. A second approach may be termed a hierarchical organization consisting of developing units (e.g. a neighborhood) which would be given a certain number of houses, churches, schools, etc. A collection of x neighborhoods constituted the next division which in turn required another scale of facilities. In this treelike fashion an entire city would be organized. A second time I sensed over-simplification. Therefore, I sought to better understand the nature of urban uses by developing criteria for analyzing these uses. There appeared to be five categories of classifying these uses: climatic condition, service, access, structural character, and growth. By climatic condition I meant the degree of natural vs. artificial condition. There were 5 qualities of climate which were critical: the need for natural light, the need for natural air supply, the orientation of the activity (outward or inward), the desirability of view, and the seasonal vs. year-round use. Furthermore, service could be clarified by knowing the size of goods carried, the type of services required (truck, train, airplane) and the frequency of service

(daily, weekly, monthly). Access refers to the origins and frequency of the customer or user. The city was to be a high density environment in which uses could be mixed three dimensionally as well as two dimensionally. Therefore, by structural quality I sought to differentiate those uses which involved heavy loads and long spans from those of a more manipulable character. In a similar way the growth of certain facilities could be either relatively static or very rapid. Another aspect of growth has to do with the manner in which a facility grows. Certain types of uses grow in units. A house, for example, usually is built all at once with little addition over time. On the other hand, community facilities like a college or hospital involve a great outlay of capital. As the need for growth occurs it is advantageous economically to be able to add to the existing capital facility. The growth of the unit type is easily handled whereas additive growth requires provision for expansion. A diagramatic summary of this use-analysis is shown below.

Having in mind a very careful analysis of these functions, I sought to organize districts of use by relating these uses in a sensible manner. A first consideration was the dynamic aspect of use allocation. Certain uses seemed to cause other uses to organize nearby, i.e., by allocating a department store use one could expect other retail stores to group for beneficial spinoff-buying. THus, I developed the idea of functional generators, followers and independents. A general term describing this effect is interdependence. Although the hierarchical idea for the entire city seemed an oversimplification, I noted that certain functions could be allocated in this way. For example, a public service like fire or police is uniformly spread over the city. Therefore, it could be broken into a hierarchical structure to advantage. Similarly, schools are hierarchical in nature. The

term, sphere of influence, is used to describe their type of structuring. A third manner of functional use grouping arose directly from the analysis. Certain uses although not interdependent shared the same needs of access, service, climate, etc. Therefore, they could be grouped where these conditions could be supplied.

Organization of uses by interdependence, sphere of influence and similar functional quality could be two or three dimensional. In that my investigation concerned a high density environment, however, I sought a three dimensional relation of use. A concept basic to this relation was the notion of growth dynamics. Functions of a very dynamic growth quality need flexibility for growth. Also the structural requirements caused heavily loaded uses to be more ground related, whereas housing units could be manipulated off the ground. A third factor was the climatic condition which organized the uses with need for natural conditions where they could receive light, ventilation, view, etc. while artificial uses (department stores) could be underneath or interior in quality. (Based on these qualities a three dimensional use districting was achieved for the entire city of 100,000.) Evolving from these three dimensional studies a spatial differentiation by zones was found. These zones may be termed compression, transition, and tension. In the compression zone the stability of growth, large-scale structural requirements and the most artificial conditions predominate. At the other extreme, the tension zone, the most dynamic, least structurally restrictive and most natural conditioned uses occur. The intermediary transition zone is the transfer from the static, rigid ordering of the compression zone to the flexible, changeable, tension zone. Based on these qualities a use allocation could be made.

The decision to locate specific uses arose directly from the studies of use zoning and the site qualities. From the earlier statements about the primacy of the two transition points to city growth, I sought to relate the use districting to the spine connecting the two. Industry, because of its need for large areas of relatively flat ground, the importance of service and the potential of growth, was placed in the flatter portions particularly near the 70-S intersection. In this manner unnecessary penetration by service vehicles could be avoided. Similarly other industry, warehousing, lumber, and building supplies related directly to the railroad-highway transition. Growth could expand linearly along the railroad. Community facilities like the hospital and community college were located with the realization that they would benefit by having room to grow as well as for their specific requirements. The retail center evolved because of the importance of regional access (the roads and service system) and the need to grow with the development of the city. Since these facilities are highly interdependent, retail growth was sought by continuity (linear) rather than by sectors. Since certain facilities would not be shown at the 200'=1" scale for the entire town, I further zoned a portion of the housing use for schools, grocery and drugs. As a general philosophy I sought to disperse the community facilities rather than concentrate them in a single district. In a high density environment an entire neighborhood could take on a character as the result of a theater, park, assembly hall, swimming pool, etc. This dispersion with easy access would also increase the communication with various portions of the town.

Coincident with the study of use districting, I was pursuing the question of movement systems. Prior to actually experimenting I developed

a philosophy concerning movement systems for the town. In a low density environment the distances between uses has been bridged by using an intermediary capsule. Realizing that the automobile was of great necessity for the function of this total region did not lead directly to its adaptation for a high density Germantown. Two major limitations characterize the use of automobiles; one, that the automobile has increasingly become a means of eliminating perceptual experience, i.e. shock reducing, super quiet and air conditioned, and second, that at the end of each journey a large storage problem occurs. Therefore, I adopted the idea of limiting automobile penetration and attempted to utilize pedestrian oriented systems as a basic mode within the city. Also since I know little about the actual potential of such facilities as moving walks, escalators, etc. I hoped to investigate their possible use. The auto would still retain primacy as a national-regional connector.

Another aspect of the automobile vs. pedestrian oriented system was the question of service. In the two dimensional city service by trucks and access by automobile are usually carried out on the same road system. However, we have begun to realize that the question of service vs. access is one of scale. At the scale of a house, service and access may well occur at the same entry. All homes require both direct service and access. At the city scale though, service and access begin to split apart. Huge delivery trucks do not flow by the same route as pedestrians to stores. Based on this notion I decided to separate the service system from the access at the larger scale of the city and reunite them in the less specialized districts. A three dimensional use organization was very conducive to a separation of this type.

From these general decisions a study of systems was begun. A first notion came about in the form of a three dimensional matrix based on the use of escalators forming spirals for movement vertically. I was interested in the question of making the transition from horizontal to vertical movement. Presently, the sequential stop-go of the elevator usually causes jam-ups when use is concentrated. An escalator, however, allows a continuous flow of people diagonally. When such single runs are linked together a spiraling movement can be achieved. At this time I also became concerned about structural systems and was investigating the potential for utilizing the movement system as a supporting structure. As depicted in the model shown, the three dimensional system could be used to form vertical trusses by triangulation with vertical members acting both as chords and elevator access.

As previously mentioned the automobile was restricted in the city. The transfer from 70-S to 118 became the key transition point for the automobile and service vehicles. At that location I designed a two level interchange which allowed the immediate segregation of service and access. The service system with its heavy loads and large vehicles was placed on the ground, within the compression zone, while the access system could be used either on grade or above grade. Unlike the growth of use districts, a movement system has to maintain continuity from the beginning. Therefore, in the development of phasing for the access and service systems I sought to allow for segmentation by spliting the system into two spines. In the first phase of this investigation primacy was given to the intersection of 70-S and 118 and 118 and the railroad - the key transition points. This coupled with the future development of a north-south linkage, the National

way to Dulles Airport, suggested a linear quality for the system. A desire to structure growth also seemed to be complemented. At stage I, the first access road and service road below would be constructed moving around Germantown (existing) to the east. The old 118 could serve as an initial supply route and the existing Germantown could be gradually phased out rather than demolished. Residents could be relocated within the new city. Desiring to limit automobile access I conceived of parking harbors which would line directly to this spine as a means. Unlike a parking garage these facilities might contain drive-in uses and would also connect directly to the pedestrian system which allows access throughout the city. Portable auto trunks would serve like shopping carts and could be taken to a house or left in the auto. In stage II, the Western spine would be added with the retail use district between the two as shown. The service system which has a basic spinal nature like that of automobile access performs different functions, however, The need of delivery to individual housing units as well as the major spine delivery to retail, etc. led to an investigation of possible service systems. A a prerequisite for such a system I sought to minimize the conflicts of intersections of pedestrian and vehicle and to provide continuous flow as much as possible. To do this I designed single and two level systems utilizing 45° turns and one-way intersections. The two level system, however, would have been cumbersome to large trucks and ramping complexities aided the issue. A second study led to the development of a simple loop system from the spine using one-way flow and T intersections as a means of eliminating conflicts. Within this system both single delivery (via main spine and single loop) or multiple delivery (via spine, loop or across loop routes) were possible. Linkage in housing would be provided by

vertical transport to units not directly related to the ground. The movement then is related to the three use zones: compression, transition and tension. In the former two the rigid nature of the use allocation (relatively) requires a differentiation of movement. In the tension zone the more dynamic qualities of growth and change suggest a more uniform movement system with defferentiation possible as specialized uses are located (a grid, e.g.)

A third concurrent aspect of this stage, the city-as-use-districts, is the development of forms. The use system suggested a three dimensional organization with mixtures of different functions. The movement system complements this use allocation by providing service and access. It has the potential of acting as a structural element for the city, the tree to which the various use forms may be attached. At this stage I began thinking about the form of the use districts. By nature the compression zone uses were ground-related, that is, the loads of their structure would be transferred directly to the earth by column and slab structures. This ground relatedness suggested the major theme for handling these uses; ground forms should manipulate the grade by retaining walls, planes, levels and be basically layers of use. On the other hand, the tnesion zone uses; dynamic, changing, manipulable needed a different formal vocabulary. Free of the ground these uses could become galaxies in space, groupings supported by a structure that would complement their dynamic character. The compression zone forms involve five dimensions, maximum - four sides and a roof. In the tension zone forms could become six dimensional where space could be related from below as well as above. Formally the layer type of structuring is very common today. Knowing that was completely feasible, I sought to investigate the galactical expression through a series of models.

At the scale of use districts the three dimensional zoning, the complementary movement system and the basic formal vocabulary were evolved. However, as en experience I had never walked around the city (in my mind's eye). Therefore in working up to the city-at-project scale I sought to emphasize the spatial-formal aspects of development to further clarify this picture. This goal led to the development of more ideas concerning the formal treatment of the various use types of the compression zone as well as investigation of structuring the tension zone uses. There appeared to be six basic types of use which might become prototypes for the development of a formal expression: housing, offices and research, retail, industrial, parking structures and community facilities. Since it was a basic philosophy to allow the architect to guide the specific project development I sought to define the major formal possibilities within the high density context for each of the use categories. The qualities of interior space and function were not considered the realm of urban design. Community facilities as the most unique uses were difficult to generalize about. Because of their static quality due to economics, they might be the use structure which could generate the image of the city. By their relation to the movement spine a person could develop a sense of the city. Growth forms seem particularly applicable to these uses; ease of addition, perhaps in linear form, seems to be inherent. Retail facilities by contrast can be specifically described. In that the essential quality of these uses is interior, their interdependence great, and their relations to the ground essential, the idea of simply linking them together in linear fashion and layering them vertically evolved. The department store as a generator could be linked at several levels in this layer structure and thus both small and large stores would benefit. The key play between continuity and distinctness of forms may be contrasted here. The retail is a continuous form where the overall

linkage is emphasized by the layers. In the office-research uses distinctness may be the dominant theme. Blocks and towers of flexible space with less interdependence to other uses characterize this use. Thus the form of these may be single towers linked by bridges like veins to important levels but retaining their distinct quality. Large scale research may be treated much like industrial uses. With large spans and roof areas industrial facilities appear to have two basic form types in this high density area. First the use may be simply modules of enclosed space with mechanical supply plenums in the roof. Since this type would result in large flat areas, these roofs could be developed as parks, sports areas, etc. for the housing nearby. The other possibility for industry is that it be developed as structural form enveloping space which could be viewed from above. Examples of both types exist within the scheme. Parking harbors have a great deal in common with industry, large open spaces with the need for mechanical supply (exhaust fumes particularly) and essentially grid like structures related to the ground. Also as in the first type of industrial form the roofs of parking structures could provide the base for tennis courts, parks, play areas to relate to housing.

These uses discussed are all compressive zone types: i.e. related to ground, structurally restrictive etc. Housing is a tension zone use. In a series of studies I sought to structure housing (which includes other manipulable uses like groceries, churches, schools, services, laundries, restaurants, multi purpose, drug stores, and play areas) in response to a very specific set of criteria. In doing so, I became involved with use, movement, form and structure - all of the vocabularies of urban design. Considering the system of organization achieved, it must be remembered that other innovation may lead to a different structure in the future. Differing structural-movement systems are possible.

In the high density housing problem I felt it necessary to be aware of specifically what was wrong before a solution could be attempted. I conjure up an image of today's high density housing (200p.p.a.) as being a collection of block like houses linked by elevator to the fround with a minimum of playlots or other community facilities there. My previous list of facilities accompanying housing suggests a desire to increase the diversity of housing related uses. Also since there is one plane, the ground, the degree of contact (communication) from the 20th floor is minimal. More generally the single mode of vertical movement (a capsule) severely limits the potentials of knowing neighbors below and above. Another aspect of this problem is the lack of both public and private outdoor space. Even the roofs of units are unused except for clothes drying. By their formal expression apartments in blocks suffer the pains of anonymity. When comparing high density housing to the ease of movement in the suburban plan, the identity of the house and the potential for private outdoor space, one can understand why the low density appeals to many.

The solution of high density housing is not ground related and therefore lacks the qualities of the ground. The direction to improving this situation is to attempt, within the scope of a budget, to create qualities of the ground for the high density situation: ability to change, private outdoor space, identity for each unit, communication with other uses and facilities. At the same time, however, there are certain qualities of high density which do not exist in low density. The climatic qualities of view, sun and air can become major themes for sectors of the development. The view of the horizon or the entire cityscape is a special privilege. Secondly, the potential of a different spatial relationsip exists. Unlike

the lower density which hugs the ground plane, high density can allow people to be in different spatial relationships to one another.

To this point the movement system has been the key form generator in high density housing. A corridor is abstractly a line which each attaches to. Other buildings are elevator core types where the line is vertical but the relationship about the same. Granting the need for service (including utilities, etc.) and access to each house, I sought to respond to forces other than movement in developing an approach. Relating to rpevious studies (3-D movement scheme) I continued to pursue the idea of a movement matrix serving as the structural system as well. Separation of the two systems (structure and movement) could be used where applicable. In the process the notion of diagonal movement gave way to a horizontal system of service and access. Based on studies of two and three dimensional structures, I sought to find a system that allowed building segmentation. For this reason the three dimensional structures with lateral thrust proved awkward. Also since most access to housing required horizontal paths, the diagonal system could only serve as a partial system. Because the mode of access was pedestrian I sought to leave open the possibility of motorizing certain walkways without interfering with existing walks. By separating vertically for each direction this could be achieved. The evolution of these concepts is shown in the models.

The next phase of this study involved testing the concepts of housing at a large scale. An early study showed that natural light would be a key factor. Also the notion of housing being completely galactical was modified. Over the main spine this relationship held true but at the extremities the housing could relate to major ground forms, foliage and

landscape qualities, directly. The model pictured below involved an attempt to first insure adequate natural light (limited number of layers od housing), second to respond to natural forms and third to capitalize on advantageous features - large parks, forested areas, near center spine, with galactical housing types.

Direct access by escalator to major commercial facilities was thought to be an essential aspect of this study. Structurally the model shown suggested the basic ideas. Each walk of the system could be a supporting truss for the housing units, the transfer to vertical members being the location of elevators, service shafts, waste removal. This system unlike three dimensional ones allows building in parts and flexibility vertically. Thus the basic formal structural nature of the uses was set.

A further study of the city-as-project scale involved finalizing the service-access spines. The retail spine required linkage by automatized walks for its function. Further, the exact nature of the access and service systems were finalized with relation to housing and their service cores. An essential quality which arose from this study was the sequential nature of motorized pedestrian movement. Some would be long runs, to office or industrial districts, while others would allow short trips, part of shopping excursions.

Having set the movement spine and formalized the use relationships, the urban design is essentially complete. The three scales, the city-as-an-organism, the city-as-use districts, and the city-as-projects, have been related to the major design factors of movement, structure, form and

functional use. As described earlier this increasing scale approach involved three levels of concern. The final level (100'=1" scale) allowed the solidifying of formal, spatial and movement qualities. The architect would then fashion his project design within this established matrix. Urban design as the context settin aspect of the total problem has hopefully provided sufficient open-endedness to allow the variety of expressions of individual taste and style that characterize a democratic society.

Part III: Numerical Data for Germantown, Maryland

The application of the basic goals to the location and context of Germantown, Maryland, led to the following data characteristics. Naturally the difference of thinking led to adjustment of certain figures, particualrly with regard to social distribution of income, population and housing. The relaization that diversity involves a different form of living than the base data suggested led to the changes.

I. Racial and ethnic characteristics:

Total population:	30,000
% of total population:	
Negro	13.38%
Other races	6.88%
Born in Puerto Rico	1.03%
Foreign born	5.53%

II. Age distribution, % of total population

Male:	
under 5 years	6.32
5-9	6.42
10-14	5.42
15-19	3.29
20-24	1.94
25-29	2.55
30-34	3.62
35-39	4.29
40-44	4.06
45-49	3.37
50-54	2.58
55-59	1.74
60-64	1.25
65-69	0.89
70-74	0.57
75-79	0.34
80-84	0.17
85 years and over	0.11
Female:	
under 5 years	6.08
5-9	6.29
10-14	5.27
15-19	3.22
20-24	2.24
25-29	3.20
30-34	4.06
35-39	4.81
40-44	4.04

45-49	3.24
50-54	3.24
55-59	2.44
60-64	1.43
65-69	1.14
70-74	0.85
75-79	0.59
80-84	0.36
85 years and older	0.25

III. Family income

Total number of families	8600
% of all families:	
$3000-3999	4.98
$4000-4999	6.96
$5000-5999	11.55
$6000-6999	12.24
$7000-7999	12.18
$8000-8999	9.06
$9000-9999	12.93
$10000-14999	16.28
$15000-24999	10.25
$25000 and over	4.04

IV. Household size

Total number of occupied dwelling units	8600
% of total occupied units	
1 person	8.70
2 persons	22.61
3 "	19.65
4 "	23.54
5 "	14.05
6 persons or more	11.50

V. Dwelling size

% dwellings of 1 room	2.51
2 rooms	2.75
3 "	7.62
4 "	13.09
5 "	16.69
6 "	25.51
7 "	16.54
8 or more rooms	15.29

Space requirements for 1975

Housing: 8600 d.u.

Standards: rooms	people/unit	percent	no./d.u.	area
1	1 person	2.51	215	250-400
1-K	1-2 persons	2.75	235	380-490
2-K	2 and/or 1	7.62	655	490-640
3-K	3-4 "	13.09	1120	600-760
4-K	4-7 "	16.69	1435	870-1030
5-K	4- "	25.51	2190	980-1150
6-K	4- "	16.54	1420	1000-1300
7-K	4- "	15.29	1310	1150-1450

Areas and Volumes:	Area(min.)	Area(max.)	Volume
	54,000	86,000	$.4-.65 \times 10^6$
	102,000	135,000	.8-1.0x "
	320,000	419,000	2.4-3.1 "
	672,000	852,000	5.4-6.8 "
	1,240,000	1,480,000	10.5-12.6 "
	2,150,000	2,250,000	18.3-21.2 "
	1,420,000	1,850,000	12.1-15.7 "
	1,510,000	1,900,000	13.6-17.1 "

Schools:	Unit Area	Total Area	Volume
4 Elementary Schools (175-300 persons)	1000/rm.	10,660x4	382,000
	3600 G	15,600x4	562,000
2 Junior High Schools (500-750 persons)	900/rm.	32,000x2	576,000
	5600 G	44,500x2	800,000
	2400 S		
	6000 A		
	3500 C		
1 High School (1000-1500)	825/rm.	69,500	625,000
	7600 G	83,000	747,000
	2400 S		
	12000 A		
	5000 C		
	7500 L		

Space Requirements for 1975 (cont.)

Retail Facilities: Based on disposable income and dollars/sq/ft/ ratio from Community Builders Handbook

	Area total	Volume
Food group	120,000	1,800,000
Eating and Drinking Places	53,000	530,000
General Merchandise group	82,000	964,000
Apparel group	35,000	350,000
Furniture, Furnishings, and Appliances group	28,000	420,000
Automotive group	68,000	680,000
Lumber, Building, Hardware group	17,000	240,000
Drug and Proprietary group	30,000	300,000
Specialty Shops Group	26,000	260,000
Services	32,000	288,000

Parking: assuming similar auto conditions (revisable)

58% one car and 36.5% two cars or equivalent to 94.5% one car/family x 8600 equals 8120 cars.
1 car requires 200 parking plus 200 maneuvering equals 400 sq.ft.

area reqd.	volume
3,248,000	25,984,000

Office and Industrial Space:

Federal and state government, private enterprise of wholesale and manufacturing orgainzations, banking and insurance	750,000	8,750,000
Research Laboratories	150,000	1,500,000
Electronic and other light industries and warehouses	1,000,000	15,000,000

Civic Facilities:	Unit Area	Total Area	Volume
1 Library	200x100	20,000	320,000
1 Museum-art gallery	2000 G 1580 S	5400	87,000
1 Auditorium-Assembly Hall for 2000	7.5 sq.ft. 5000 F 4000 P	24,000	960,000
1 Theater for 800	75x150	11,250	281,000
3 Cinemas (600-1500)	80x150	12,000x3	1,440,000
5 Multipurpose Halls	50x100	5000x5	200,000
6 Places of Worship	50x100	5000x6	1,200,000
3 Gymnasiums	50x84	4200x3	315,000
2 Covered Swimming Pools	150x70	10,500	630,000
2 Bowling Alleys	2400/alley 20 A	48,000x2	1,440,000
500 Rm. Hotel&Motel 2 100R Motels	25,000G 23,800P 9,000S	58,000x2	1,160,000
1 300R Hotel	75,000G 47,000A 18,000S	140,000	1,400,000
1 Hospital-500 beds	96,000B 64,000C	160,000	1,600,000

Space Requirements for 1975 (cont.)

Recreational and Sports Facilities:

	Unit Area	Total Area	Volume
Playlot:	6000-1000 per 100 children	9000-15,000	135,000-225,000
Playground:	3-7 acres optimal 1 acre/1000 5-15 yrs. age	30 acres or 5-10 playgrounds	
Playfield:	10 acres min. 30 acres opt. 50 acres max.		
Forest Preserve and Conservation Areas	Great Senaca State Park @ 4-5000 acres Little Senaca State Park		Great need for rejuvanation of certain land areas through reforesting and soil treatment
Farming Areas:	Presently 197,000 acres. Retain the most homogeneous sites where possible and probably continue in dairy and livestock products.		
Sports Areas:			
1 Soccer field	36,000		
5 Baseball Diam.	97,500	487,500	
30 Tennis cts.	3500/courts	105,000	4,200,000
3 Football flds.	75,600	226,800	
2 Track fields	206,000 705' straight	412,000	
2 Golf courses	30-50 acres	60-100 acres	

Definition of Termanology

Land Based--Is the function of such a scale and type as to require direct connection to the land, i.e. land use?

Rate of Change--Does the function change in direct proportion to the increase of population or is it subject to variable rate of change?

Climatic Criteria:

A. Is this function dependent on natural light for its daytime function?
B. Is the function one requiring interior space, i.e. protected from climate changes, needing heating, a man-made function?
C. Does the function suggest inward orientation or could it benefit from outward function? Does it lead in a sequence to something else, need for outward orientation?
D. What type of air supply is essential to maintaining this function?

Menas of service: How are the goods necessary to the maintenance of this function brought to it?

Source of Customer: At what scale of city or area does this function draw its customers, not implying economic?

Types of interaction: What levels of social intercourse, if any are inherent in this form of activity?

A. Interest--Interaction stemming from a basic category of interest, i.e. the function there.
B. Formal--Interaction based on occupational or basic business transactions.
C. Personal Selection--interaction by choice.
D. Chance Interaction--Spontaneous social intercourse between strangers or relatively unknown peoples.

Urban economic functions:

A. Generator--function whose location creates external economies for other functions, encourages development.
B. Follower--function dependent on others for source of customers.
C. Independent--function which neither generates nor follows, a large scale function.

Hierarchy of Interior Space: Is the nature of the people who utilize this space individual, group, mass, public or private?

Hierarchy of Exterior Space: same as interior criteria.

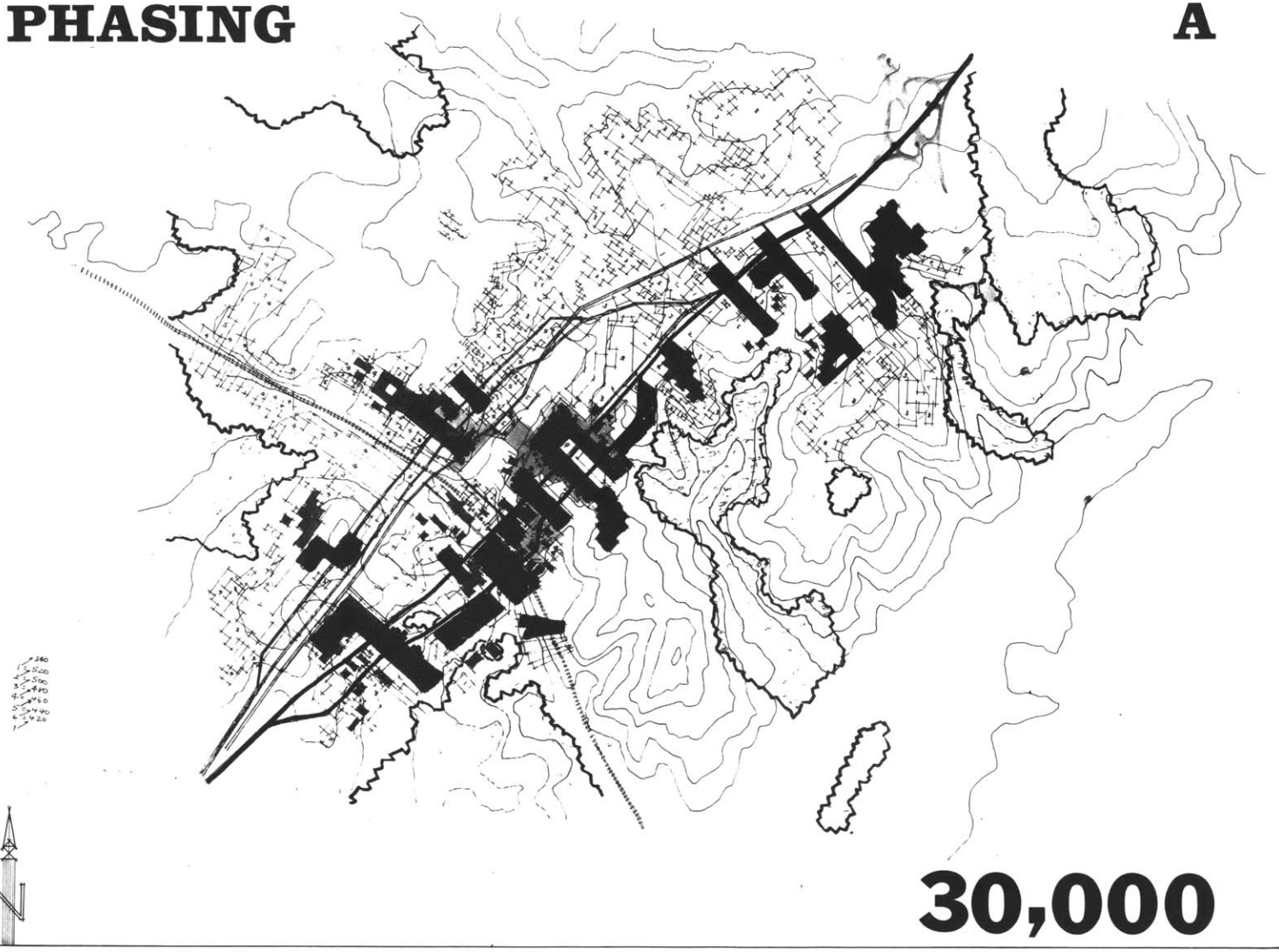
Economic or Psychological Criteria: What economic or psychological need is fulfilled by this space?

Part IV: Reproductions

Plan development of the Germantown for 100,000

PHASING

A



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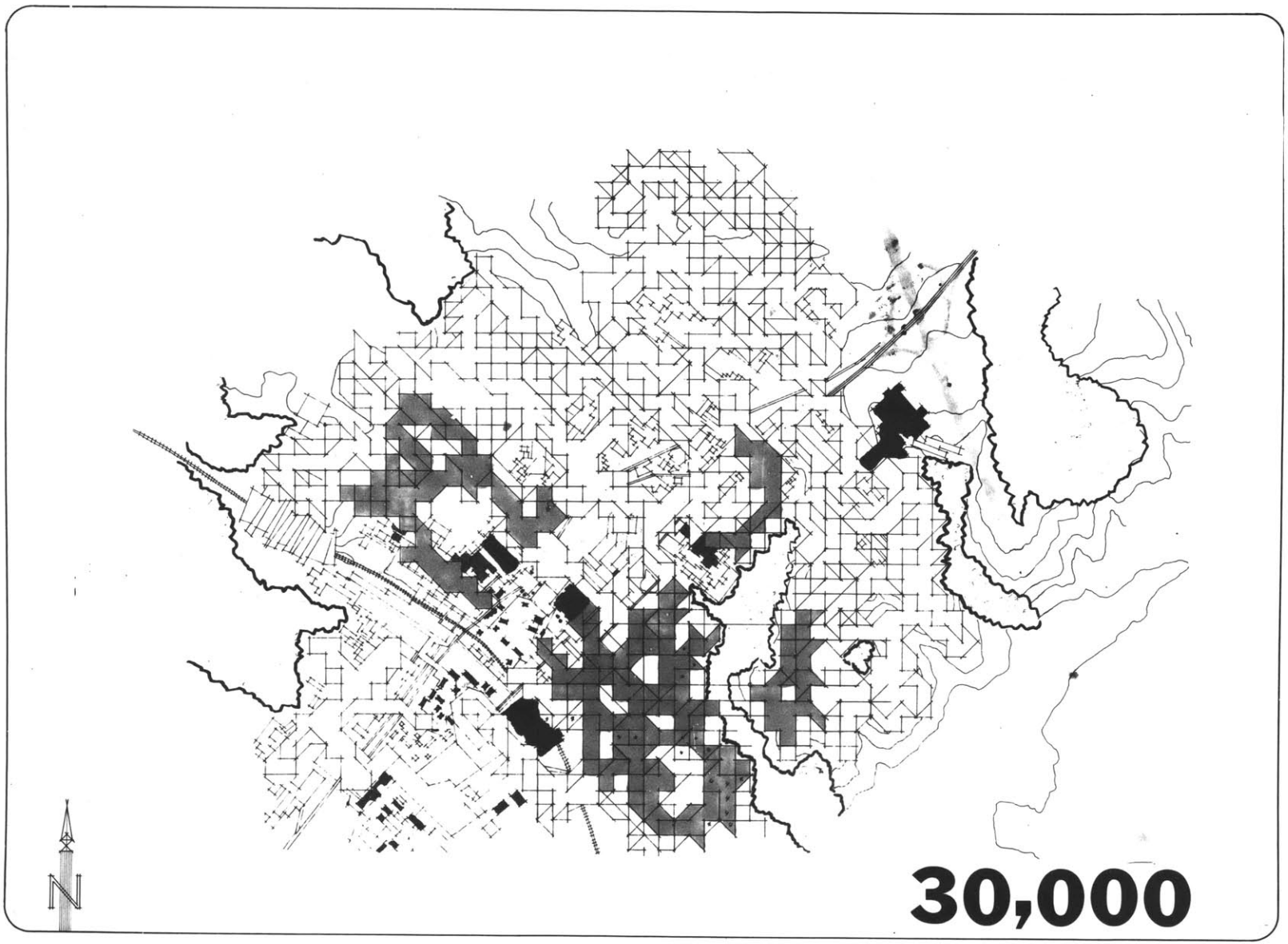
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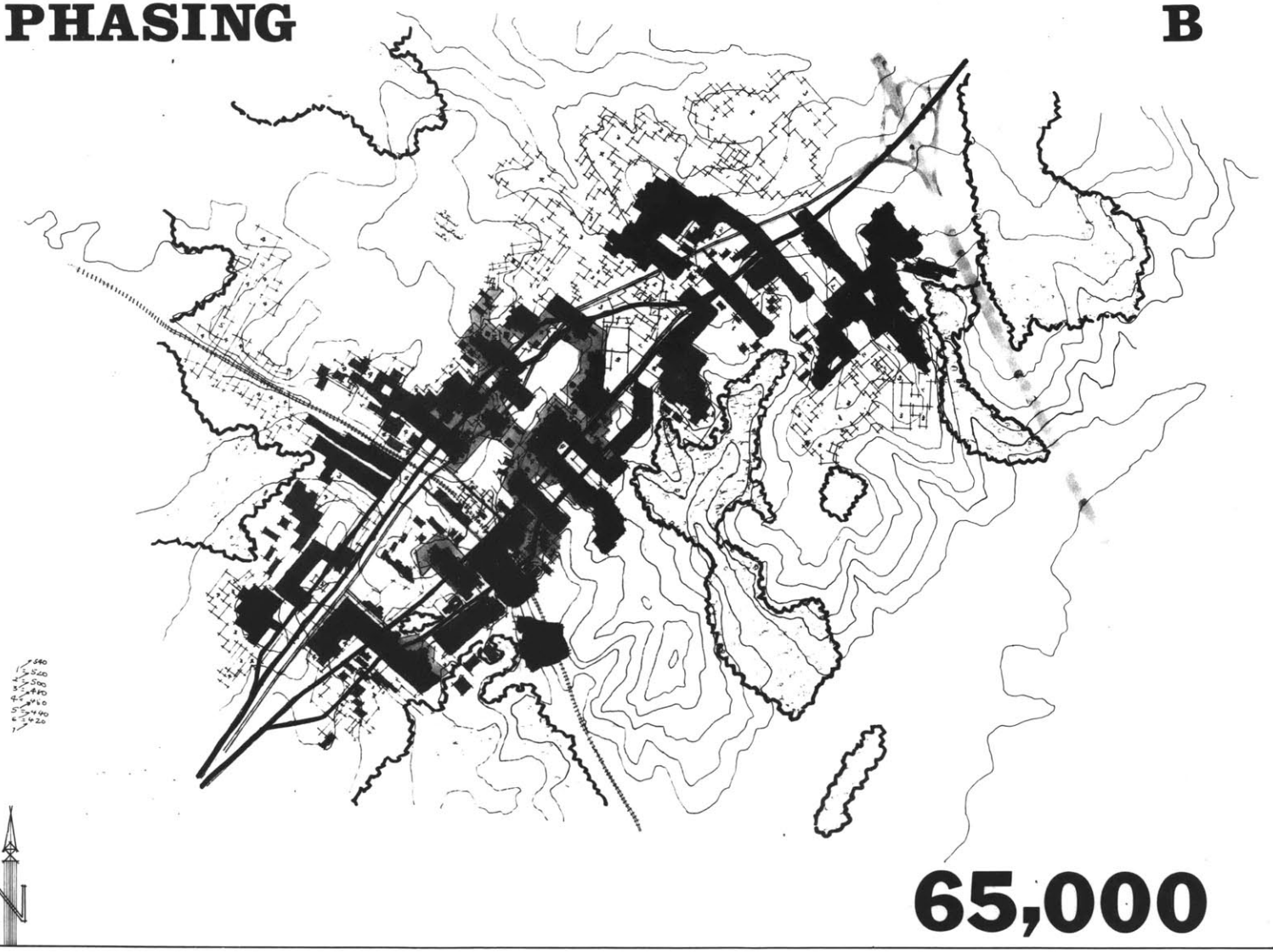
B



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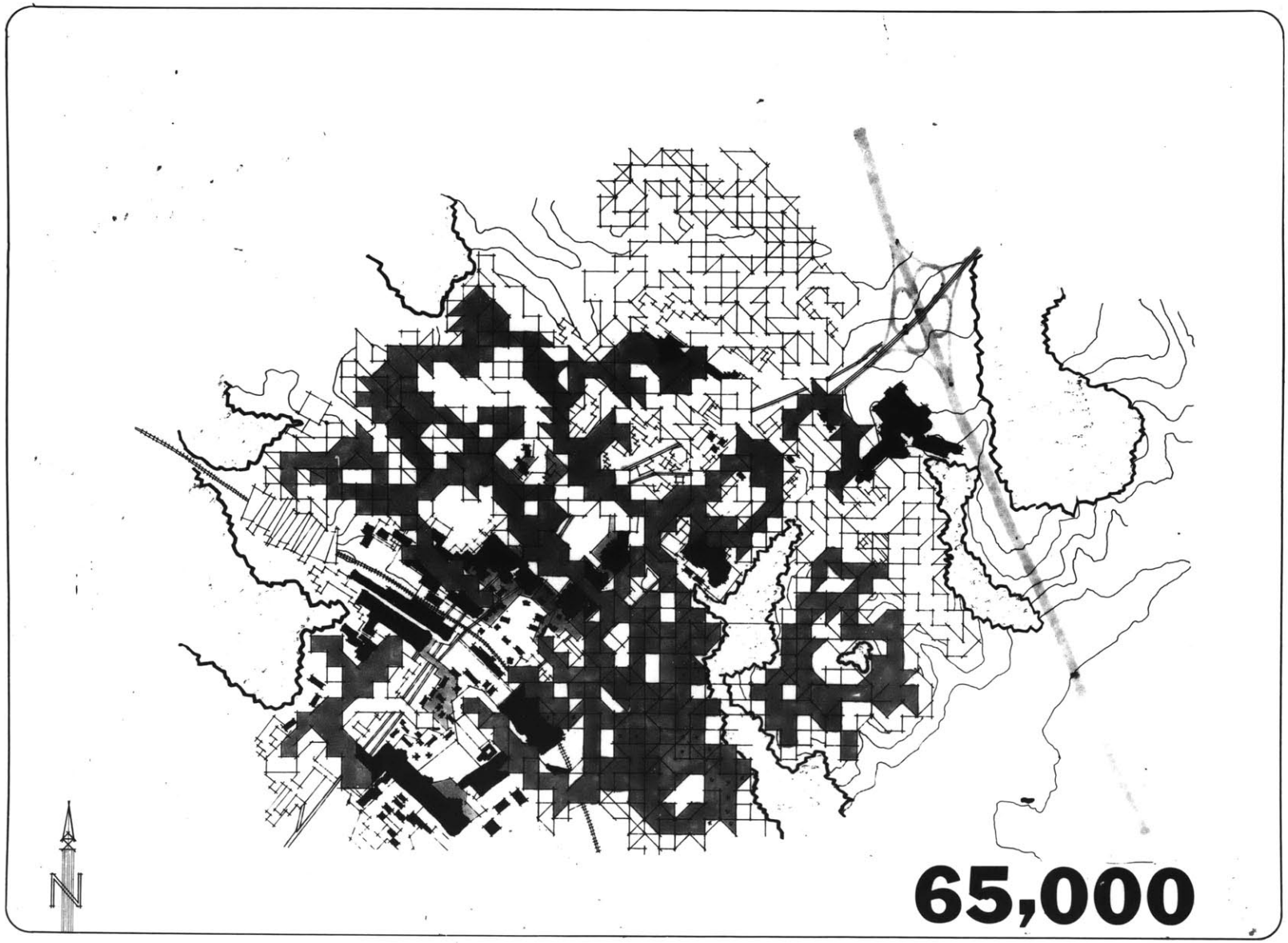
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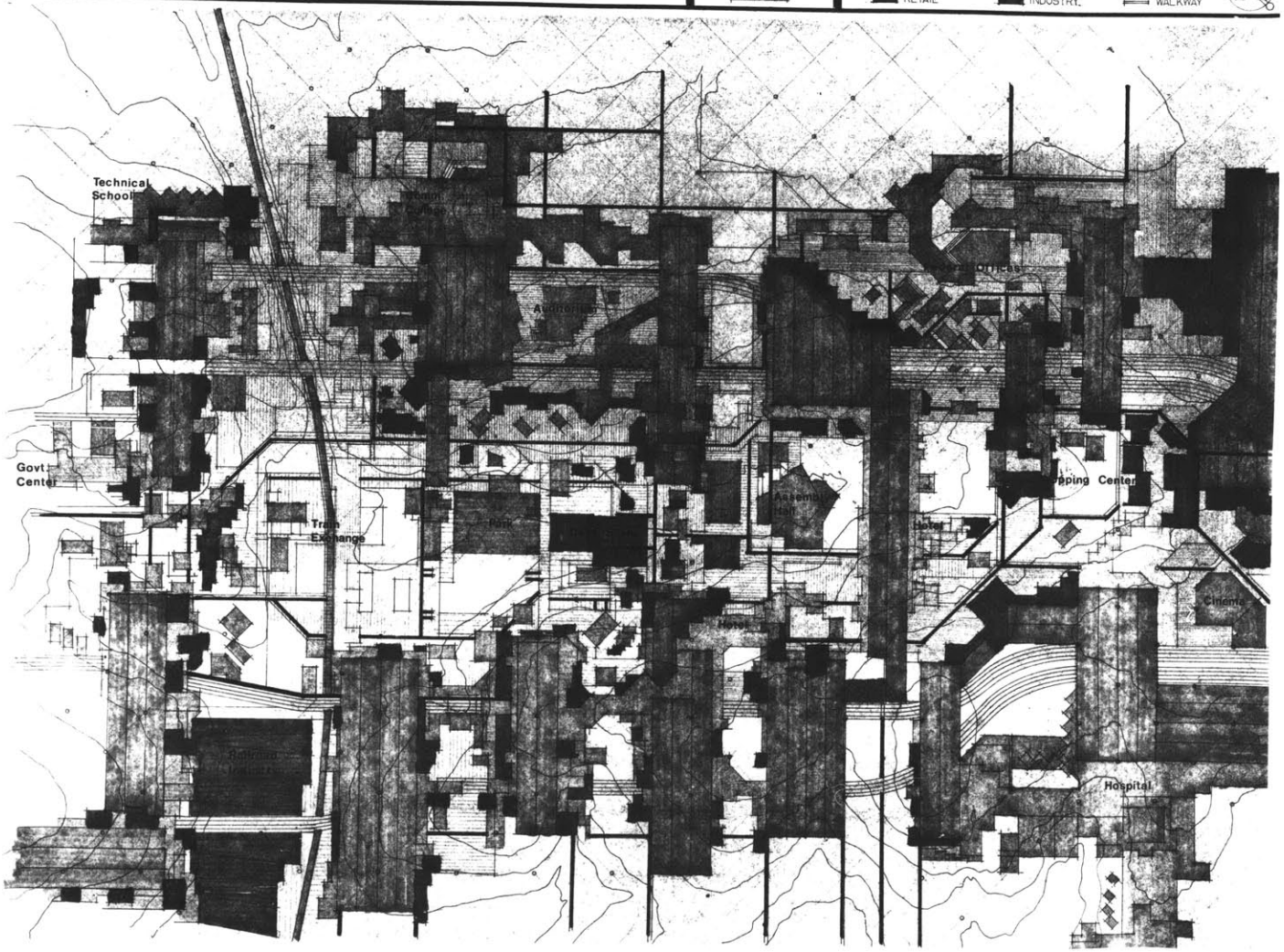
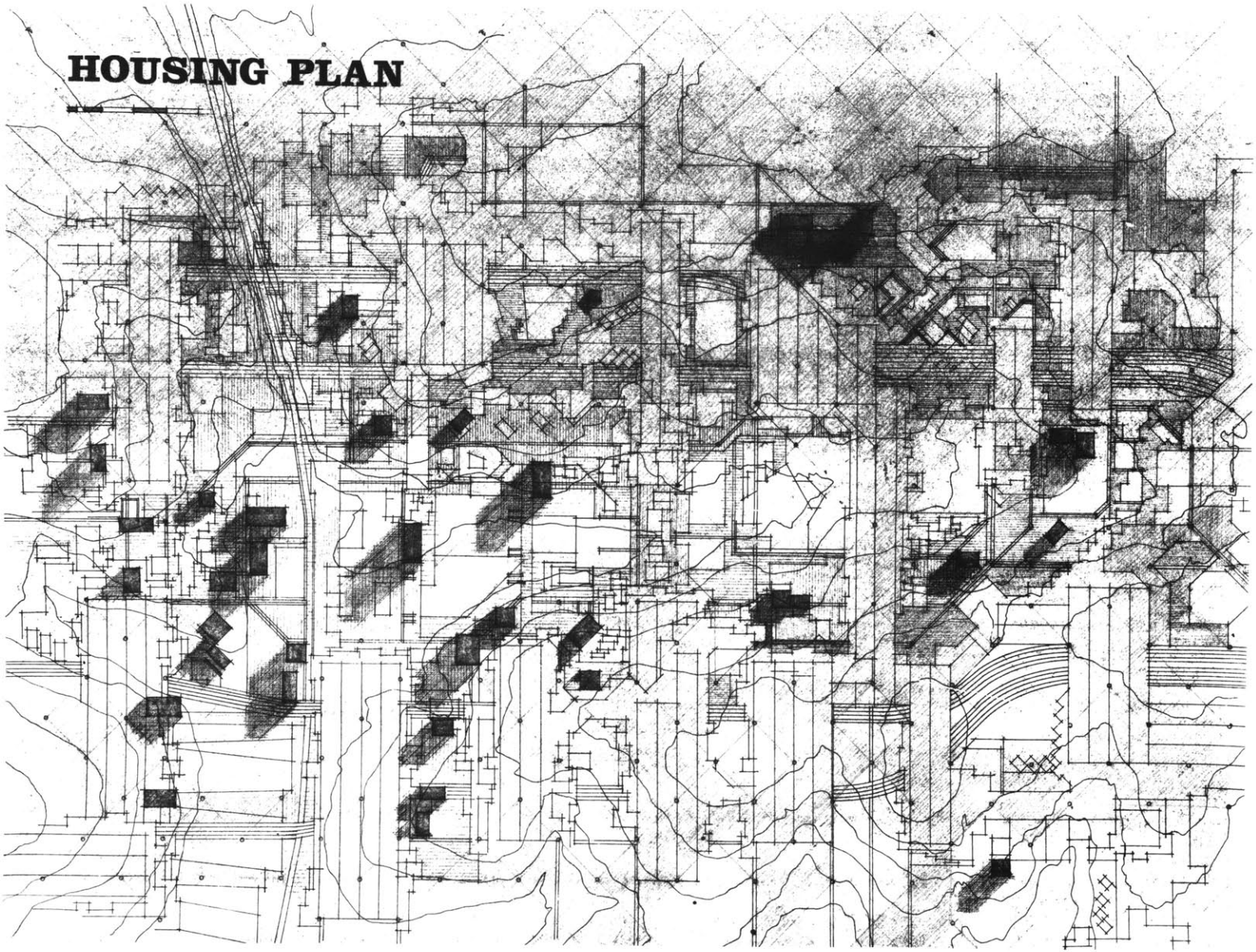
65,000

GERMANTOWN

USE PLAN

COMM. FACILITIES
OFFICES
RETAIL
HOUSING
PARKING
INDUSTRY
ACCESS
SERVICE
WALKWAY




HOUSING PLAN

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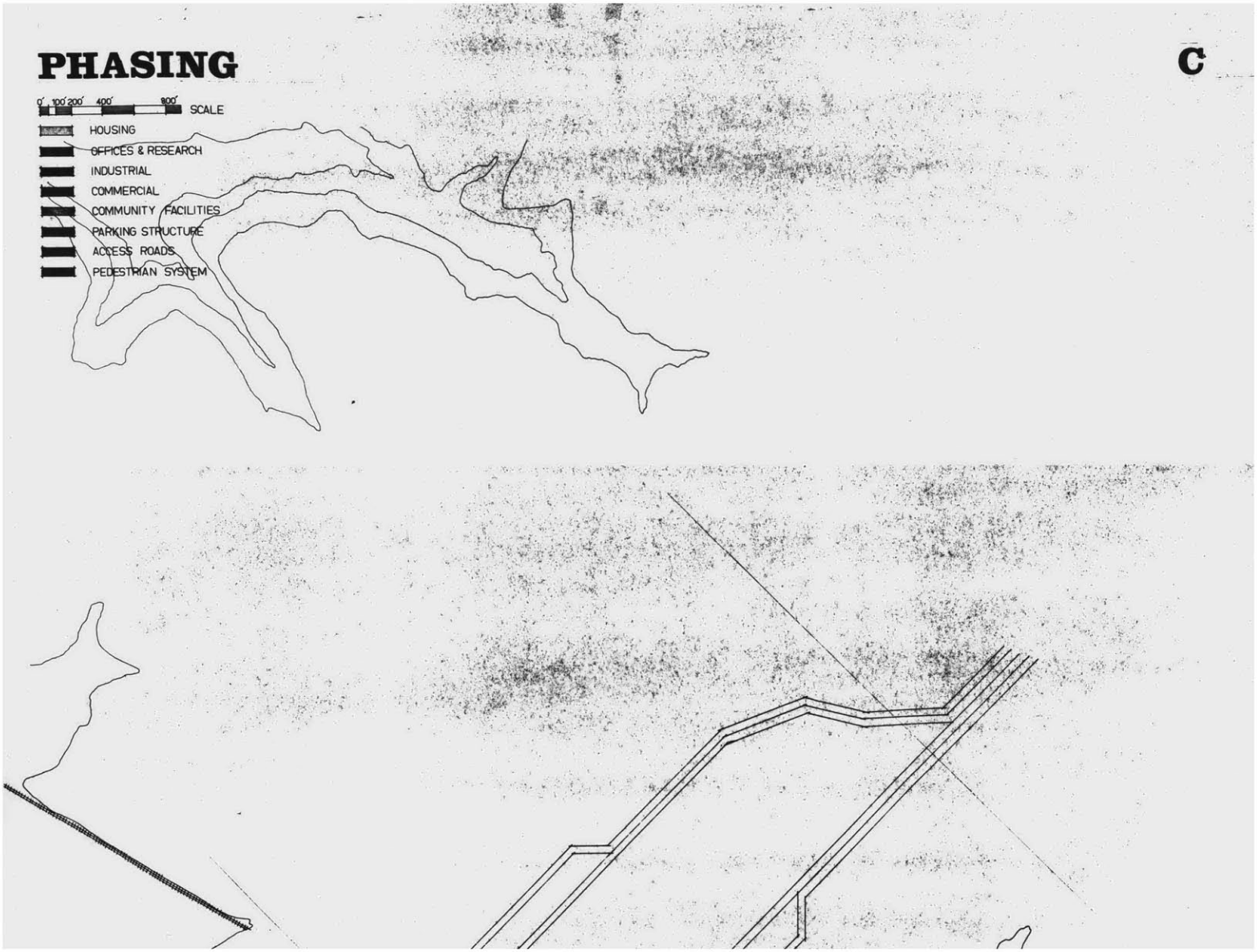
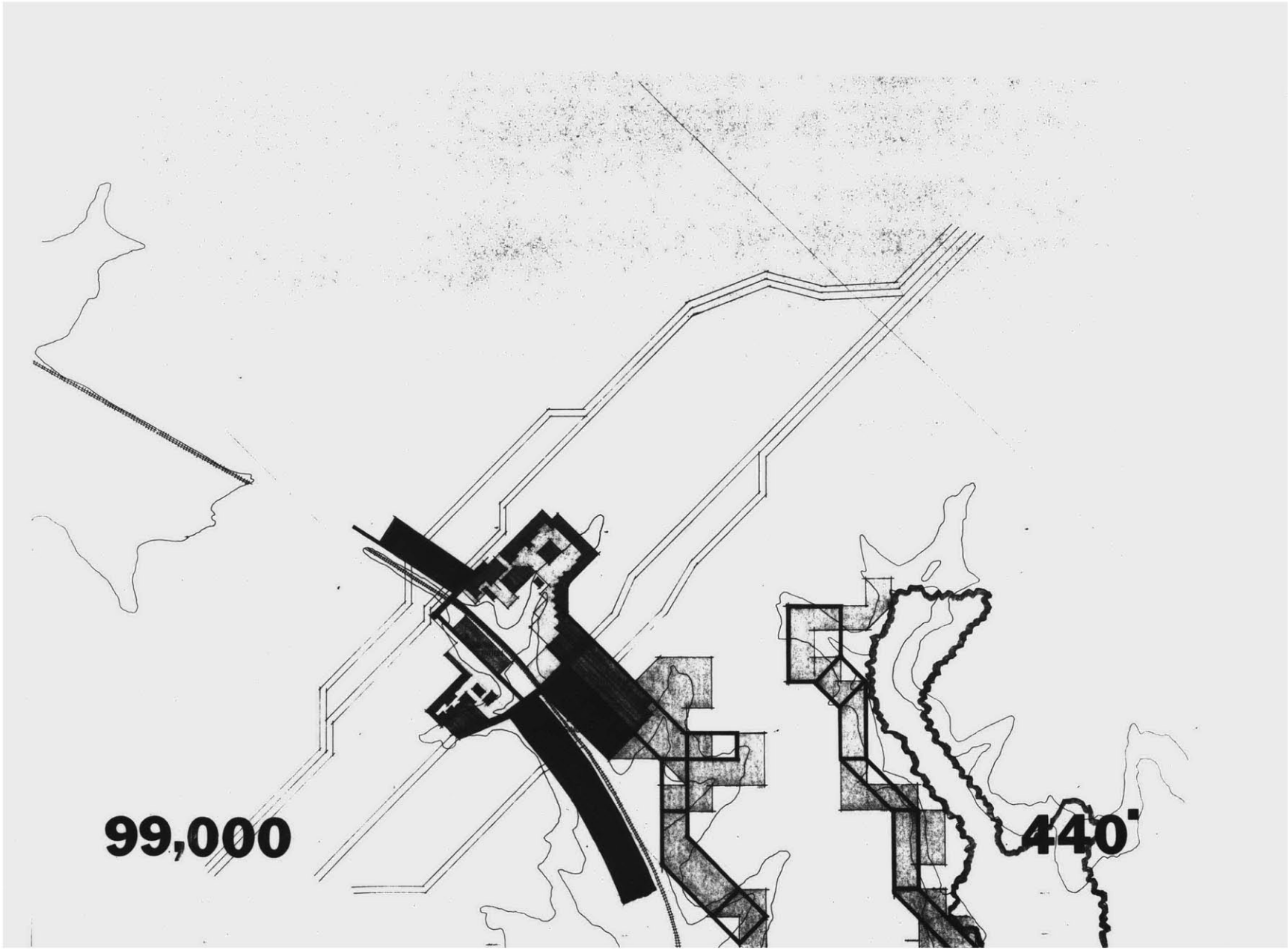
C


0' 100' 200' 400' 800'
SCALE
HOUSING
OFFICES & RESEARCH
INDUSTRIAL
COMMERCIAL
COMMUNITY FACILITIES
PARKING STRUCTURE
ACCESS ROADS
PEDESTRIAN SYSTEM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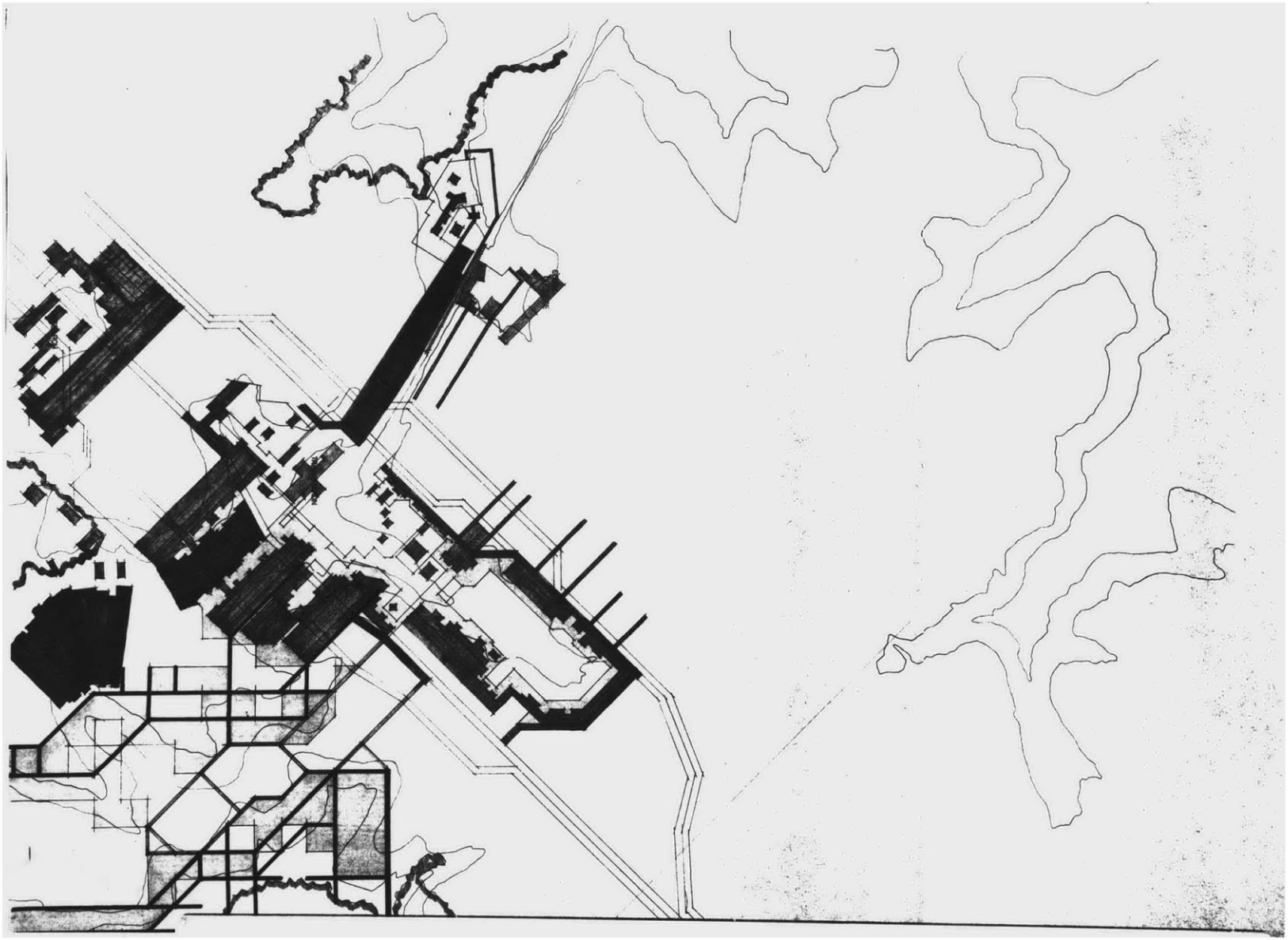

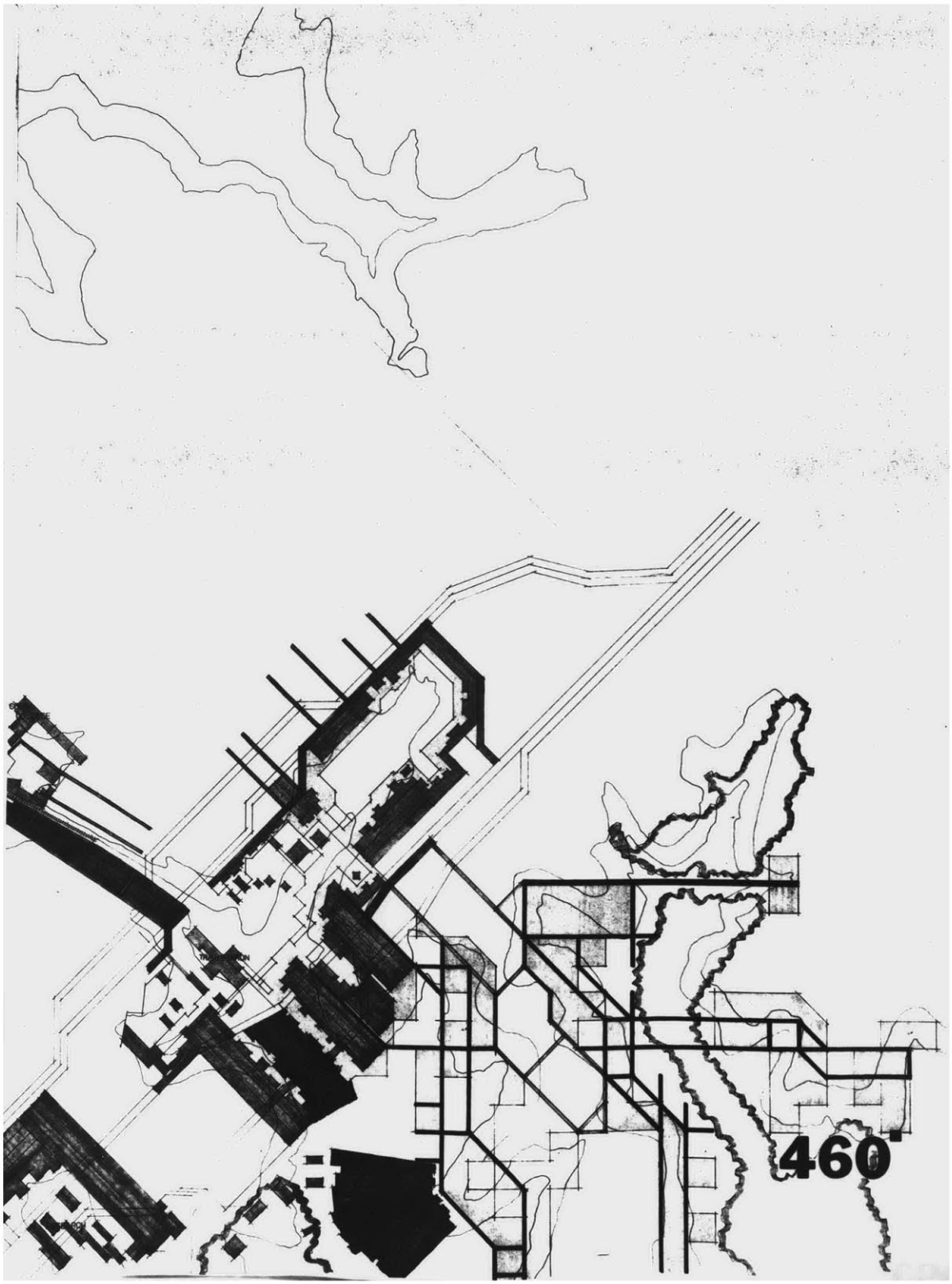
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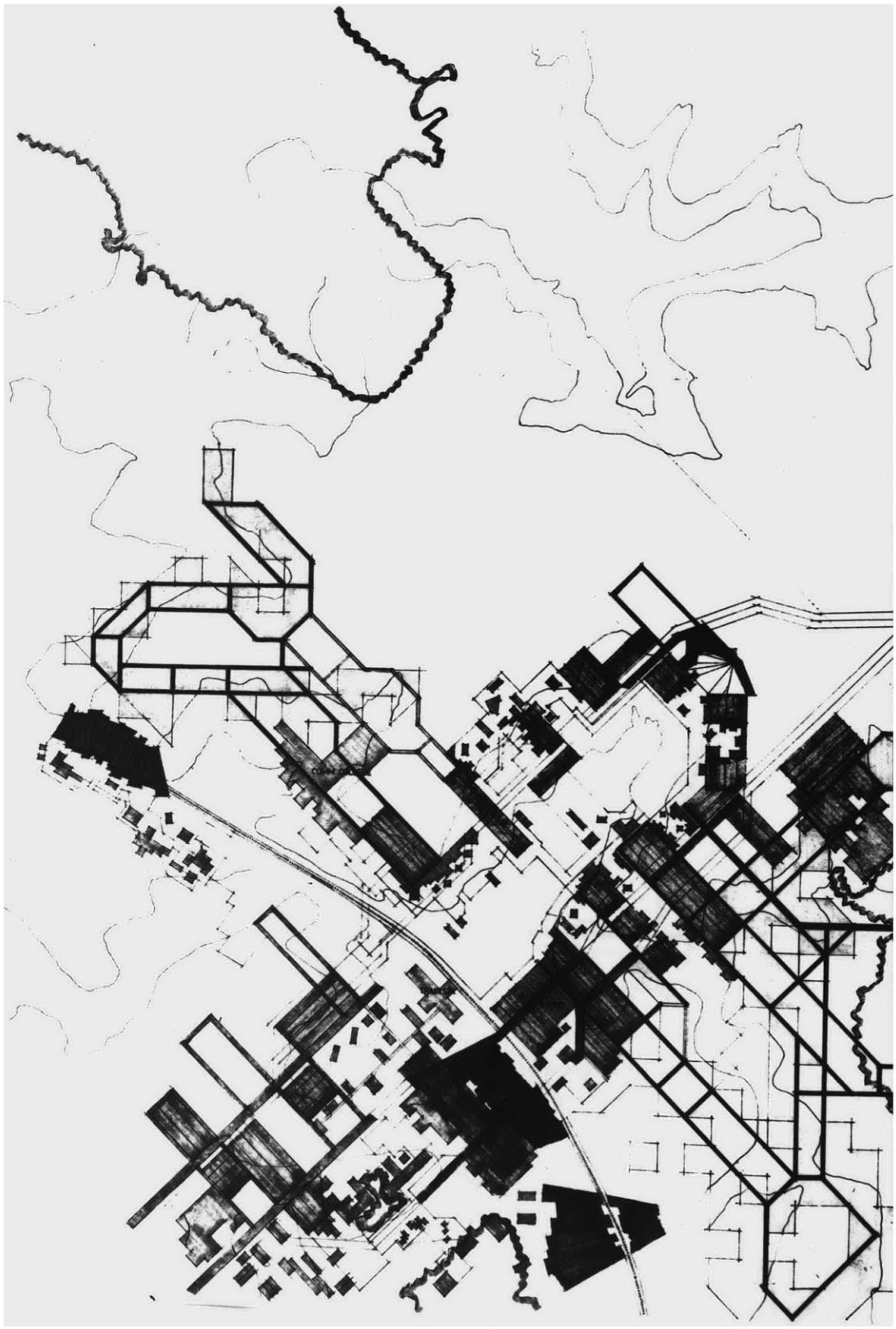
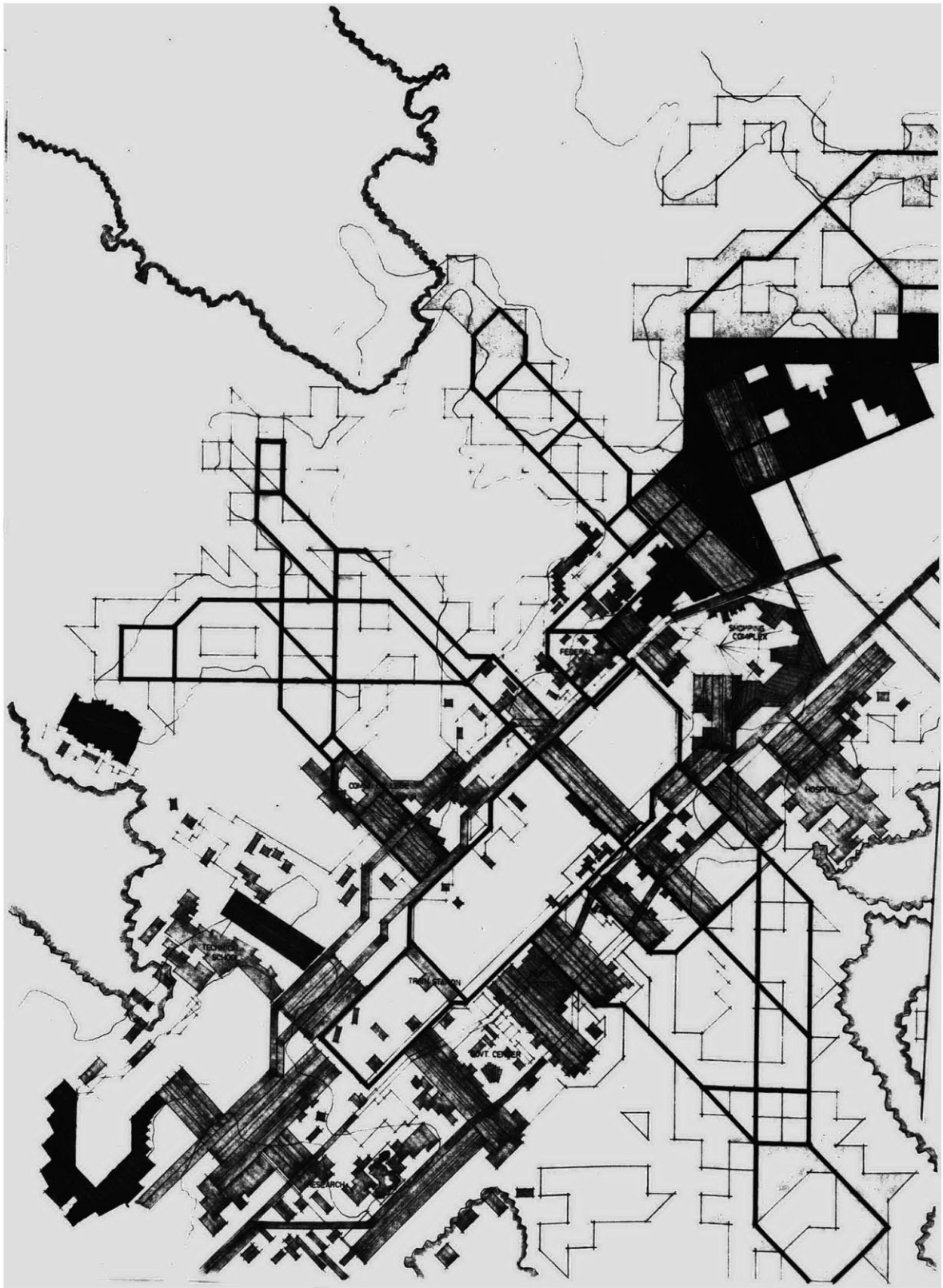
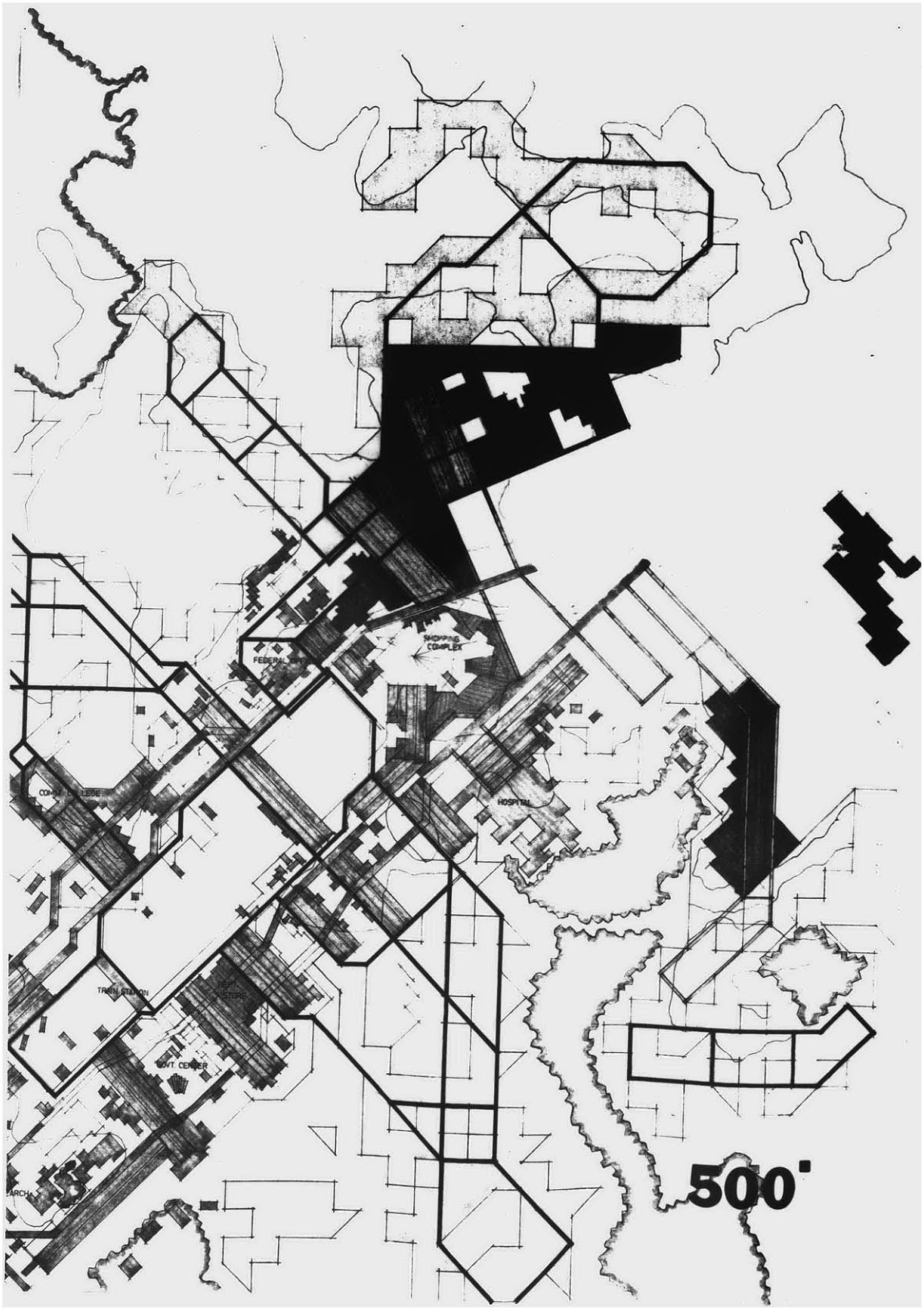



480'


SHOPPING COMPLEX
TRANSIT STATION
GOVT. CENTER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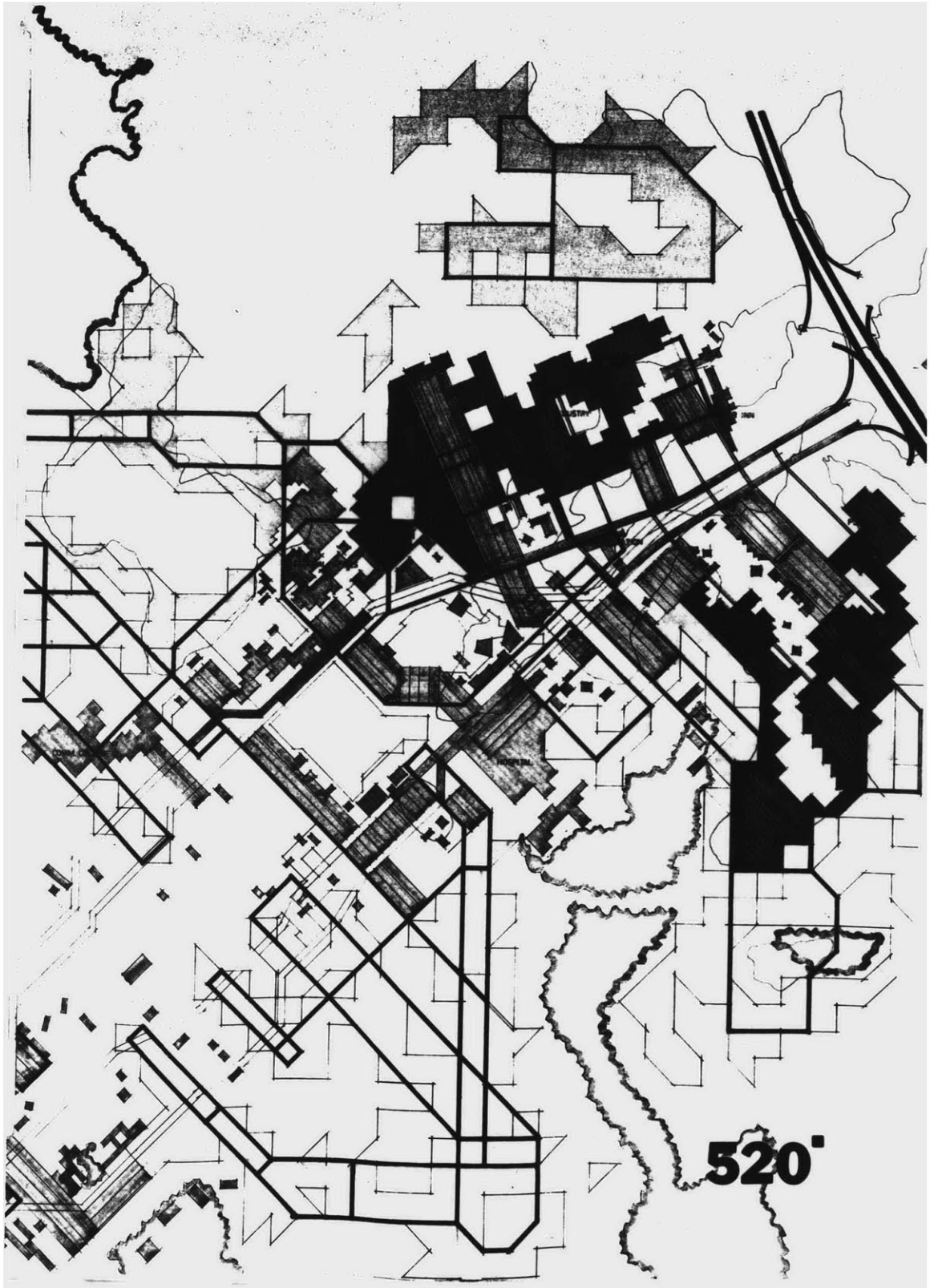
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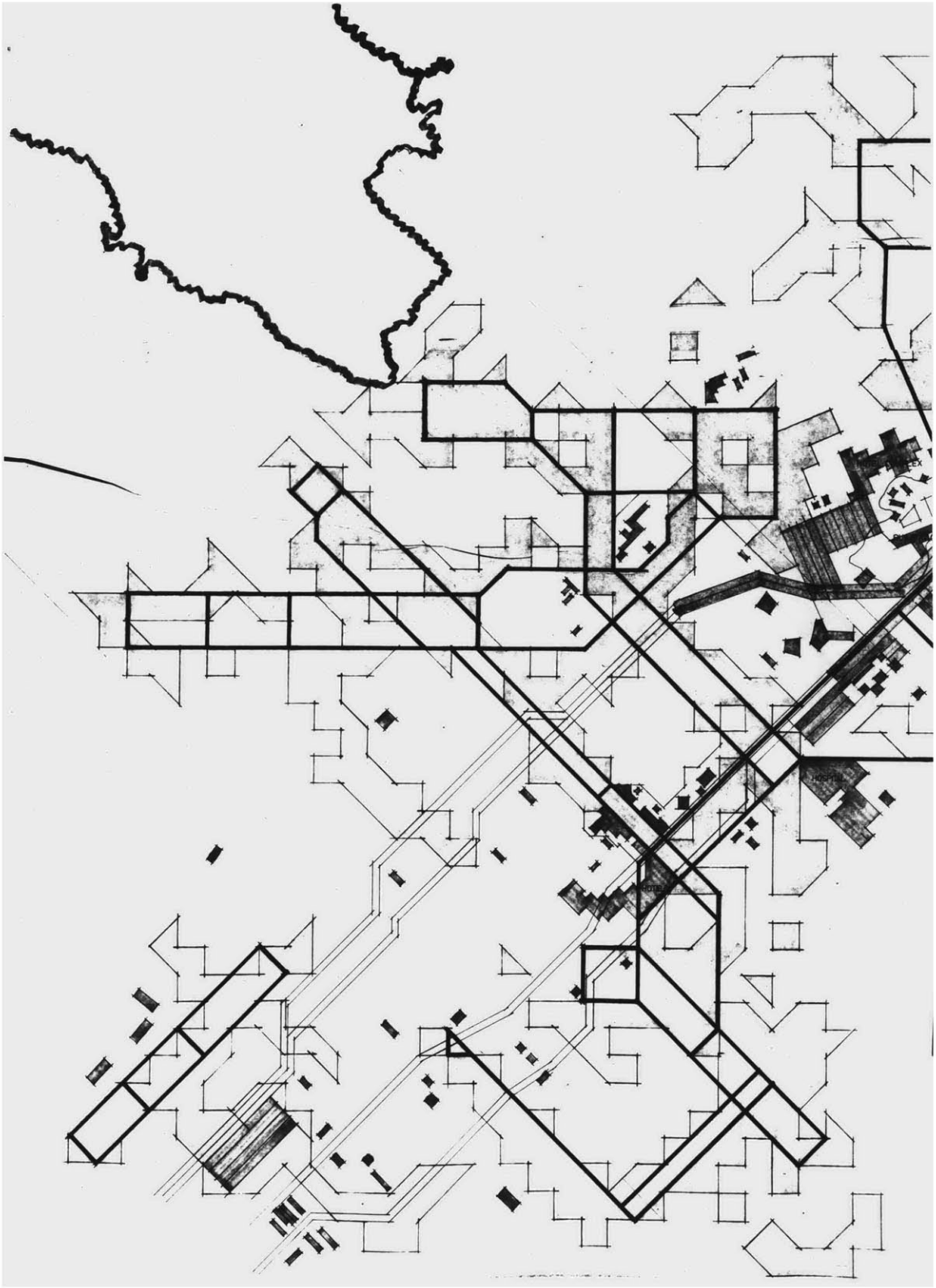

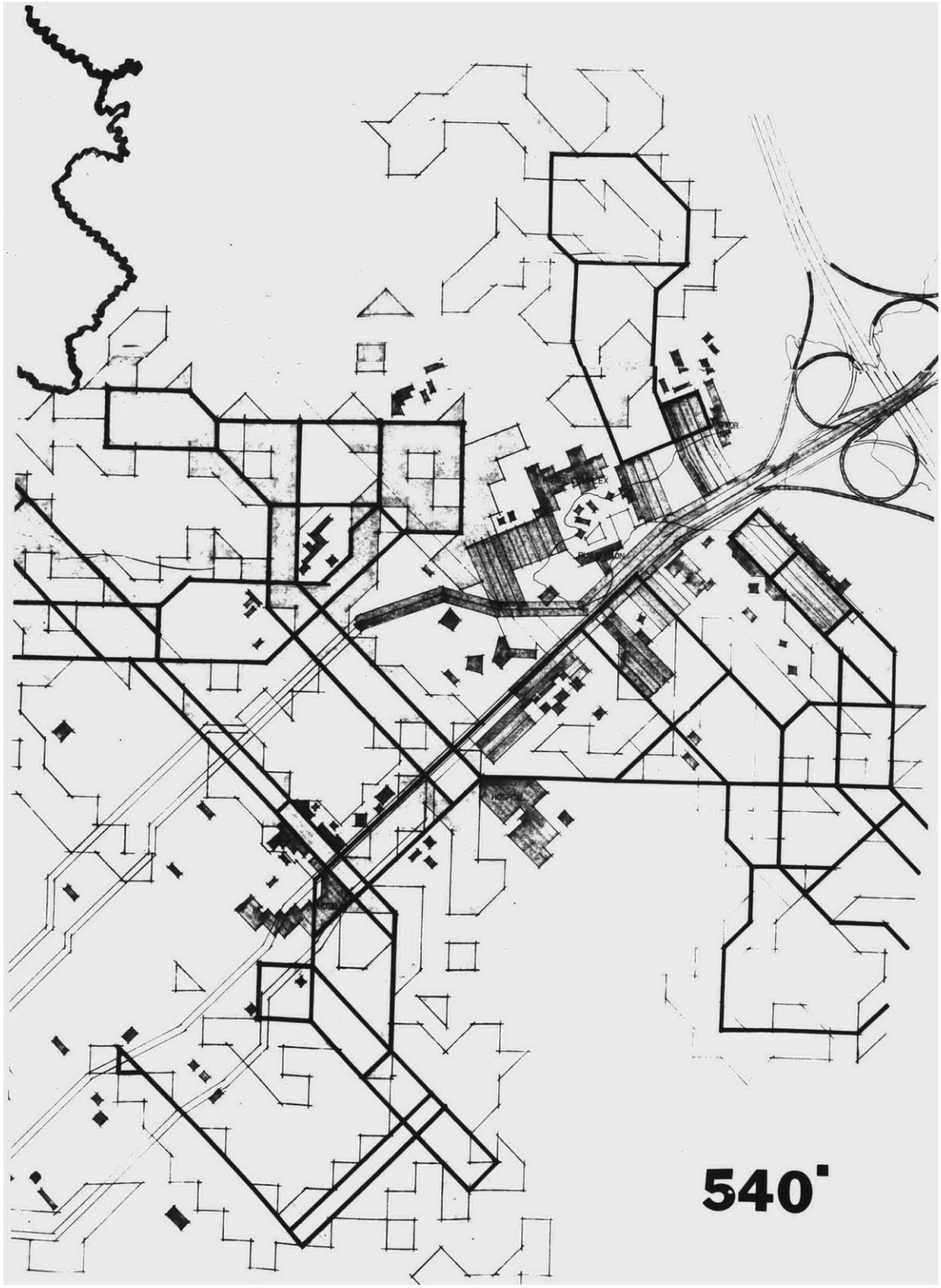
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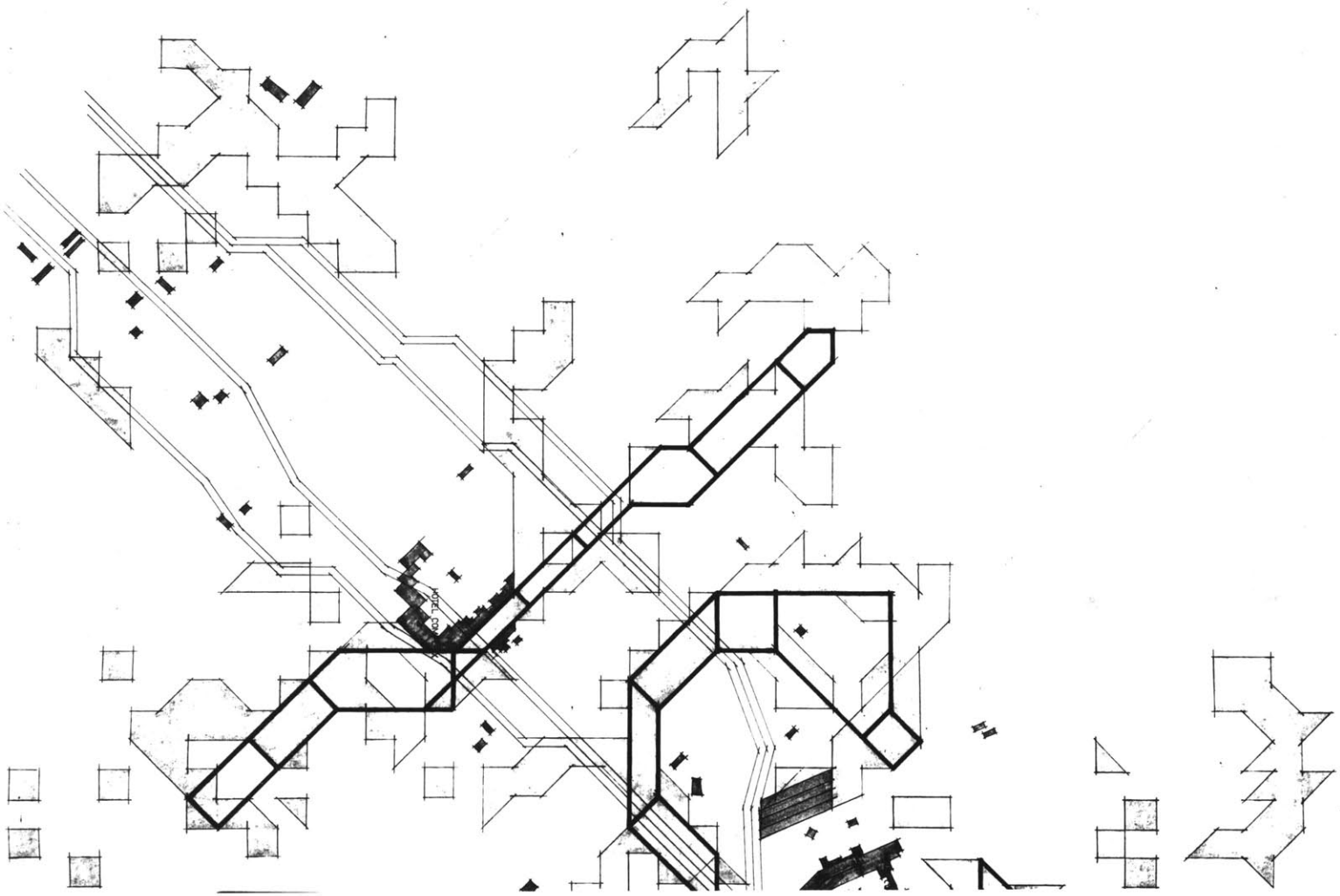
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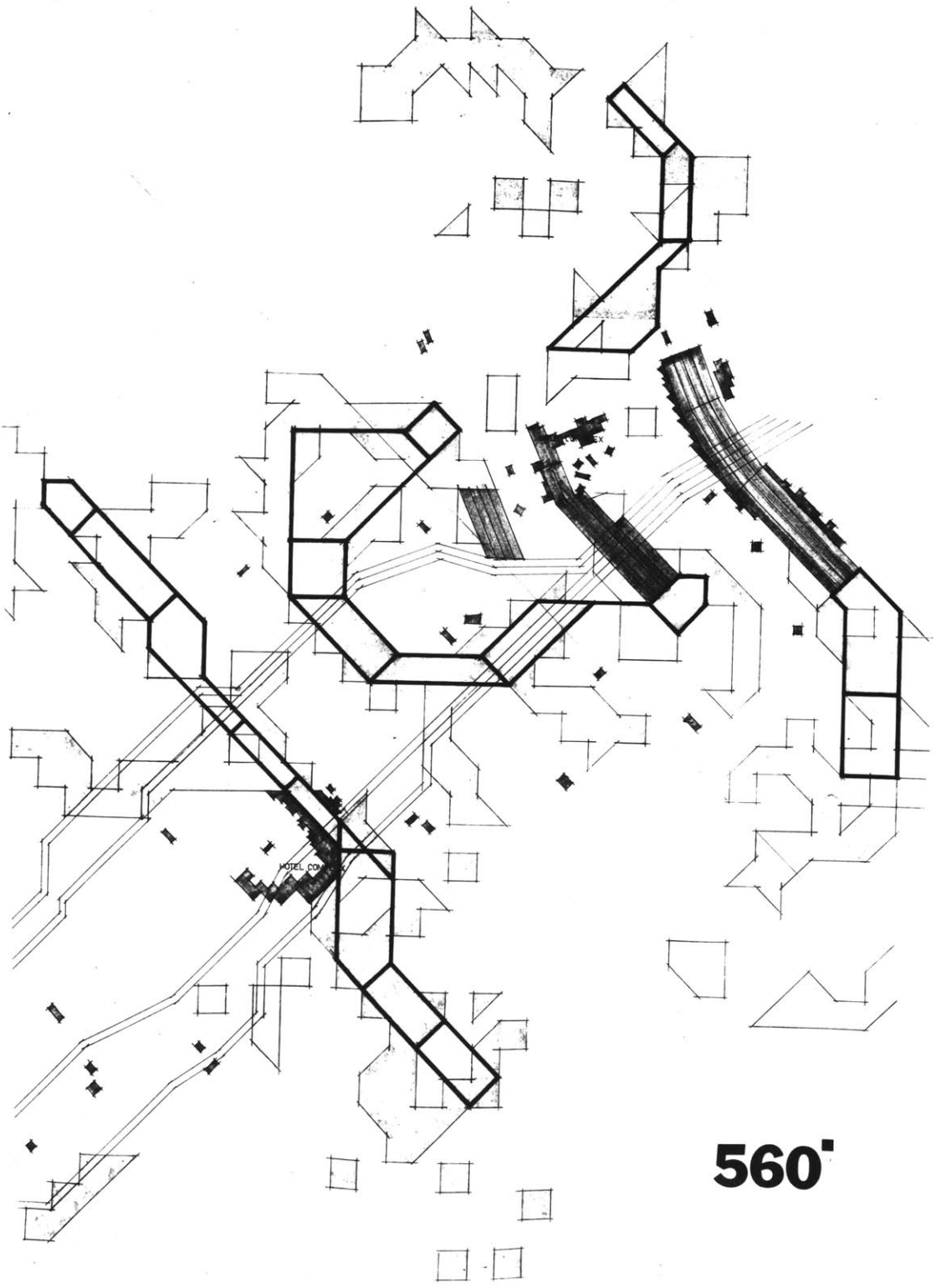
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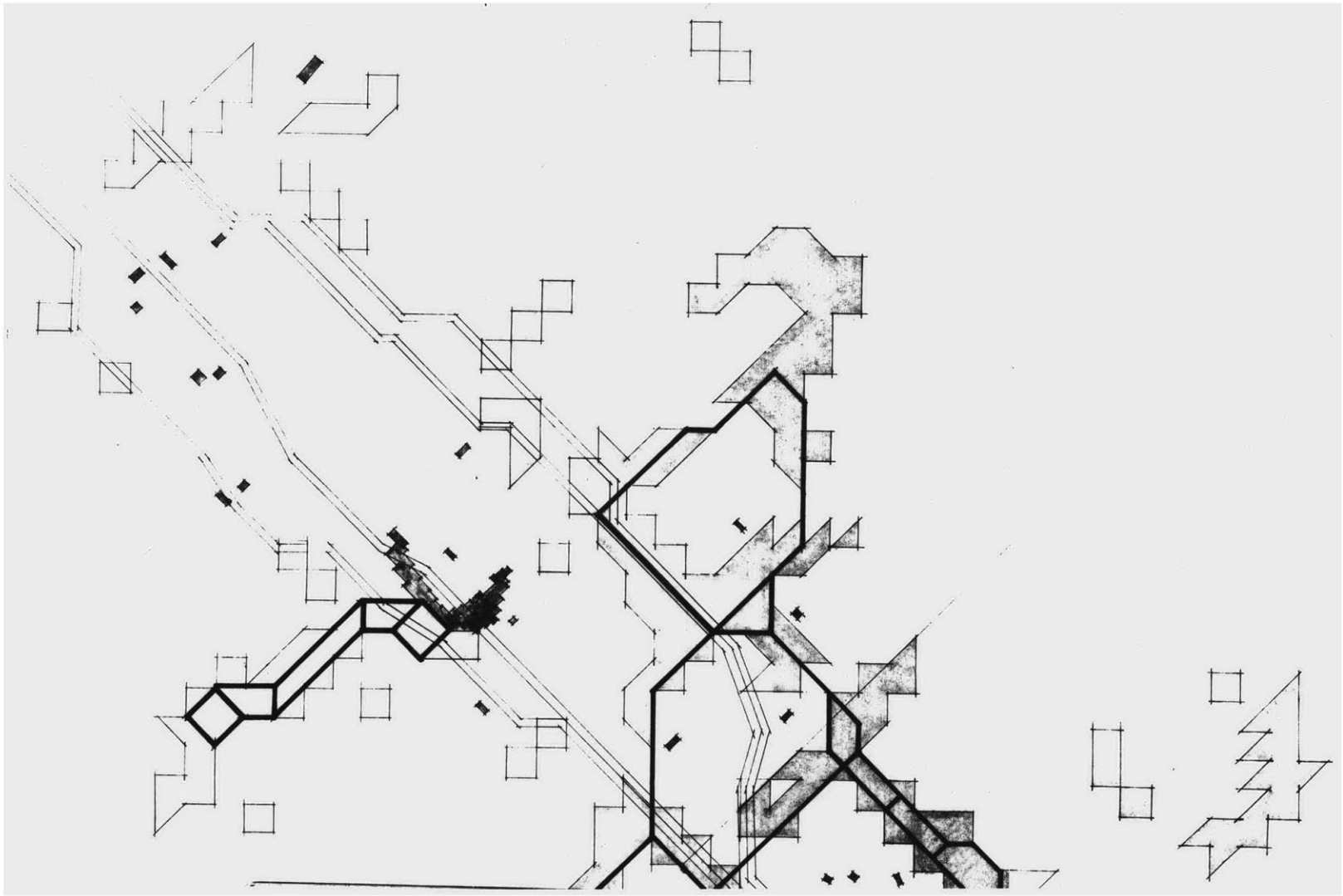
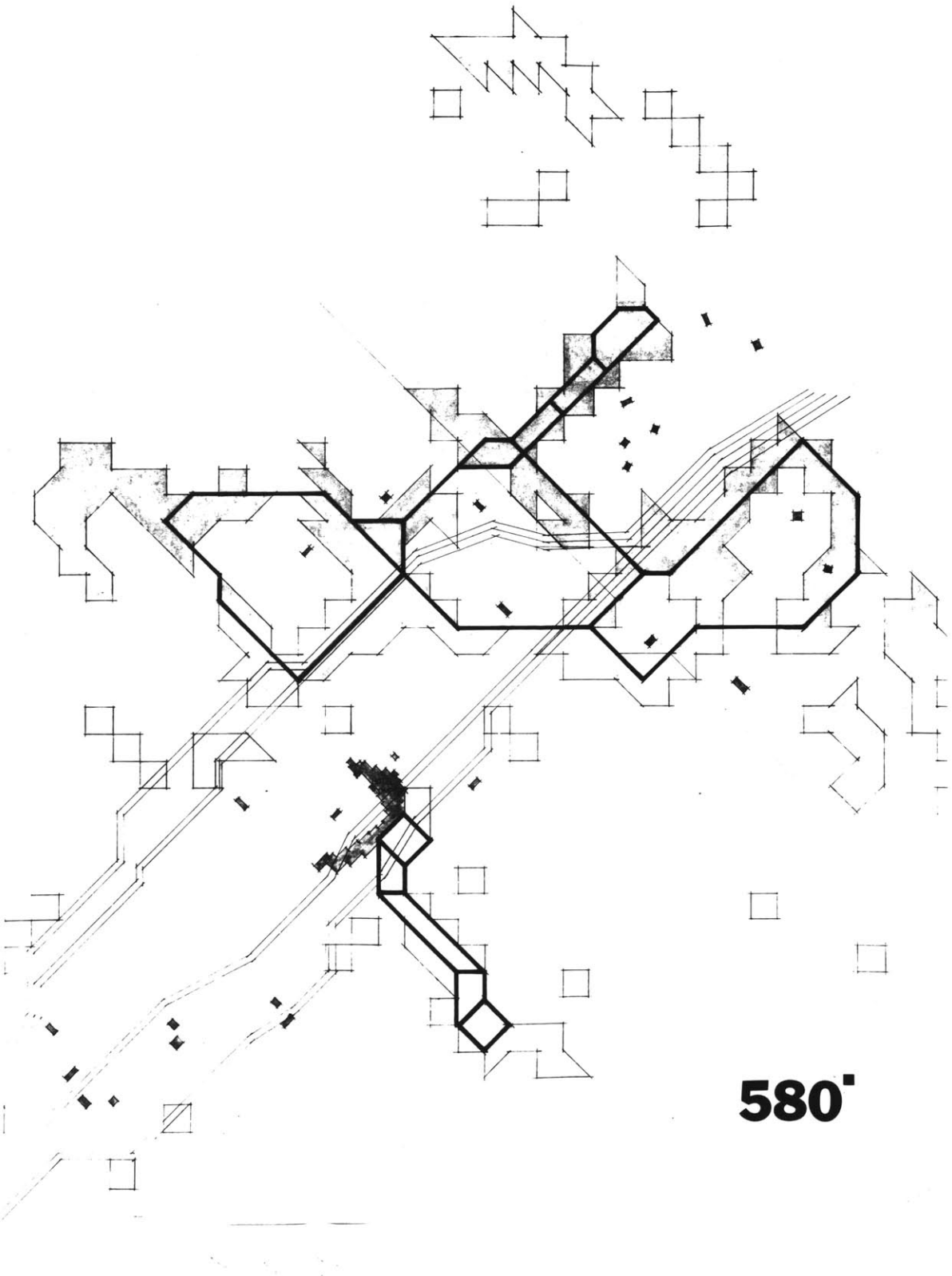
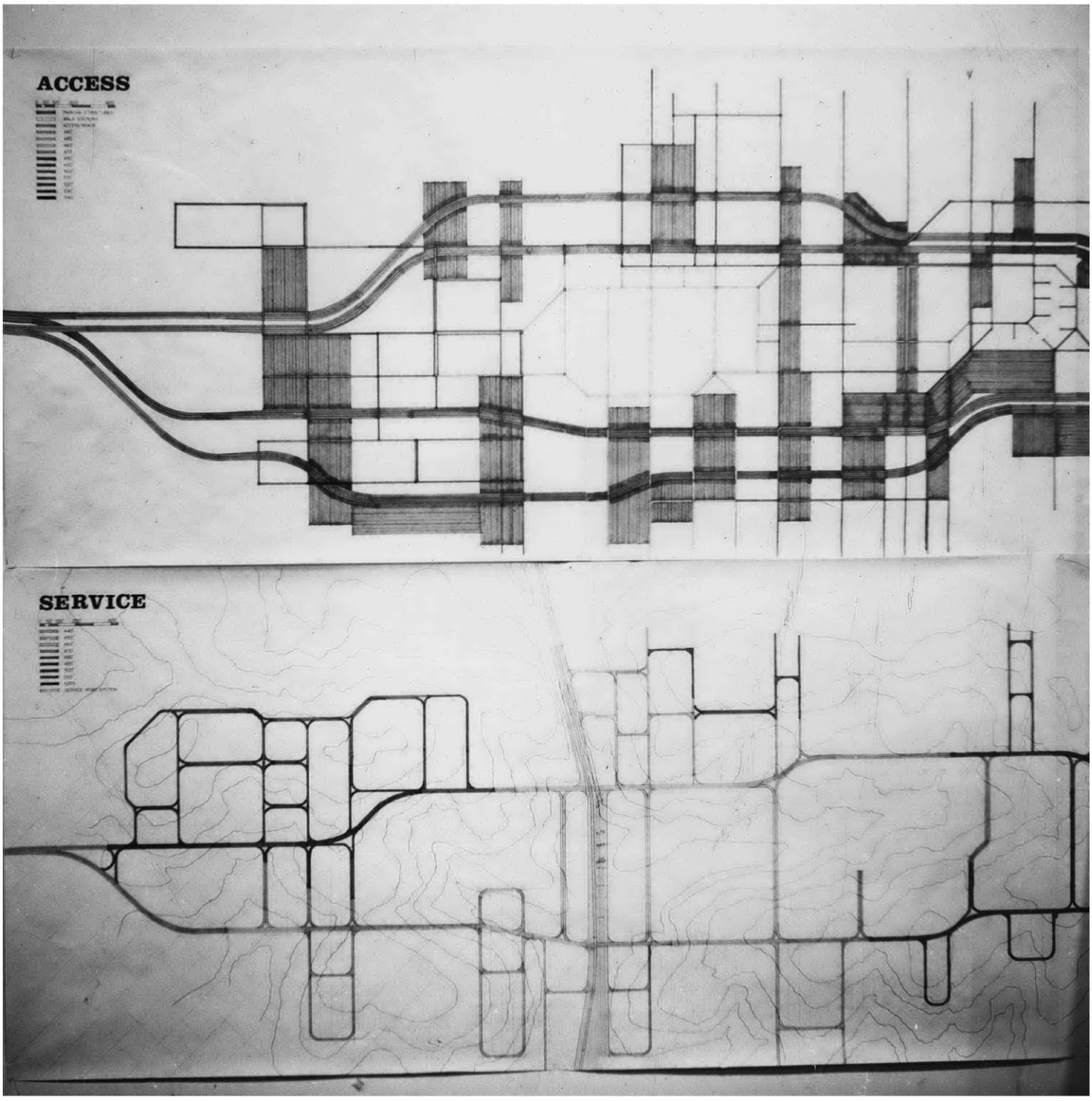
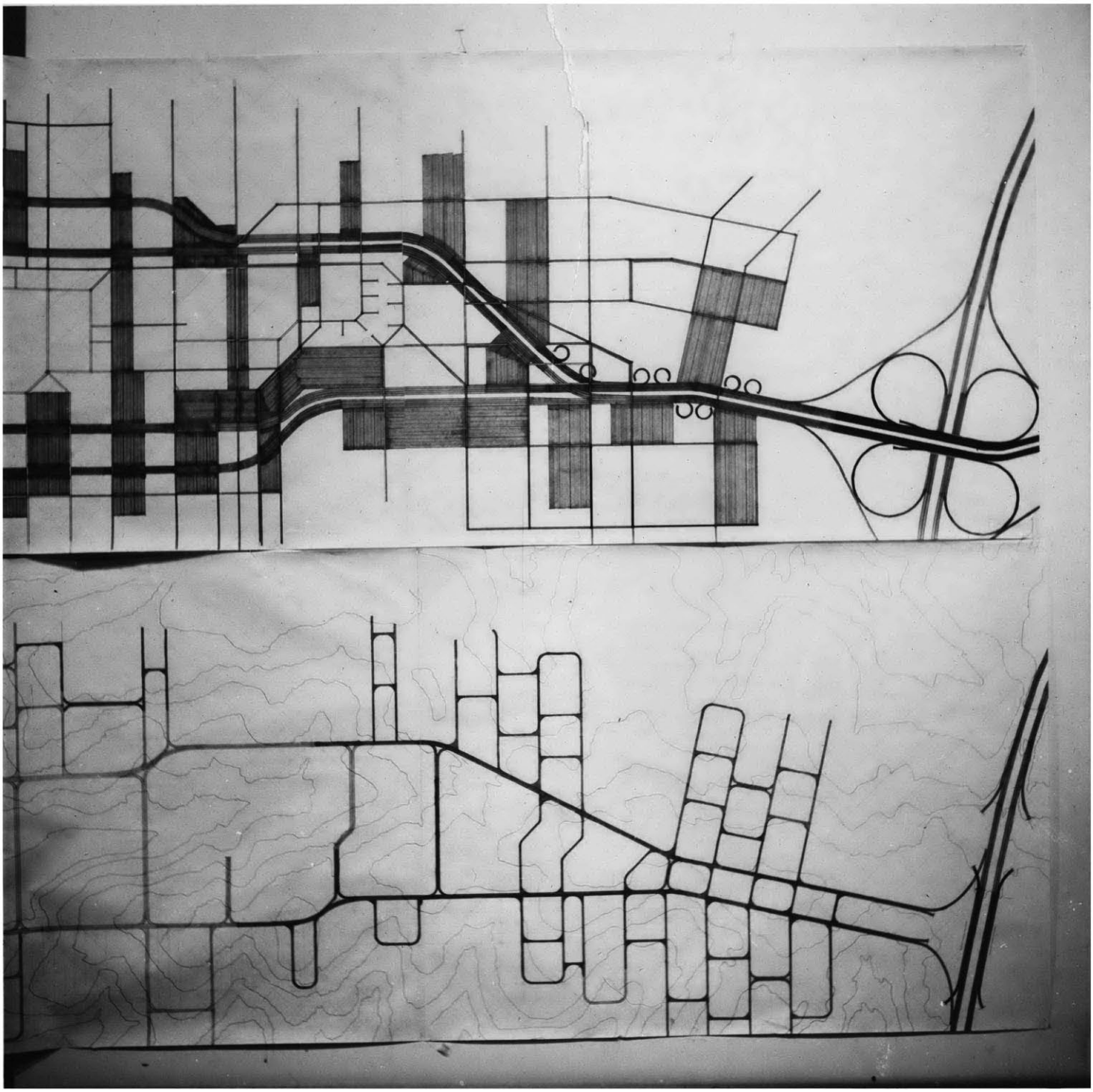


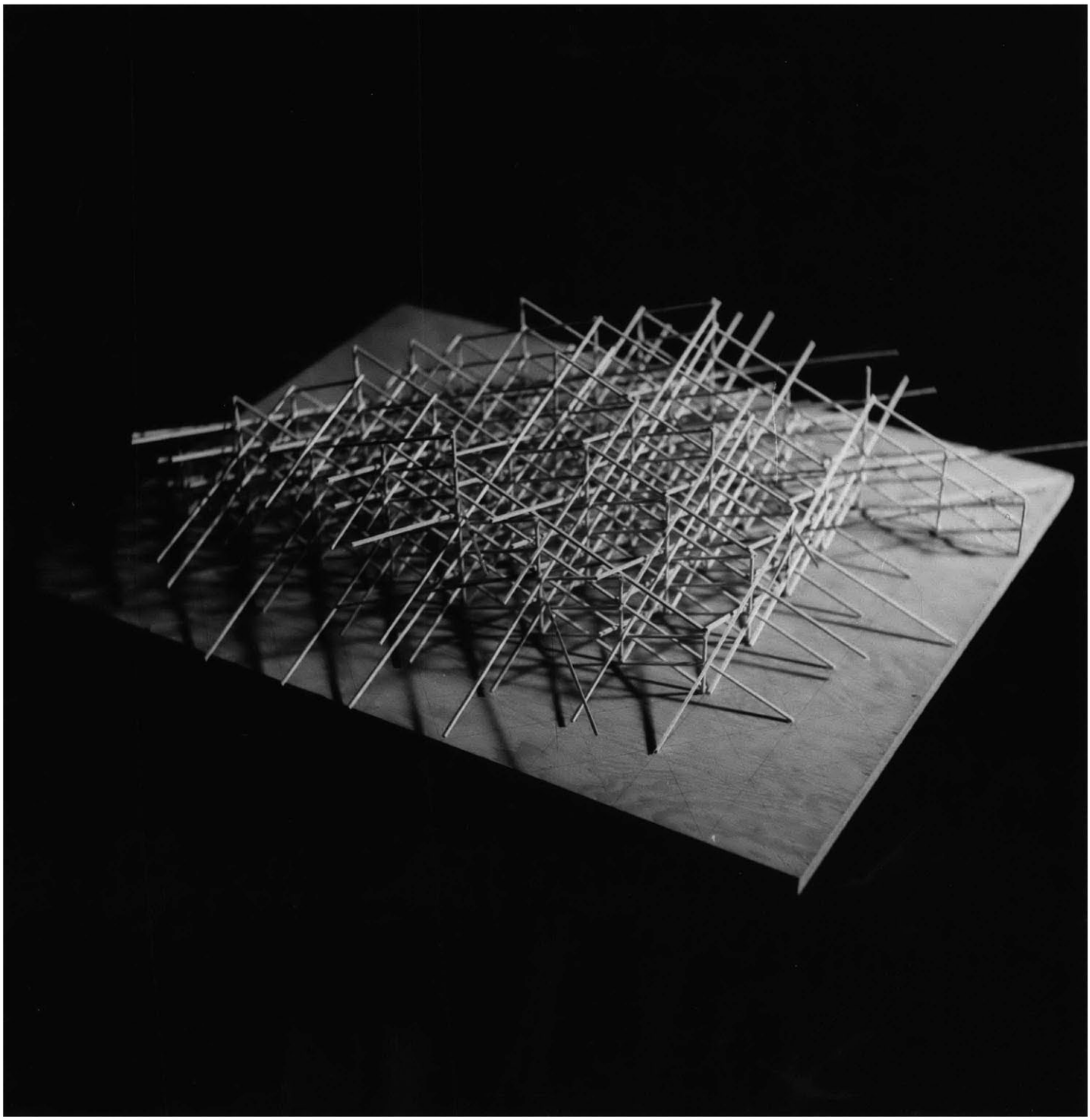

580

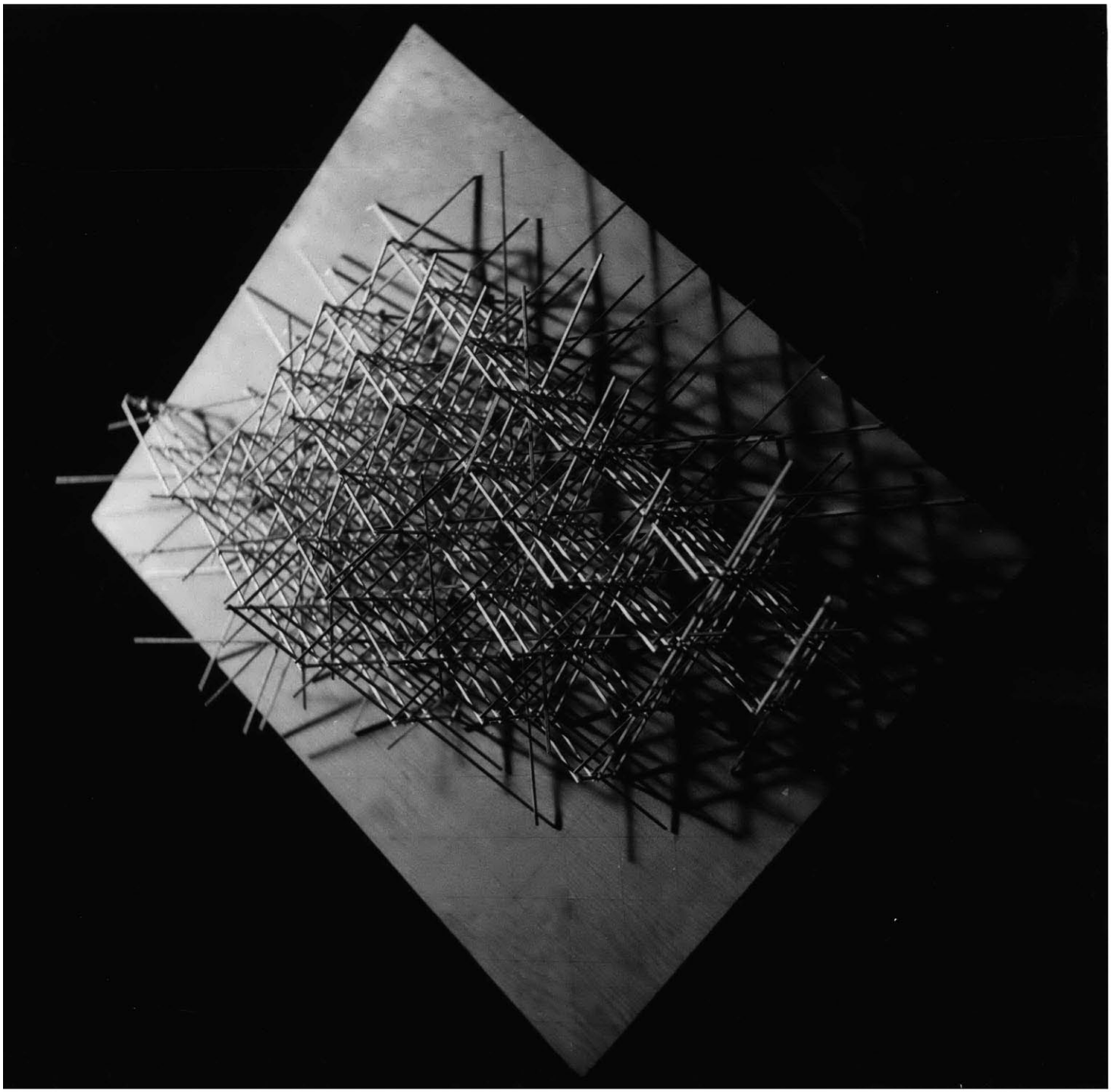
Major circulation systems for the Germantown development

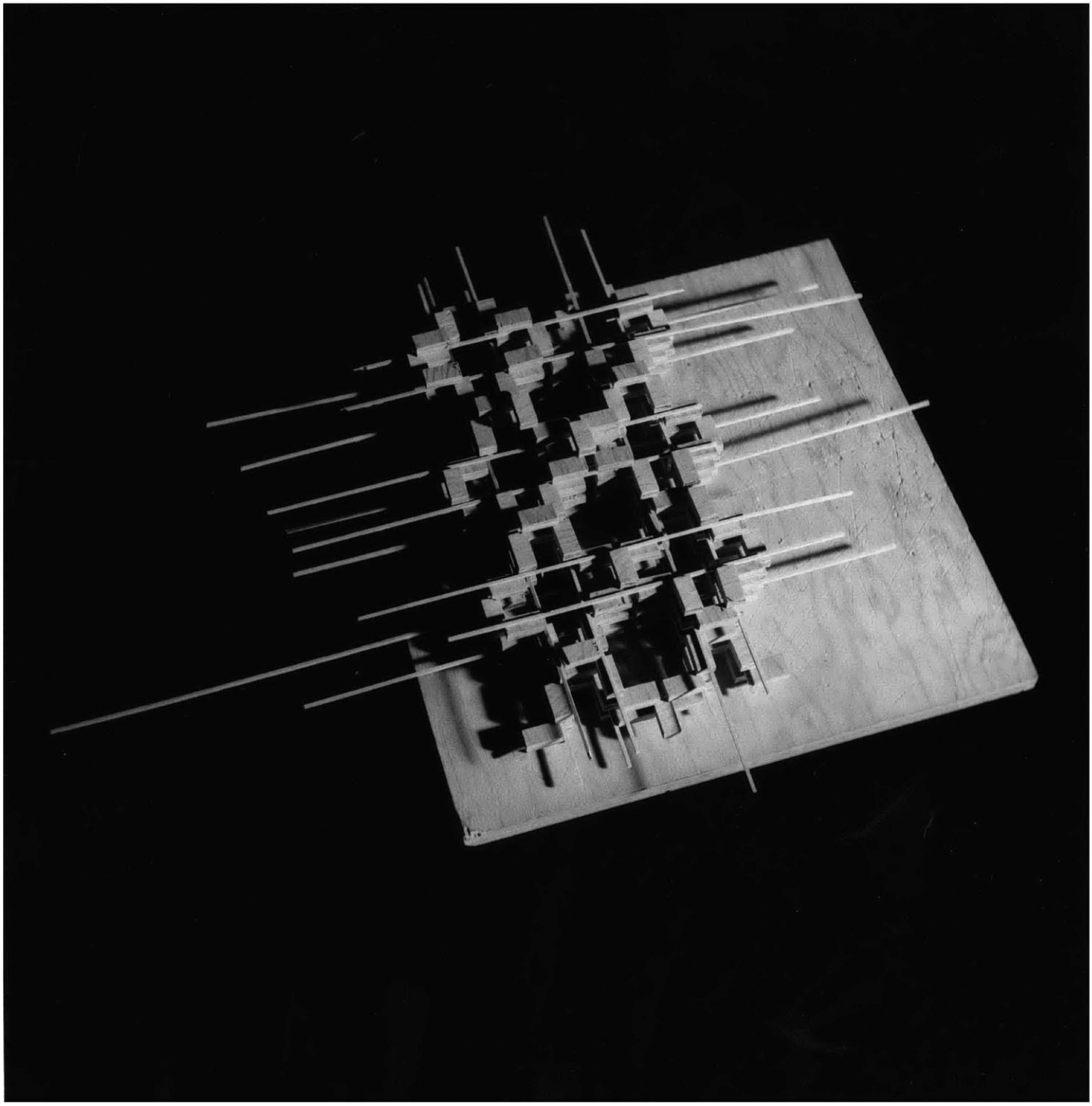

ACCESS
SERVICE

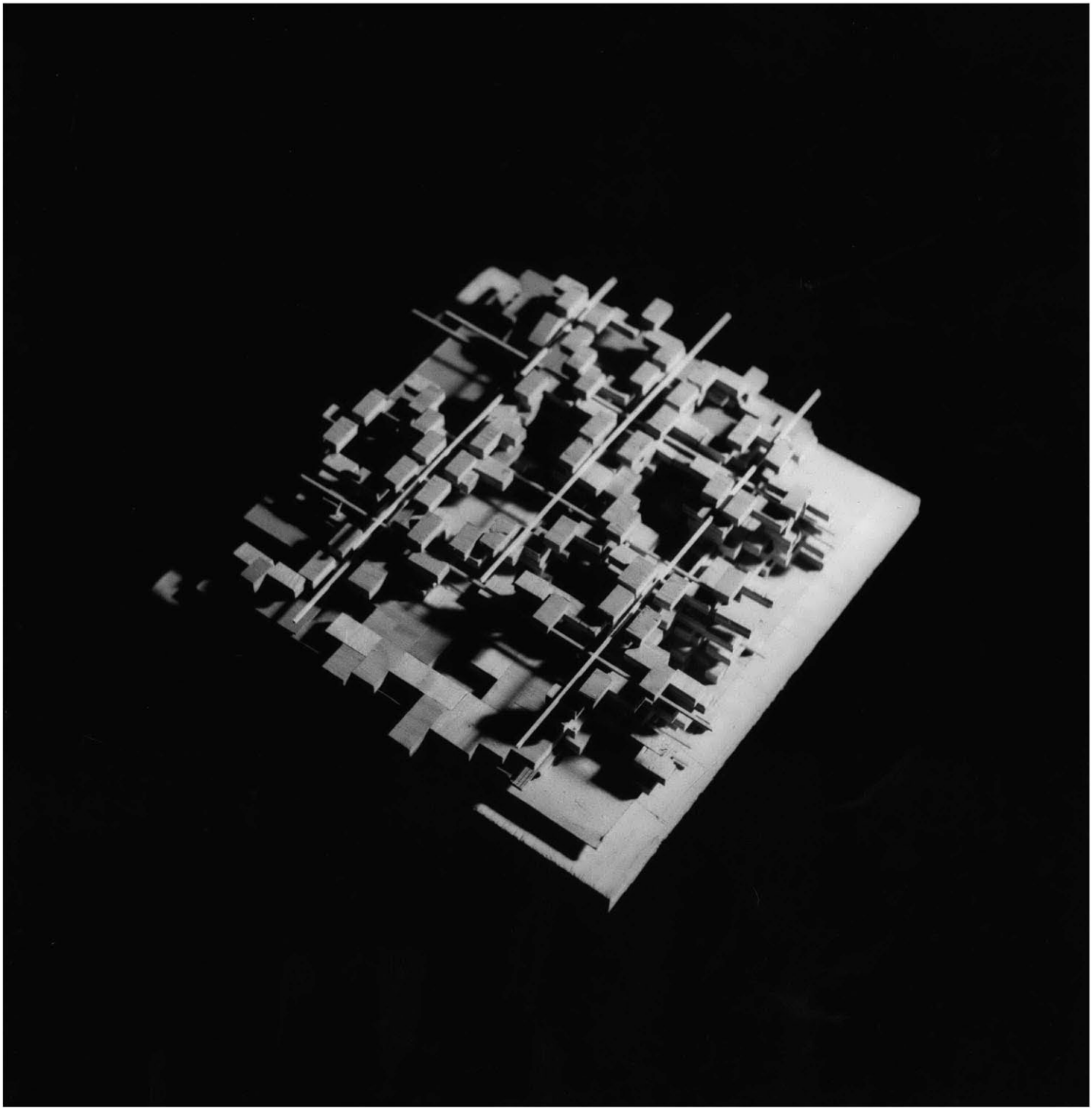


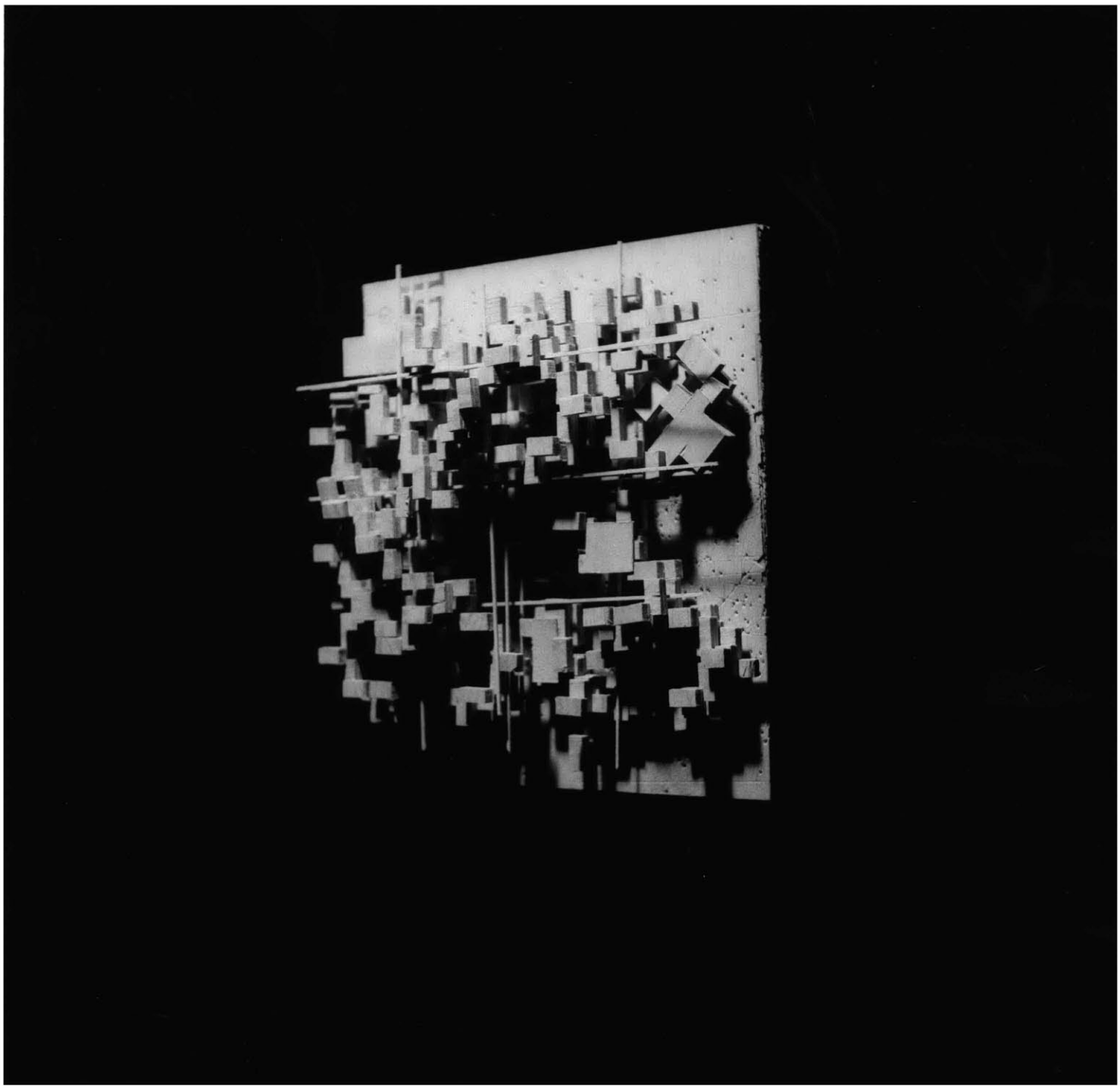
Development of structuring for non-grade oriented functions

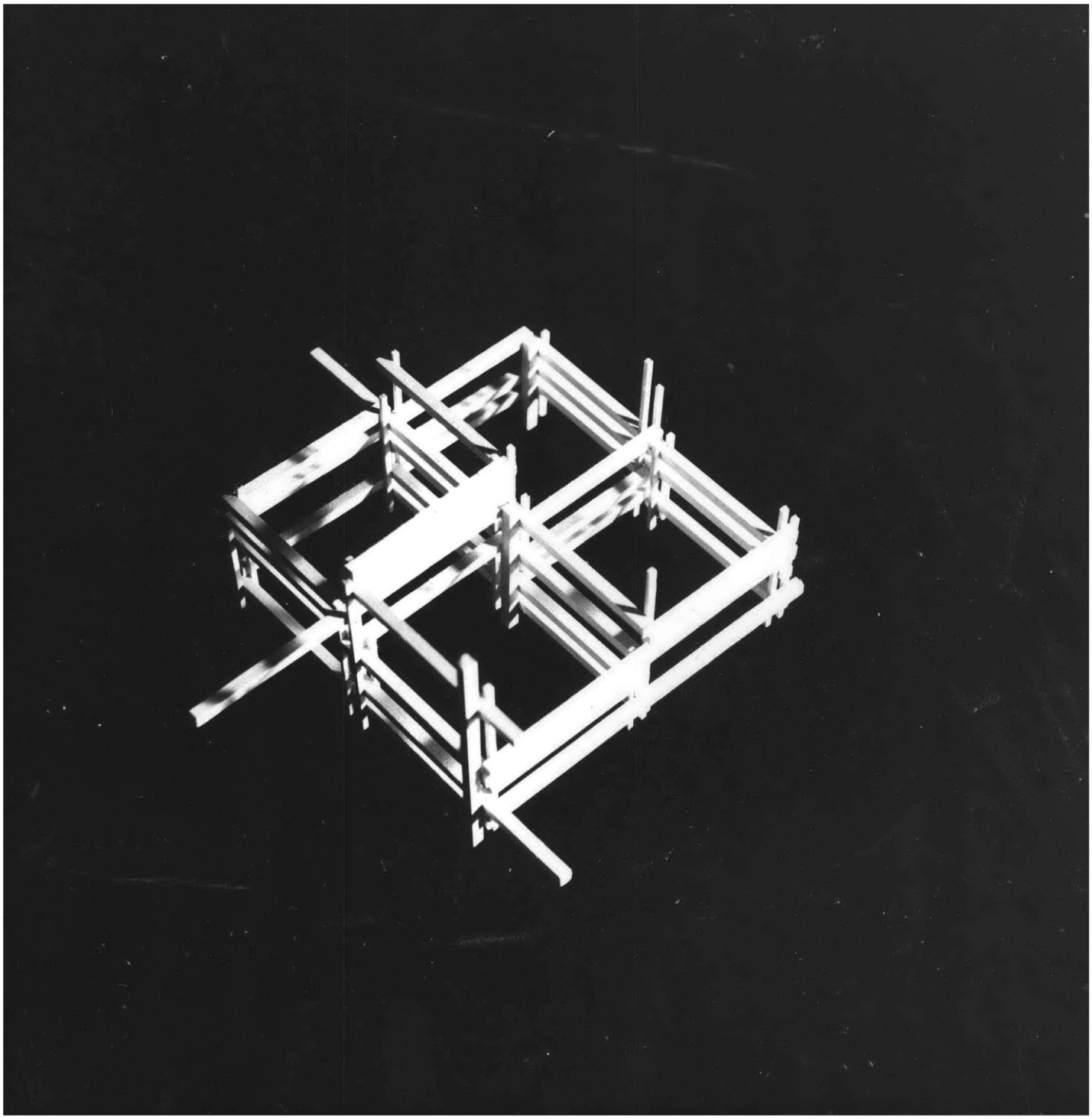




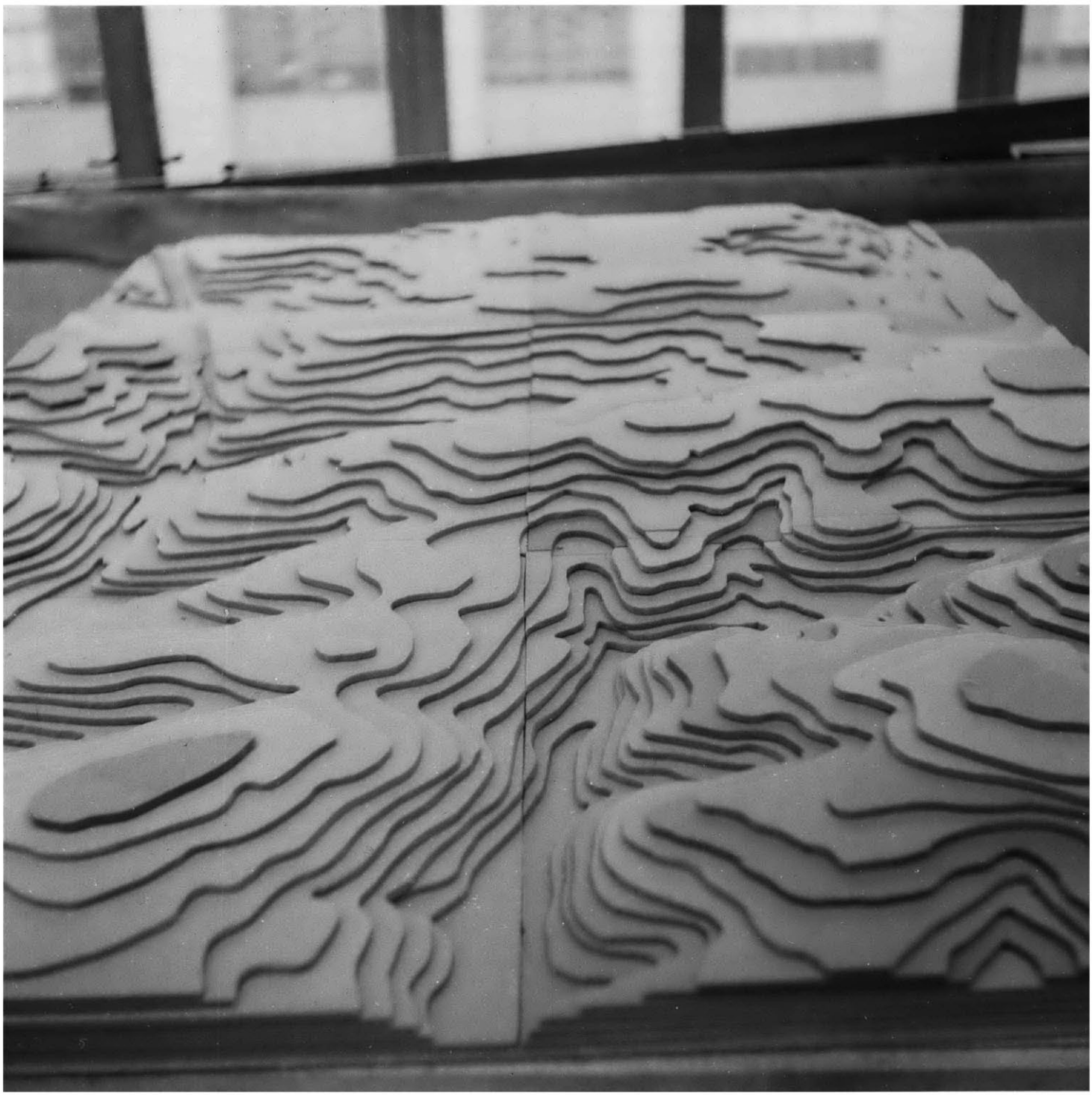


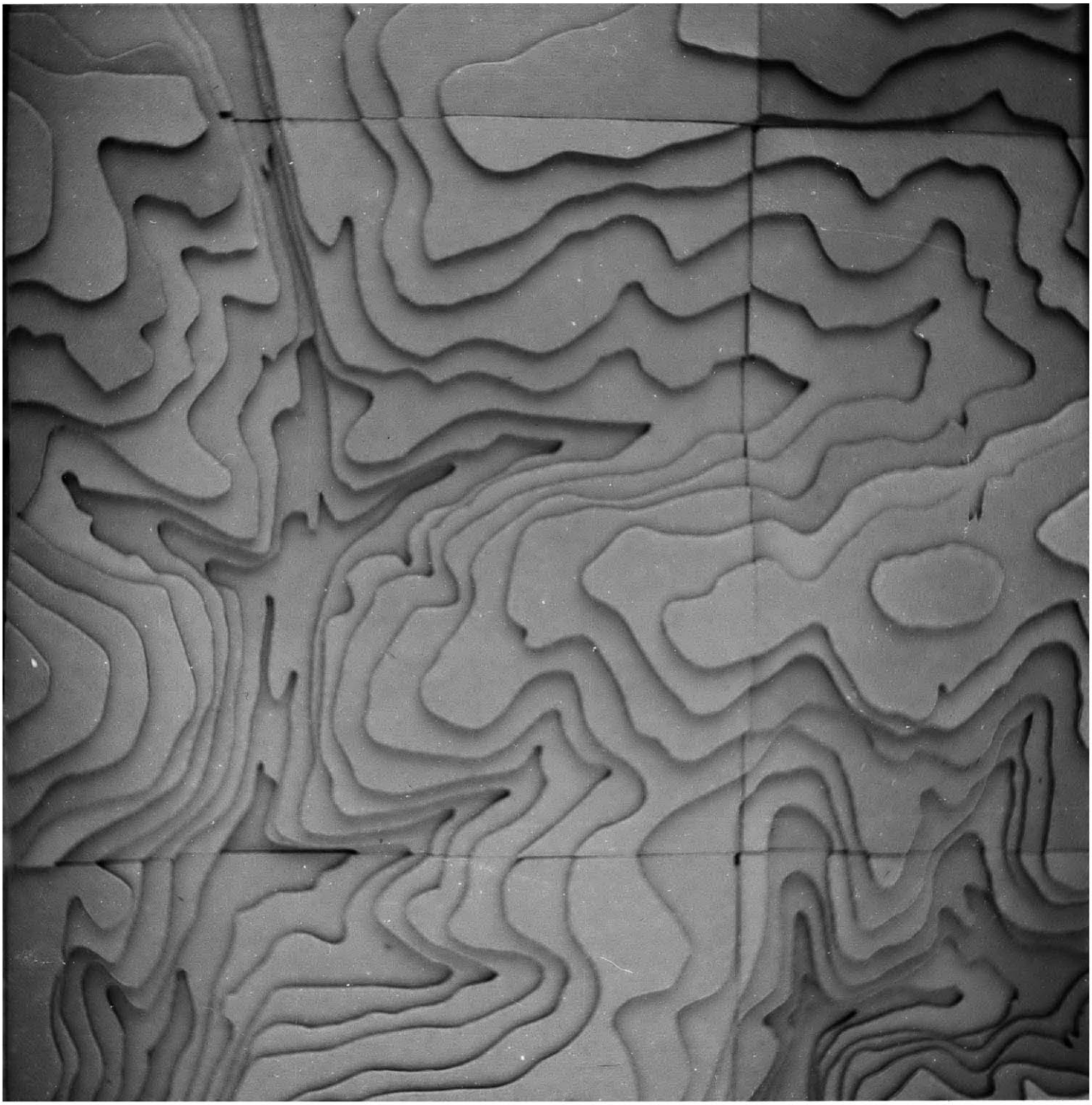


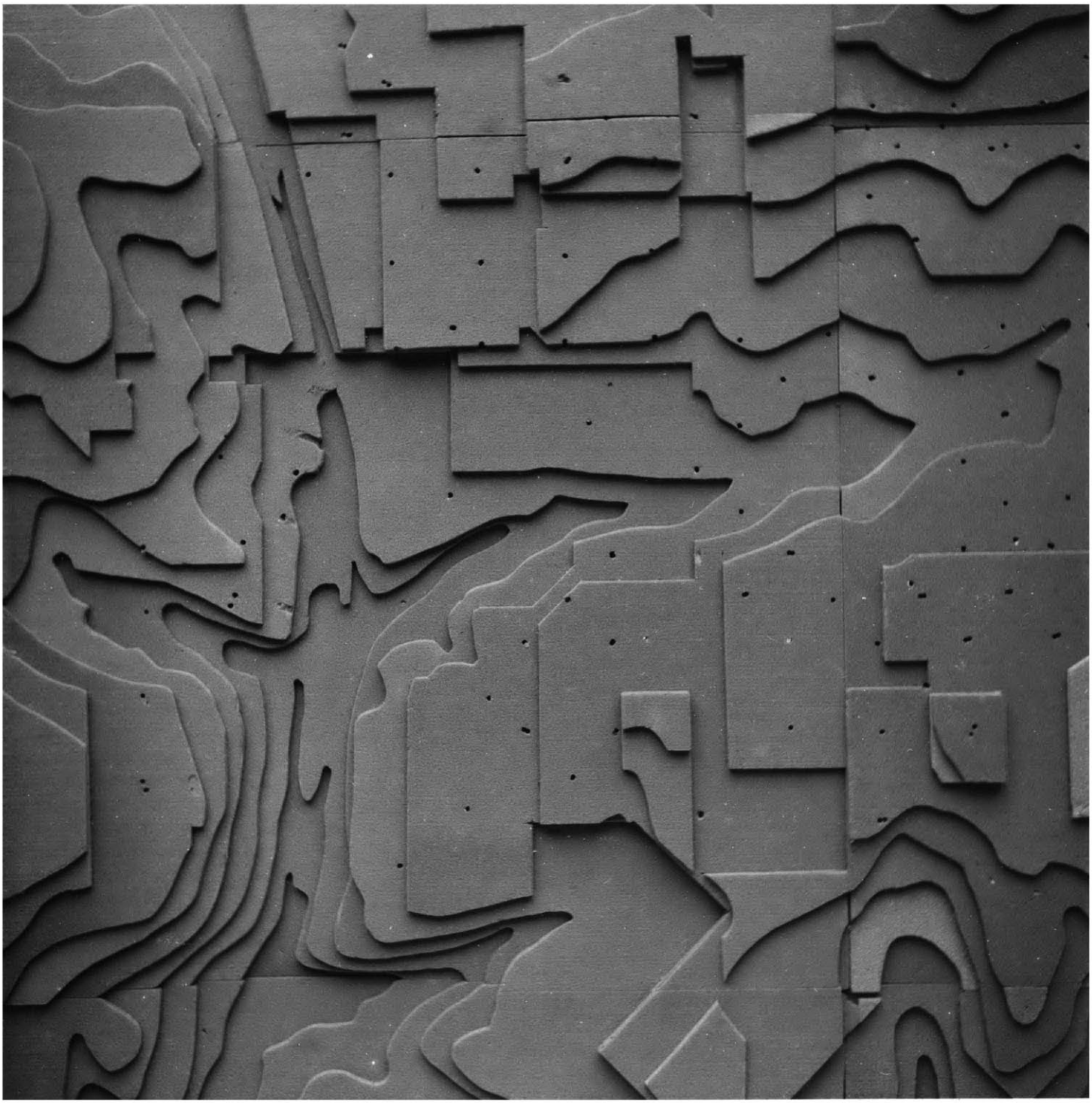


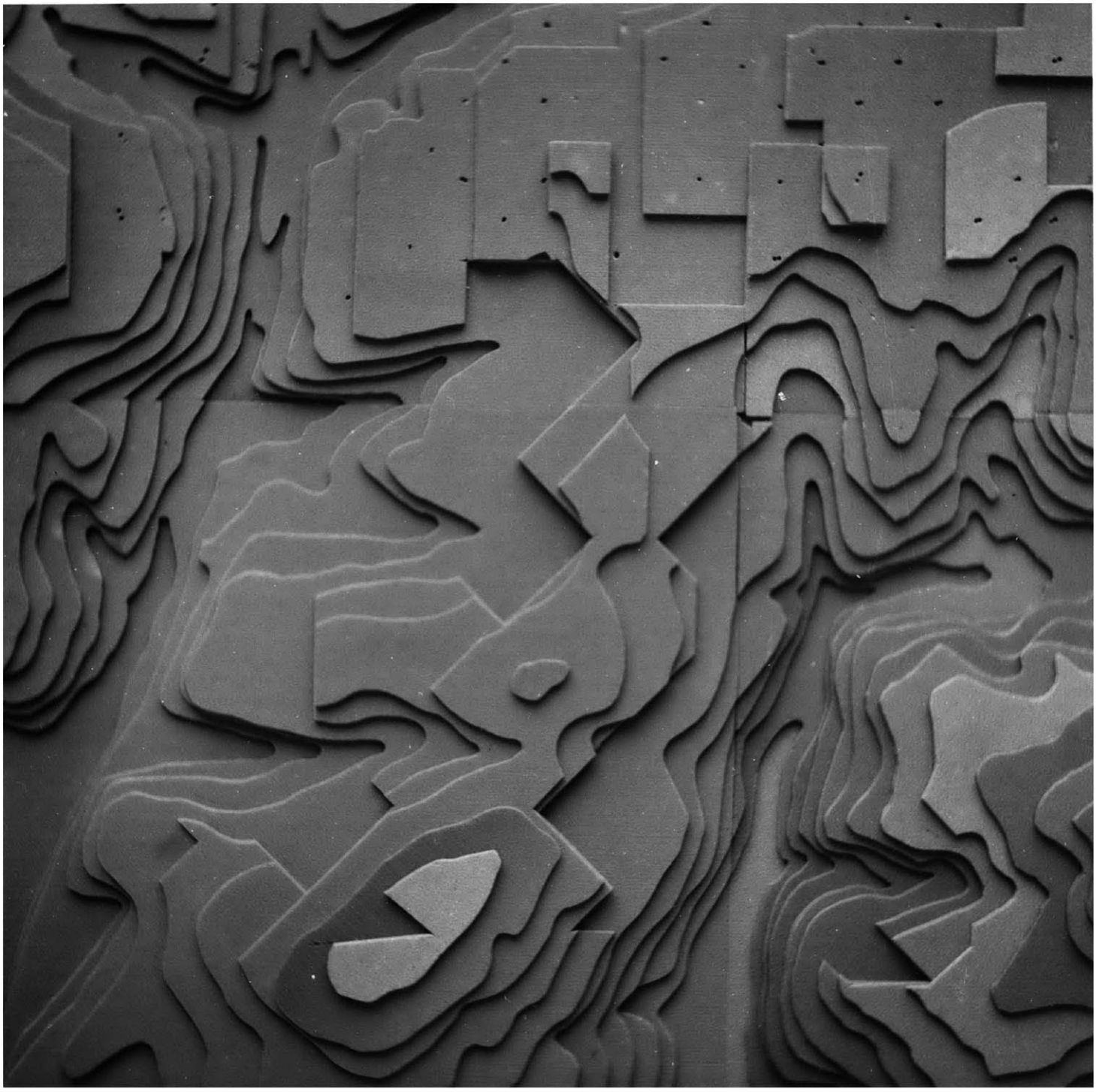


Development of grade to receive the ground-oriented functions









Plan and perspective views of model