ARCH 121 – INTRODUCTION TO ARCHITECTURE I

WEEK 2: Form: Primary Elements, Primary Shapes (2D), Primary Solids (3D) and Properties of Form

(From: Ching, F., Architecture: Form, Space and Order)

1. Primary Elements of Design

This lecture will present the conceptual elements of design in the order to their growth: from the point to a one dimensional line, from the line to a two dimensional plane, from the plane to a three dimensional volume, and from volume to form and space. Together with the visual elements of design, these conceptual elements form the vocabulary of architectural design.

1. Primary Elements of Design

A. Conceptual Elements of Design:

a. Point
b. Line
c. Plane
d. Volume
e. Form
f. Shape
g. Space

B. Visual Elements of Design:

a. Color
b. Texture
c. Size
d. Shape

2. Principles of Design:

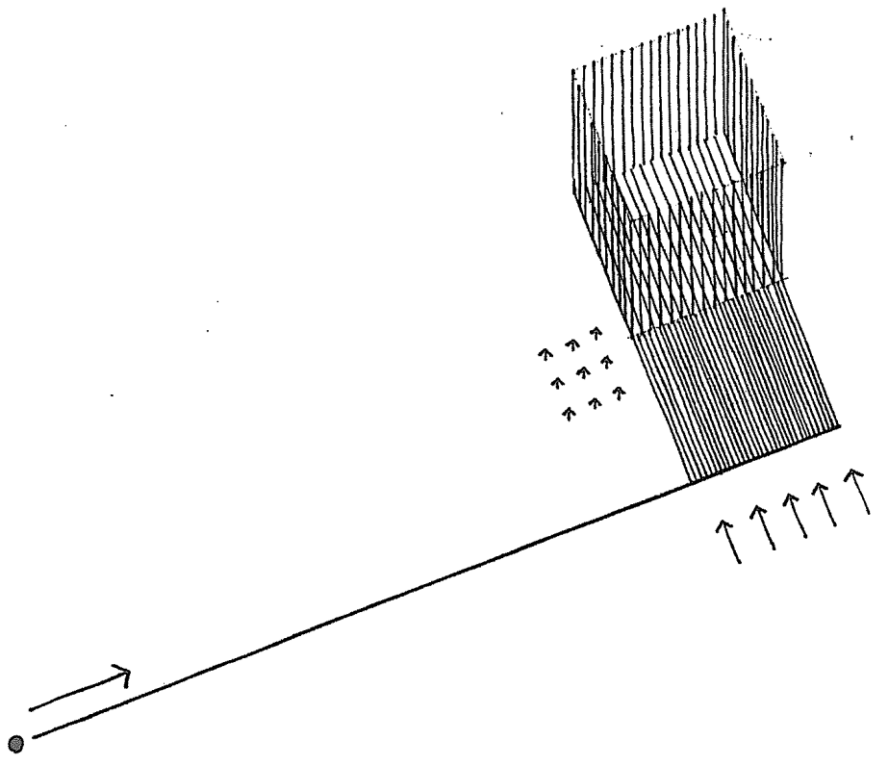
a. Unity
b. Balance
c. Hierarchy
d. Scale
e. Dominance
f. Contrast (and Similarity)
g. Rhythm
h. Repetition

A. Conceptual Elements of Design:

a.b.c. Point, Line Plane

As conceptual elements, the point, line, plane, and volume are not visible except to the mind's eye. While they do not actually exist, we nevertheless feel their presence. We can sense a point at the meeting of two lines, a line marking the contour of a plane, a plane enclosing a volume, and the volume of an object that occupies space.

When made visible to the eye on paper or in three-dimensional space, these elements become form with characteristics of substance, shape, size, color, and texture. As we experience these forms in our environment, we should be able to perceive in their structure the existence of the primary elements of point, line, plane, and volume.

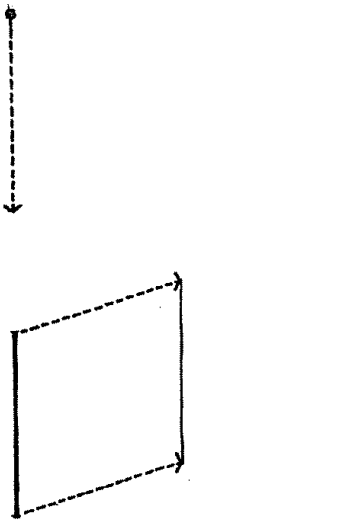


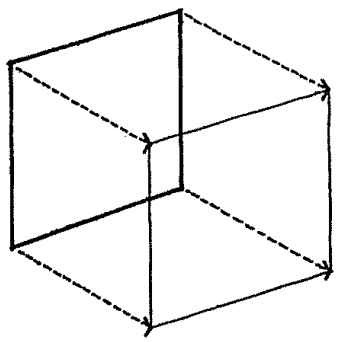
Point indicates a position in space.

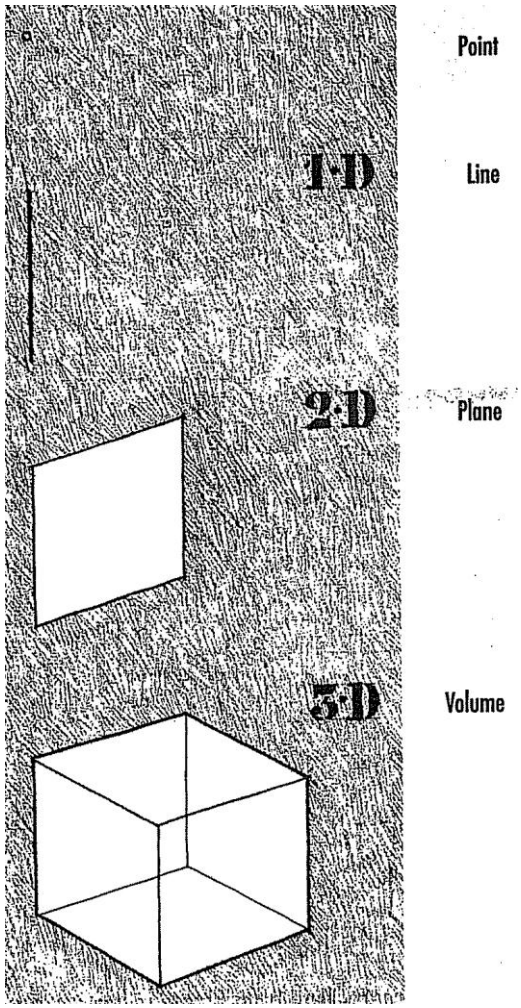
Line A point extended becomes a with properties of:
- length
- direction
- position

Plane A line extended becomes a with properties of:
- length and width
- shape
- surface
- orientation
- position

Volume A plane extended becomes a with properties of:
- length, width, and depth
- form and space
- surface
- orientation
- position





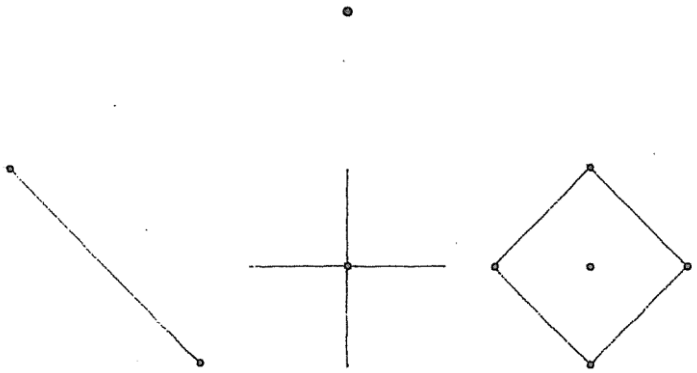


a. Point

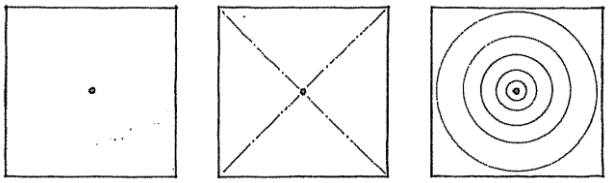
A point marks a position in space. Conceptually, it has no length, width, or depth, and is therefore static, centralized, and directionless.

As the prime element in the vocabulary of form, a point can serve to mark:

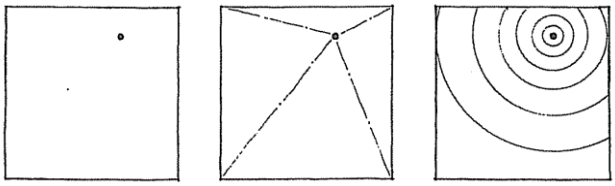
- the two ends of a line
- the intersection of two lines
- the meeting of lines at the corner of a plane or volume
- the center of a field



Although a point theoretically has neither shape nor form, it begins to make its presence felt when placed within a visual field. At the center of its environment, a point is stable and at rest, organizing surrounding elements about itself and dominating its field.

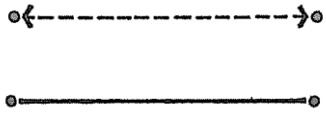


When the point is moved off-center, however, its field becomes more aggressive and begins to compete for visual supremacy. Visual tension is created between the point and its field.

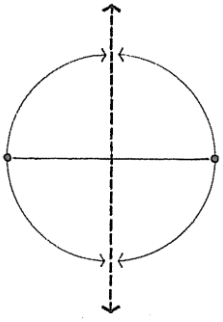


b. Line

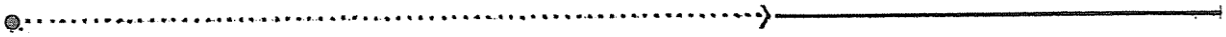
Two points describe a line that connects them. Although the points give this line finite length, the line can also be considered a segment of an infinitely longer path.



Two points further suggest an axis perpendicular to the line they describe and about which they are symmetrical. Because this axis may be infinite in length, it can be at times more dominant than the described line.



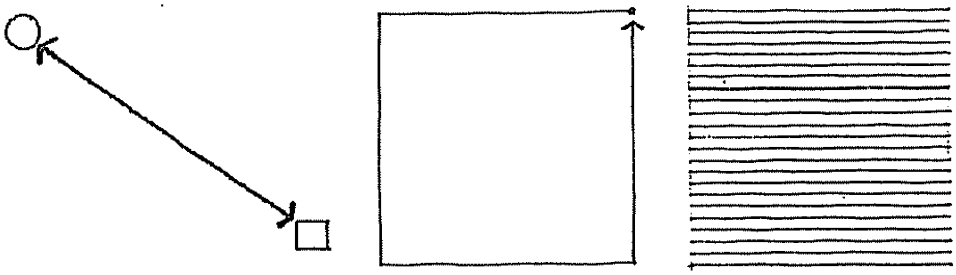
A point extended becomes a line. Conceptually, a line has length, but no width or depth. Whereas a point is by nature static, a line, in describing the path of a point in motion, is capable of visually expressing direction, movement, and growth.



A line is a critical element in the formation of any visual construction.

It can serve to:

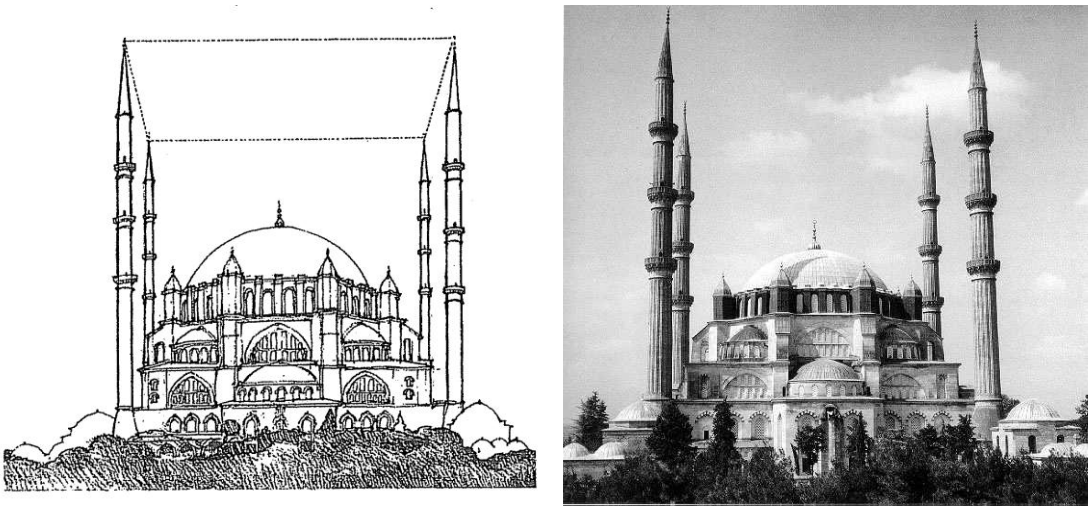
- join, link, support, surround, or intersect other visual elements
- describe the edges of and give shape to planes
- articulate the surfaces of planes



Vertical linear elements, such as columns, obelisks, and towers, have been used throughout history to commemorate significant events and establish particular points in space.

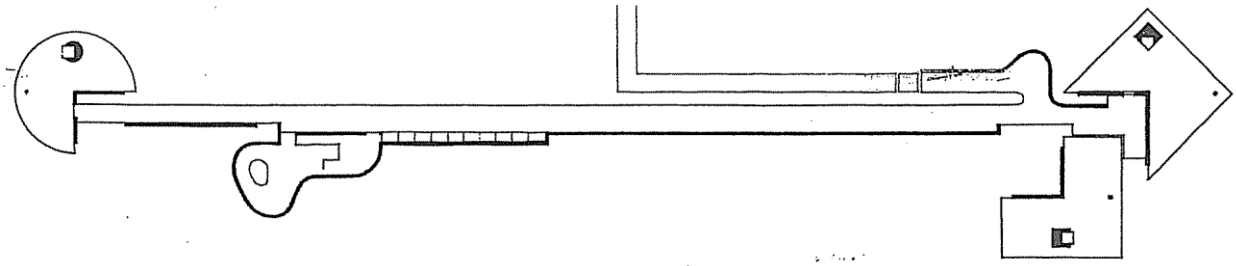
Obelisk of Pharaoh Senusret I, Al-Maalla area of Al-Matariyyah district in Heliopolis, Cairo (left), The Column of Marcus Aurelius in Piazza Colonna, Italy (right)

Vertical linear elements can also define a transparent volume of space.



Selimiye Mosque, Mimar Sinan, Edirne

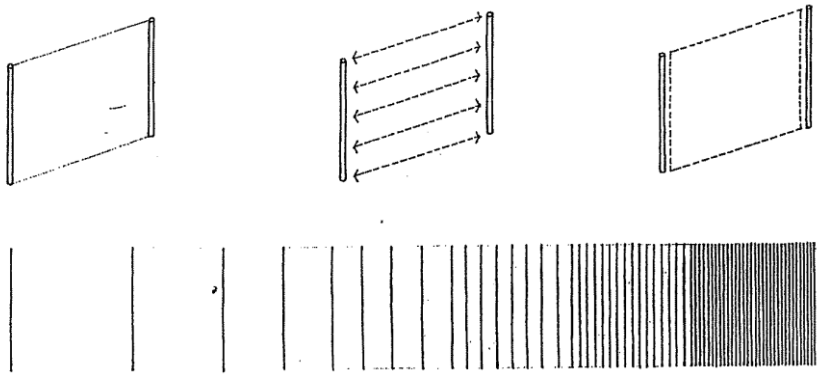
Although architectural space exists in three dimensions, it can be linear in form to accommodate the path of movement through a building and link its spaces to one another.



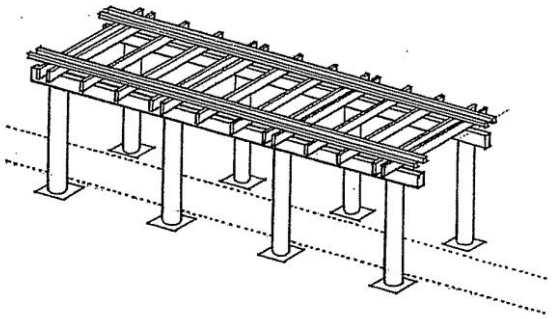
House 10, 1966, John Hejduk

c. Plane

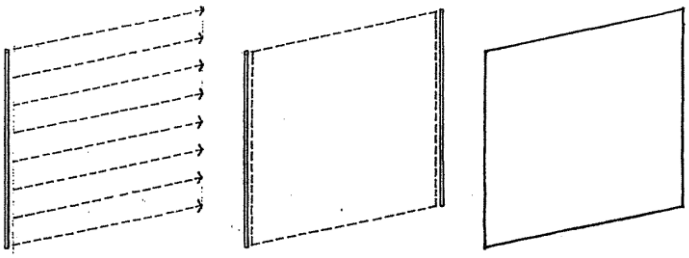
Two parallel lines have the ability to visually describe a plane. A transparent spatial membrane can be stretched between them to acknowledge their visual relationship. The closer these lines are to each other, the stronger will be the sense of plane they convey.



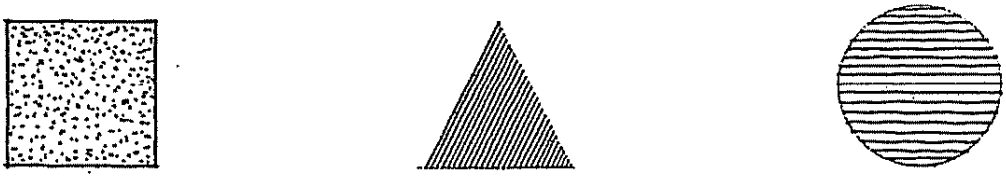
The linear members of trellises and pergolas can provide a moderate degree of definition and enclosure for outdoor spaces while allowing filtered sunlight and breezes to penetrate.



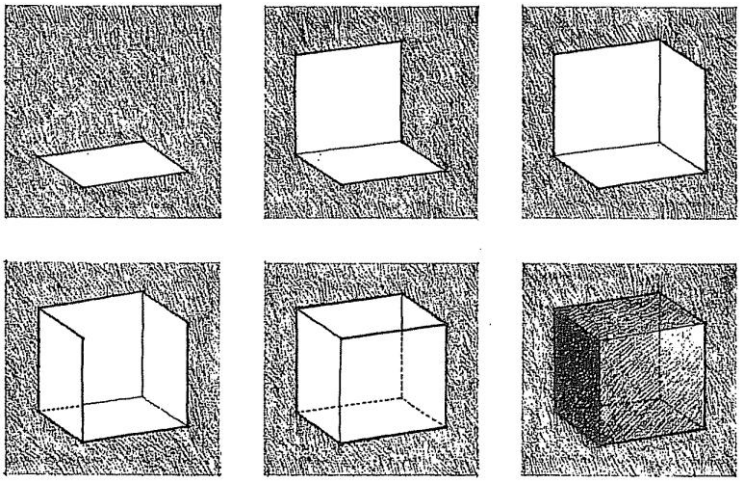
A line extended in a direction other than its intrinsic direction becomes a plane. Conceptually, a plane has length and width, but no depth.



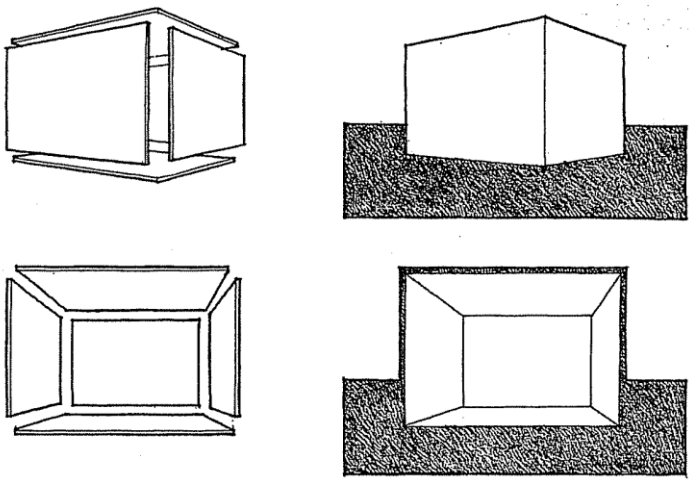
Shape is the primary identifying characteristic of a plane. It is determined by the contour of the line forming the edges of a plane



In the composition of a visual construction, a plane serves to define the limits or boundaries of a volume. If architecture as a visual art deals specifically with the formation of three-dimensional volumes of mass and space, then the plane should be regarded as a key element in the vocabulary of architectural design.



Planes in architecture define three-dimensional volumes of mass and space. The properties of each plane—size, shape, color, texture —as well as their spatial relationship to one another ultimately determine the visual attributes of the form they define and the qualities of the space they enclose.



In architectural design, we manipulate three generic types of planes:

Overhead Plane

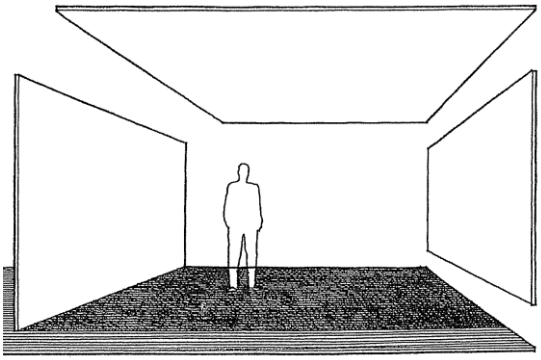
The overhead plane can be either the roof plane that shelters the interior spaces of a building from the climatic elements, or the ceiling plane that forms the upper enclosing surface of a room.

Wall Plane

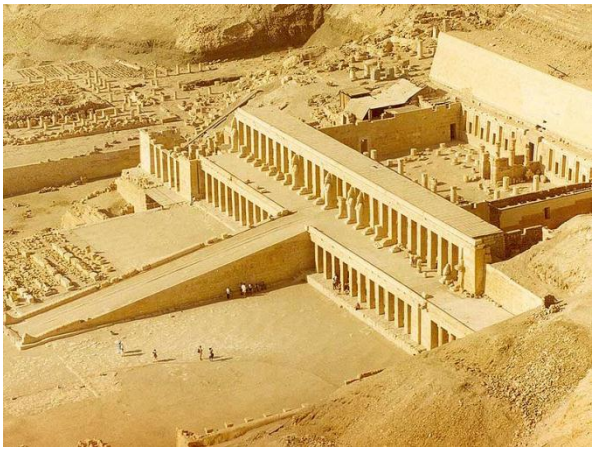
The wall plane, because of its vertical orientation, is active in our normal field of vision and vital to the shaping and enclosure of architectural space.

Base Plane

The base plane can be either the ground plane that serves as the physical foundation and visual base for building forms, or the floor plane that forms the lower enclosing surface of a room upon which we walk.



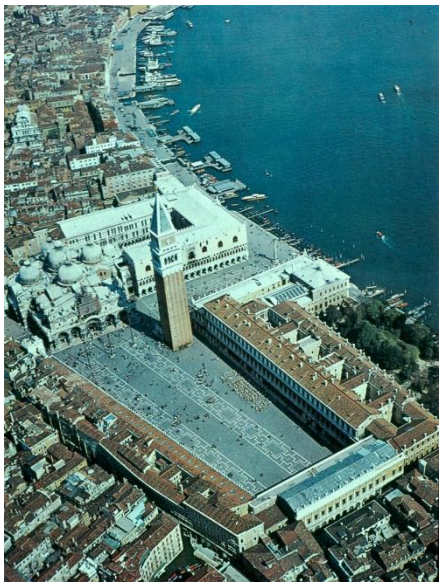
The ground plane itself can be manipulated as well to establish a podium for a building form. It can be elevated to honor a sacred or significant place; bermed to define outdoor spaces or buffer against undesirable conditions; carved or terraced to provide a suitable platform on which to build; or stepped to allow changes in elevation to be easily traversed.

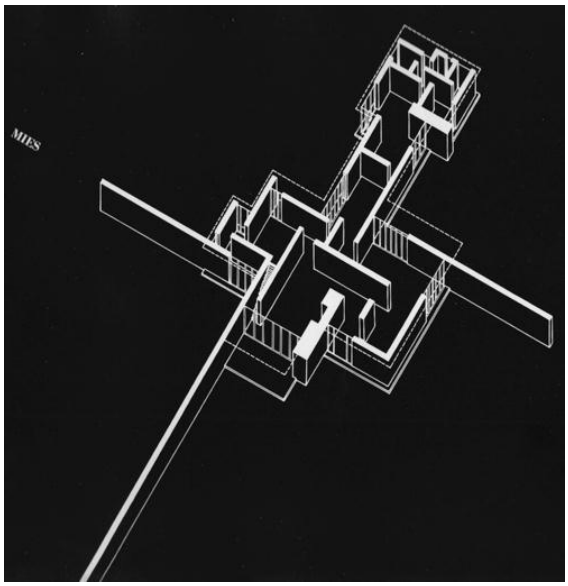


Base plane: Mortuary Temple of Queen Hatshepsut, Egypt, with three terraces approached by ramps

As a design element, the plane of an exterior wall can be articulated as the front or primary facade of a building. In urban situations, these facades serve as walls that define courtyards, streets, and such public gathering places as squares and marketplaces.

A compelling way to use the vertical wall plane is as a supporting element in the bearing-wall structural system. When arranged in a parallel series to support an overhead floor or roof plane, bearing walls define linear slots of space with strong directional qualities. These spaces can be related to one another only by interrupting the bearing walls to create perpendicular zones of space.





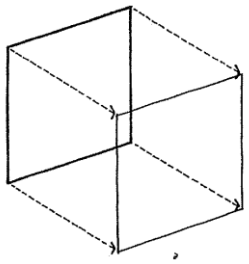
Wall Plane: Piazza San Marco, Italy, the continuous facades of the buildings form the walls of the urban space (left), and Country House in Brick by Mies van der Rohe, the free standing brick load bearing walls create an interlocking series of spaces (right)

The roof plane is the essential sheltering element that protects the interior of a building from the climatic elements. The form and geometry of its structure is established by the manner in which it spans across space to bear on its supports and slopes to shed rain and melting snow. As a design element, the roof plane is significant because of the impact it can have on the form and silhouette of a building within its setting.

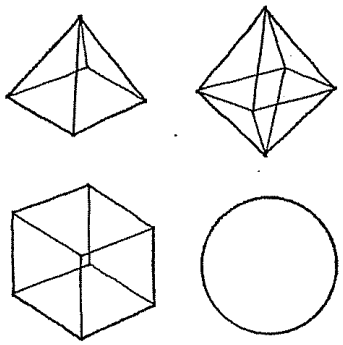
Roof plane: Robie House, Chicago (left) and Falling Water (Kaufman) House by Frank Lloyd Wright (right); roof and floor planes are extending to form overhangs that protect the house from rain and sun and at the same time they are expressing a sense of horizontality.

d. Volume

A plane extended in a direction other than its intrinsic direction becomes a volume. Conceptually, a volume has three dimensions: length, width, and depth.

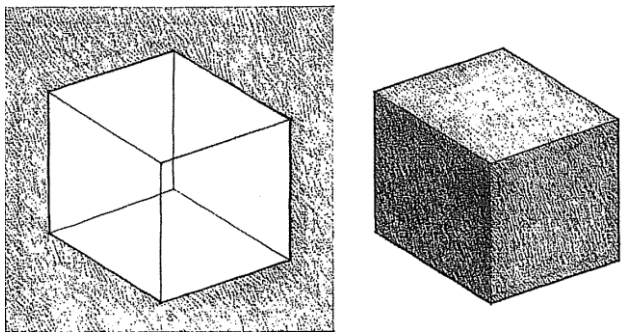


Form is the primary identifying characteristic of a volume. It is established by the shapes and interrelationships of the planes that describe the boundaries of the volume.



Every volume has a (regular or irregular) form. The volumes above have the forms of a pyramid, a cube and a sphere.

As the three-dimensional element in the vocabulary of architectural design, a volume can be either a solid—space displaced by mass—or a void—space contained or enclosed by planes.



Building forms that stand as objects in the landscape can be read as occupying volumes in space.

Building forms that serve as containers can be read as masses that define volumes of space.

Form standing as an object: Chapel at Ronchamp Chapel, France, by Lecorbusier (left); and Form as a mass that define a volume of space: Piazza Maggiore, Bologna, Italy (right)

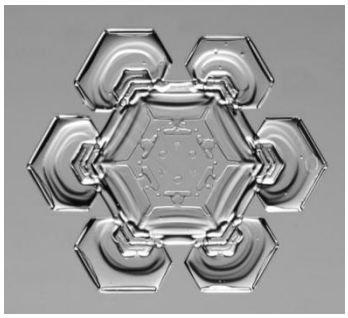
e. Form

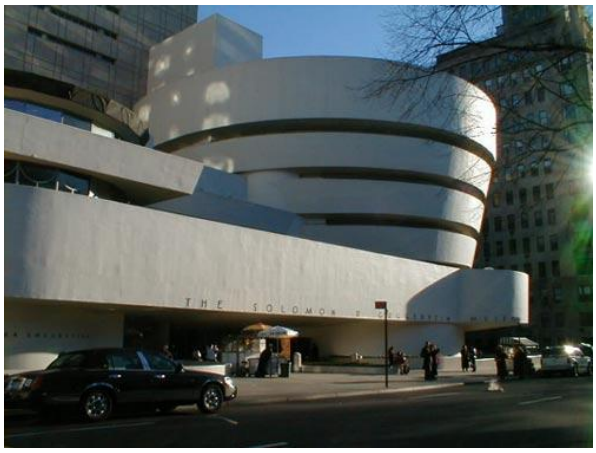
Form is an inclusive term that has several meanings. It may refer to an external appearance that can be recognized, as that of a chair or the human body that sits in it.

Form refers to the shape, visual appearance, or configuration of an object.

It may also allude to a particular condition in which something acts or manifests itself, as when we speak of water in the form of ice or steam.

In art and design, we often use the term to denote the formal structure of a work—the manner of arranging and coordinating the elements and parts of a composition so as as to produce a coherent image.



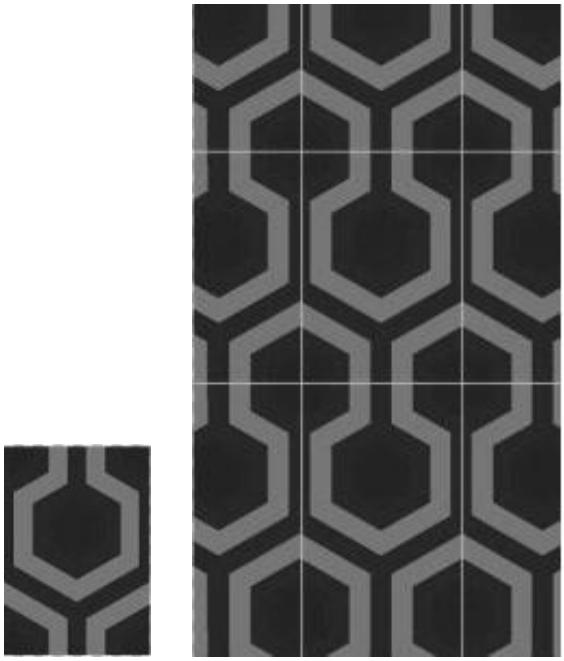



Guggenheim Museum, New York, by Frank Lloyd Wright (left), Sydney Opera House, Australia, by Jorn Utzon (right)

f. Shape

While form often includes a sense of three-dimensional mass or volume, shape refers more specifically to the essential aspect of form that governs its appearance—the configuration or relative disposition of the lines or contours that delimit a figure or form.

Shapes are flat and two-dimensional. They may be circles, squares, triangles, organic, etc. When shape is repeated, pattern occurs.

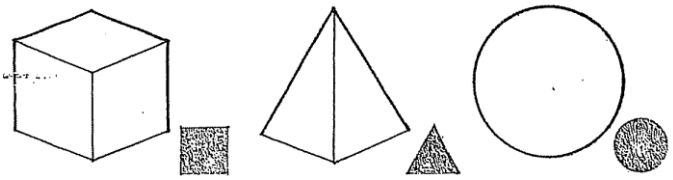


g. Space

Space is the area between and around objects. The object fills positive space while negative space surrounds the object. Space is created in a two-dimensional artwork by using perspective, overlapping, and color and value creating the appearance of depth or distance.

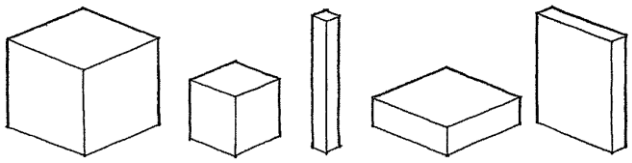
B. Visual Elements of Design (Visual Properties of Form):

Shape The characteristic outline or surface configuration of a particular form. Shape is the principal aspect by which we identify and categorize forms.



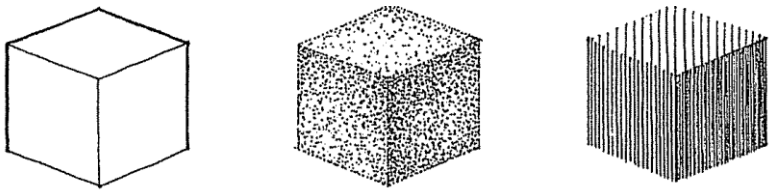
In addition to shape, forms have visual properties of:

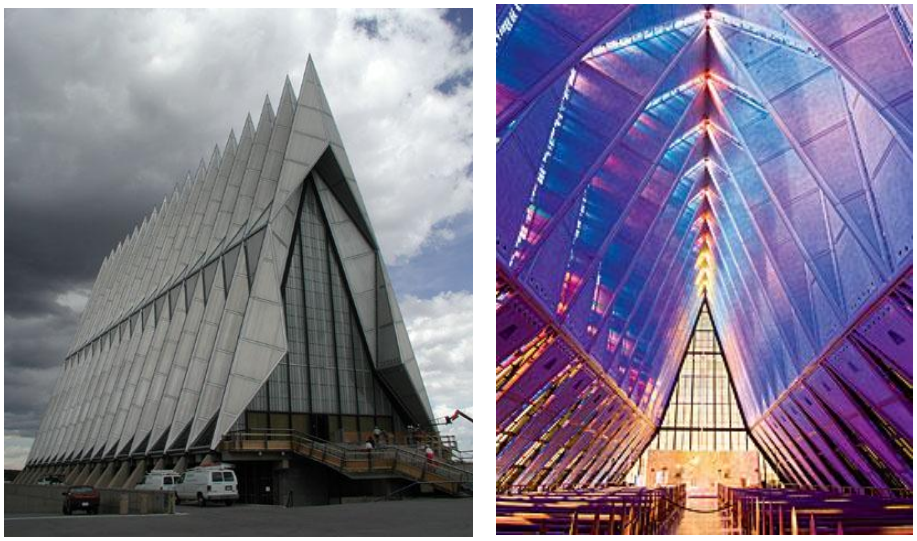
Size The physical dimensions of length, width, and depth of a form. While these dimensions determine the proportions of a form, its scale is determined by its size relative to other forms in its context.



Color A phenomenon of light and visual perception that may be described in terms of an individual's perception of hue, saturation, and tonal value. Color is the attribute that most clearly distinguishes a form from its environment. It also affects the visual weight of a form.

Texture The visual and especially tactile quality given to a surface by the size, shape, arrangement, and proportions of the parts. Texture also determines the degree to which the surfaces of a form reflect or absorb incident light.





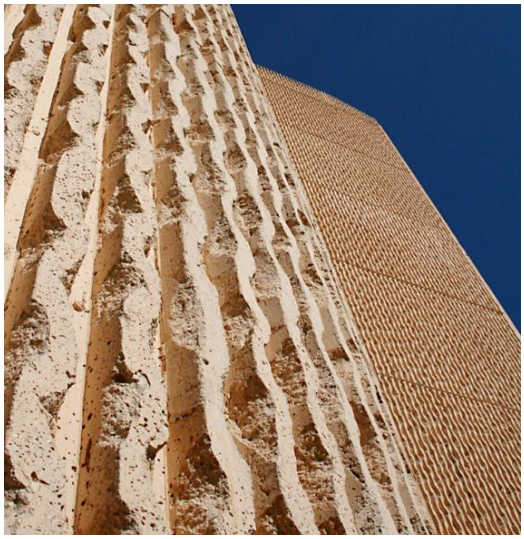
Shape in Architecture (primary shapes): Air Force Academy Chapel, 1962, Colorado, USA , by Walter Netsch


Size in Architecture (Monumental Architecture-grand in size): Sacre Coeur Basilica, Paris, France (left); Size in Architecture (Domestic Architecture-humble in size): Mudbrick houses in Yaprakbası village, Turkey (right)

Size in Architecture (Domestic Architecture-humble in size): Mudbrick houses in Harran

Color in Architecture: Unite d'habitation, Marseilles, France by Le Corbusier

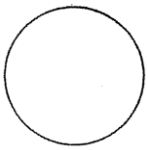
Color in Architecture (at the interiors)



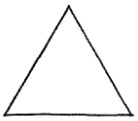
Texture in Architecture

3. Primary shapes

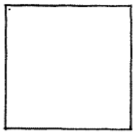
The most significant primary shapes are the circle, triangle, and square.



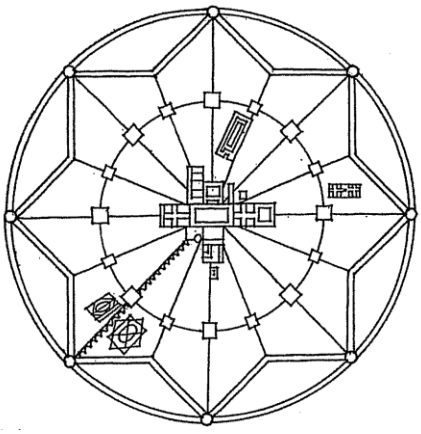
Circle A plane curve every point of which is equidistant from a fixed point within the curve



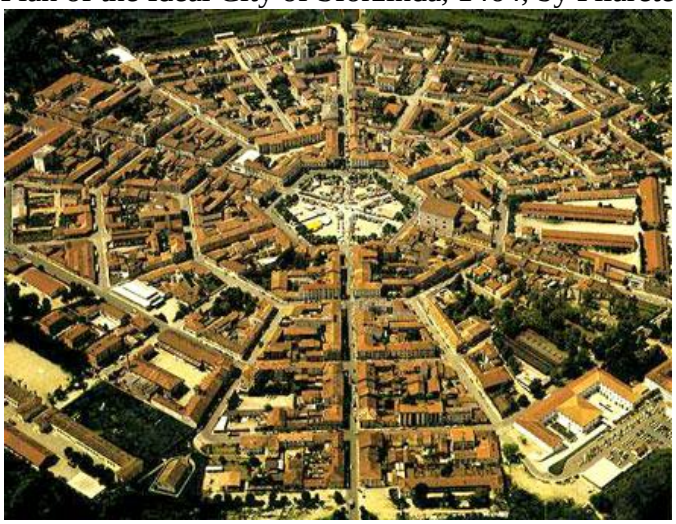
Triangle A plane figure bounded by three sides and having three angles



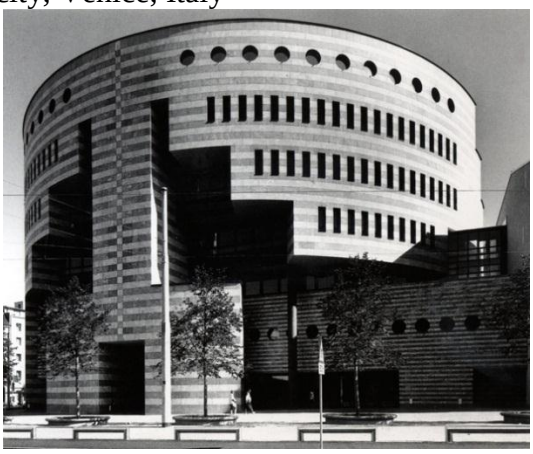
Square A plane figure having four equal sides and four right angles



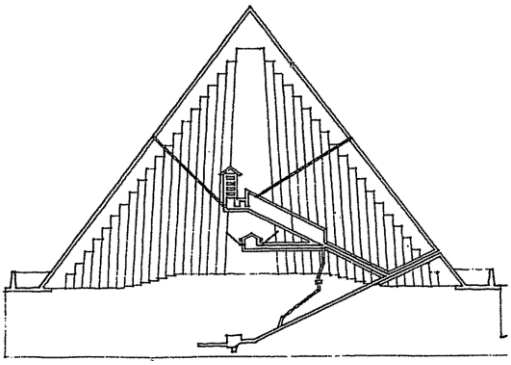
Circle is a centralized, introverted figure:
Plan of the Ideal City of Sforzinda, 1464, by Filarete



Circle gathers everything around a center:
Palmanova city, Venice, Italy



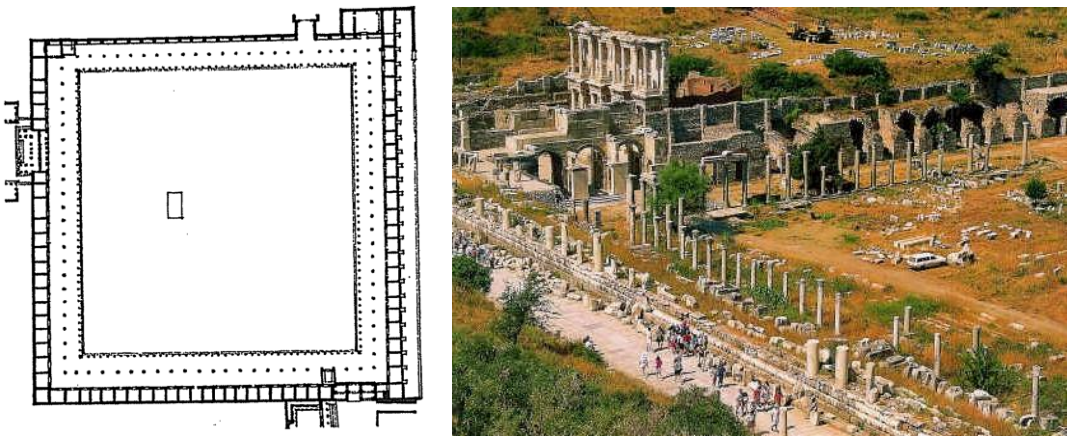
The use of circle in buildings (marking the center): Museum of SF Moma by Mario Botta, San Fransisco (left); The use of circle in buildings (creating a nodel point): Union Bank of. Switzerland Bael, Switzerland, by Mario Botta



Triangle is a stable figure: Great Pyramid of Cheops at Giza

Triangles in architecture (marking a point in space): Transamerica Pyramid, San Francisco (left)

Triangles in architecture (creating sharp edges and dramatic effects): Department of Chemical Engineering, MIT, Boston by I.M. Pei

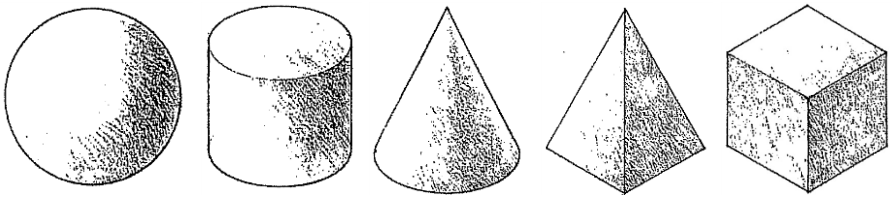


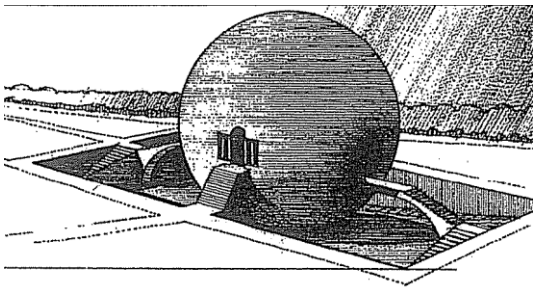
Square is static and neutral: Agora of Ephesus

Squares in architecture (creating a nodal point): Modena Cemetery by Aldo Rossi, San Cataldo, Italy (left); Squares in architecture (could be used as a part of composition): Cube House, Chihuahua, Mexico (right)

4. Primary solids

The most significant primary solids are the cube, pyramid, sphere, cylinder, and cone. They are the volumetric (3 dimensional) forms generated from the primary shapes.

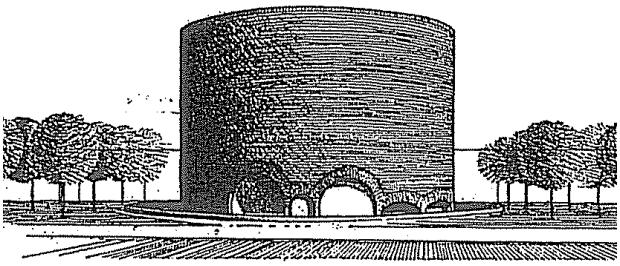




Maupertius, Project for an Agricultural Lodge, 1775, Claude-Nicolas Ledoux

Spheres in architecture, cover and define introverted interior spaces

Spheres in architecture (creating spatial definition): The Montreal Biosphère by Buckminster Fuller, 1967. Photo: Ryan Mallard (left); Spheres in architecture (getting clustered together as living organisms): Nicholas Grimshaw, Eden Project, Cornwall, UK (right)

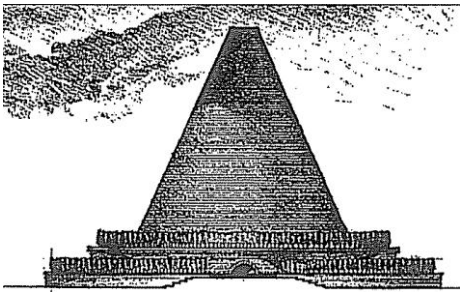


Chapel, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1955, Eero Saarinen and Associates

Cylinders in architecture, define introverted interior spaces but they have a dinamism towards the sky

Cylinders in architecture (creating nodal points): Petra Winery in Suvereto , Italy by Mario Botta

Cylinders in architecture (played on top to arrange the direction of sunlight and view): Mario Botta Church of St John Mogno



Project for a Conical Cenotaph, 1784, Étienne-Louis Boulée

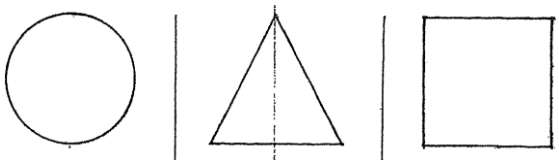
Cones in architecture, define introverted interior spaces but they have stability on the ground and a dinamism towards the sky


Cones in architecture (creating nodel points): Takoma Museum of Glass, Washington by Arthur Erickson (left); Cones in architecture (could be used as inverted): Reichstag, Berlin, Germany; Foster and Partners

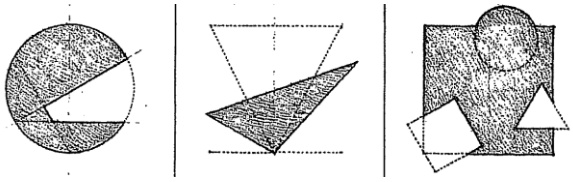

Cones in architecture (could be played in form to control sunlight intake): Le Cone de la Vulcania by Hans Hollein, France

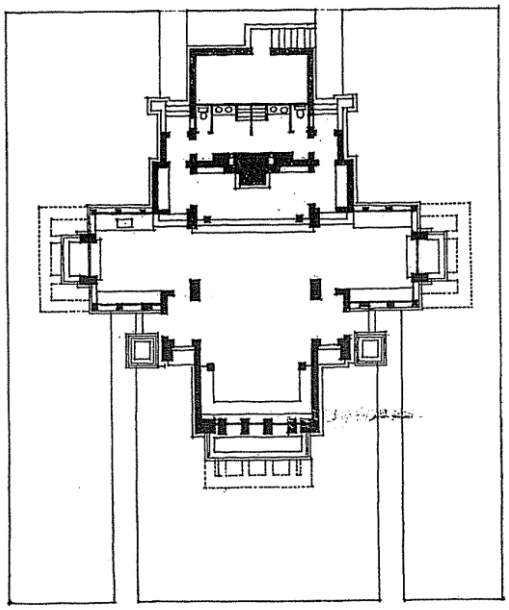
4. Regular and irregular forms

Regular forms refer to those whose parts are related to one another in a consistent and orderly manner. They are generally stable in nature and symmetrical about one or more axes. The sphere, cylinder, cone, cube, and pyramid are prime examples of regular forms.

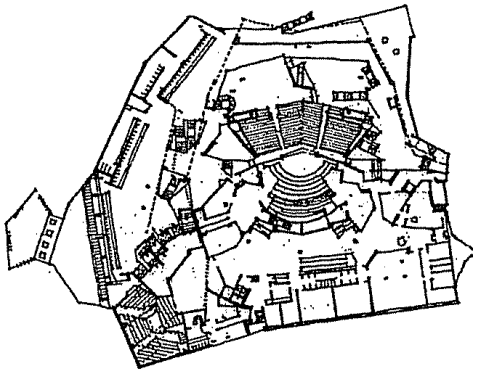


Irregular forms are those whose parts are dissimilar in nature and related to one another in an inconsistent manner. They are generally asymmetrical and more dynamic than regular forms. They can be regular forms from which irregular elements have been subtracted or result from an irregular composition of regular forms.





A Regular Composition of Regular Forms:
Coonley Playhouse, Riverside, Illinois, 1912, Frank Lloyd Wright



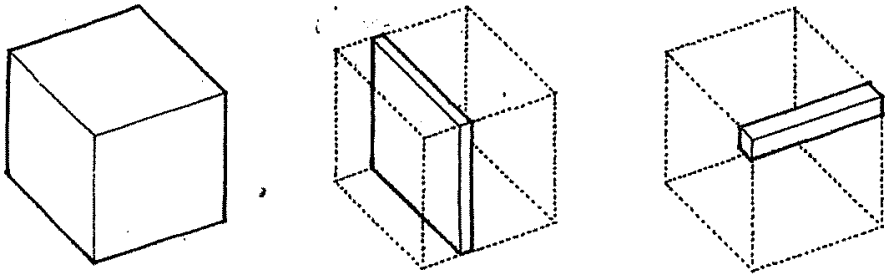
Irregular Forms:
Philharmonic Hall, Berlin, 1956–63, Hans Scharoun

5. Transformation of form

All other forms can be understood to be transformations of the primary solids, variations which are generated by the manipulation of one or more dimensions or by the addition or subtraction of elements.

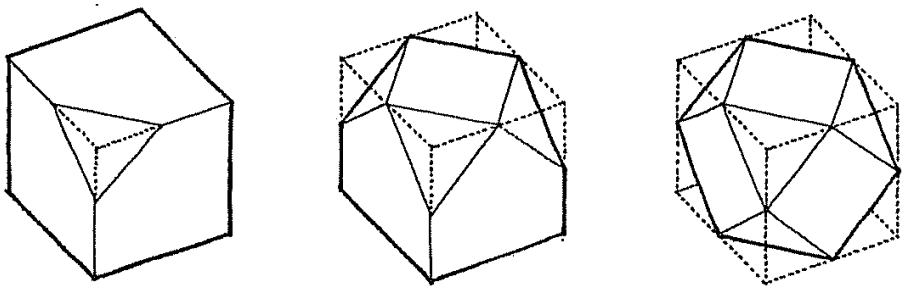
Dimensional Transformation

A form can be transformed by altering one or more of its dimensions and still retain its identity as a member of a family of forms. A cube, for example, can be transformed into similar prismatic forms through discrete changes in height, width, or length. It can be compressed into a planar form or be stretched out into a linear one.



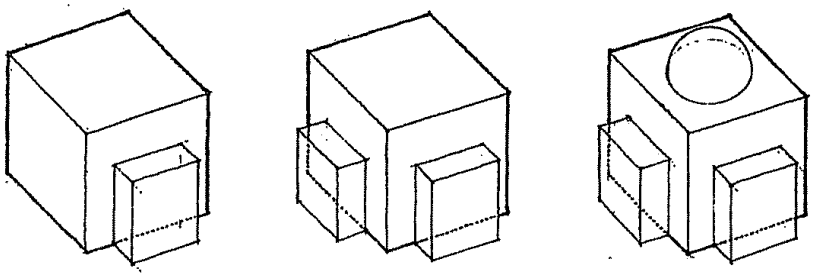
Subtractive Transformation

A form can be transformed by subtracting a portion of its volume. Depending on the extent of the subtractive process, the form can retain its initial identity or be transformed into a form of another family. For example, a cube can retain its identity as a cube even though a portion of it is removed, or be transformed into a series of regular polyhedrons that begin to approximate a sphere.



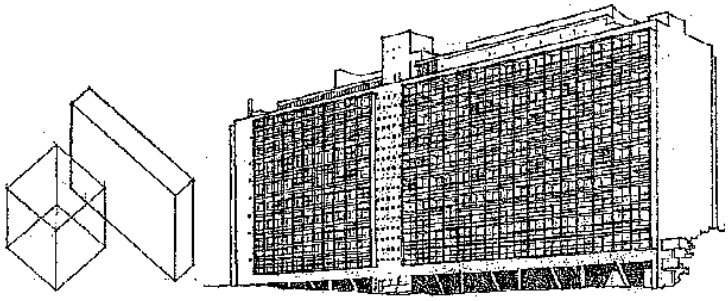
Additive Transformation

A form can be transformed by the addition of elements to its volume. The nature of the additive process and the number and relative sizes of the elements being attached determine whether the identity of the initial form is altered or retained.

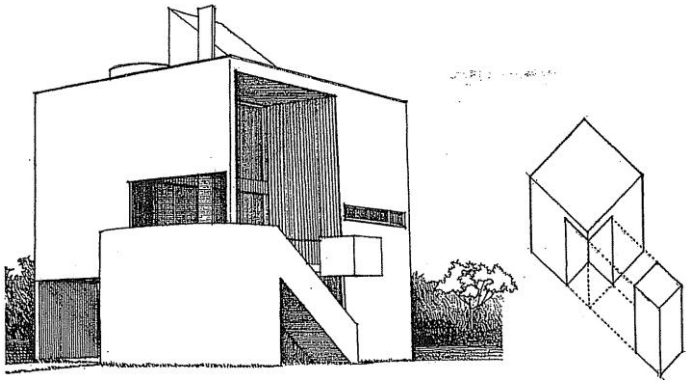


Dimensional Transformation of a Cube into a Vertical Slab:

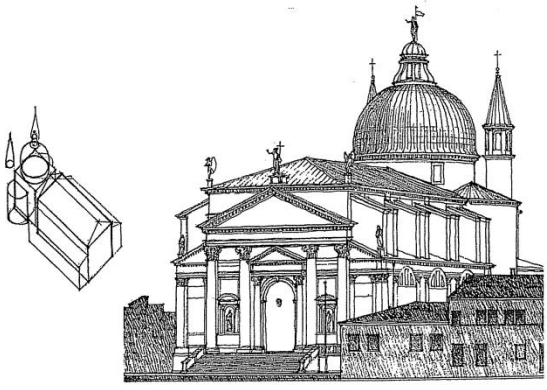
Unité d'Habitation, Firminy-Vert, France, 1963–68, Le Corbusier



Subtractive Transformation Creating Volumes of Space:
Gwathmey Residence, Amagensett, New York, 1967,
Charles Gwathmey/Gwathmey Siegel



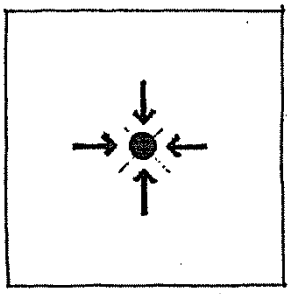
Additive Transformation of a Parent Form by the Attachment of Subordinate Parts:
Il Redentore, Venice, 1577–92, Andrea Palladio

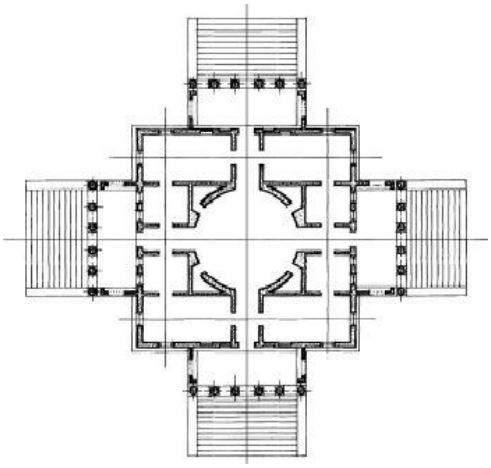


Additive forms could be categorized according to their relationships:

Centralized Form

A number of secondary forms clustered about a dominant, central parent-form

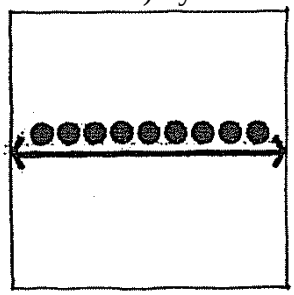


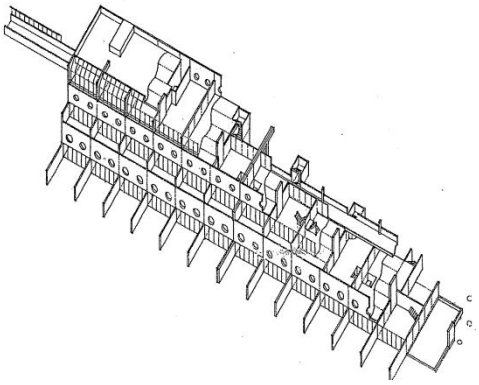


Centralized form – static and stable: Villa Capra (La Rotunda) by Palladio, Italy

Linear Form

A series of forms arranged sequentially in a row

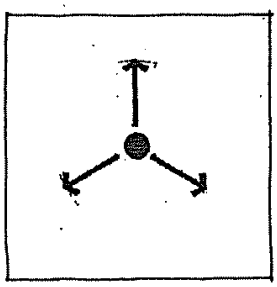


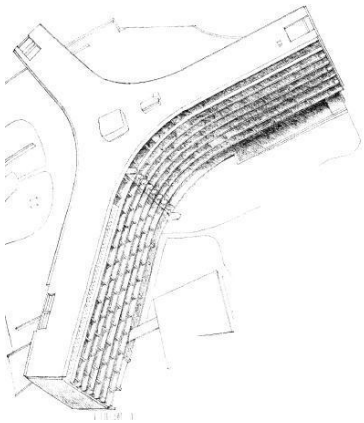


Linear form - dynamic and directional: Runcorn New Town Housing, by James Stirling

Radial Form

A composition of linear forms extending outward from a central form in a radial manner

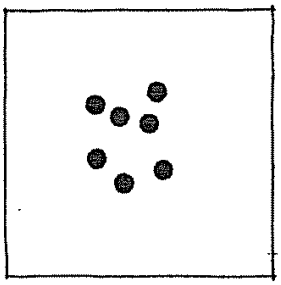




Radial form: Secretariat building, UNESCO Headquarters, Paris, by Marcel Breuer

Clustered Form

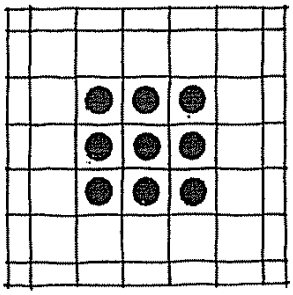
A collection of forms grouped together by proximity or the sharing of a common visual trait



Clustered form: Habitat Israel, Jerusalem, Moshie Safdie

Grid Form

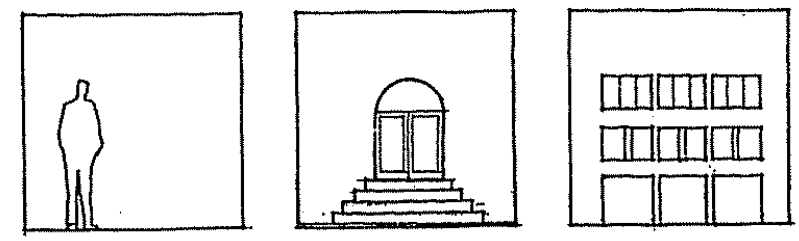
A set of modular forms related and regulated by a three-dimensional grid



Grid form: Nagakin Capsule Building, Tokyo, Kisho Kurokawa

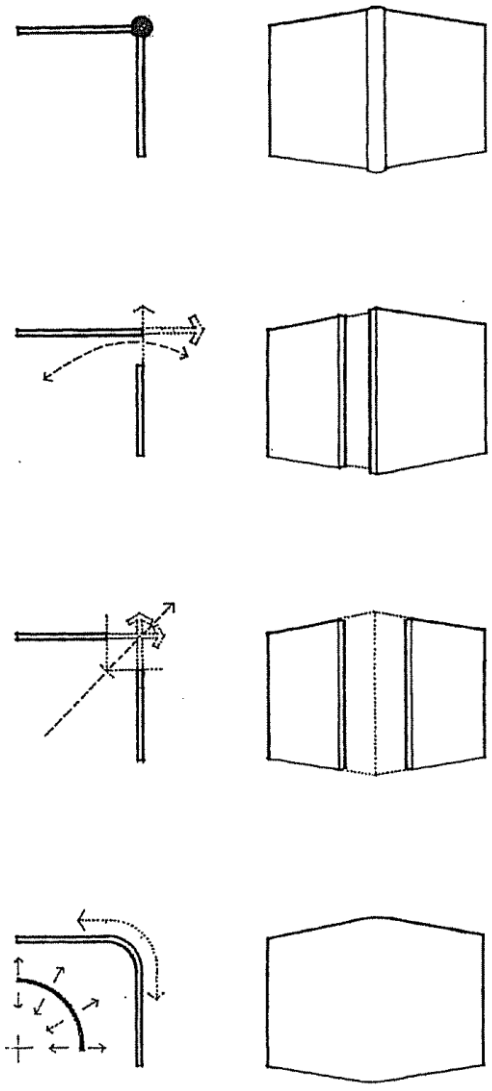
6. Articulation of form

Form could be further articulated (transformed in terms of its surface) by playing with its corners and surface planes:

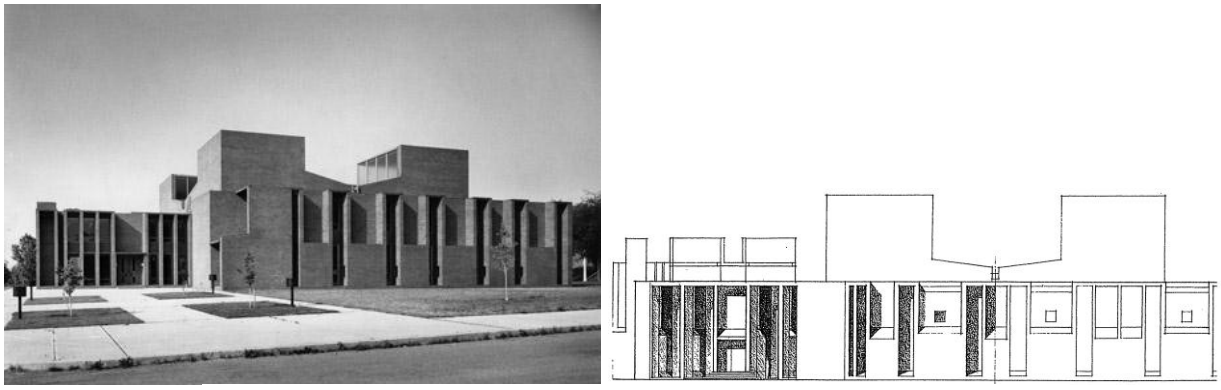


Surface articulation

Windows, doors, stairs etc .could be used as elements to create surface articulation



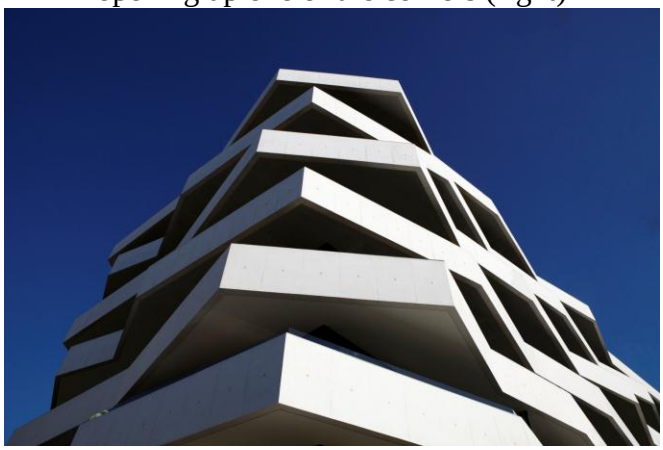
Corner articulation
Corners could articulated by opening or chamfering the edges



First Unitarian Church, Rochester, New York, 1956–67, Louis Kahn.
The pattern of openings and cavities interrupt the continuity of the exterior wall planes.

Surface articulation


Corner articulation made by a chamfered corner (left); Corner articulation made by extending and opening up one of the corners (right)



Corner articulation by playing with the shapes of the corners