1974

Form/Space and the Language of Architecture

Frederick Jules
University of Wisconsin - Milwaukee

Form/Space and the Language of Architecture

by Frederick Jules

PUBLICATIONS IN ARCHITECTURE AND URBAN PLANNING
Center for Architecture and Urban Planning Research
University of Wisconsin-Milwaukee
P. O. Box 413
Milwaukee, WI 53201

Additional copies of this report are available for $7.50 prepaid by writing to the above address.

Report R74-1

PUBLICATIONS IN ARCHITECTURE AND URBAN PLANNING
Center for Architecture and Urban Planning Research
University of Wisconsin-Milwaukee
P. O. Box 413
Milwaukee, WI 53201

Additional copies of this report are available for $7.50 prepaid by writing to the above address.

Report R74-1

Contents:

Introduction

This work has two major objectives. The first is to look at architectural forms and spaces and identify the meanings the average viewer associates with them. The second objective is to relate these meanings and define the grammar that can be used to organize meaningful architectural compositions. Through this organization, the reader will develop the ability to consciously read a work of architecture and perhaps will even enhance his ability to design by using the grammar as a framework for logical self-criticism.

To accomplish these objectives the subject is approached first through current concepts of human perception. These provide the groundwork from which elements of space and form can be analyzed for their perceptual significance in an architectural composition.

A grammar of architectural space/form is slowly developed from this analysis. It starts with the simplest elements of form and grows to encompass concepts of sequence and pattern in total architectural compositions.

It is hoped that in the end the reader will have developed a greater understanding and enjoyment of architecture. And,if he is a designer, his art may become more effective.

Notes on Illustrations

All the illustrations have been taken from the private collections of my friends. Each was selected for its richness and content and not to prove one simplified point. To get the most out of each picture, I have located them near the text that describes their dominant characteristic, and I have listed key words in the margins that express these characteristics and other important characteristics that are discussed in other parts of the book. It is the reader's task to analyze the pictures and come to his own conclusions: no attempt is made to simplify this process because it is through this personal analysis that appreciation grows for a good work of architecture.

Credit for each illustration is given in the margins by the initials of the following contributors: Frederick Jules, Harvey Rabinowitz, Keven Forseth, Merrill Gaines, Robert Beckley, Tim McGinty, and Wayne Attoe. Captions and credits are read from right to left and top to bottom.

Acknowledgments

I would like to acknowledge the great assistance I received in preparing this work from the following friends:

Carol Jules
Tim McGinty
Wayne Attoe

I have also received invaluable help from two project assistants: Kevin Forseth with the graphics and Gary Kegler with the literature search.

The Senses

An environment must be perceived to be understood. Thus, it is imperative that the designer of environments understand and appreciate how humans perceive and interpret their physical surrounds. This knowledge provides the basic groundwork for becoming an effective designer.

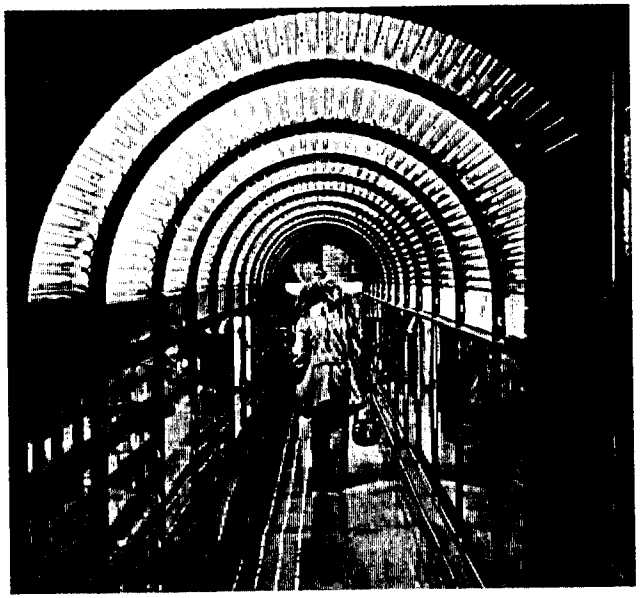
There are seven ways in which humans sense their environment. Of these, only two stand out as extremely important in our ability to sense and understand an architectural environment. The first, and most dominant sense, is that of sight. It is our most highly developed sense and gives us our greatest range of distance perception. Coordinated with sight is the internal sense of balance developed by the semicircular canals in our ears. These give us a constant set of axes forming a basic horizontal and vertical orientation from which we can sense our relationship with the earth. Surprisingly slight deviation from these axes is immediately evident to most people.

The third most important sense in relation to architecture is that of touch. It is through touch that we add associations or meanings to objects in our environment. These associations are learned at an early age and they are with us all our lives. Meanings associated

with some objects may be: their relative softness, weight, warmth, sharpness, and possible danger to us. Meanings such as these become ingrained in us at an early age (when we are first experiencing the world), and in later life we react almost instinctively to similar characteristics in known and unknown objects. The element of distance associated with touch is of major importance to architects. When an object comes without our reach, we anticipate the possibility of touching it and take steps to do so or not depending on our attitude toward it. In this way, our environment becomes immediate and understandable to us.

The remaining senses are those of taste, sound, smell, and heat. The requirements of human comfort have very narrow limits in terms of these senses, so they cannot be overlooked in the designing of physical environments; but they have little to do with form apart from association. For example, part of our memory of a particular environment might be that it was cold and drafty. This work is intended to deal with the attributes of architectural form, and therefore these secondary senses will not be elaborated upon. Suffice to say that in relation to form, these senses tend to corroborate perceptions of the physical environment sensed by

sight, balance, and touch. When they do not, we become uncomfortable until we are able to resolve the conflict.



Motivation

Before one can understand how the physical environment is perceived by an individual, it is essential to understand the capacity of humans to store information and their motivation to do so. It is evident that men and animals have an innate desire to live, and to live well (thrive). This desire requires active participation in an environment that is both physical as well as social. To thrive we must enjoy interaction with our environments and positively seek out those that are most fulfilling. For this to occur we must be able to correctly perceive our environment (physical & social), associate it with other situations, and store information. All these are positive motivations of the individual. They are also all based on interpretations of information gleaned through the senses. The psychologist Gibson states "that the visual world is an unlearned experience, that it is meaningless when seen for the first time, and that what one learns is to see the meaning of things"[1] (and situations). Gibson categorizes some of the meanings we associate with objects, such as their use or the satisfaction of a physical or emotional need. Objects also may have abstract or social meaning. Obviously, architectural forms are comprehended

A distance associated with touch.
A close environment.

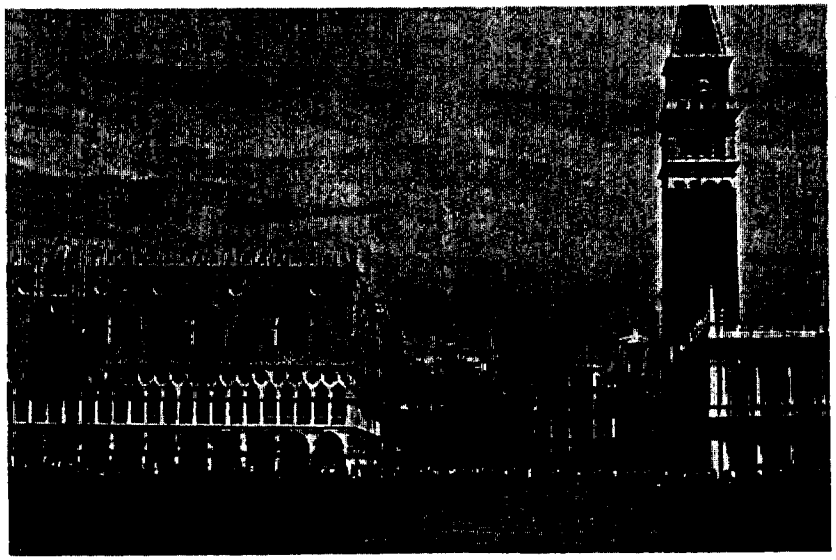
Johnson Wax Co.
1936
Racine, Wisconsin
Frank Lloyd Wright
TN

An environment which is both physical as well as social.

Linderhof
1870
Bavaria
Franz von Seitz
WA

1

Gibson, James, The Perception of the Visual World, Houghton Mifflin Co., Boston, 1950
p. 200



through a balance of many of these types of meaning. "Church" has symbolic meaning as a word as well as a form. The form definition of a church may vary with locality and historical era, but it has fairly narrow limits within those contexts. Our understanding of the environment depends on a stored knowledge or wealth of meanings associated with particular objects, their relationship to other objects and our motivations.

Though man has greater storage capacity for meaning than other animals, there are limits. Much study is underway to determine exactly how the brain stores information, and as yet there is no definitive answer.

It is known, however, that information is coded into patterns. In the specific case of vision, much of this coding is done by the eye itself with only patterns being transferred to the brain.[2] Because of the limitless range of possible experiences and the limited storage capacity of the brain, redundancy is the first part of the environment to be filtered out. For example, when one first looks at a red wall, the cone sensors in the eye start firing impulses to a second layer of sensors in the eye that code the pattern for the brain. This layer

Physical and social environments

Sheriton Palace Hotel
Circa 1906
San Franscisco, Calif.
RB

Piazza San Marco
Venice
WA

Museum of Modern Art Garden
New York, NY.
RB

The Cannery
1968
San Franscisco, Calif.
Joseph Esherick
TM

2
Kolers, Paul, 'Some Psychological Aspects of Pattern Recognition,' in Recognizing Patterns, Studies in Living and Automatic Systems, Ed. by Paul Kolers and Murray Eden. MIT Press, Cambridge, Mass. 1968 pp. 4-61

reduces the information coming from a number of cones to one message to the brain. At the same time, it sends a message back to the cones asking for less information as long as there are no changes in the perceived environment. And so the cones quickly reduce the amount of information they are returning to the second level. The individual does not sense change in what he is "seeing" because the brain has experienced that pattern of messages and has identified a single experience: red.

The meaning of this and of other perceived characteristics of an object are interpreted in relation relation to prior experiences of similar objects or situations. The associated meanings may require the individual's brain to ask for more information from the eye, or the brain may decide not to bother and again ask for less information. Since our interpretations are based on the object's relationship to its environment and on our past experience, we are adept at identifying proportional differences between situations. However, we are fairly poor at quantifying them. We can say that something is about "twice as bright" but we cannot put a number on it. Where we fall short, we have invented machines such as the light meter to make exact judgments.

Symbolic form.
The dominance of symmetry.

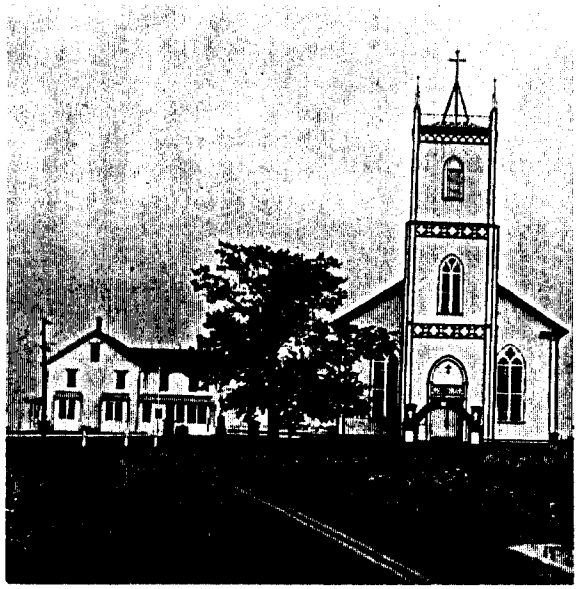
Church
Prince Edward Island, Canada
anon.
WA

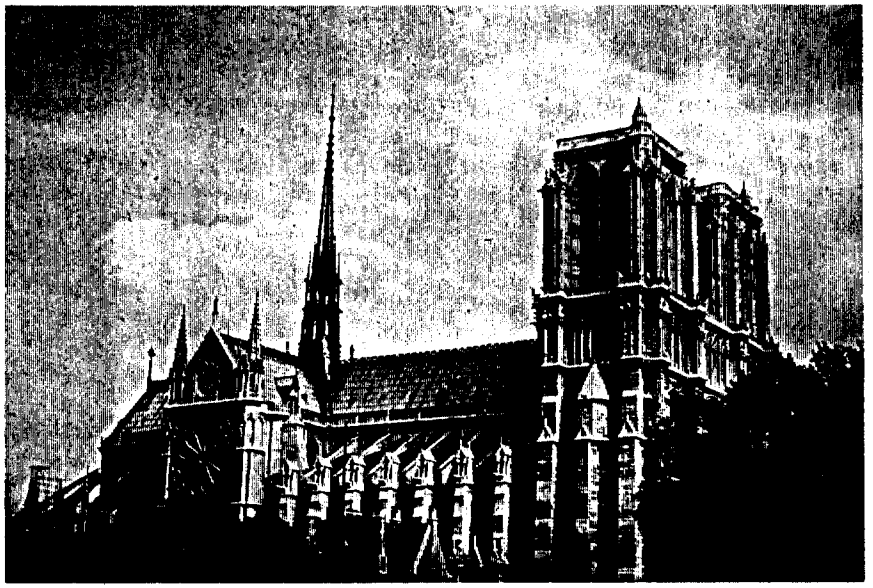
Symbolic form.

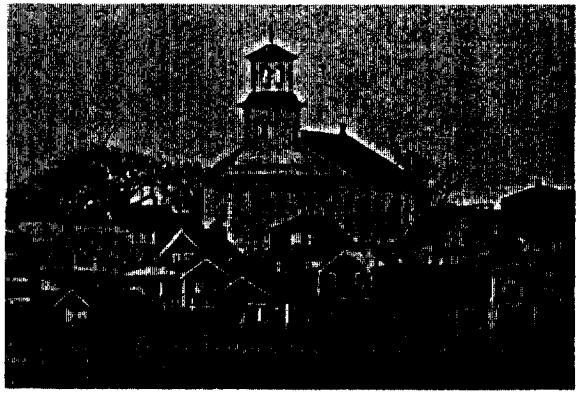
Notre Dame Cathedral
Paris, France
WA

Symbolic form.
Scale dominance.

Church
Provincetown, Mass.
anon.
FJ







Upon understanding what motivates perception, we can see logically how we deal with the physical environment encountered in daily life. An environment which is new to us is sensed more fully than one to which we have become accustomed. The more familiar the environment, the more synthesized our mental pattner for it and the less necessary it is to deal with it consciously. Moving through familiar spaces, we do not have to look for the entrances and exits: we know their relative locations. The more open the environment, the less need there is to perceive it and the more difficult it becomes to do so. Conversely, the closer the environment, the more readily it is perceived. Considering the fact that the architecture we tend to get closest to is usually a barrier of some type (doors or walls) much of our experience is based on negotiating these barriers when they interfere with goals on the other side of them.

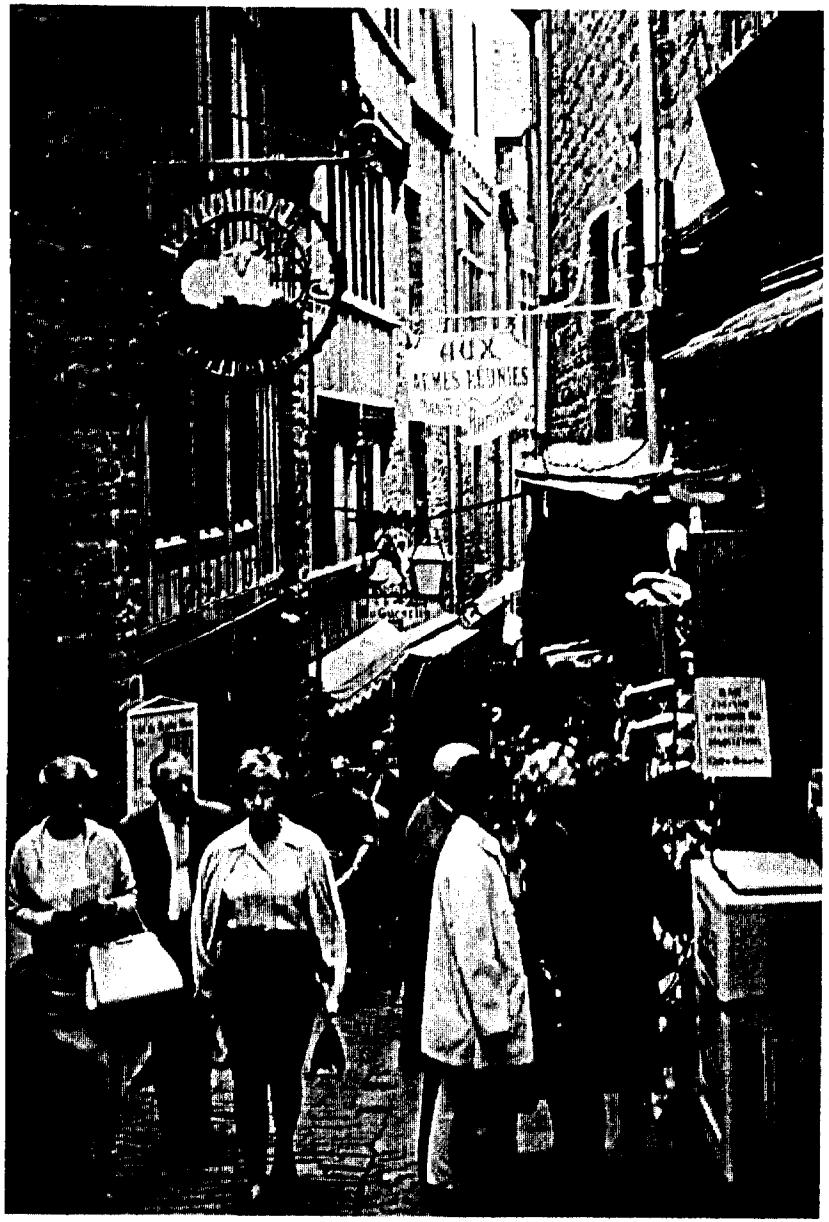
Motion, because it is a set of experiences (eye stimulations), generally requires more perception than passivity. However, patterns of motion can also become repetitious, such as our movement in relation to familiar buildings and pathways. These movements in the visual field become assimilated as we learn the environment and our movement within it becomes "second

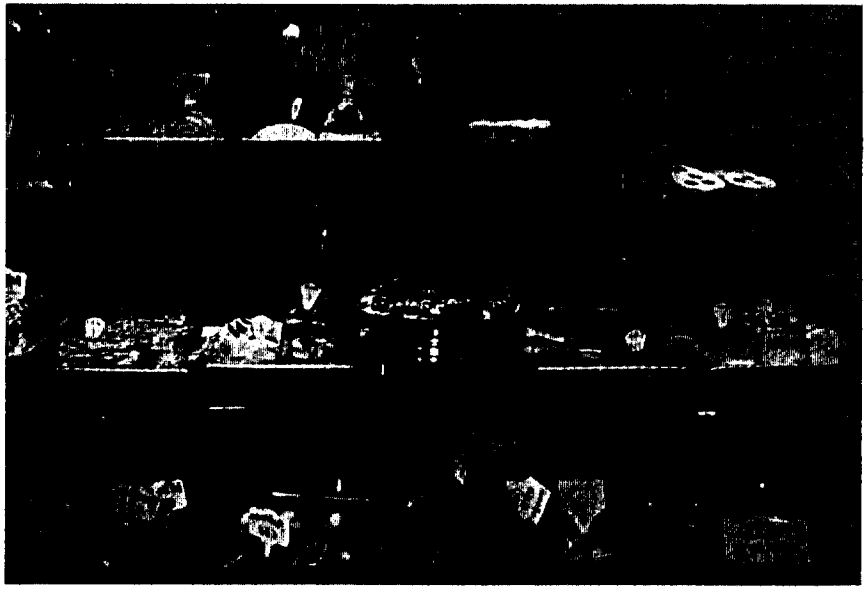
A close environment
A physical as well as social environment.

Street scene
St. Michel
RB

Finding something to eat.

Store window
Strasbourg
TM


AUX
ARMES RÉUNIES



nature." Motion through environments with erratic forms and motion requires conscious perception. This is evident when walking in a crowd or walking through an electric eye door. Similarly, pedestrians regard cars with great care they they approach because they are associated with danger and unpredictable movement.

Motivational drive, or our frame of mind, also strongly affects our perception of a physical environment. When preoccupied with thought, we may be totally unconscious of our environment. This is typically true when we are reading, for example. We also can be thinking as we walk, in which case we only marginally monitor our environment. If our thought is directed toward a physical goal such as finding a place to eat, our brain quickly filters out extraneous information until the goal is fulfilled or some other mediating drive takes over.

The final qualifiers of human perception are the natural limitations of our senses. These are not of great importance to the architect, however, because they are outside the comfort ranges we use in designing buildings. It must be acknowledged that experiencing architecture probably takes up little of the average person's time. We con-

tinually pursue meaningful physical and social experiences throughout our lives. For the built environment to support this, it must contain meaningful, enjoyable, and comprehensible architecture or it will be avoided or ignored. Architecture can reinforce or deny social experiences.

Its ability to do this is based on how we perceive forms and the meanings we associate with them. The remainder of this work will deal with hierarchies of formal organization and how they can be used to design effective environments.

The Eye

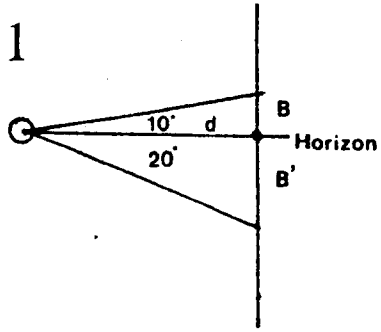
At this point we have a general idea of how and why we experience our environment. However, the architect must understand more specifically how the eye and brain working together affect our conceptualization of the environment in which we live, what this implies in terms of architectural design.

Our visual field is the area in which objects are visually perceived. Our visual field can be subdivided into cones of vision which represent the limits of our ability to perceive characteristics of our environment. In descending order, the cones of vision of the human eye perceive: motion, brightness, color, form. In daily life, our eyes are in continual motion expanding our visual field and directing our attention to various significant objects within that field. This movement of eye or body shifts our cones of vision quite regularly, but they remain proportionally the same; we perceive motion before brightness, etc. Information in the larger cones of vision can motivate us to shift an image to the center of all our cones of vision in order to see the object more clearly. For example, the motion of a car may draw our visual attention to it when we are crossing a street.

Form is the most dominant aspect of architecture to be perceived. In general, our cone of vision for form scans across the angle of view shown in Figure 1.[3] We scan horizontally more than vertically because it is physically easier for us and viewing 20° above the horizon is tiring. Vision also extends twice as far below the horizon as above it. Therefore, it is easy to ascertain what part of an architectural environment is generally in view. Typically, within this band of vision, there are nodes of interest which the eye spends more time on, the nodes being those areas in the panorama with greater content (detail, differentiation, or cultural significance). At times we may seek something which is represented by a symbol or sign. Such information is usually displayed above the horizon line and we have learned to look for it there. Signs above stores are the most common example.

Once we have spotted something of interest, the eye examines it in a somewhat random manner. The fixation points of the eye jump quickly around the object being viewed. They do not follow contour but focus on specific areas of contrast; in areas where there is stronger contrast or more numerous instances of contrast, the eye fixates more often. Meaning also

1



B+B' = (d×.176)+(d×.364)

3 Dreyfuss, Henry, The Measure of Man, Whitney Publications, New York, 1959

plays a significant role, and the eye fixates more often on parts of an object that are expected to convey significant information. In looking at a friend, for example, our eyes return often to the eyes and mouth to detect meaning in their expression.

The eye and brain work together to enhance our perception of the environment. Enhancement occurs where we see contrast in our field of vision. Contrast in architecture can be light/dark, color, slant (edge) or a combination of these. At the line of contrast, such as where two colors abut, enhancement occurs. The two colors set the cones in our eyes firing impluses to a nerve network in the eye that interconnects the sensors and sends information to and from them and other nerve networks that eventually lead to the brain. If a set of proximally related cones are sensing the same color, they fire less frequently. However, if the nerve network finds that the proximal cones are sensing different colors (a contrast situation), it requires them to fire more often. In this manner, we receive more information in areas where contrast occurs. Interconnected nerve networks continue to reduce information (a reduction of about 120:1)[4] before it is sent to the brain, but contrast is

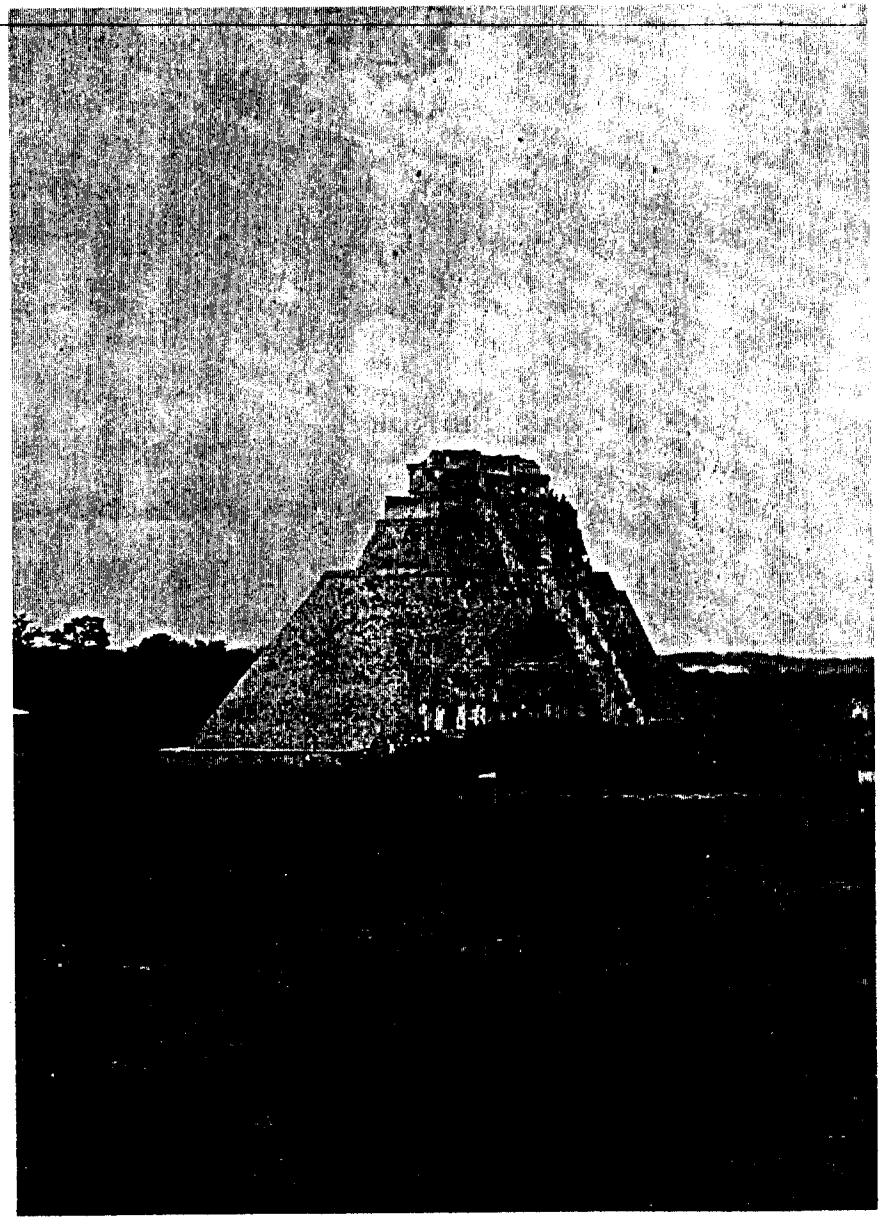
4
Kolers, Paul, 'Some Psychological Aspects of Pattern Recognition' pp. 4-61

clearly transmitted. The other forms of contrast interact with the eye and brain in a similar manner. The greater the contrast, the more enhancement occurs. Enhancement cannot occur where we see smooth transitions in slant or from light to dark or color to color. This means that our perception of these changes is poorer.[5] Contrasts can exceed our physical limits. Op Art produces color contrasts that are so great they seem to shimmer at the line of contrast, and large light/dark contrasts are not unusual in architecture, forcing our eyes to adapt to one of these conditions and to lose detail in the other. Architecture can utilize all these types of contrast to express subtle hierarchies of meaning (perception).

Contrast enhancement at edge; none at curve.

Uxmal
Pre-Columbian
Yucatan, Mexico
Aztec
FJ

5
Zune, Leonard, Visual Perception of Form, Academic Press, New York, 1970 pp. 40-45



Gestalt Principles

Gestalt psychologists have long contended that man's perception is organized around innate responses to configurational wholes and not necessarily to individual element. Their contentions are based on exhaustive tests which have isolated a set of principles of perception. Some of these are of great interest to the architect because they describe how a visual organization will be perceived, and how the architect can affect one's perception of a building. We can use the Gestalt principles to give visual meaning (organization) to an architectural composition and to realize our concept of the building in relation to its functions and the environment in which it is placed.

FIGURE GROUND:

"The first and simplest configurations are qualities on a ground. All visual forms possess at least two distinguishable aspects, a figure portion called figure and background called ground. ...Figure and ground have certain contrasting properties: figure occupies an area that is smaller than that of the ground; figure has distinguishable parts, ground has none; figure has contours, ground is boundless; figure appears to be near to the observer, ground ap-

pears to extend behind the figure unbroken by it; figure has thing-like quality, ground is formless, diffuse, infinite. In short, figure is more strongly organized than ground"[6] In architecture, figure and ground qualities are directly related to the observer's field of view and his distance from the object. Thus, figure ground qualities of the environment are continually changing, i.e. dynamic. However, contrast between architectural elements can enhance our perception of one of them as a figure thus giving it accentuated importance. This can be accomplished inside as well as outside the building envelope.

CENTER OF GRAVITY

Forms have centers of gravity. "Visual forms may possess one or several centers of gravity about which the form is organized. The center of gravity exercises an inordinate influence upon the form."[7] The centers of gravity in an architectural composition can be manipulated to elicit a strong sense of differentiation between its parts.

GOOD CONFIGURATION

Our perception (understanding) of the environment always involves the simplication of it. We abstract its essential form and organize it into simpler wholes. Thus, the Gestalt psychologists say "...form will al-

6 Ibid. p. 133

multiple figure/ground.

Aigues-Mortes
Medieval
Southern France
RB

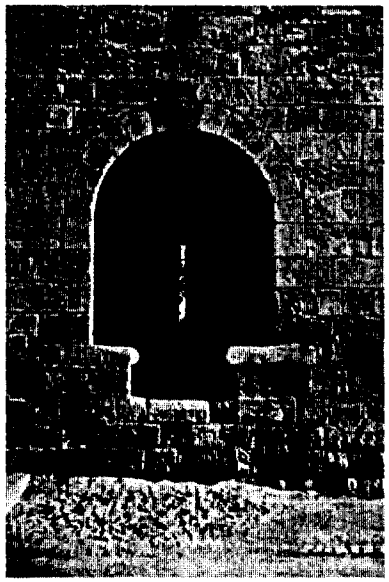
Centers of gravity.
Form intersection.

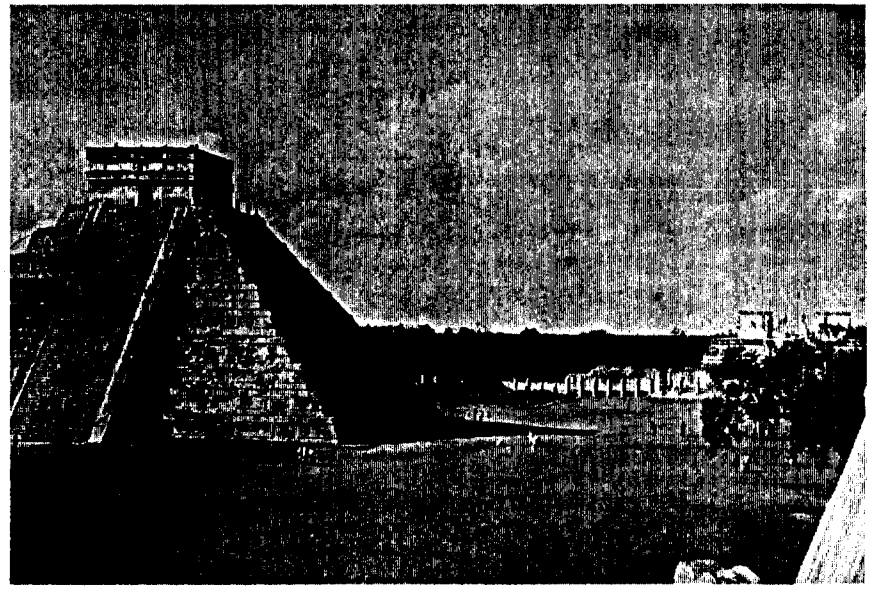
Barn
Florida
WA

Figure/ground.
'good' form.
static mass.

Chiche-itza
Pre-Columbian
Yucatan, Mexico
Aztec
FJ

7 Ibid. pp. 124-126





ways be as 'good' as the prevailing conditions allow. ...'good' here means regular, symmetric, simple, uniform, close, showing uniform direction--in short, exhibiting the minimum possible amount of stress."[8] Our simplifing of the environment into understandable wholes follows these other Gestalt laws:

LAW OF SIMILARITY: "Visual pattern elements that are alike tend to form groups."[8]

LAW OF PROXIMITY: "Visual pattern elements having smaller distances between them tend to group together."

LAW OF GOOD CONTINUATION: "If there are several alternate ways in which a pattern element may be included in the total pattern, the simpler and more regular way will be chosen."

LAW OF SYMMETRY: "Symmetrically located pattern elements will tend to organize themselves and associated elements into groups."[8]

Knowing that such types of configurations are seen as groups of related elements, we can use these principles to design those relationships we want to be apparent. And conversely, we can de-emphasize undesirable relationships by eliminating the characteristics that induce this understanding. For example, suppose we need to place two elements in close proximity but prefer that they not be perceived as

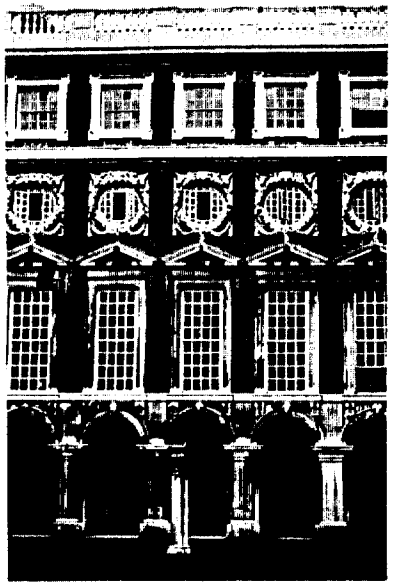
8
Ibid. pp. 124-126

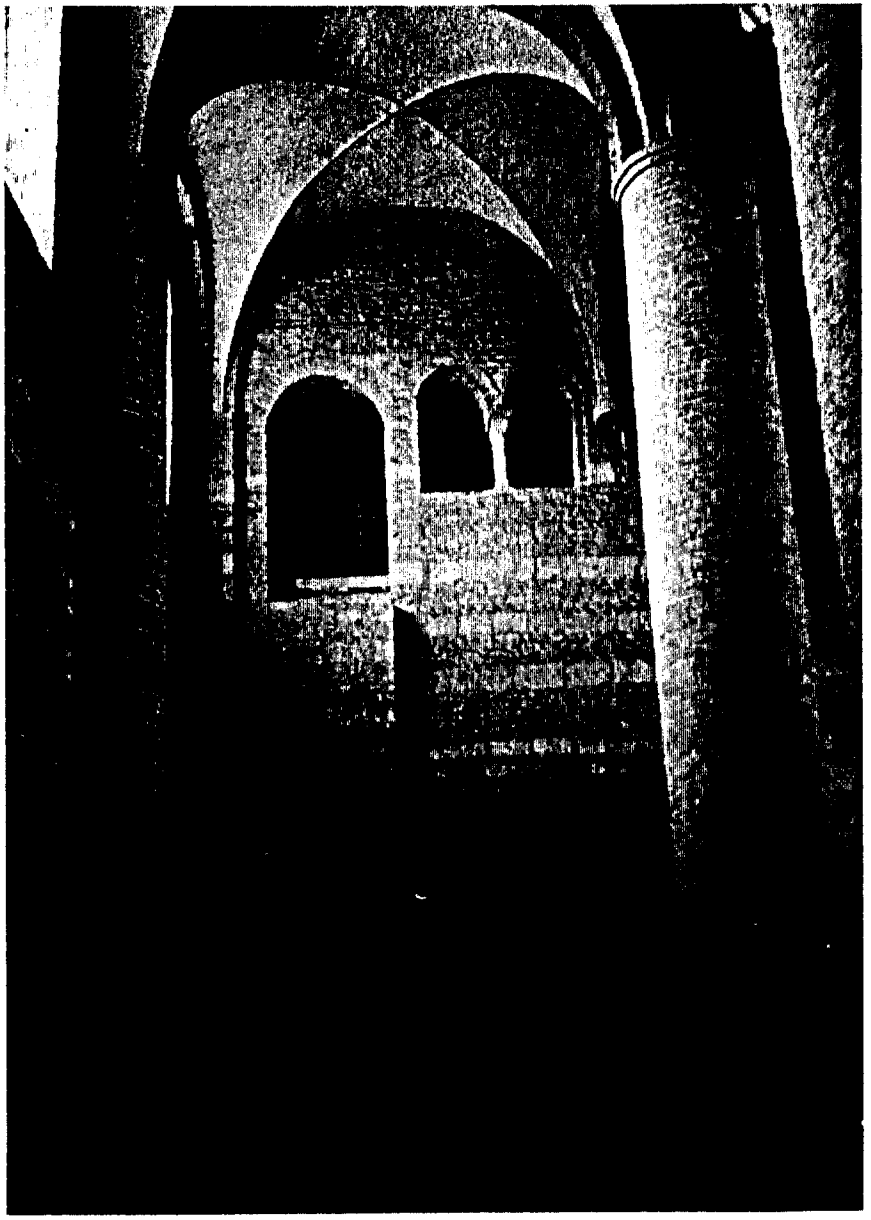
Grouping by similarity, proximity, and good continuation.

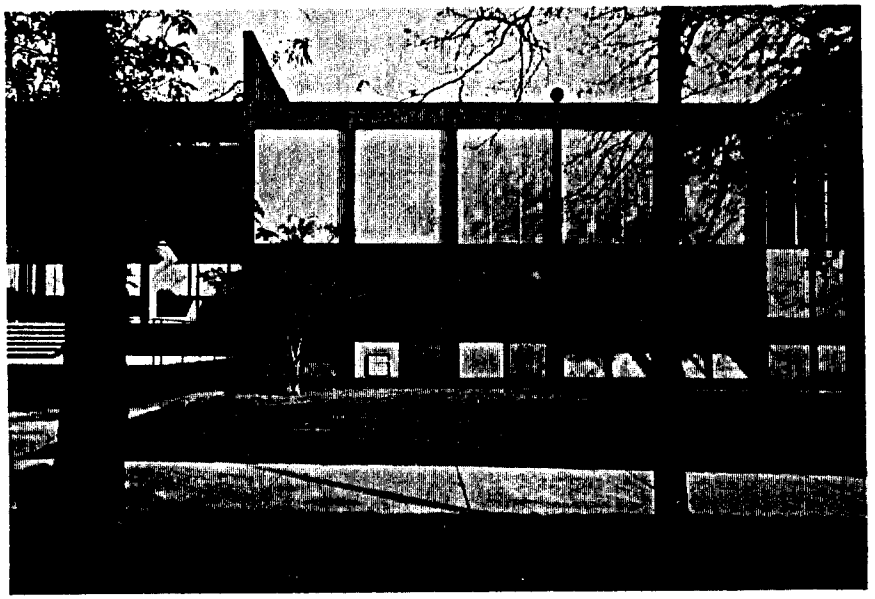
Hampton Ct. Palace
1695
London, England
Christopher Wren
WA

Grouping by similarity, proximity, symmetry, figure/ground. Texture.

Tournous Cathedrial
TM







being related. In this case, we might try to group each element with a different set or other elements by providing good continuation and similarity among the elements within each set and, poor continuation and dissimilar form between the sets. Hierarchies of relationship can be developed by careful manipulation of Gestalt relationships and contrast. In the sequential viewing of a building, groupings may form and dissolve as we change our orientation. Gestalt tests have proven that "visual forms may fuse to produce new ones; simple forms fuse more easily than complex ones; forms of the same strength fuse more easily than forms of different strength."[9]

And finally, the Gestaltists have identified two additional phenomena of perception which prove to be very powerful tools for the architect. The first is CLOSURE: we tend to perceive incomplete forms as complete or closed. Architects use this tendency to make a space function both as a place and as part of a continuing composition; the place is defined by implied closure while continuity is developed in accordance with the principles of perception. The second phenomenon is the LAW OF REPRODUCTION: "Visual forms leave after-effects that make them easier to remember than other, non-configurated wholes. If only a part of a form reappears, having

Grouping by similarity and proximity. Directionality.

Richards Medical Research Building
1957
Philadelphia, Pa.
Louis Kahn
TM

Grouping by similarity, proximity, proportionality, and good continuation.

Crown Hall, IIT
1950
Chicago, Ill.
Mies Van Der Rohe
FJ

9 Ibid. p. 132

appeared before together with the rest of the whole form, it will tend to reinstate the whole form."[10] In the context of architecture this phenomenon can be used to make an environment clear and easily understandable, and is an asset in designing such places as an airport.

At this point, it is convenient to review our objectives. As architects, we are designing environments that in their final state have physical form. This form is visually understood by the society that uses it, and this understanding is founded in the Gestalt laws of perception. Our task, then, is to make the form understood as we would like it to be understood by manipulating the elements. The form of architecture is usually a composition or set of compositions whose parts are related and are perceived according to a hierarchy of order. The parts are held together by linking gestalts while hierarchies are achieved through contrast in gestalt. We will look at the hierarchies achieved by contrast in subsequent chapters.

Gestalt principles can be applied to those characteristics of architecture other than form, such as location in three dimensional space, color, texture, and mass, and culture content related to form, location, color, or mass. Man's ability to perceive depth, i.e., the location of objects in three dimensional

Implied closure.
Center of gravity.
Symbolic scale.

Capitol
Washington, D.C.
FJ

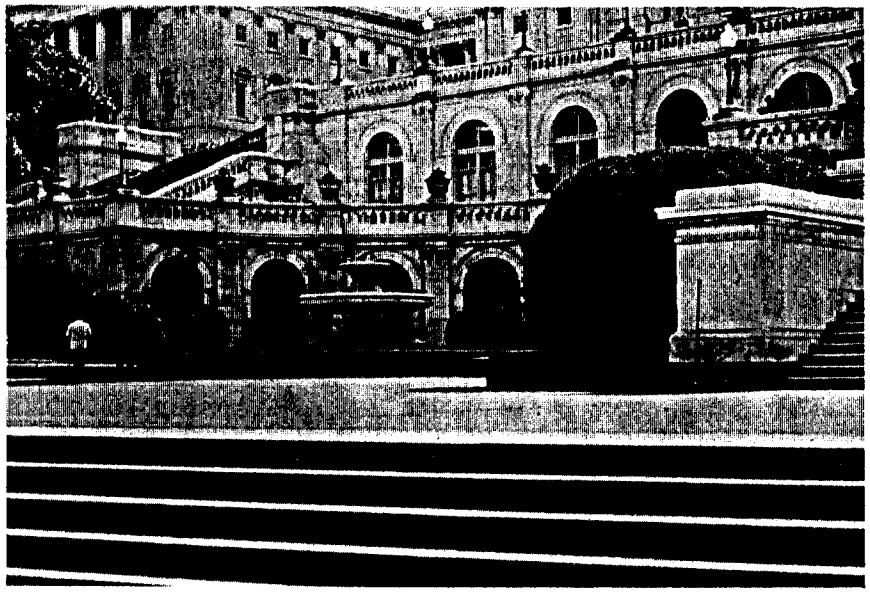
Implied closure.
Symbolic materials.
Texture.

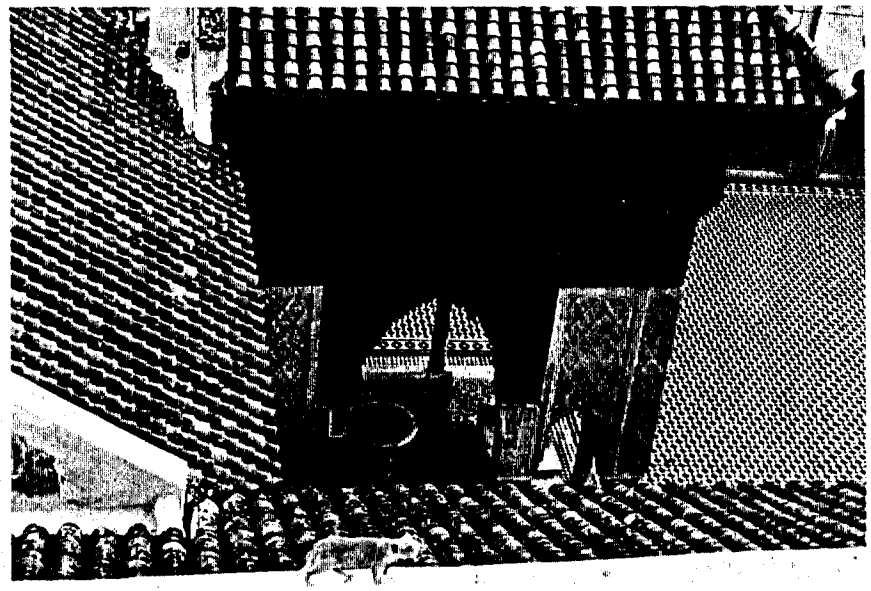
Mosque
Fez, Morocco
FJ

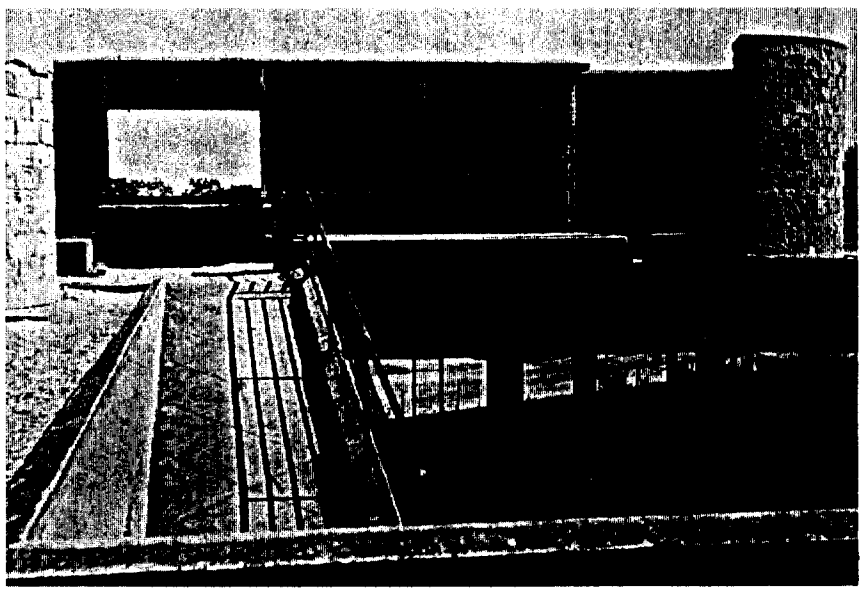
Implied closure.

Villa Savoie
1929
Poissy, France
Le Corbusier
RB

10
Ibid. p. 133





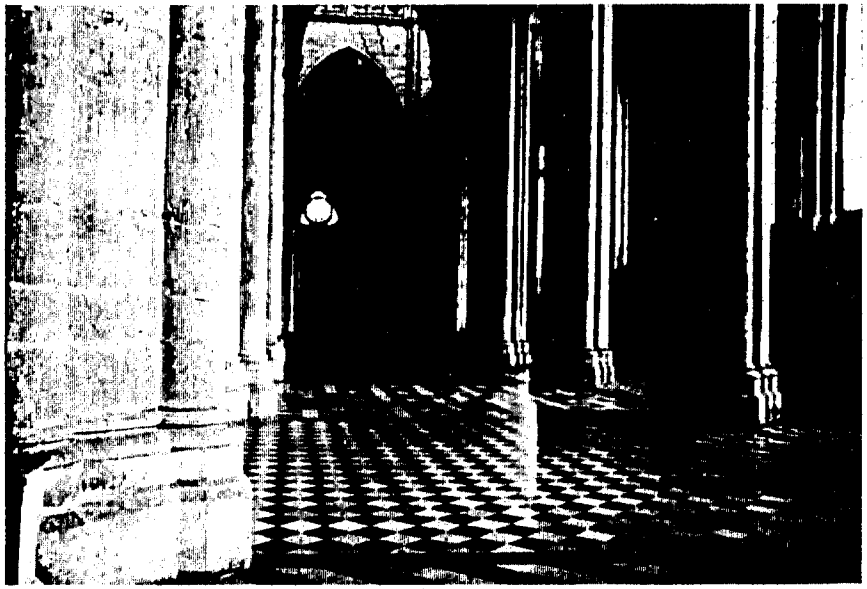


space is crucial to his ability to understand his environment.

Physical environments usually are perceived while the individual is moving through them. Binocular disparity and parallax combined with other depth clues give us our strongest sense of relative location of physical elements. Parallax gives us a rate of change in the environment which we associate with distance. Thus, the closer we move toward an object, the more its form is perceived to change. Binocular disparity (the views produced by the separation of the eyes) allows us similar perceptions, within a limited range of roughly 20 feet, without motion. Monocular depth clues tend to reinforce what we perceive through parallax and cultural experience. Monocular depth clues include the relative size of similar objects, linear perspective, overlap, and texture-density gradients. Relative size of similar objects presupposes a learned scale and form relationship between a number of physical elements which is then interpreted as a certain distance disparity. Linear perspective presupposes an understanding of rectangular forms and the expectancy of an observer to view them. Texture gradients imply similar expectation. Man is also quite capable of dealing with moving objects if

Relative size of similar objects.
Linear perspective.
Overlap.
Texture-density gradients.

Church interior
TM



their motion is smooth, since most depth judgments are made in relation to rate of change of the image perceived. Thus, depth clues provide many more bench marks for understanding the environment in Gestalt terms than do two dimensional pictures. Proximity, form continuation, similarity, etc., become relationships we almost always see in three dimensions. There is one final depth clue called aerial perspective. It is a color gradient that affects the perceived color of buildings and landscapes. The atmosphere has color, and this color combines with the color of an object. The more atmosphere between an object and a viewer, the greater the degree of atmospheric color saturation. Thus, the amount of dilution of the object's actual color by atmospheric color gives us a depth clue. Color in architectural models tends to be misleading because it does not compensate for aerial perspective.

Color as a characteristic of architecture also can be manipulated to form gestalts that express desired visual relationships. Color has three basic qualities that are perceived by the human eye: brightness, hue and saturation. These qualities are transmitted to the eye via light reflected from the environment. Intensity or brightness "is the amount of physical energy pre-

sent in the light."[11] The hue (color) is produced by specific wave lengths of light. Saturation refers to the purity of the color, and a single wave length of light provides the greatest saturation of one color. The Gestalt law of similarity implies that if two colors have the same saturation or intensity they will seem to group. The law of (good connection and) continuation implies that if color hue, saturation or brightness change at an even rate from element to element, the elements will be perceived as a related group. Conversely, a grouping effect can be eliminated by contrasting all of the three qualities of color. In addition to the gestalts that can be produced using color, there are other effects of color that cannot be disregarded by the designer. "Color affects muscular tension, cortical activation (brain waves), heart rate, respiration and other functions of the body, and also arouses definite emotional and aesthetic reation." Colors can be divided into categories of warm and cool. Reds and yellows seem warm, while blues and greens seem cool. White is cool. Warm colors produce excitation, while cool ones relax. Warm colors are perceived to advance, while cool ones recede. Relative brightness also affects our perception of an environment: the brighter the more exciting,

[11] Hochbert, Julien, Perception, Prentice Hall Inc., 1964 p. 22

the darker the more sedentary and relaxing. Thus, if we wish to design a relaxing bedroom, we should choose a cool color with low brightness. Conversely, an active kitchen might require a bright yellow.

Colors are symbolic as well. In the United States, red symbolizes danger, while in Chica and Japan it symbolizes long life. The color of a cultural symbol can be its primary characteristic; for example, in Morocco, the mosques are identifiable by the green color and their tile roofs. It must be noted, however, that a color, to be symbolic, must fall within the prescribed range of hue, saturation, and brightness.

A sense of mass is another dominant characteristic of architecture and architectural materials. A sense of mass is a feeling for the interrelationship of material characteristics and their combination. We learn a material's weight per quantity, its hardness or softness, its texture, size, etc. We combine this information to sense mass. Our perception of mass is relative to past experiences and to the physical context in which we are seeing an object. The most massive form of any particular material is a solid volume; the larger the more massive. It is perceived as less massive as

it is punctured or hollowed out. Mass is also a sense of the gravitational force on an object, and in relation to this it has an implied rest state, i.e., on the ground, and a dynamic state, i.e., above the ground. Objects can be related by having similar mass, or a hierarchy of elements can be implied by a hierarchy of mass.

We have looked at form, location, color, and mass of an object as variables the architect can manipulate to produce desired interpretations of that object. However, Gibson is correct when he says "Perhaps we should conceive of form not as a thing but as merely one of the variables of things. The projected shape of a perceived object would then be only one of its visual qualities among others such as slant of its surfaces, its size, its color, its texture, and its distance, all of which can vary continuously along a scale or dimension." We sense the totality of an object above and beyond its individual characteristics. The design process is one of balancing characteristics to produce a total effect. We can manipulate characteristics that contrast or blend in a grouping of objects to alter the relative meaning of each object. We may produce dominant sensations by using extremes of one characteristic while maintaining

neutral degrees of others. This can be accomplished with an individual element; however, it is usually employed in composing a number of elements: one uses Gestalt relations to hold the composition together while using contrast to identify significant places within the composition.

And finally, and most importantly, we must return to the concepts of meaning and expectation. We have cultural and contextural expectations of our environment. We have come to expect standard door sizes, ceiling heights, amounts of illumination. When we see them, we take them for granted, and their significance is diminished. As the context varies, expectations may vary. In the summer, one may expect comfort from a cool-toned, hard-surfaced, open environment, while in the winter comfort might be expected from a warm, highly textured, close environment. An environment may be designed to alter one's emotional state or affect one's sense of well being. Departures from expectation stimulate the viewer. For example, feelings of monumentality or coziness can be elicited through surprises of scale. Architecture is the delicate balance of meaning associated with the built environment. The meanings may be intrinsic to our way of seeing (Gestalts) or they may be culturally or emo-

Mass.
Texture.
Weight per quantity.
Hardness.

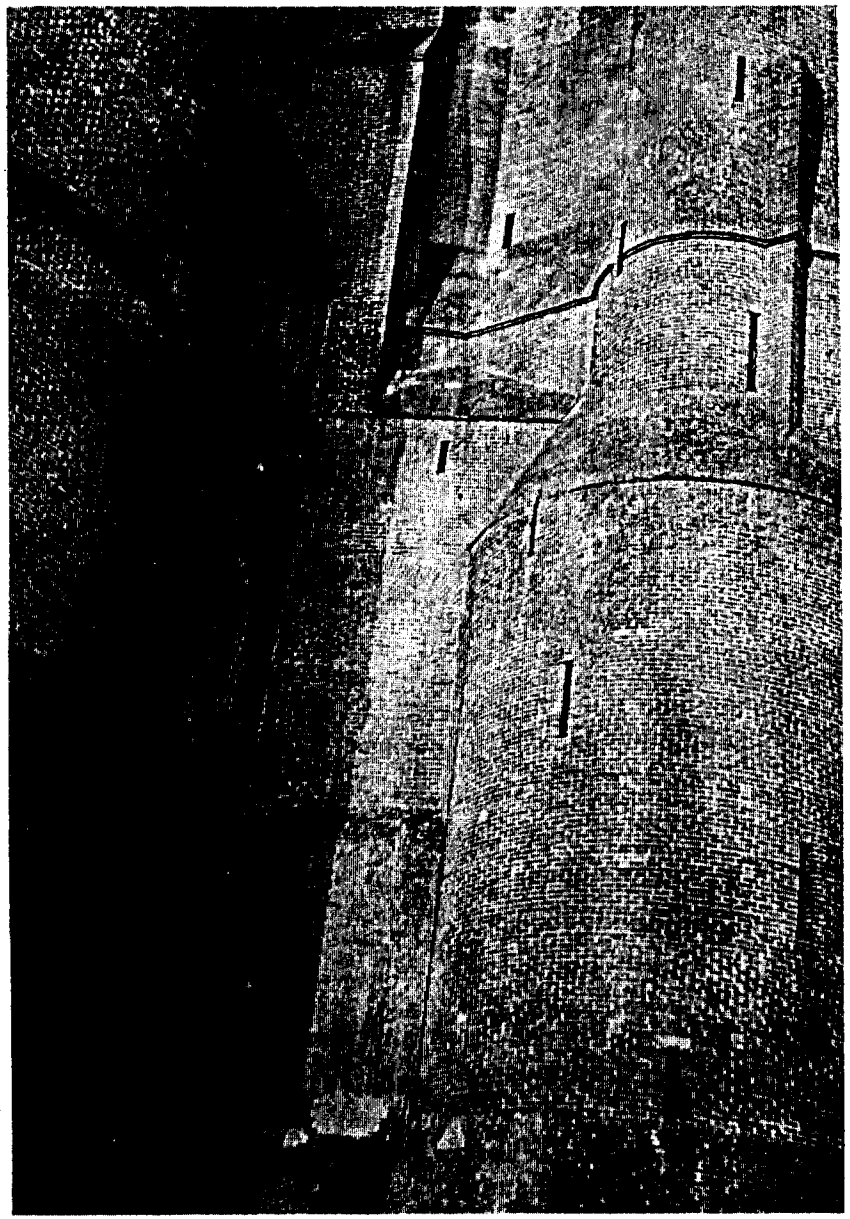
Albi Cathedrial
Southern France
RB

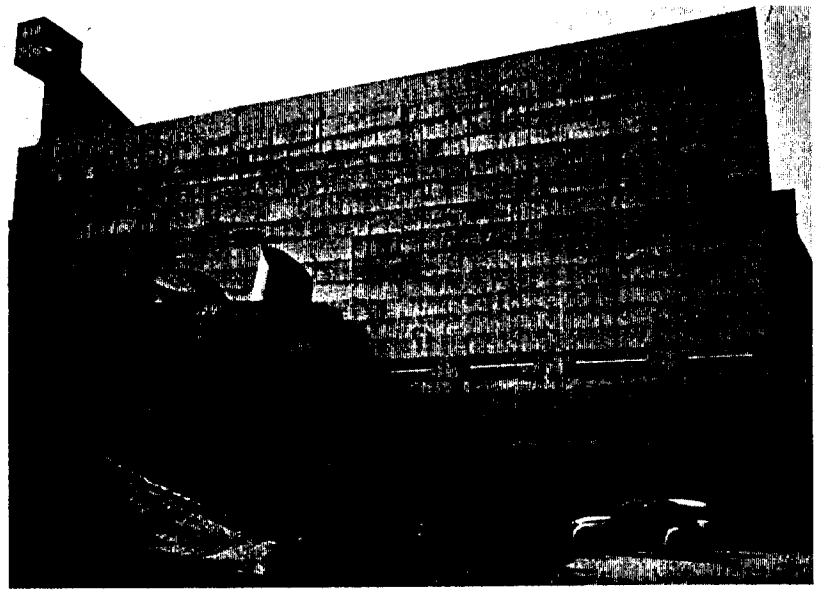
Mass.
Hierarchy by contrast.
Rest state.

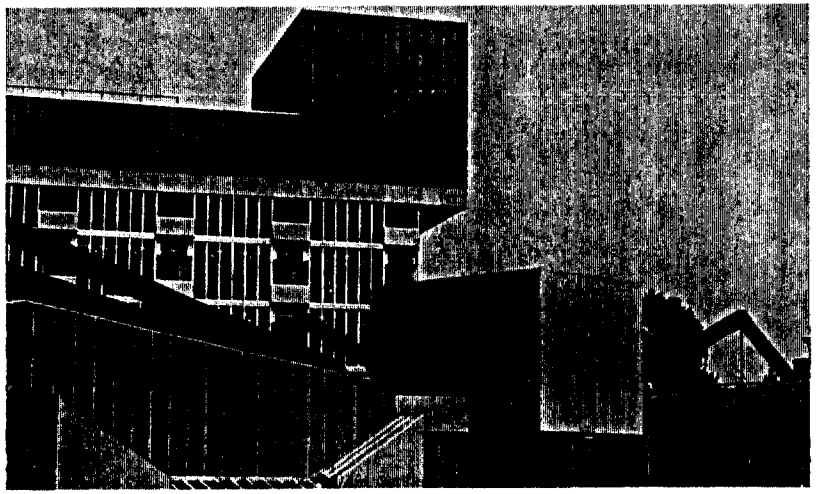
Marie De La Tourette
1960
Eveux, France
Le Corbusier
TM

Mass
Dynamic state
Glazing pattern

Harvard Science Complex
1972
Cambridge, Mass.
Jose Louis Sert
FJ







tionally significant. The architect uses all the characteristics of an object--form, location, color, mass, cultural and emotional content to produce a single totality. A great architect accomplishes this without waste.

Contrast of texture

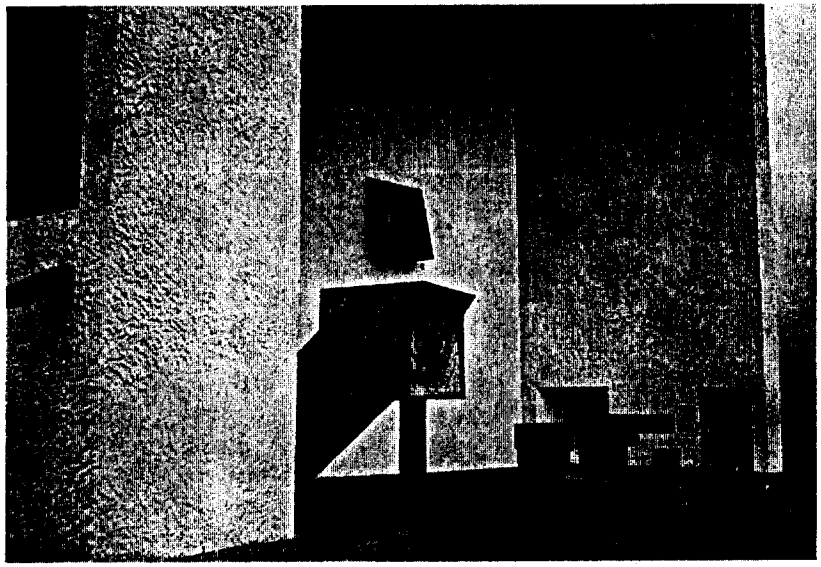
Boston, Mass
Paul Rudolph
FJ

Contrast with expectations
contrast of texture
contrast of 'good form'
contrast of color

Notre Dame Du Haute Saone
1950
Ronchamp, France
Le Corbusier
TM

Contrast of texture
figure/ground
Implied closure
Social significance
Dynamic curvature

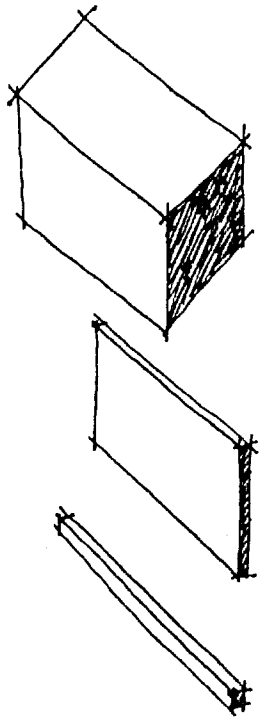
Notre Dame Du Haute Saone
1950
Ronchamp, France
Le Corbusier
TM



Elements of Form

This chapter analyzes relationships between elements of architectural form. It relates form relationships back to the principles of perception/cognition discussed in previous chapters and puts them, as much as possible, in hierarchical order. This ordering is important to the designer of buildings so that he can understand the order of significance in which perceptual stimuli are received and understood by the general viewer in their designs and designs of others.

To accomplish this task, it is necessary to identify the basic elements of architectural form (including the spaces these forms imply), and some standard classifications by which they can be ordered. Architectural forms and space can be broken down into three element types: lines, planes, and volumes. In architecture, the elements are generally three dimensional volumes defined by edges, but as they become long or flat it is convenient to consider them as lines and planes respectively. This convenience also helps us when we wish to consider a part of an architectural composition from a particular location within that composition. Here, we can talk about a wall plane that is in our cone of vision which if viewed from some other vantage point might be



more readily recognized as the surface of a volume. The three elements of form/space can be classified and compared by relative scale, directionality, element type, and location in a total composition. The hierarchy based on element type is normally perceived as volumes, then planes, then lines. This hierarchy is based on the amount of closure these components typically provide for the activities the viewer is pursuing. A volume usually contains an activity, while a plane separates activities and a line directs one to them. Within this hierarchy, hierarchies of scale, strength of Gestalt, and dynamic qualities of direction are possible with scale being dominat over the other two. For example, when we look at a cityscape the largest volumes dominate the view and, in fact, seem to order themselves in significance by scale. Since most architecture does have some Gestalt, the differences in clarity between building Gestalts is not a major ordering factor. A contrast in color may be. However, a scale gradation is still more significant. Great differences in scale can change the hierarchy of elements i.e., a large plane can be perceived as dominant over small volumes if in context both are perceived as figures in a background. However, such relationships are uncommon in architecture.

Volume, plane, line hierarchy.
Rhythm

Carpenter Center
1964
Cambridge, Mass.
Le Corbusier
FJ

Hierarchical order by scale

Moulay-Idriss, Morocco
FJ

A line directs toward activity

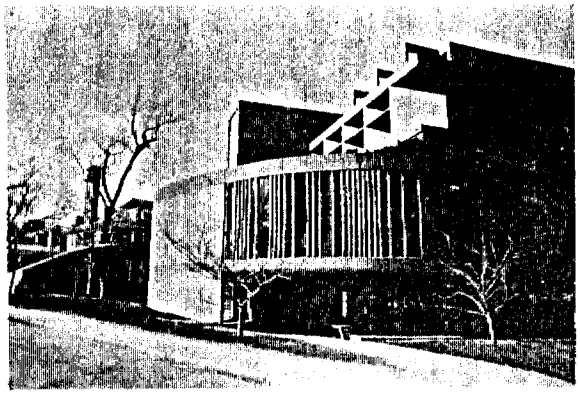
Aigues-Mortes
Medieval
Southern France
RB

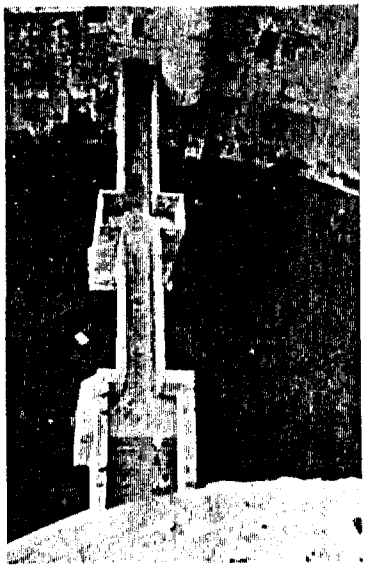
Volume contains activity.
Rhythm
Scale dominance
Grouping by similarity
Significant center of gravity

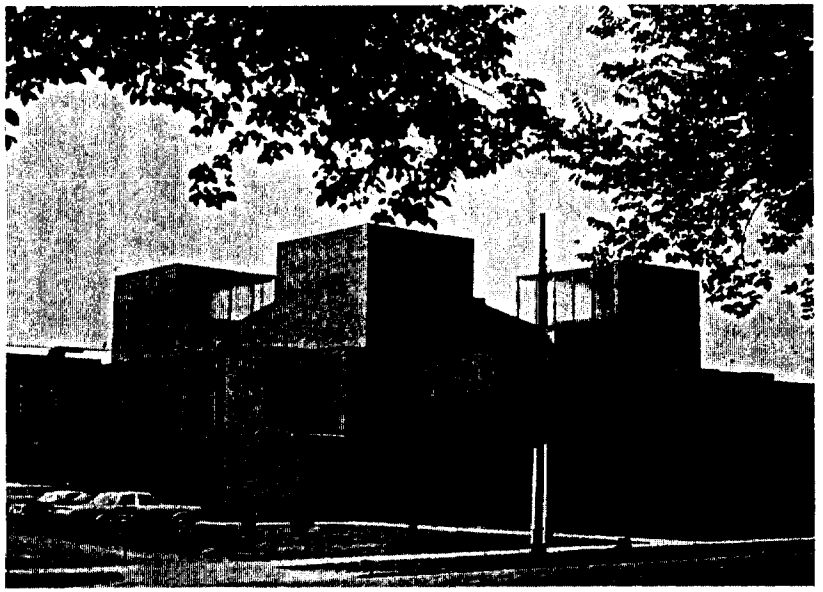
First Unitarian Church
1959
Rochester, N.Y.
Louis Kahn
TH

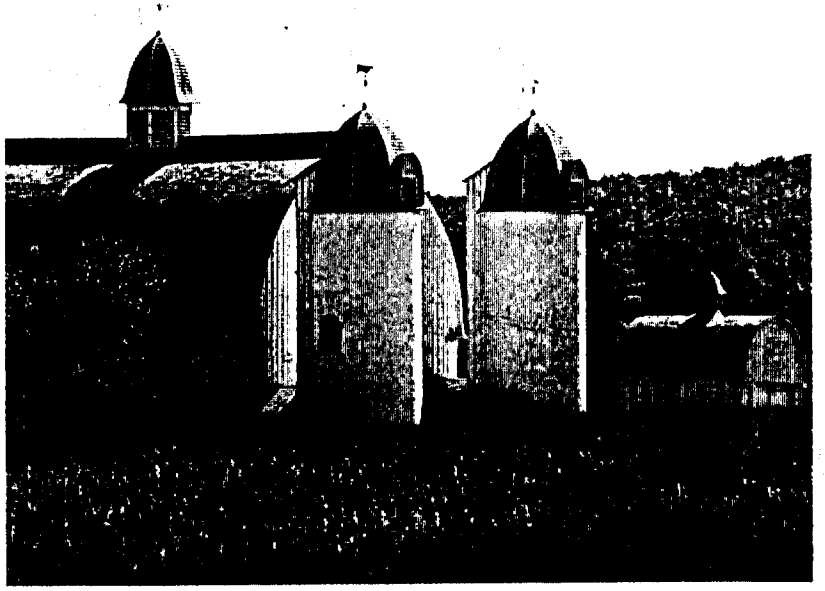
Hierarchical order by scale

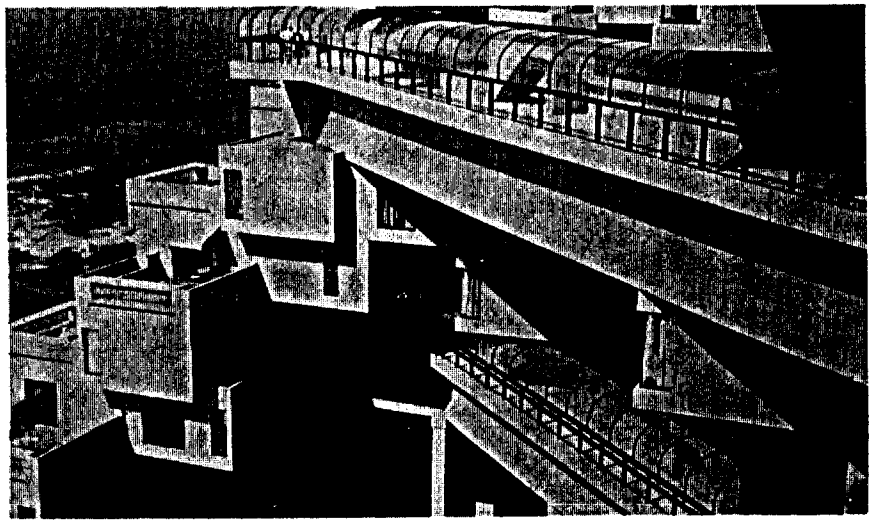
Barn
Glen Haven, Michigan
anon.
FJ

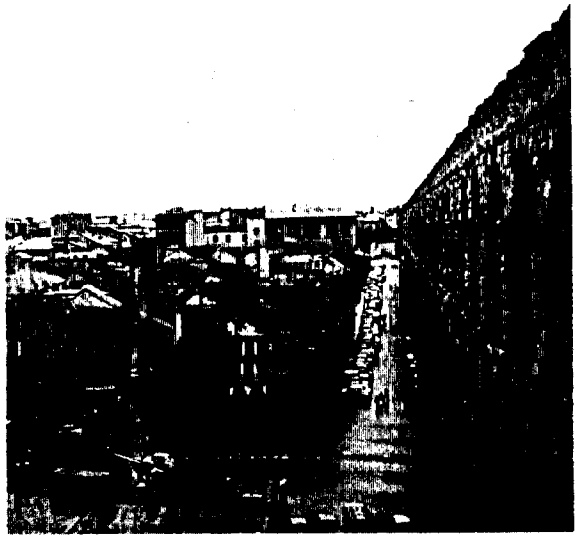












The three element types have intrinsic characteristics in an architectural context. Lines denote direction (along the line), significant end points (at the end of the line), and boundary (from end to end or side to side). Intersections of lines identify a third point with more 'content' than the end points. This 'content' can be described as the resulting reference point (the intersection) from which relative judgments of distance and angle of intersection can be made. There are the following Gestalt implications for the various angle sizes formed by the intersection of lines, planes or volumes: an acute angle implies direction toward the apex of the angle; a 90 degree intersection implies discontinuation of the surfaces at the apex and less direction than acute or obtuse angles; an obtuse angle or curve implies continuation along the surface forming the angle. In addition, they all imply closure; the more obtuse the angle the softer the sense of closure.

Dynamic qualities of architectural form provide another yardstick by which we can analyze the built environment. The word dynamic will be used here to mean a situation in which a visual stimulus requires the viewer to make relational judgments between characteristics of

Plane separating activities
Sequence and color contrast
to enhance separation.

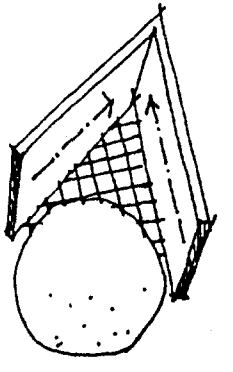
Kresge College
University of California
1973
Sana Cruz, Calif.
MLTW/Turnbull Assoc. and
Charles Moore Assoc.
WA

Scale dominance of lines over volumes.

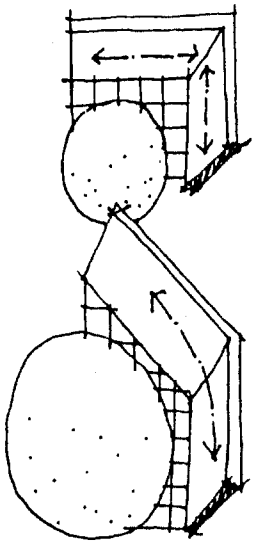
Habitat 67
1967
Montreal, Canada
Moshe Safdie
RB

Scale dominance of planes over volumes.

Roman aguaduct
Segovia, Spain
FJ



form or space. The stronger the stimulus the more dynamic the situation. For example, the sense of direction along an axis is dynamic. The longer and more directional a volume or plane, the more dynamic it becomes, i.e., the more it requires the viewer to recognize its directionality. If we accept the Gestalt viewpoint, we can build a hierarchy of importance to the viewer based on the dynamics of a situation presented to the viewer from a particular location in an architectural composition. A hierarchy based on dynamic qualities looks like this: first, ground is more dynamic than figure,[12] orientation off axis is more dynamic than on axis, implied relationships are more dynamic than completed forms, and direction in completed forms is more dynamic than forms without direction. Within these levels scale provides an intermediate hierarchy. The dynamic quality of ground in a figure/ground relationship meets our definition of dynamic because it backs focus, and because of this it makes us feel uncomfortable. This discomfort motivates us to look around until we see figures to fixate on and can coordinate our activities in relation to them, thus alleviating our discomfort. Similarly, because of our sense of equilibrium, we find relationships that are not vertical, horizontal,



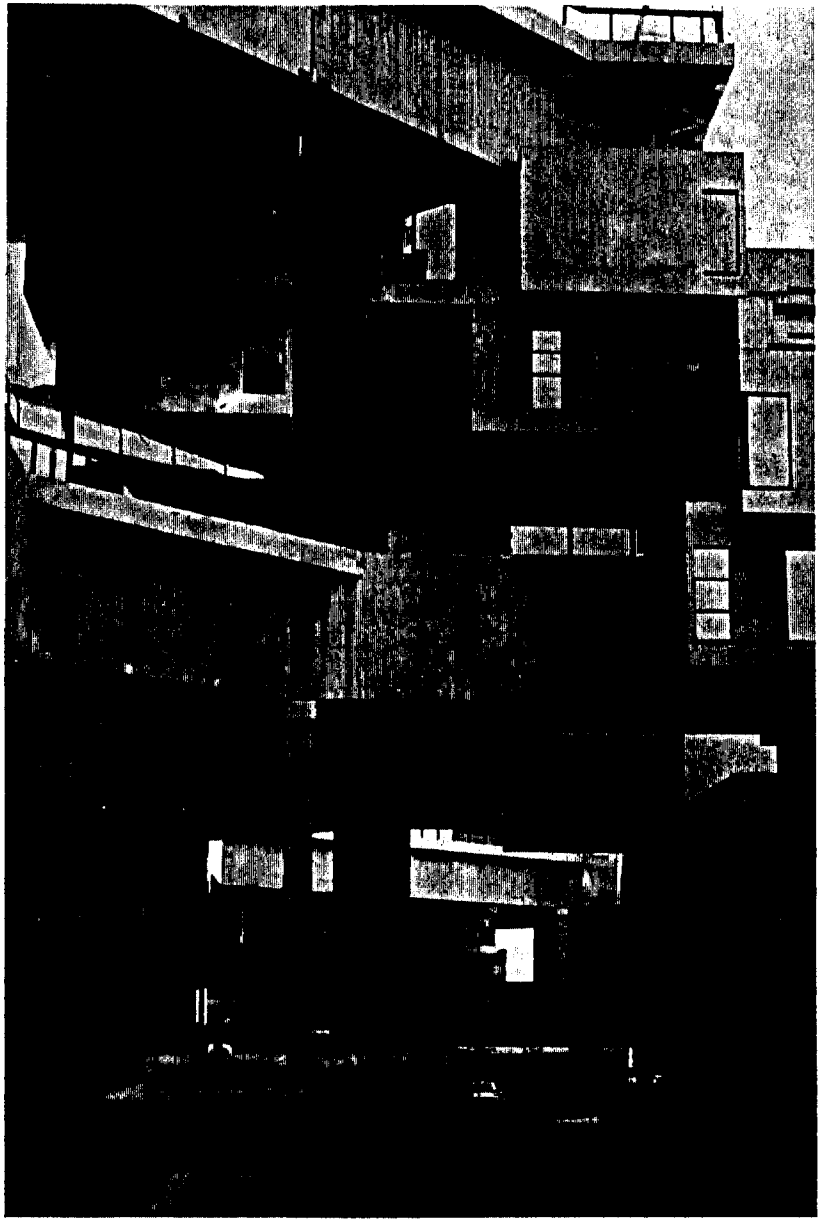
Acute to obtuse angles of intersection.
Implied closure
Dynamics of an unbalanced composition.

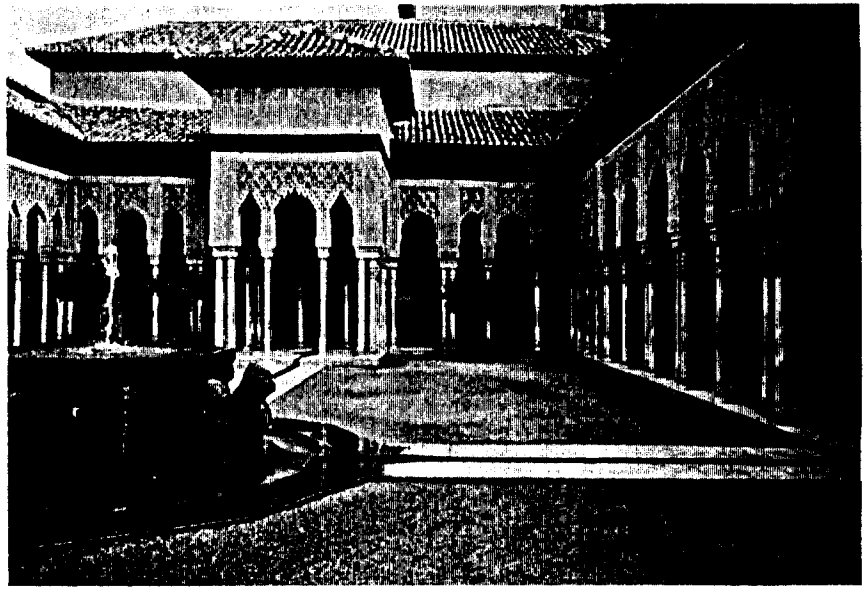
Habitat 67
1967
Montreal, Canada
Moshe Safdie
WA

Dynamic off-axis orientation.
Reinforced center of gravity.

Alhambra
1230
Granada, Spain
FJ

12
Leonard, Michael, 'Humanizing Space,' in Progressive Architecture, April 1969. p. 128



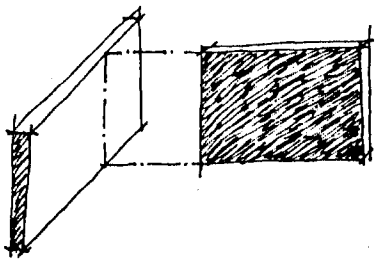


or parallel with our view point dynamic.[13] They require us to make quantitative judgments to stabilize our and the object's relationship to the environment. Obviously, the more an object is out of equilibrium, the more strongly we sense it. These sensations can be hierarchically ordered, and the strongest is the most significant. Implied relationships are more dynamic than completed ones because they demand the viewer to complete the composition. For example, two planes implying intersection because of their directional quality would make the viewer provide the continuation to make the form 'good' in the Gestalt sense.

Venturi suggested, in Complexity and Contradiction in Architecture, that a designer could superimpose different form/space organizations to reflect the complexity of any real design problem and that in doing so he would heighten the user's perception and enjoyment of the final solution. He states "if the source of both-and phenomena (double function of a space) is contradiction, its basis is hierarchy, which yields several levels of meaning among elements with varying values.

...Simultaneous perception of a multiplicity of levels involves struggles and hesitations for the observer, and makes his perception

[13] 'Humanizing Space, p. 129



more vivid."[14] The hierarchies of form/space are developed by contrasts in their characteristics which yield logical sequences of perceptual stimulation. The strength of a designer comes in his ability to organize forms/spaces to produce the hierarchies he intends.

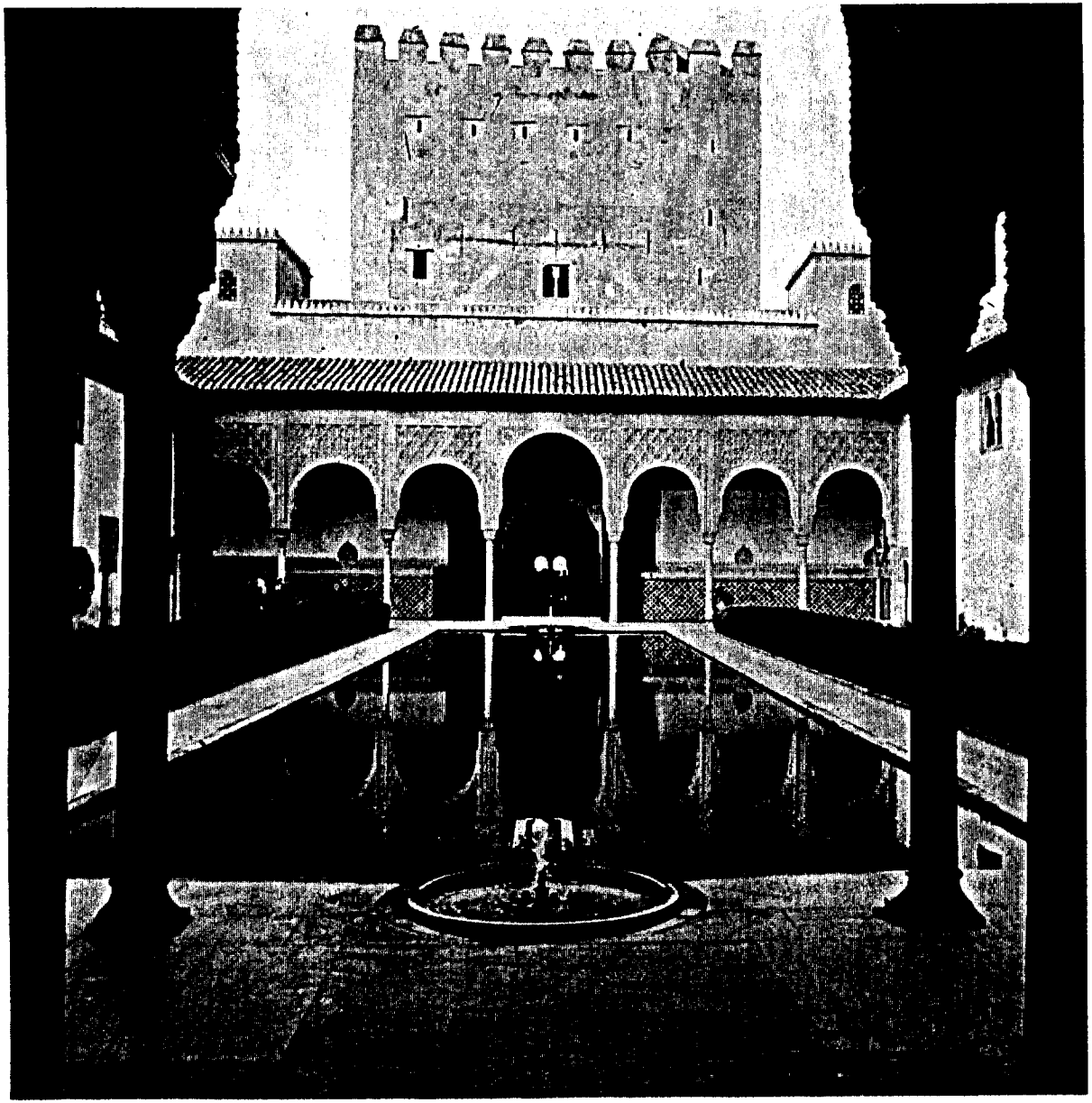
14 Venturi, Robert, Complexity and Contradiction in Architecture, The Museum of Modern Art, New York, 1966.

Static on-axis orientation.
Linear perspective
Axial symmetry
Major axes domination

Alhambra
1230
Granada, Spain
FJ

Directionality of an acute volume intersection.
Dynamics of a figure/ground relationship.
Dynamics of a non-axial relationship.
Dramatic edge contrast

Alhambra
1230
Granada, Spain
FJ

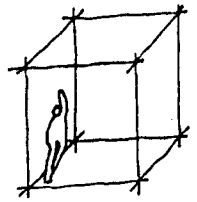


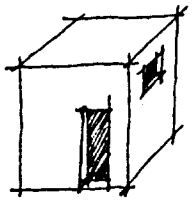
A Room in Context

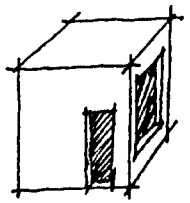
This chapter takes the elements of architectural composition and analyzes them in relation to standard architectural configurations for rooms and groupings of rooms. Architecture is the organization of rooms into a perceptual whole, i.e. composition. The composition is the context in which the room has meaning and the composition in turn, is part of some larger context. We will look first at "the room", and slowly move from there out into the potentials of various patterns and sequences that form compositions. The line at which one thing forms the context for another is vague and is in a perceptual sense relative to the objectives of the viewer. In architecture, the context in which an object is situated is always larger in scale than the object. The context, by definition, has meaning in relation to the object, and it is the architect's responsibility to control the context in which one perceives part of a architectural composition so that it reflects his concerns no matter at what location the viewer draws the object/context line.

We will approach the standard architectural configuration for rooms by logically deforming a neutral room/space and analyzing each defor-

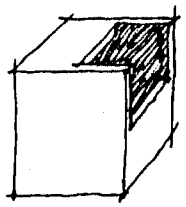
mation separately. The analysis will again stress hierarchies inherent in various degrees of form deformation, because it is through an understanding of hierarchies that we can relate changes in form to their meaning in context. The neutral room/space selected for deformation is a 12 foot cube. It was chosen because it is easily within the range of good depth perception and even a good intuitive/tactile perception can be expected. It also somewhat minimizes the importance of the viewer's location, which becomes more critical as the size of a space grows. We can describe this neutral space from the inside as being a static volume with its center of gravity centered on itself and having no links to any outside context. The first, and most basic, manipulation we can do with this space is to create minimal links between it and the surrounding environment. This is done by making holes (doors and windows) in it from which we can view the outside environment. The resulting form might be considered a 'place' for a function to occur. The position, size, shape and number of openings has a great effect on the 'personality of the space'. Let us consider one opening, a window: as it increases in size, there is a corresponding growth in the spaces relation to the outside

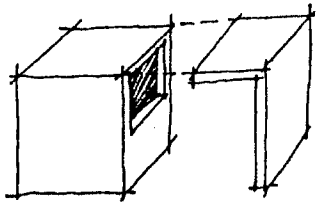






environment. This relationship can be enhanced or diminished by window location. Thus, the location and shape of the windows express the intention of the designer to control the space's relationship to the exterior environment. The significance of this relationship is dependent on the physical or social interest inherent both inside and outside the room and on how well the opening focuses our view on the salient features of the outside environment. Window shape, especially as the openings increase in size, affects our sense of the form of our neutral space. The more horizontal or vertical the opening's shape, the more the room takes on the same perceptual quality. Our response to the location of openings has a great deal to do with our expectation of what is normal. Departures from the norm heighten the significance of the opening. As openings move above our horizon line, our sense of enclosure by the walls increases. As openings move below our horizon, our sense of closure by the roof increases. These sensations become more significant as the openings increase in size and number and begin to encroach on the corners of the space. As corners give way to openings, our sense of closure in the space decreases and the opportunity for connection with the exterior context increases.



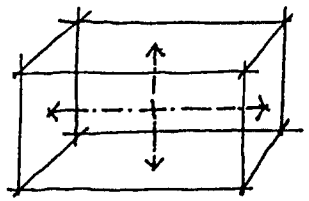


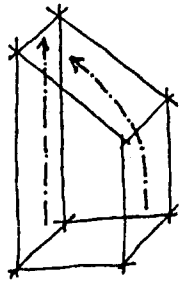
Implied continuation of form from inside to outside provides the strongest connections between two spaces. As these connections multiply, the spaces become intimately related and their centers of gravity as experienced from either space tend to move toward a common center of gravity. At some point on this continuum, a common center of gravity is attained at which time we can consider the two spaces as one.

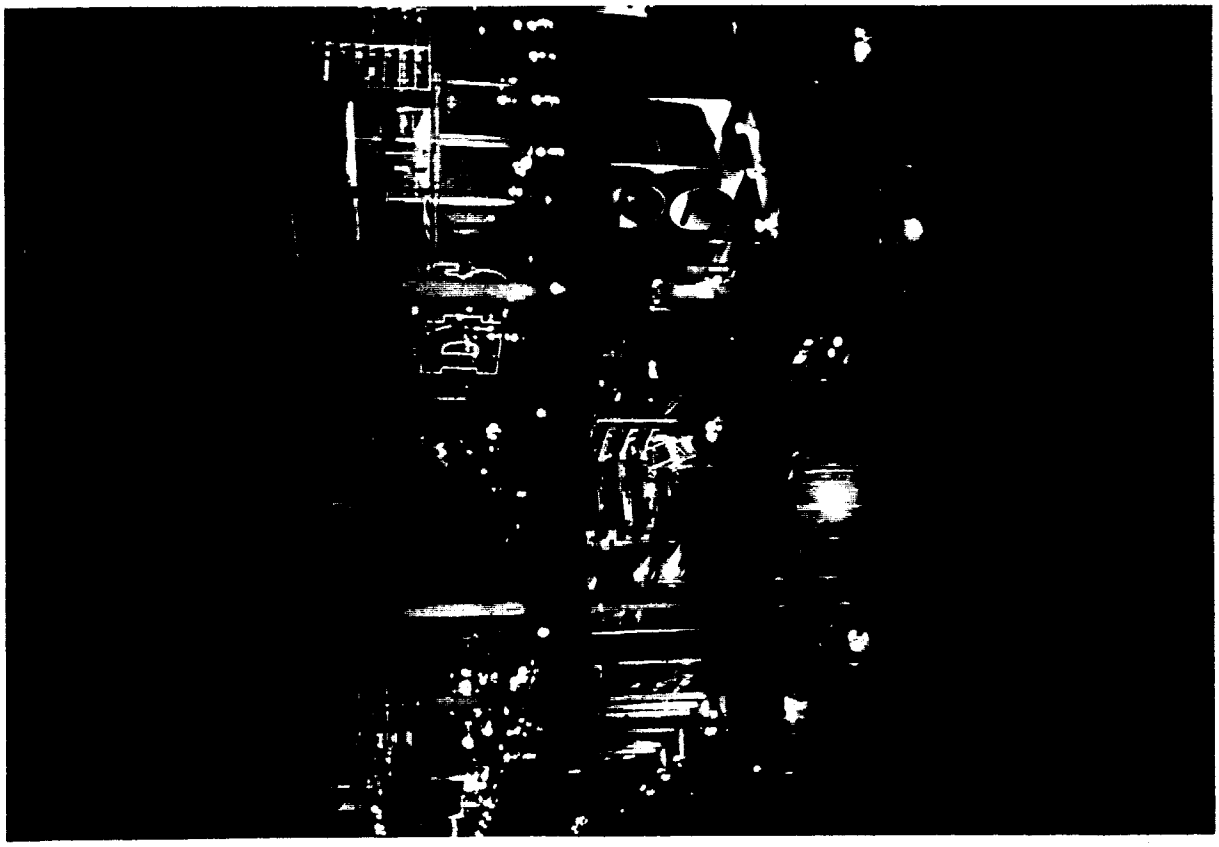
The second, and again basic, deformation we can make on our neutral cube is one of form. The simplest change is to expand parallel walls to give direction. This action generates a hierarchy of importance based on the length of the major and minor axes, with the contrast between the two providing the scale by which to judge the relative strength of various axes. The next level of deformation of the cube consists of extending two rectangular sides which have a common edge. This produces a space that is internally directional toward the edge formed by the two planes intersecting at an obtuse angle. The quality of links with the external environment again depends upon destroying the edges; but because the form is internally directional, destroying the edge that is produced by the acute intersection of two planes provides the greater potential for

Maximum relationship to the outside environment.
Planar vocabulary.

Design Research
1969
Cambridge, Mass.
Benjamin Thompson
NG

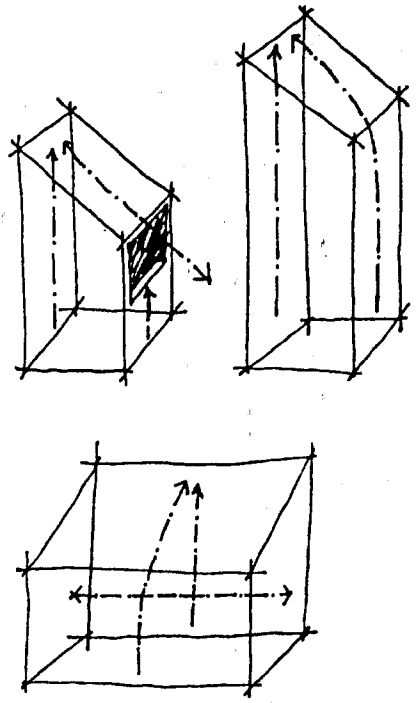






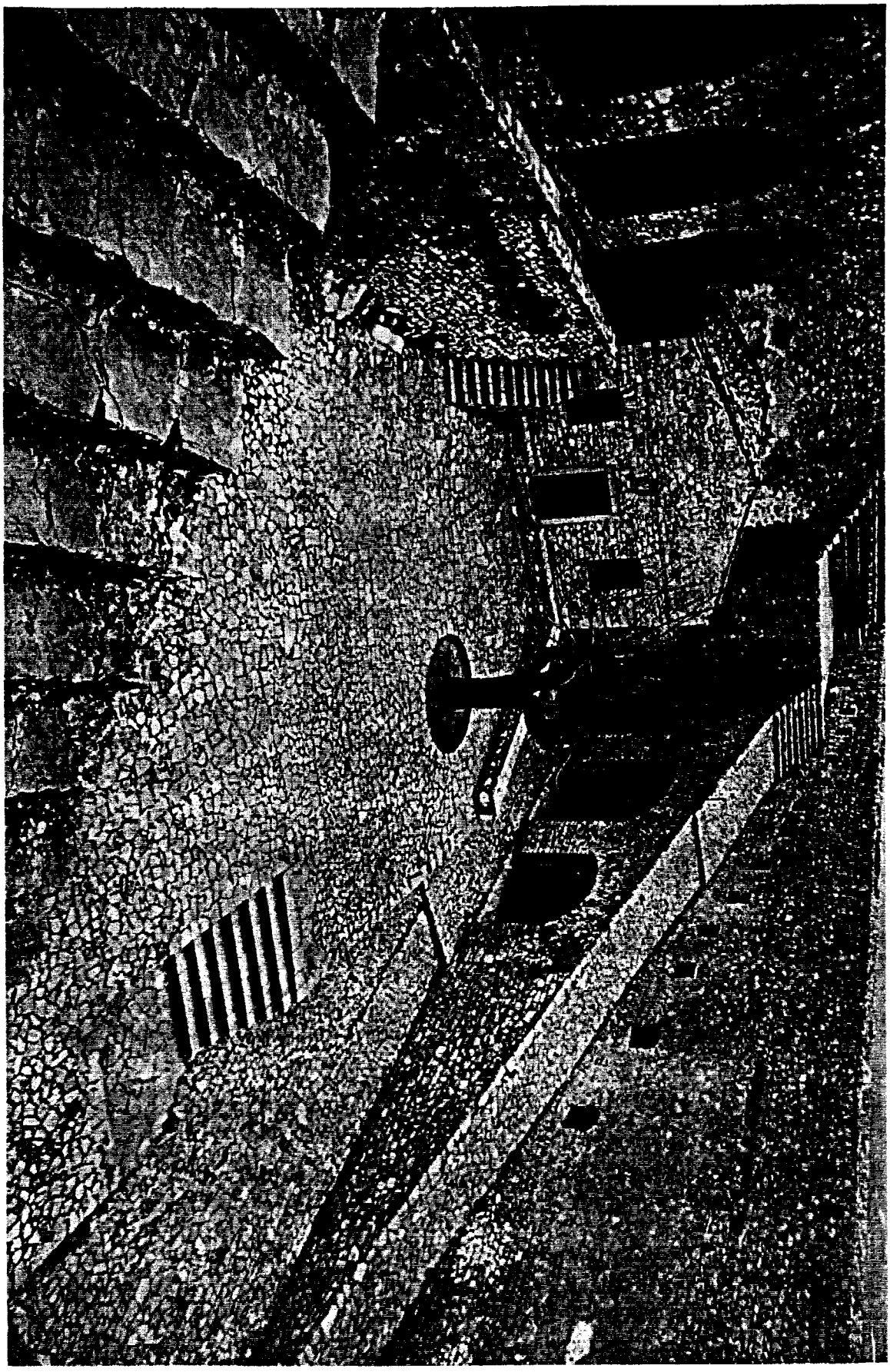
connection with the exterior environment if all other variables remain the same. Destroying the edge with good continuation lessens the directional quality of the space considerably. Combining parallel expansion with intersecting plane expansion produces forms with characteristics that can be directionally reinforcing or multi-directional. Multiple use of both of these ways of deforming a cube produces irregular shapes which are dynamic because of the multi-directional quality of the resulting space. In these cases, the spatial characteristics that imply direction as well as the ones that imply links with the exterior environment are essentially the same as those in simpler deformations.

Some thought must be given now to other regular geometric forms (hexagons, octagons, etc.) commonly used in architecture. In comparison to the cube, or forms derived essentially from deformations of the cube, these other regular geometric forms have more edges (therefore more obtuse surface intersections) and tend to have better continuation from surface to surface. At some point, as edges are added to regular geometric forms, the inside surfaces are perceived as continuous or essentially a curved surface. The stronger the sense of curvature, the more

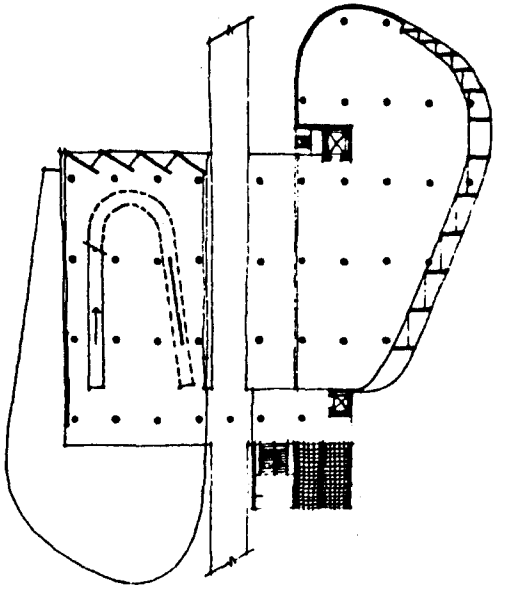


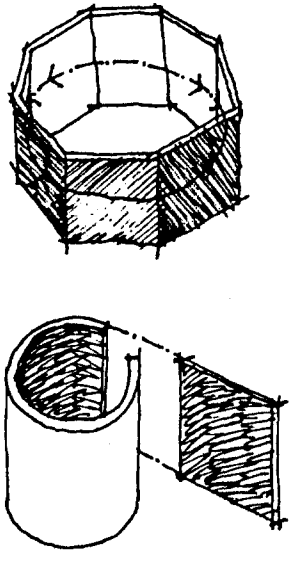
Multi-directional space.
Direction into an acute angle.
Significance of the upward direction.
Texture continuity

Venetian Fort
15th c.
Naflion, Greece
FJ



extreme the center orientation of the space becomes. This characteristic gives these forms more potential for a 'both/and' situation as their surfaces are penetrated and links with the outside are developed. Axial expansion is possible with these regular geometric forms, and their expansion generates the same hierarchical effect that we have seen in the similar expansion of rectangular forms. And finally, as curve surfaces develop, we lose much of our distance and scale perception for lack of visual clues. This fosters an extremely dynamic situation which makes contrasts with it vivid.





Dynamic curvature.
Multiple grid patterns.

Carpenter Center
1964
Cambridge, Mass.
Le Corbusier
KF

Patterns and Sequence

An architectural composition of room size space/forms is held together by patterns and sequences. In all physical design situations, the architect is organizing a total composition within a physical and social context. The characteristics of patterns and sequences form the grammar by which such compositions are developed and understood, and it is a necessity that the architect know them. A pattern is composed of combinations of repetitive elements. Different types of patterns are formed by different types of element combinations. A sequence is composed of a linear

perception of elements having characteristics that relate them as well as ones that amplify their differences. A sequence can be organized as a controlled contrast of elements with implied hierarchical and directional significance.

Man's ability to perceive patterns and sequences is severely limited by his capacity to recall information. Though there have been no rigorous studies to determine the maximum complexity of architectural sequecnes that can be remembered, one would guess, based on tests of alphabetic sequences, that typically only 3 to 5 different variables can be perceived. A composition

may contain many more variables, but the perceived ones will be those 3 to 5 variables with the greatest contrast or similarity. The architect should keep this in mind, for manipulating too many variables can be a waste of effort. However, understanding of an environment need not rest entirely on the user's ability to recall information. An architect may refresh the user's memory by giving him a number of vantage points within the composition from which to survey where he has been and where he is going. This allows him to read the composition carefully without relaying exclusively on recall.

Patterns grouping by similarity and proximity.
Rhythm
Compositional termination

Peabody Terrace
Housing, Harvard University
1964
Cambridge, Mass.
Jose Louis Sert
FJ

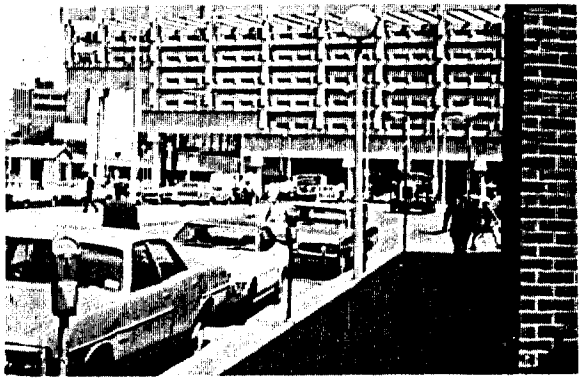
Overview of a sequence

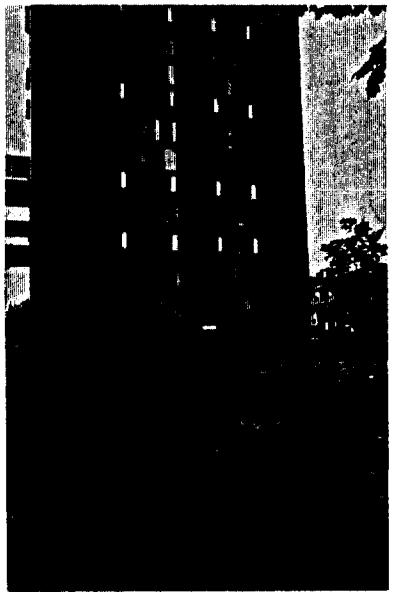
Design Research
1969
Cambridge, Mass
Benjamin Thompson
MG

Parking Garage
Boston, Mass.
Gerhard Kallman
FJ

15

Simon, H., and Kotowsky, K., ' Human Acquisition of Concepts for Sequential Patterns,' in Psychological Review, Vol. 70 No. 6 ,1963. pp. 534-546.



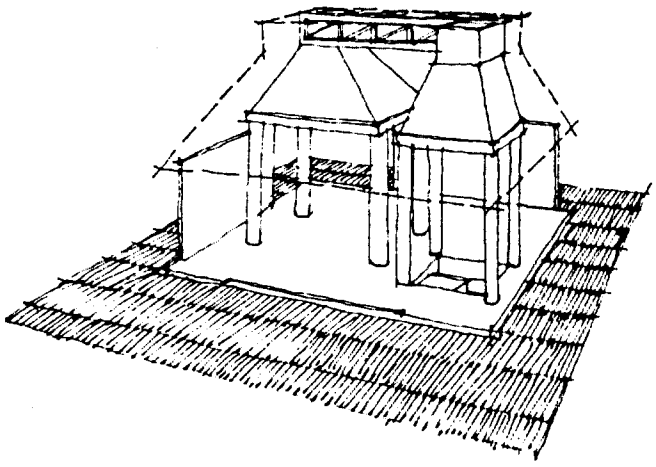


A sequence is composed of places and transitions differentiated from each other by contrasts and related to each other by similarities. Contrast and similarity between elements are based on relationships of scale, mass, static vs. dynamic qualities, color, light, texture, continuation or discontinuity, pattern and cultural significance, open vs. closed, public vs. private, exterior vs. interior and proximity. As an example, one might use warm colors to identify place while using cool colors to identify transition (contrast), yet hold the color brightnesses and saturation the same (similarity) to provide continuity.

Patterns have some basic configurations that are gestalts. They include similarity, symmetry, and various alignments of grids, radial patterns, interlocking and nesting forms. An architectural composition of space/form is a balancing of the interrelationships between each space/form element and its physical context. We may simplify our analysis by looking at the hierarchies that can be perceived between two space/forms in different relationships to each other. A total composition must be treated as the cumulative effect of the relationships of each space/form to all other space/forms that make

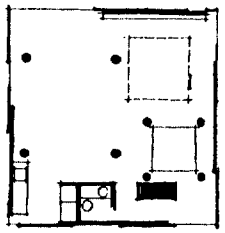
up its context. The possible relationships are: one element is inside the other, one is penetrating the other, they are adjacent, and they are separated by some distance.

At building scale, if one element is inside another, the relationship can be described as a figure in a background. The sequential hierarchy experienced in such a situation is the dominance of the larger space over the smaller one. Scale is the dominant contrasting characteristic, while the sense of closure--one upon the other--is the relationship that binds them together. The smaller element gains more significance for the observer if it is located at the center of focus of the enclosing space and exhibits some cultural meaning. The ceremonial center of a cathedral provides the best example of this phenomenon.



Element within element
Implied closure
Strong relationship of smaller spaces to their larger context because of the extensive openness of the smaller spaces.

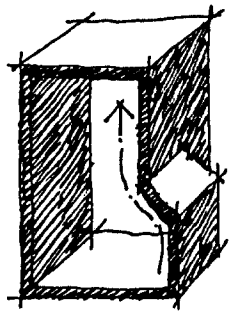
Moore House
1965
Orinda, Calif.
Charles Moore
KF



Two elements can be inter-penetrating. In this case, hierarchy between the forms is based first on their difference in scale; and if there is none, it is then based on

the relative strength of the gestalts formed by the dynamic characteristics of the spaces. The domination of smaller spaces by larger ones is typically reinforced by the dynamic qualities of the smaller space. However, contrast can be used effectively in such circumstances to strengthen the sense of sequence. while maintaining the dominance of the larger space. If the intersecting spaces are of similar size, the one exhibiting the stronger sense of closure or penetration will dominate.

There are a number of characteristics of space/form relationships that we instinctively perceive as hierarchically ordered. End points in a linear composition seem to us to have more significance than other locations within the composition. If there is a change in level, the upward direction is more significant than the downward. Lighter spaces tend to have more significance than dark ones in our culture because we expect activities to occur in them. If a total composition has a center of gravity, it will dominate. And if it has a major axis, that too will dominate. Larger elements are dominant over smaller ones. Good architects use these principles of hierarchy to form spatial sequences that orient the user to the spaces and to their relationship in the

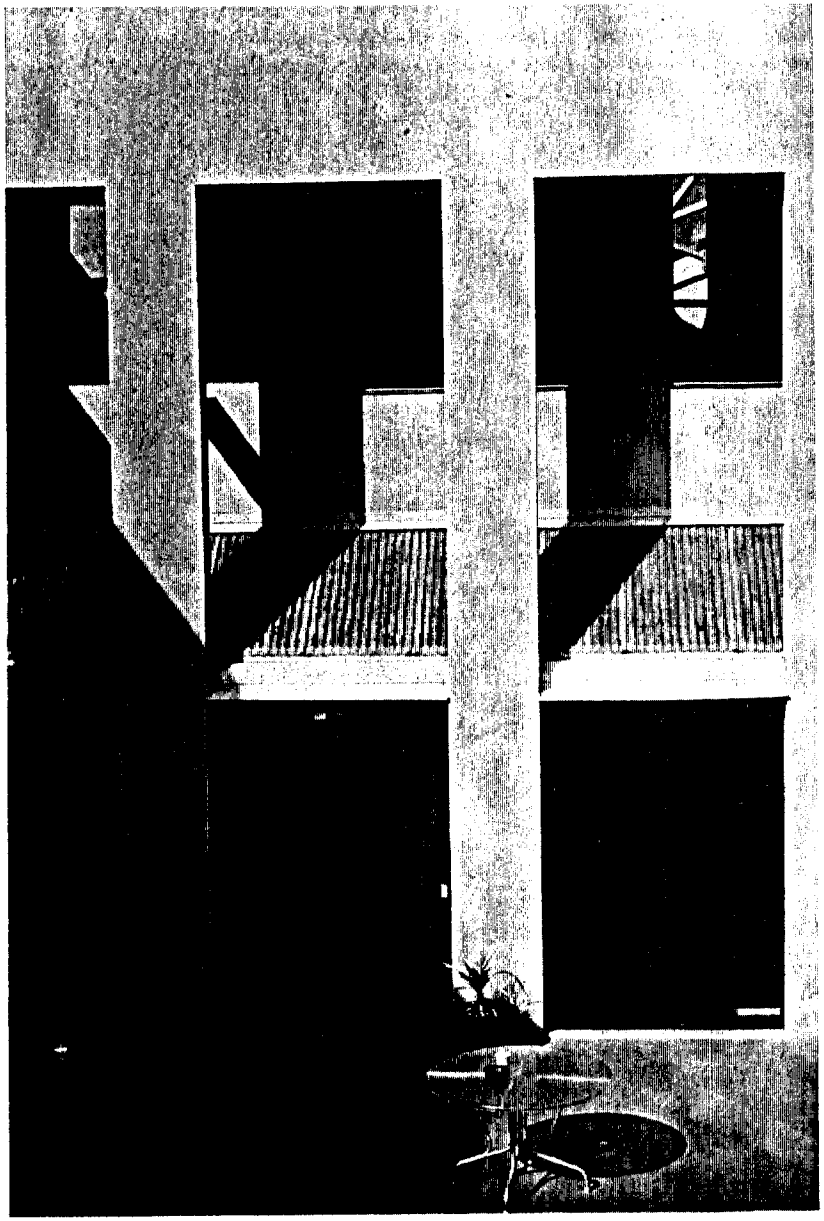


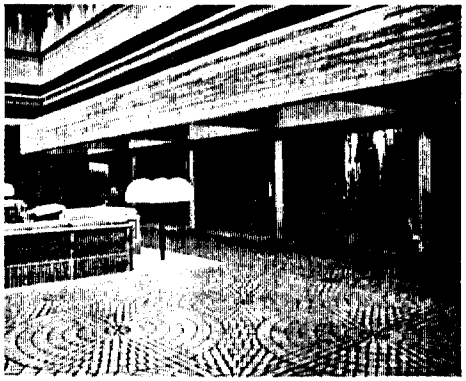
Inter-penetrating space
Scale dominance
Closure by walls enhanced by high windows.

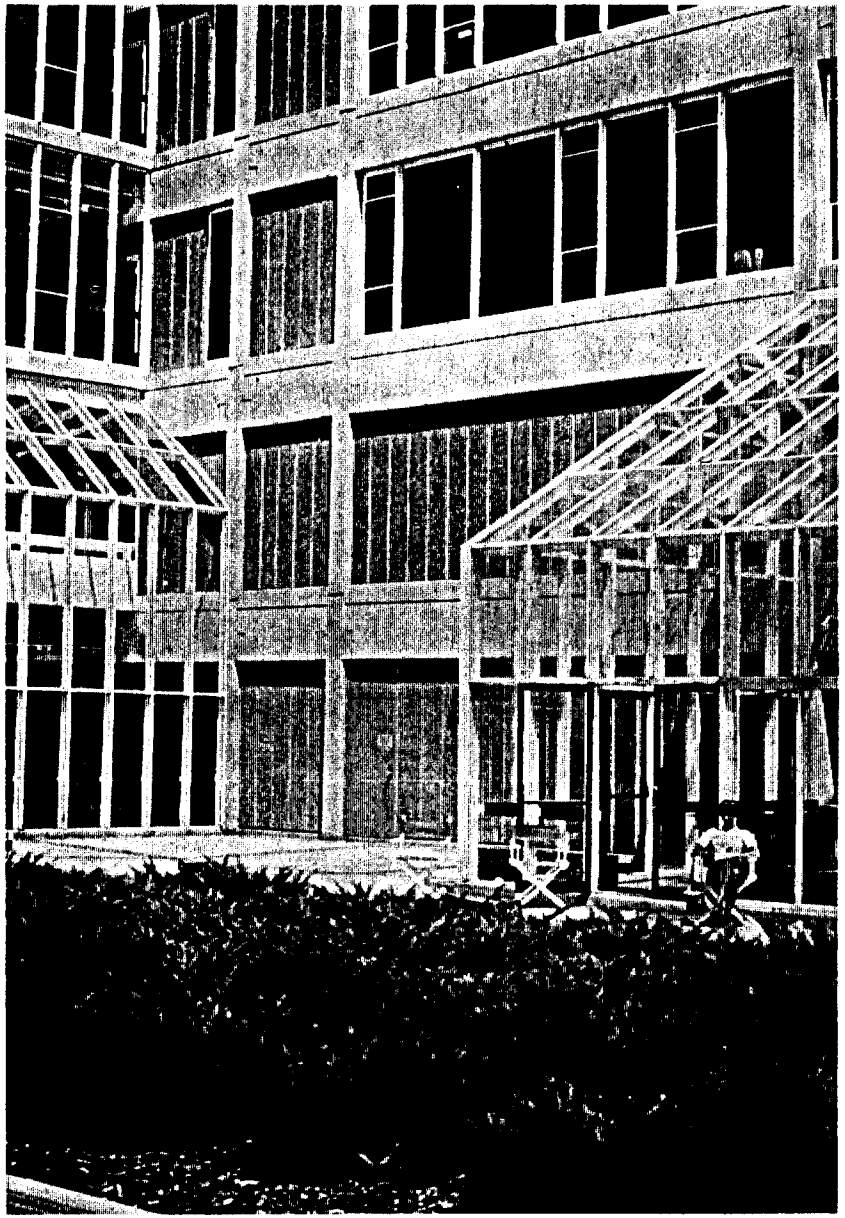
Dorm at Brynmawr
Brynmawr, Pa.
Louis Kahn
TM

Planar vocabulary developing sequence.
Inter-penetrating space.
Scale dominance.

Faculty Club- University of Calif.
1966
Santa Barbara, Calif.
Moore, Lyndon, Turnbull, Whitaker
WA







total composition. Bad architecture disregards these principles and as likely as not suffers from misinterpretation based on our instinctive perceptions.

Patterns have implied hierarchies as well, and these can be used to reinforce organization concepts. The most widely used pattern is the rectangular grid. In its simplest form, its characteristics include edge similarity, constant space size and constant space shape, and some significance given to the edge intersections. One of the reasons for which this pattern is used so widely is its flexibility. It can be stretched along its axes to give direction to the composition; and within the pattern, sequences can be developed by varying the element sizes. Nesting and interlocking forms can be developed by deforming the grid. Its use has become standard in designing housing units with varying numbers of bedrooms. Other even more complicated element nests have been produced to provide different size spaces in repetitive compositions.

There are other regular grid systems that have been used by architects to plan spaces. These include triangular grids, hexagonal grids, octagonal grids (which pack with rectangular grids), etc. These grids are not

Inter-penetrating space.
Scale dominance.
Texture contrast.

Regency Hyatt House
1971
Chicago, Ill.
John Portman
TH

Inter-penetrating space.
Scale dominance.
Contrast in mass and closure.

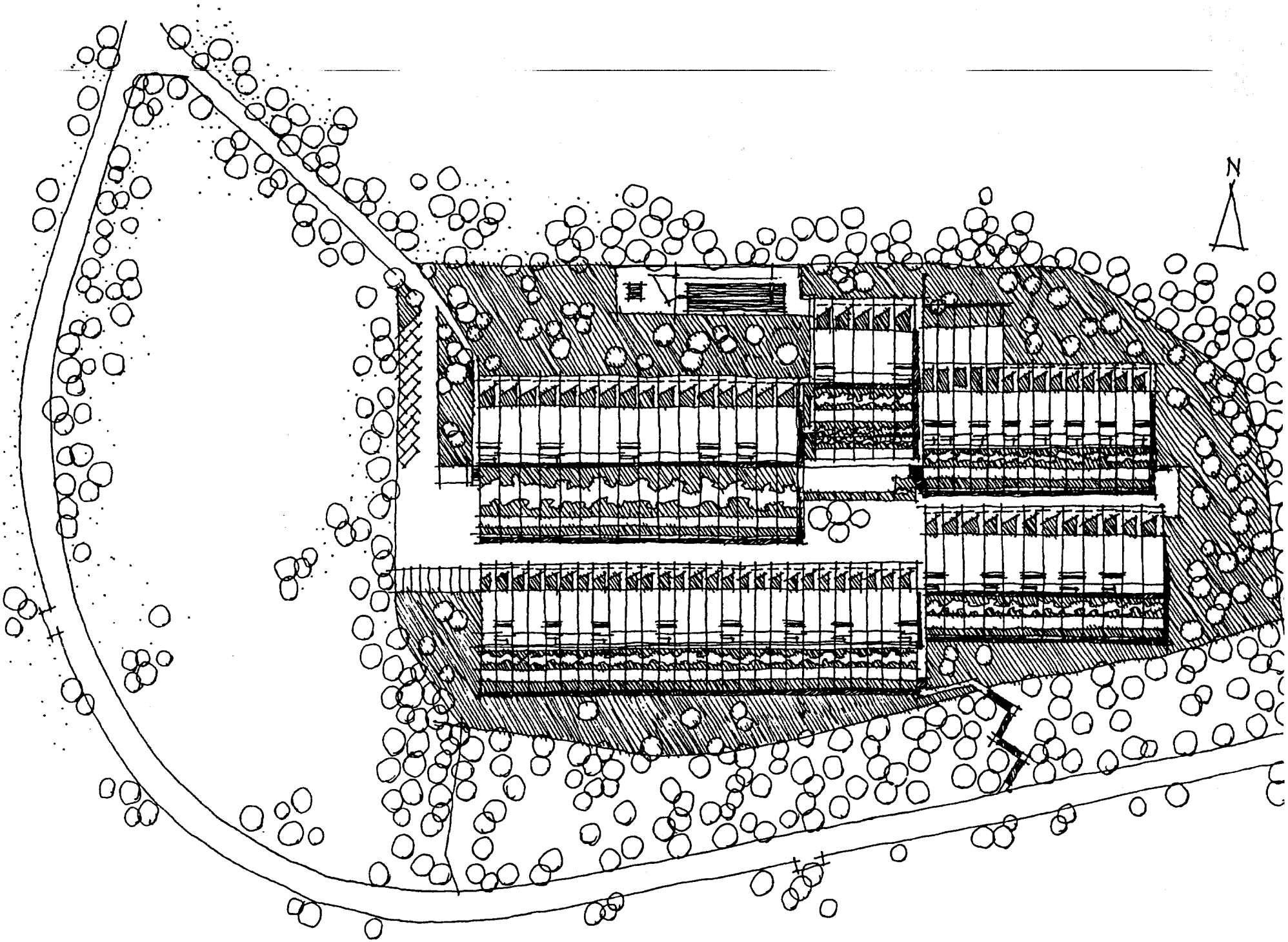
Harvard Science Complex
1972
Cambridge, Mass.
Jose Louis Sert
FJ

Inter-penetrating space.
Dynamic qualities of smaller forms reinforcing their secondary significance.
Scale dominance in form/space and axes.
Significant end point to a linear composition.

Barn
Sheboygan Co., Wis.
none
WA

Stretched grid to develop major and minor axes.
Center of composition emphasized by large scale space and path intersection.

Halen Development
1959
Bern, Switzerland
Atelier 5
KF


N

Square grid.
Dominance of larger grid over smaller.
Grouping by similarity.
Major and minor axes.
Symmetry of translation.

Richards Medical Research Building
1957
Philadelphia, Pa.
Louis Kahn
KF

Grid abutting large square.
Center of gravity dominance.
Scale dominance.
Sequence at entry developed along a dominant axis.

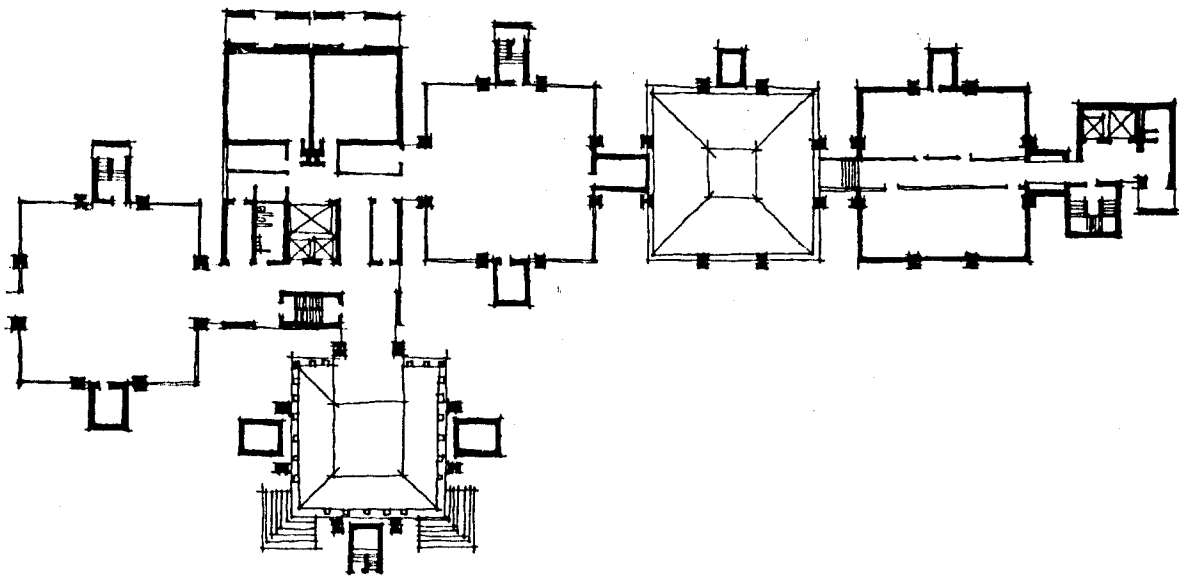
First Unitarian Church
1959
Rochester, N.Y.
Louis Kahn
KF

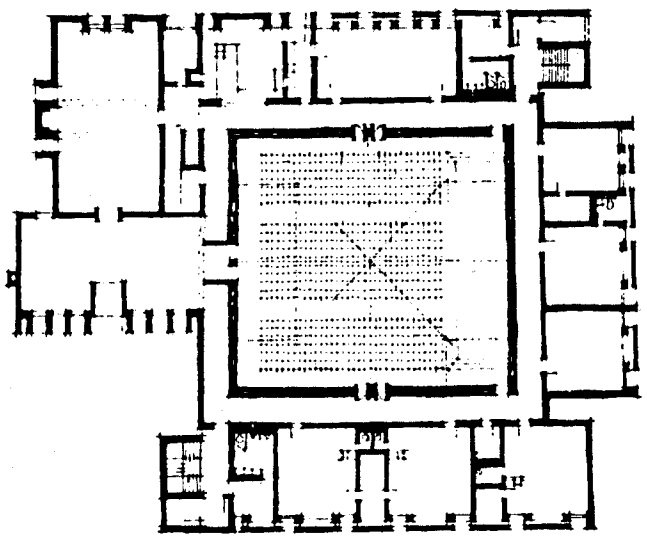
Importance of path intersection.
Center of gravity reinforced by open space texture
hierarchy and scale of adjacent buildings.

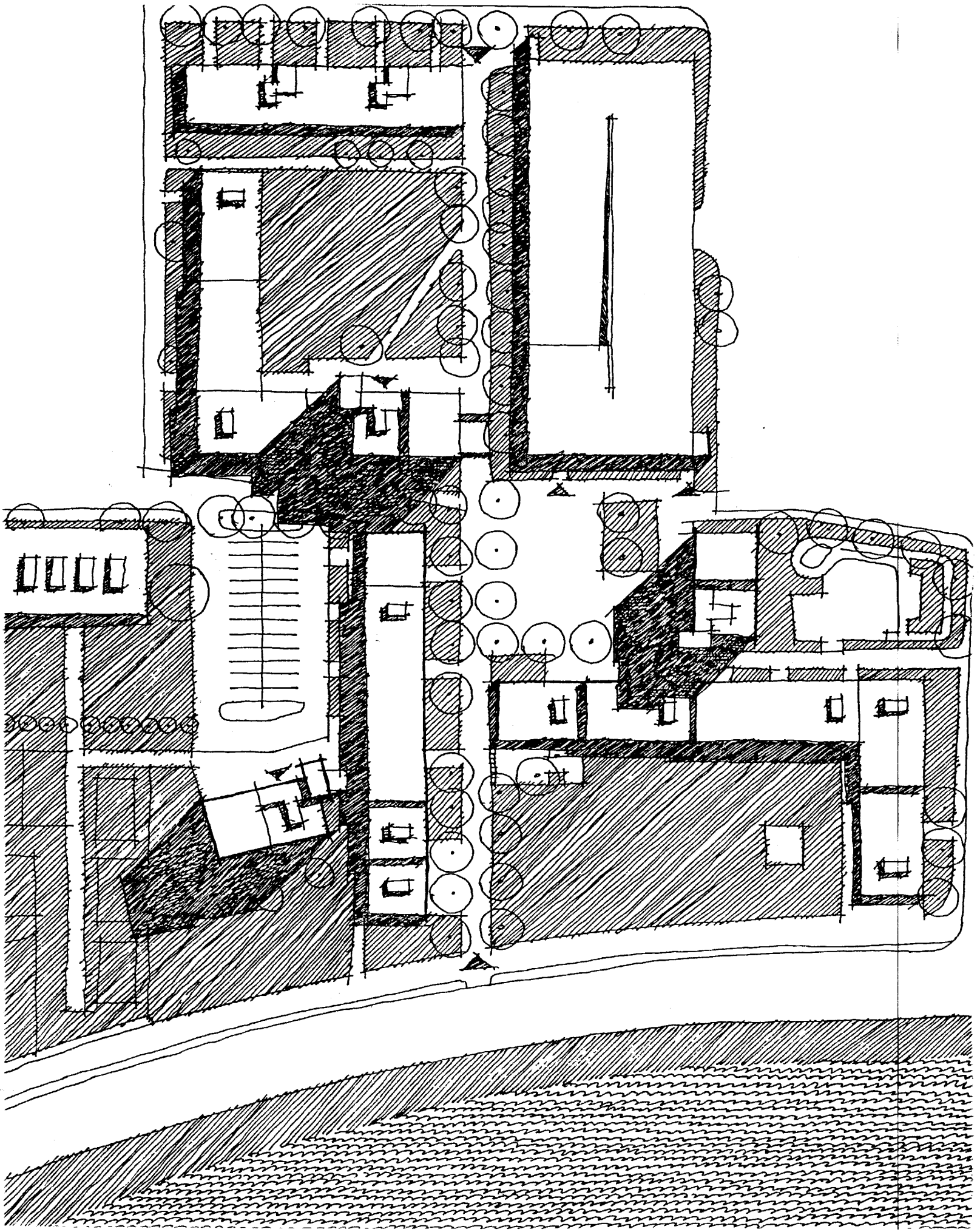
Peabody Terrace
Dorms, Harvard University
1964
Cambridge, Mass.
Jose Louis Sert
KF

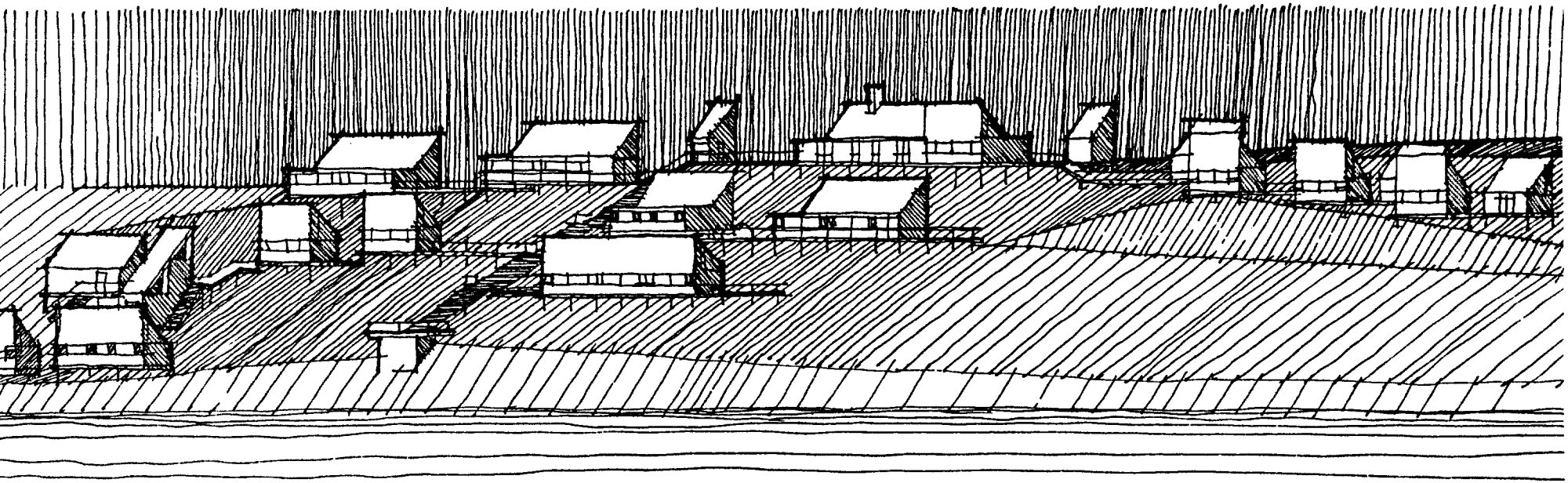
Stretched rectilinear grid.
Dominance of axes intersection reinforced by scale and density of elements.
Hierarchy based on significant vertical direction.

Haystack Mountain School of Crafts
1961
Deer Island, Maine
Edward Larabee Barnes
KF









as flexible as the rectangular grid and have some very rigid implied hierarchies that are appropriate to some situational needs. The hexagonal grid, for example, has better continuation along its sides than the rectangular grid, giving the space more inward focus. The octagonal grid is even more centrally focused; and where it has to nest with a rectangular grid, a spatial hierarchy of scale is produced in which the octagon is dominant. There are numerous geometric organizations with considerably different hierarchical orders. An architect might select one because its hierarchy fits a particular design situation. It is possible to invent a set of rules for comfortable transition from one grid type to another. These can allow a certain amount of flexibility, and the transformation rules become the perceivable pattern of network characteristics.

Another standard organization follows the radial pattern. It is either center-oriented (if the closure follows a circular pattern around a center) or dispersing and centering (if the closure follows radial lines from a point).

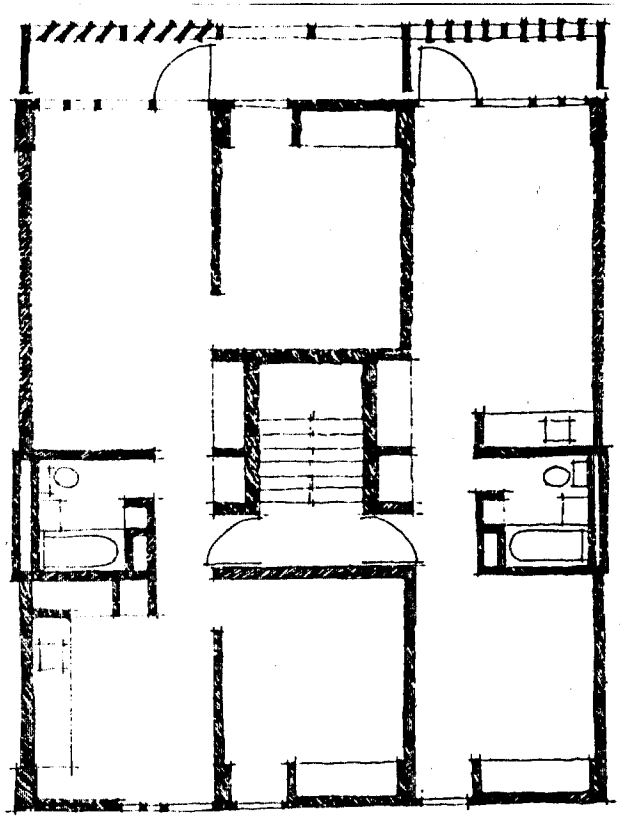
Finally, there are the regular organizational patterns of symmetry. There are 3 basic types of symmetry: rotation, translation, and reflection. Symmetry hinges on the rela-

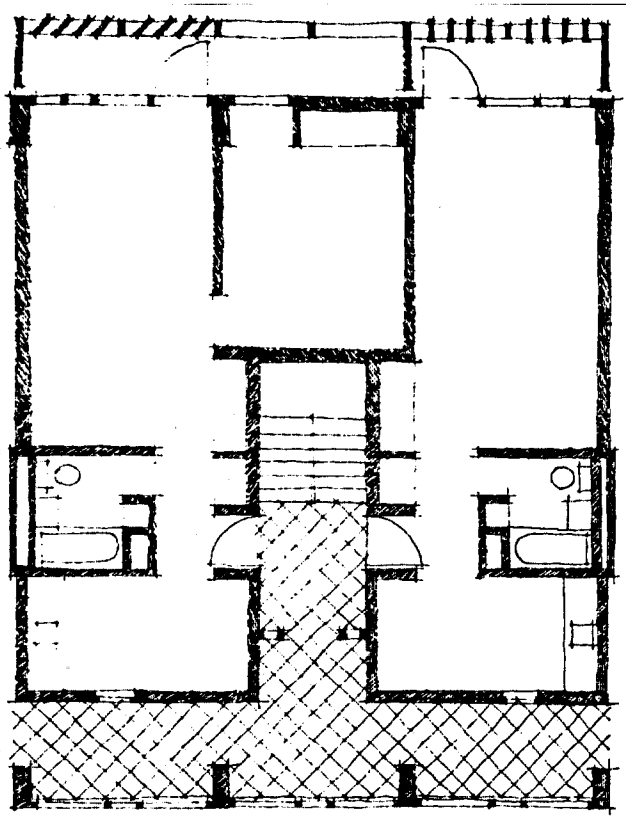
Nesting rectilinear forms.

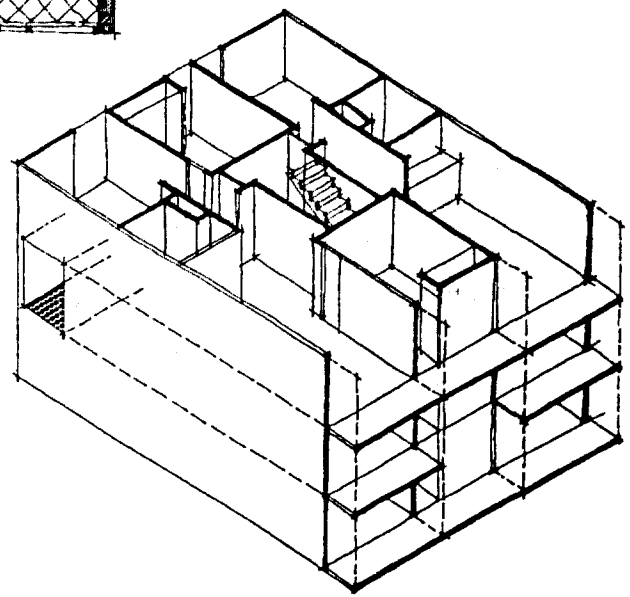
Peabody Terrace
Dorms, Harvard University
1964
Cambridge, Mass.
Jose Louis Sert
KF

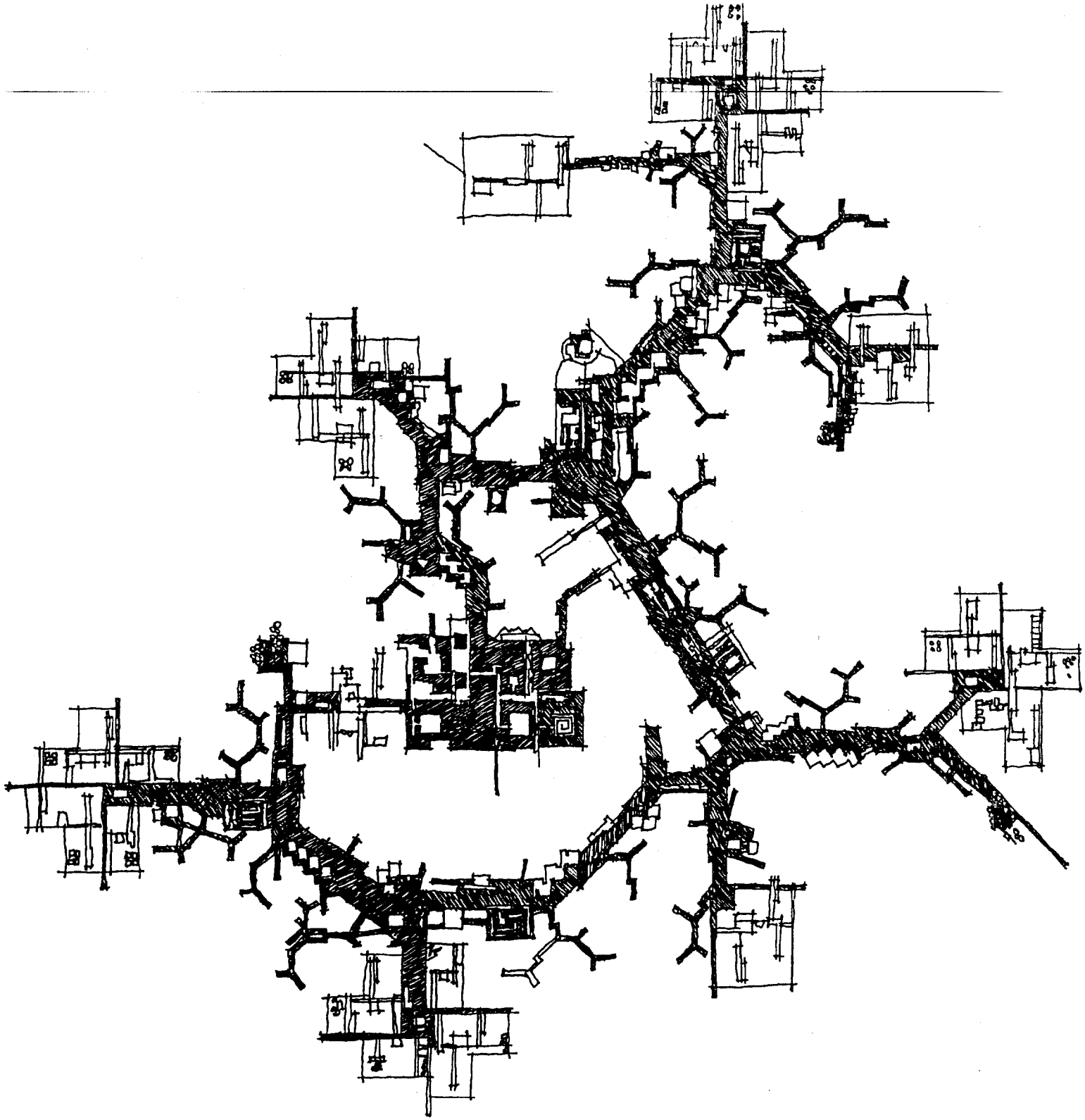
Flexible network based on a hexagonal and rectilinear grid.

Toulouse-le Mirail Project
1961
Candilis-Josic-Woods
KF









tion to an axis or center, and the Gestalt laws of similarity and symmetry say that we will perceive such organizations as groups of related elements. Thus, we can use symmetry to relate what otherwise might be considered unrelated elements.

We also must look at how two dissimilar patterns can intersect or overlap to produce hierarchies of significance. The most prevalent example of pattern intersection is that of one rectangular grid intersecting with another or larger scale and different orientation. While both patterns have similar characteristics, the interruption of the finer grain grid by the larger one produces a diagonal or tension or contrast which is more significant to a viewer than uninterrupted cells in the smaller pattern. Urban patterns with diagonal streets are an example. The diagonal usually becomes a major axis often leading to some significant location in the city as an end point. High land use and density usually evolve around such diagonals.

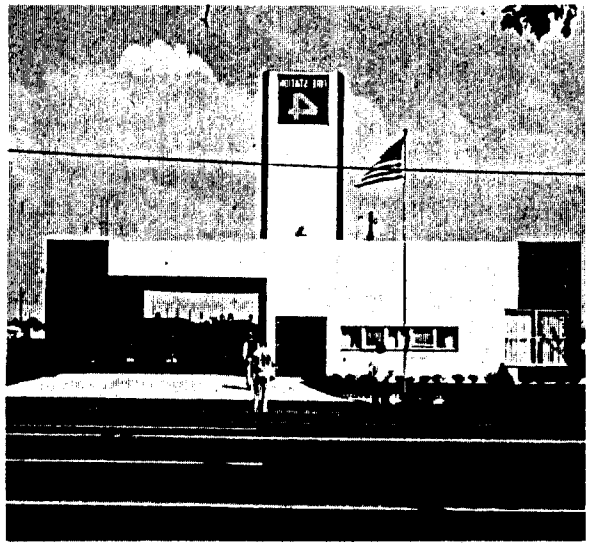
Superimposed patterns at the same scale produce either a new pattern or a situation in which the patterns can be recognized alternately. Alternating perceptions provide the 'both/and' characteristics that Venturi describes. They enrich a

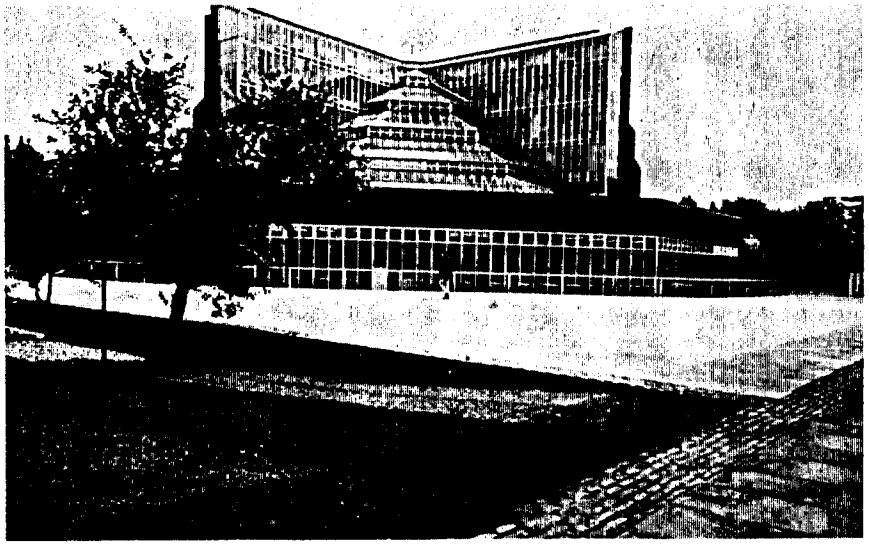
Symmetry
A square composition reflected about both its axes.
Positive/negative space and color contrast used to define the square.
non-symmetrical elements used for richness and tension.

Fire House 4
1967
Columbus Ind.
Robert Venturi
TM

Symmetry
Rotational and reflected.

History Building, Cambridge University
1966
Cambridge, England
James Stirling
FJ





composition, where each pattern may express a different meaning. Where they intersect, we get tension and the complexity of two forces in contrast.

Two or more patterns can abut in harmony forming an architectural composition with significance given to the axes formed by the adjacency or by the more complex pattern. In Aalto's New York apartments, we see a grid intersecting with a radial pattern. The grid or more common pattern is used for service spaces, while the radial pattern forms the housing which is the served space. An axis is formed at their intersection and becomes a major circulation line; progressive points on a perpendicular axis are used to radiate the walls of the apartment units.

Finally, we may recognize some non-regular patterns in buildings. These are styles and are usually particular to an individual architect or subculture. They are basically a set of form/spaces with particular characteristics which help the designer limit solution choices and give an overall cohesive quality to a composition through repetition and similarity. The shed roof style is an example. It is basically a grid in plan with all the possibilities a grid allows. In section, however,

A grid superimposed over a radial pattern.

Goldenberg House
1959
Rydal, Pa.
Louis Kahn
KF

Intersecting grid and radial pattern described in text.

Neue Vahr Apts.
1963
Bremen, Germany
Alvar Aalto
KF

Intersecting grid and radial pattern.

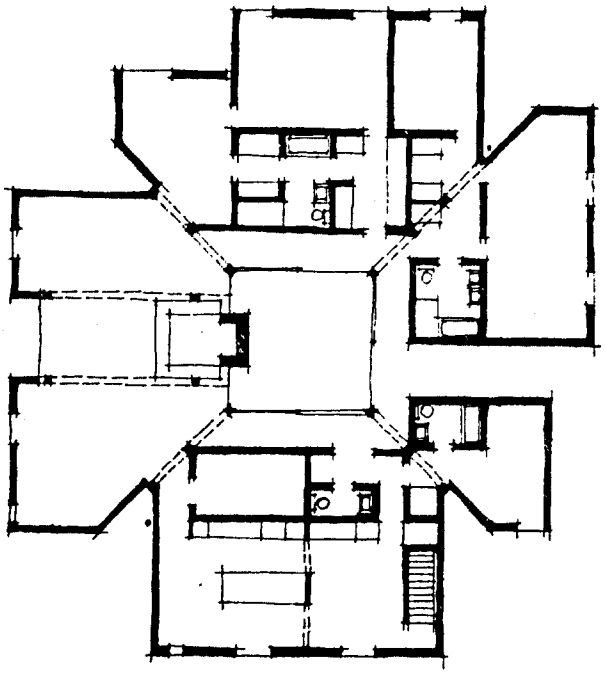
Wolfsburg Cultural Center
1958
Wolfsburg, Germany
Alvar Aalto
KF

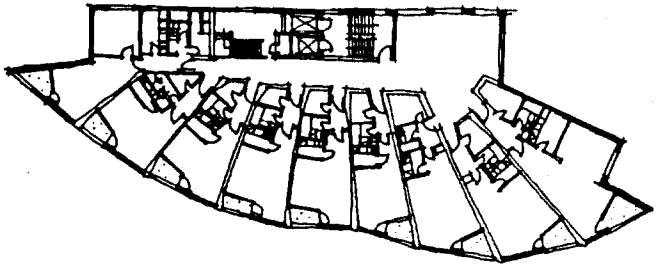
Radial plan intersecting with a grid.

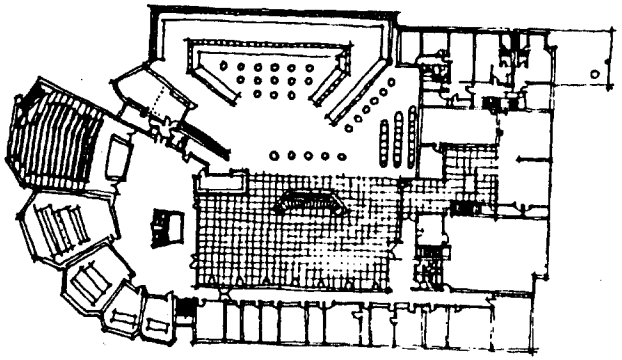
History Building Cambridge University
1966
Cambridge, England
James Stirling
KF

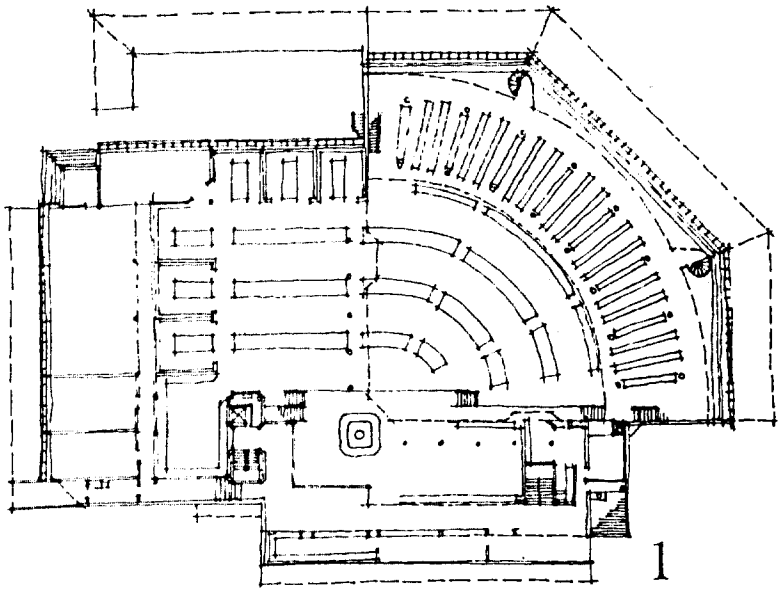
Centrally focused space.
Scale contrast expressed by viewing boxes.
Implied closure.

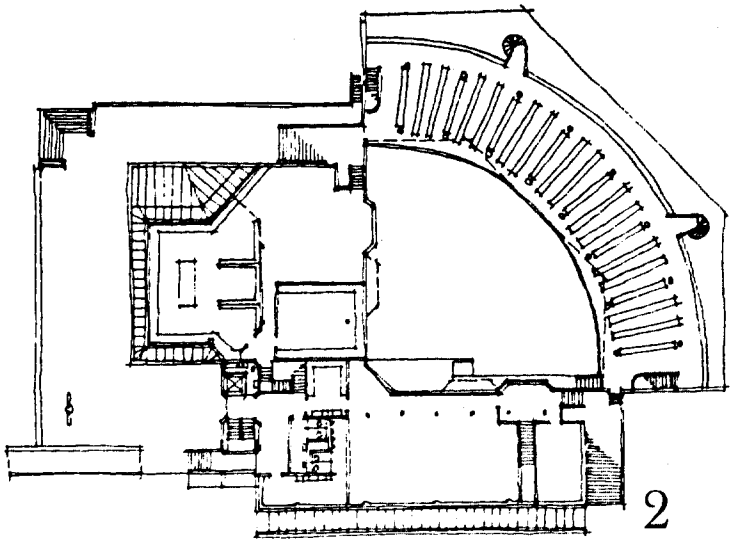
History Building Cambridge University
1966
Cambridge, England
James Stirling
FJ

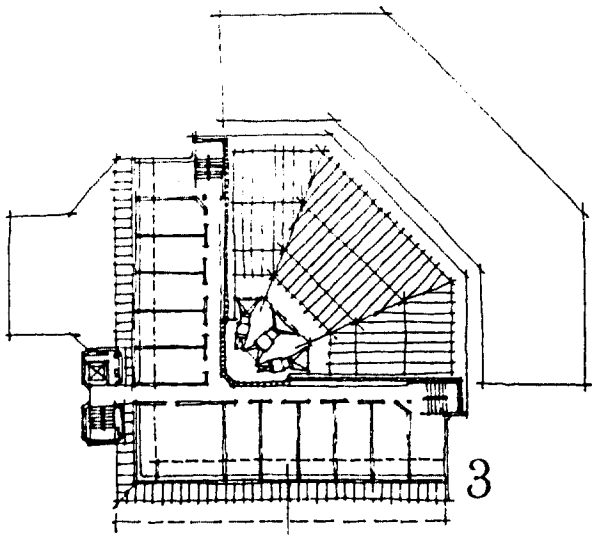


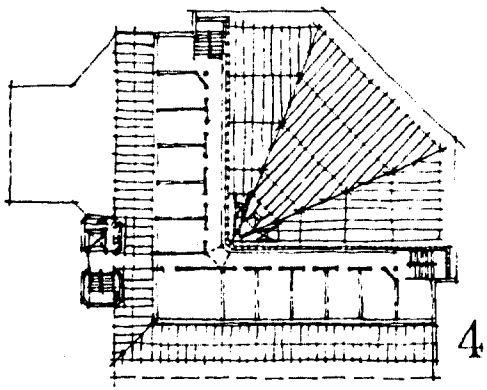


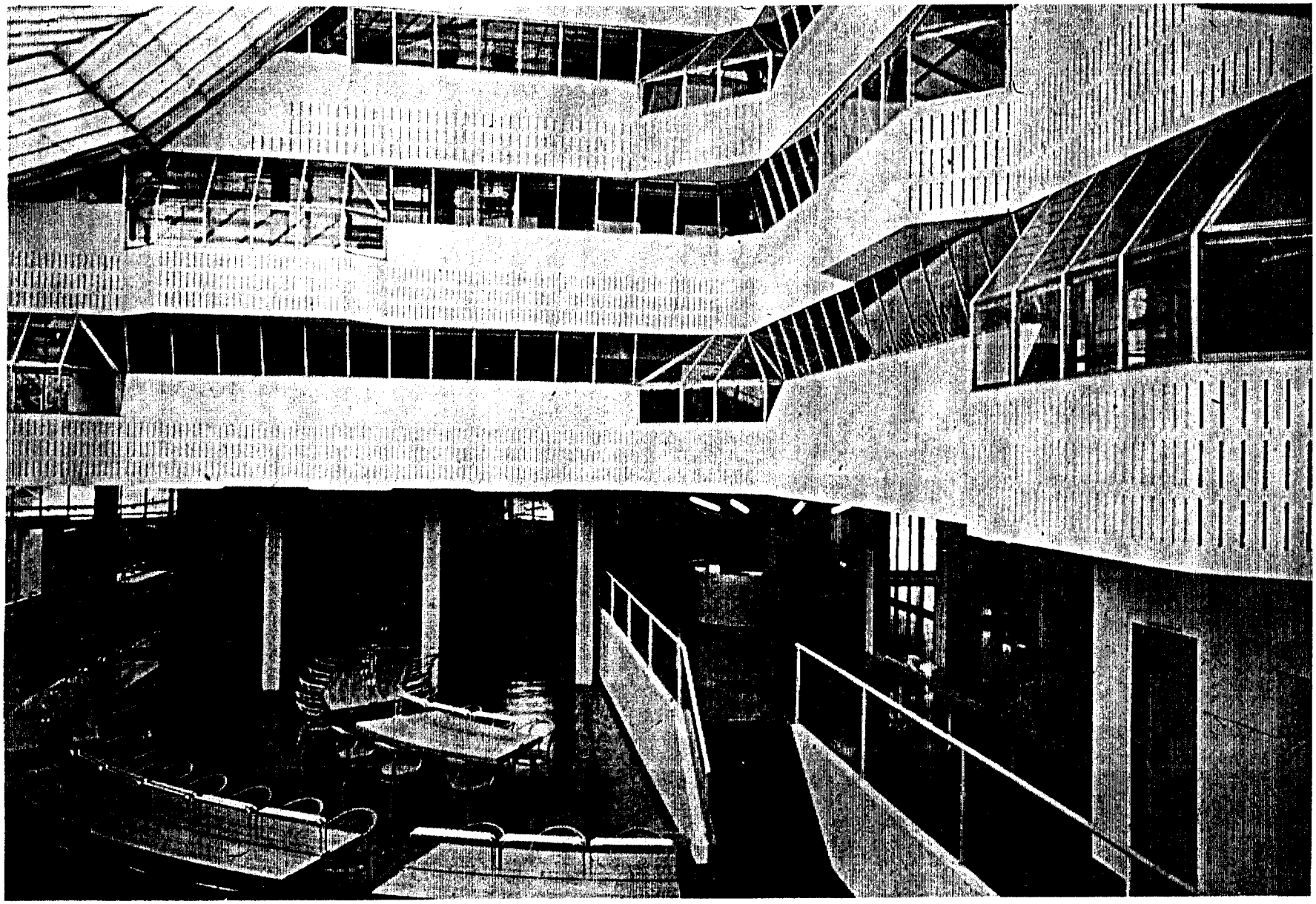



1


2

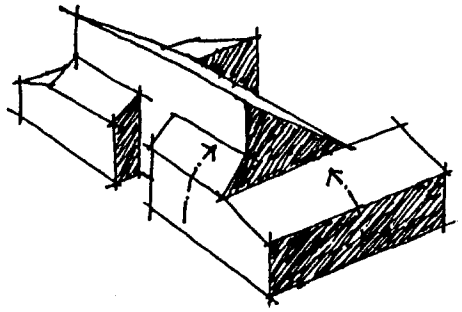

3


4



it is very directional (toward the peak). This directional quality allows the designer to relate elements tightly by making them inflect toward each other. Flow and directional axis may be provided in plan by stretching the grid, or in section by good continuation and flow from space to space.

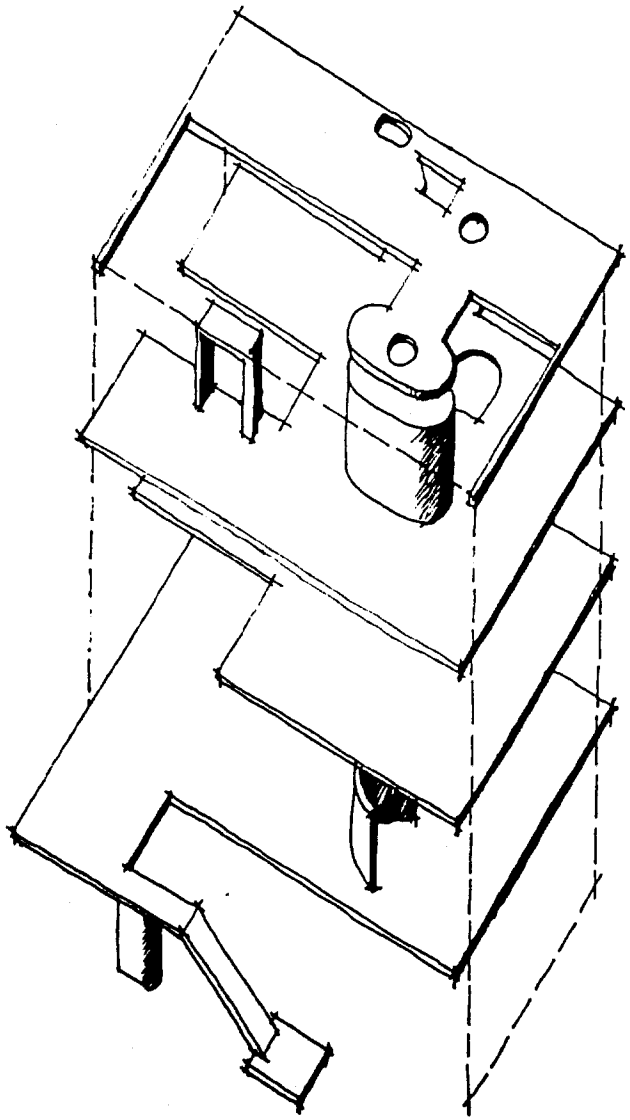
In the end, selection of appropriate element forms, sequences, and patterns for a specific design problem depends on the objectives of the designer. Skill in choosing the right combination comes from practice and a clear image of what one desires to accomplish.

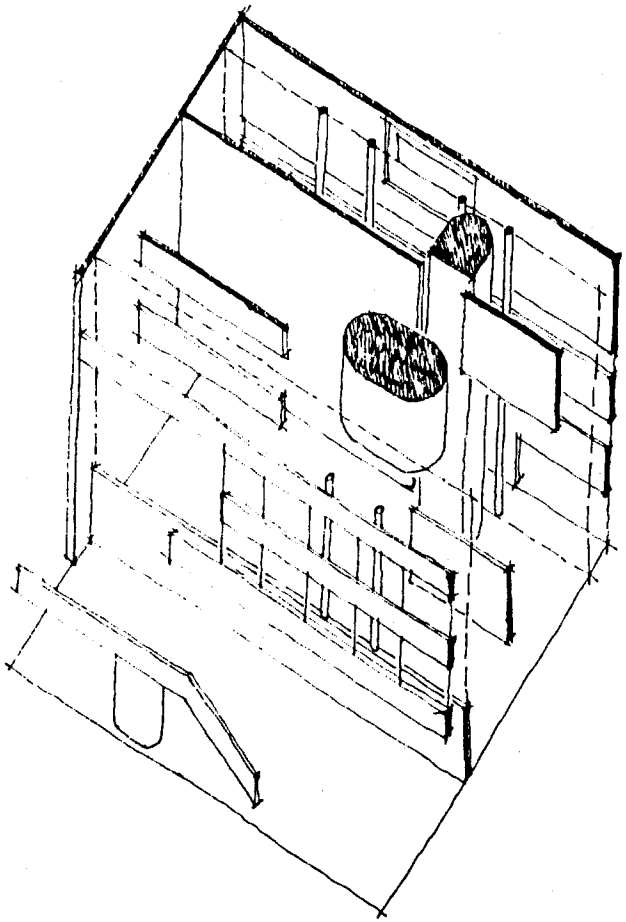


Study of the planar style of one of Le Corbusier's houses.

Villa 'Les Terraces
1926
Garches, France
Le Corbusier
KF
after an illustration by
Bernhard Hoesli in
Transparenz

Notre Dame Du Haute Saone
1950
Ronchamp, France
Le Corbusier
TM





Select Bibliography

The Senses

Gibson, James, The Perception of the Visual World, Houghton Mifflin Co., Boston, Mass. 1950 pp. 155-162, 166-196

Hall, Edward, 'Proxemics and Design', in Design and Environment, Winter 1971 Vol. 2, No. 4 pp. 24,58

Zusne, Leonard, Visual Perception of Form, Academic Press, New York, 1970.

Motivation

Cherry, Colin, On Human Communication, MIT Press, Cambridge, Mass. 1957

Kolers, P. and Eden, M., (Eds.), 'Recognizing Patterns,' and, 'Some Psychological Aspects of Pattern Recognition,' in Studies in Living and Automatic Systems, MIT Press, Cambridge, Mass., 1968.

Lynch, Kevin, The Image of the City, MIT Press, Cambridge, Mass. 1960 pp. 95-117, 46-90.

The Eye

Dember, William, The Psychology of Perception, Holt, Rinehart, and Wilson, New York, 1960.

Dryfuss, Henry, Measure of Man, Whitney Library of Design, 1967.

Hochberg, Julien, Perception, Prentice Hall, Inc. New Jersey, 1964.

Ittelson, W., Visual Space Perception, Springer Publishing Co. Inc., New York, 1960.

Gestalt Principles

Beck, Jacob, Surface Color Perception, Cornell University Press, Ithaca, New York, 1972. pp. 40-41, 50-56, 98-109, 145-158

Birren, Faber, Color: A Survey in Words and Pictures, University Books, Inc. New Hyde Park, New York, 1966 pp. 177-179, 186-188, 202-212

Birren, Faber, Functional Color, The Crimson Press, New York, 1937 pp. 96-118

A Room in Context

Ashihari, Y., Exterior Design in Architecture, Van Nostrand Rinehold Co., New York, 1970.

Leonard, Michael,'Humanizing Space,' in Progressive Architecture, April, 1969.

Patterns and Sequence

Alexander, C., Hirshen, S., Ishikawa, S., Coffin, C., Angel, S., Houses Generated by Patterns, Center for Environmental Structure, Berkeley, Calif. 1970.

Alexander, Ishikawa, Silverstein, A Pattern Language Which Generates Multi-Service Centers, Center for Environmental Structure, Berkeley, Calif. 1968.

Critchlow, Kenneth, Order in Space, The Viking Press, New York, 1970.

March, L., and Steadman, P., The Geometry of Environment and Introduction into Spatial Organization in Design, RIBA Publications Limited, London, 1971.

Simon, H., and Kotovsky, 'Human Acquisition of Concepts for Sequential Patterns, in Psychological Review, Vol. 70, No. 6, pp. 534-546, 1963.

General

Arnheim, Rudolf, Art and Visual Perception, University of California Press, Berkeley, Calif. 1971.

Danby, Miles, Grammer of Architectural Design, Oxford University Press, New York, 1963.

Davis, Ruth Danielson, A Review of Design Fundamentals, The College Printing and Publishing, Inc. Madison, Wisconsin, 1969

Hesselgren, Sven, The Language of Architecture Volumes 1 & 2, Applied Science Publishers LTD, London, England, 1969.

Isaac, Arg, Approach to Architectural Design, University of Toronto Press, 1971.

Norberg-Schulz, Christian, Existence, Space & Architecture, Praeger Publishers, New York, 1971

Norberg-Schulz, Christian, Intentions in Architecture, MIT Press, Cambridge, Mass., 1965

Prak, Luning, The Language of Architecture, Mouton & Co., Paris, France, 1968.

Venturi, Robert, Complexity and Contradiction in Architecture, Museum of Modern Art, New York, 1966.