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CHENNAI ACADEMY OF ARCHITECTURE AND DESIGN

PERIYAPALLAYAM, CHENNAI.

# NATA 2024

## PREPARATORY GUIDE

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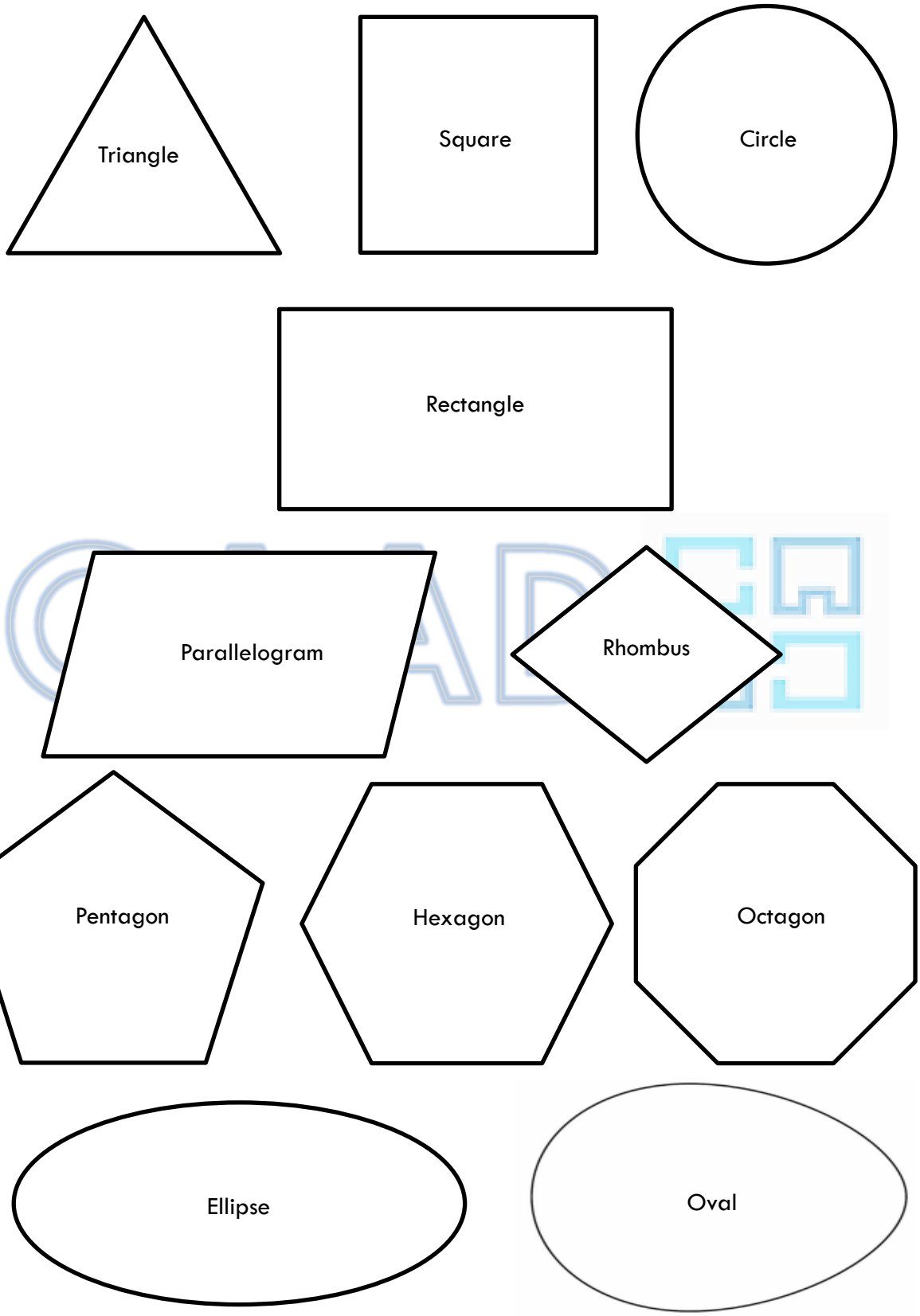
# LOGICAL DERIVATION

Ability to decode a situation, composition, context and generate meaning. Understanding the minute information hidden in a particular situation and drawing conclusions.

# LOGICAL DERIVATION

## INTRODUCTION TO BASIC SHAPES

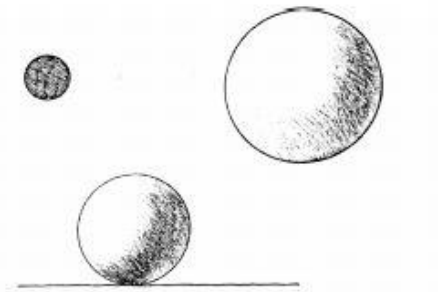


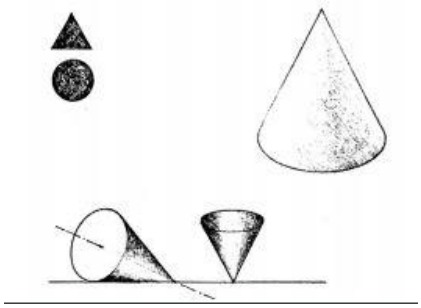
# LOGICAL DERIVATION

## INTRODUCTION TO PRIMARY SOLIDS

### SPHERE

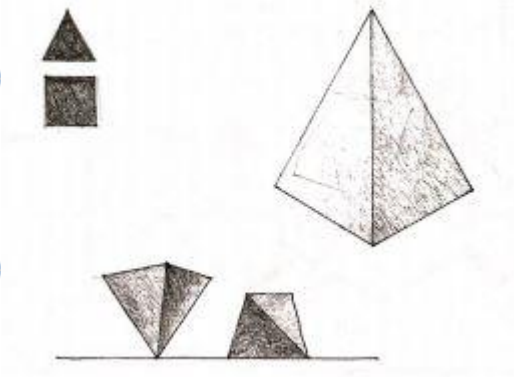
A solid generated by the revolution of a circle about its diameter. It has no directional quality, neither horizontal nor vertical, but simply static A sphere is a centralized and highly concentrated form. It is self-centred & normally stable in its environment. In any point it retains its circular shape.





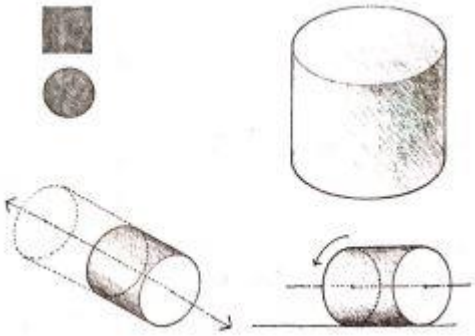
### PYRAMID

A polyhedron having a polygonal base and triangular faces meeting at a common point or vertex. The pyramid has properties similar to those of the cone. Because all of its sides are flat planes. However its stable on all its faces.



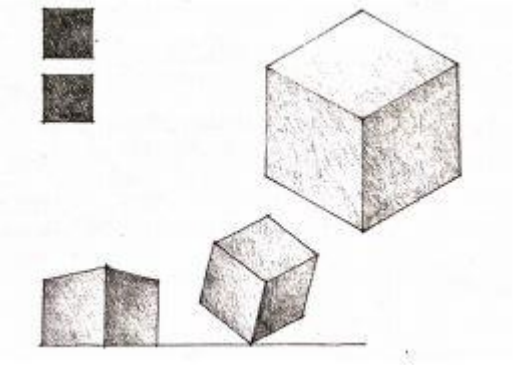
### CYLINDER

A solid generated by the revolution of a rectangle about one of its sides. A cylinder is centralized about the axis passing through the centres of two circular faces. A cylinder is stable if its rests on its one of the circular faces.



### CUBE

Prismatic solid bounded by six equal square sides, the angle between any two adjacent faces being a right angle. It is stable on all its sides excepts when it stand on its edges.



### CONE

A solid generated by the revolution of a right triangle about one of its sides. Like the cylinder, the cone is a highly stable form when resting on its circular base. It can also rest on its apex in a precarious state of balance.

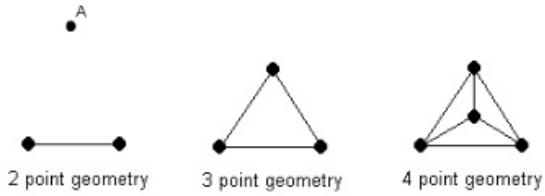
*Reference: Architecture Form, Space and Order - FRANCIS D.K CHING*

# LOGICAL DERIVATION

## INTRODUCTION TO ELEMENTS IN ARCHITECTURE

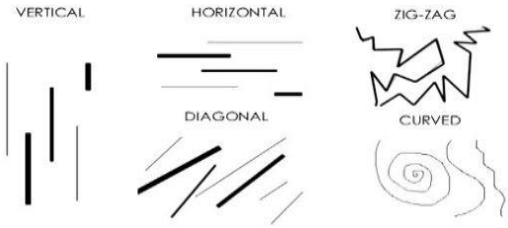
### POINT

A point or mark is the smallest and most basic element. The single point represents a visual stop. Two points represent a direction. Three points makes the eyes move in a closed path. They signify a shape.



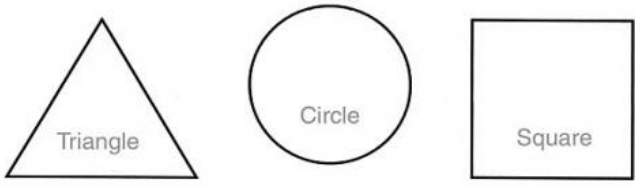

### LINE

Point that is extended along a direction. Line has length and describes a point in motion. Expresses direction, movement and growth. Line also defines the edges of planes and give them the shape. A Line can articulate the surfaces of planes. A line is a form with width and length, but no depth. The direction, weight, and character of line convey many different states and emotions.




### SHAPE

Shape is an area that is contained within implied lines. Shapes have two dimensions-length and width, and can be geometric or free-form. A shape is formed when the lines encloses an area. Shapes whether geometric or organic it adds interest to the design.




### SPACE

Space is three-dimensional volume that can be empty or filled with objects. It has width, height, and depth. The form defines the space.

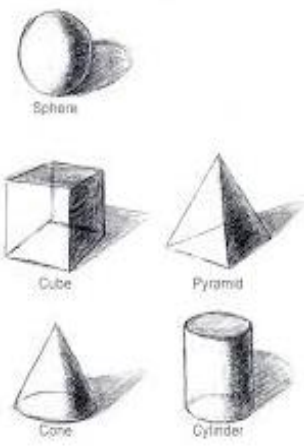
### COLOUR

Colour adds the magic element to a design. Each colour has a mood, an emotion and different levels of significance.

Colours can reflect warm or cool, hard or soft, light or dark, passive or active, all of which when used individually or in combination of one another greatly affects the mood.

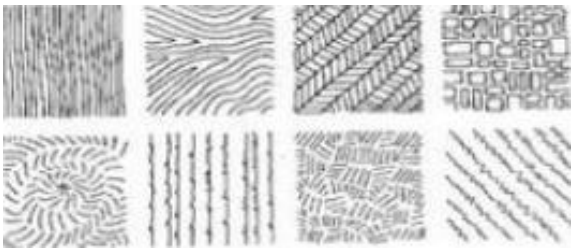

### FORM

Form is any three dimensional object. They can be measured in terms of height, width, breadth. Form describes volume and mass, or the three dimensional aspects of objects that take up space.




### TEXTURE

Texture refers to the surface quality. Textures can create a more three-dimensional appearance on this two-dimensional surface. it can be categorized as visual and tactile texture.



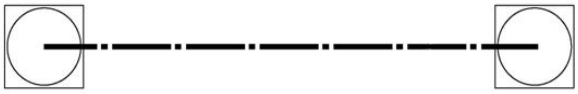
*Reference: Architecture Form, Space and Order - FRANCIS D.K CHING*

# LOGICAL DERIVATION

## INTRODUCTION TO PRINCIPLES IN ARCHITECTURE

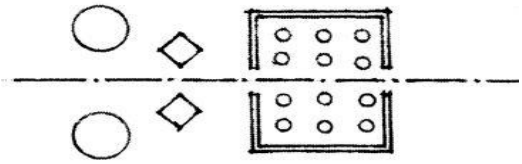
### AXIS

A Line established by two point in space about which form and spaces can be arranged in symmetrical and balanced manner



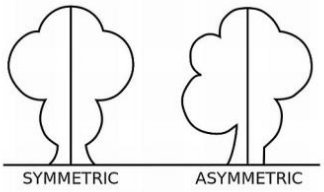
### SYMMETRY

The balanced distribution and arrangement of equivalent forms and spaces on opposite sides of dividing plane or about a centre axis



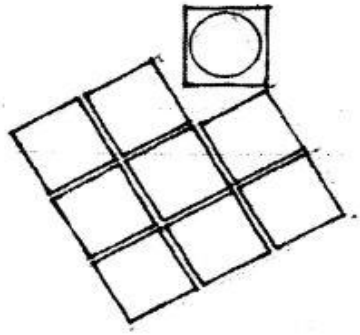
### ASYMMETRY

Asymmetrical or Informal Balance Parts of the design are not identical but are equal in visual weight on opposite sides of dividing plane or about a centre axis




### HIERARCHY

The articulation of importance and significance of form or space by its size shape and placement relative to other forms and spaces of organization

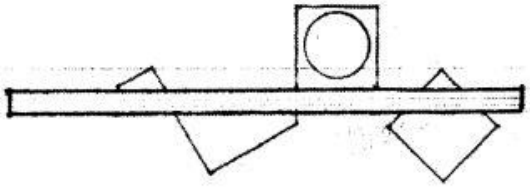


### RHYTHM

Unifying movement characterized by patterned repetition or alteration of formal elements or motifs in same or modified forms

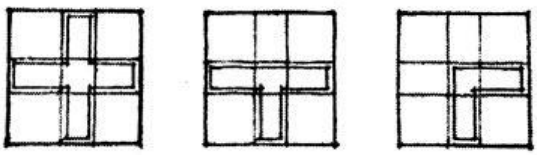
### DATUM

A line plane or volume that , by its continuity and regularity , serves together , measure and organize a pattern of form and spaces.



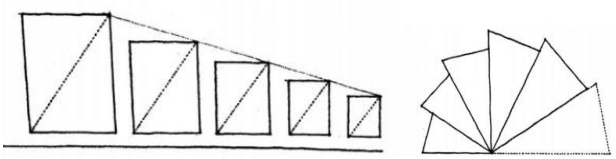
### TRANSFORMATION

The principle that an architectural concept or organization can be retained, strengthened and built upon through a series of discrete manipulation and transformations.



### REPETITION

Repetition refers to one object or shape repeated; pattern is a combination of elements or shapes repeated in a recurring and regular arrangement; Rhythm is a combination of elements repeated, but with variations



*Reference: Architecture Form, Space and Order - FRANCIS D.K CHING*

# LOGICAL DERIVATION

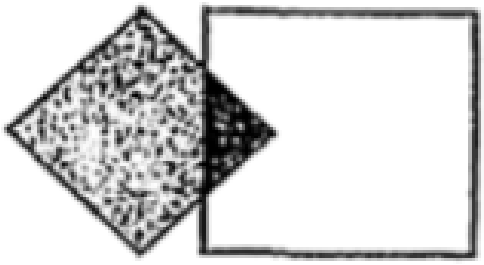
## INTRODUCTION TO SPATIAL RELATIONSHIPS

**SPACE WITHIN A SPACE**

A large space can envelope and contain a similar space within its volume. Visual and spatial continuity between the two spaces can be easily accommodated

**INTERLOCKING SPACES**

An interlocking spatial relationship results from the overlapping of two spatial fields and the emergence of a zone of a shared space. Each space interlocking retains its identity. But the intersection of two spaces is subjected to a number of interpretations

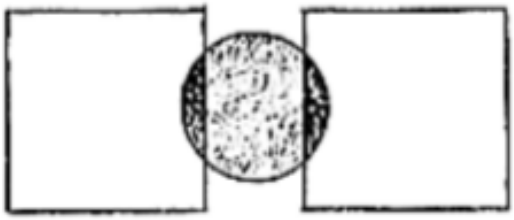


**ADJACENT SPACES**

Two spaces may abut each other or share a common border. It allows each space to be clearly defined and to respond, each in its own way to functional or symbolic requirements

**SPACES LINKED BY A COMMON SPACE**

Two spaces which are separated by a distance can be linked or related to each other by a third, intermediate space. The visual and the spatial relationship between the two spaces depends on the nature of the third space.



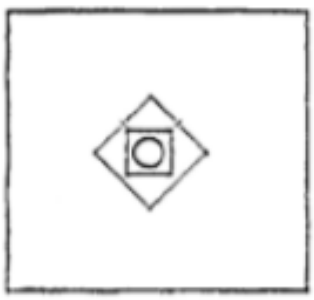
*Reference: Architecture Form, Space and Order - FRANCIS D.K CHING*

# LOGICAL DERIVATION

## INTRODUCTION TO SPATIAL ORGANIZATION

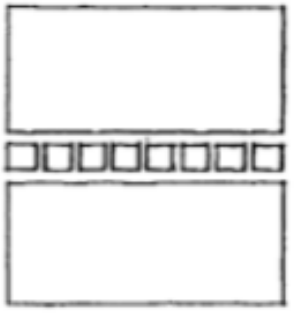
### CENTRALIZED ORGANIZATION

A centralized organization is a stable, concentrated composition that consists of a number of secondary spaces grouped around a large, dominant central space. The central unifying space of the organization is generally regular in form and large enough in size to gather a number of secondary spaces about its perimeter.



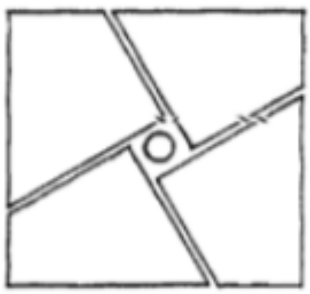
### LINEAR ORGANIZATION

A linear organization consists essentially of a series of spaces. These spaces can either be directly related to one another or be linked through a separate and distant linear space. It usually consists of repetitive spaces which are similar in size, form and function. It may consist of a single linear space that organizes along its length a series of spaces that differ in size, form and function.



### RADIAL ORGANIZATION

A radial organization of space combines elements of both centralized and linear organizations. It consists of a dominant central space from which a number of linear organizations extend in a radial manner. Whereas a centralized organization is an introvert scheme that focuses inward on its central space a radial organization is an extrovert plan that reaches out to its context.

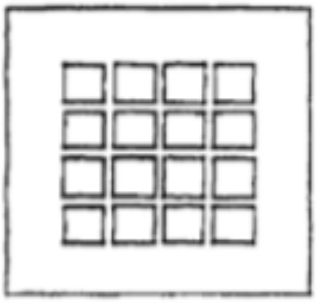


### CLUSTERED ORGANIZATION

A clustered organization grouped by proximity or the sharing of a common visual trait or relationship

### GRID ORGANIZATION

Space organized within the field of a structural grid or another three dimensional framework



*Reference: Architecture Form, Space and Order - FRANCIS D.K CHING*

# LOGICAL DERIVATION

## TESSELATIONS AND PATTERN & FRACTALS

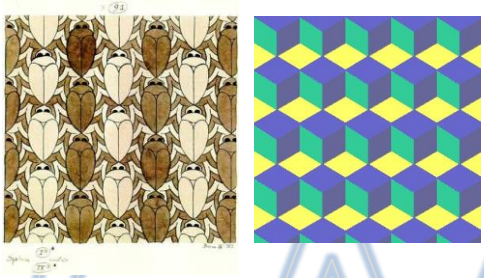
"Filling two-dimensional planes has become a real mania to which I have become addicted and from which I sometimes find it hard to tear myself away."

- M. C. Escher

There a three types of tessellations:
Translation, Rotation, and Reflection.

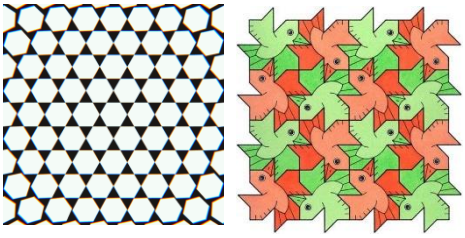
### TRANSLATION

A Tessellation which the shape repeats by moving or sliding.



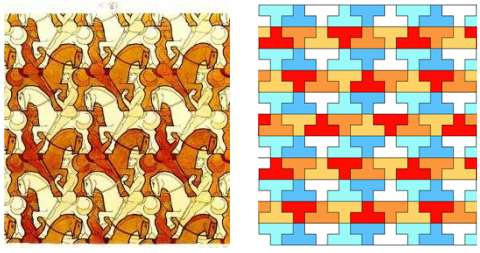
### ROTATION

A Tessellation which the shape repeats by rotating or turning.



### REFLECTION

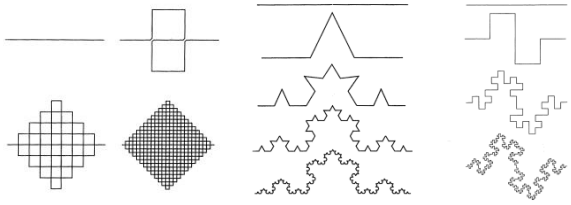
A Tessellation which the shape repeats by reflecting or flipping.



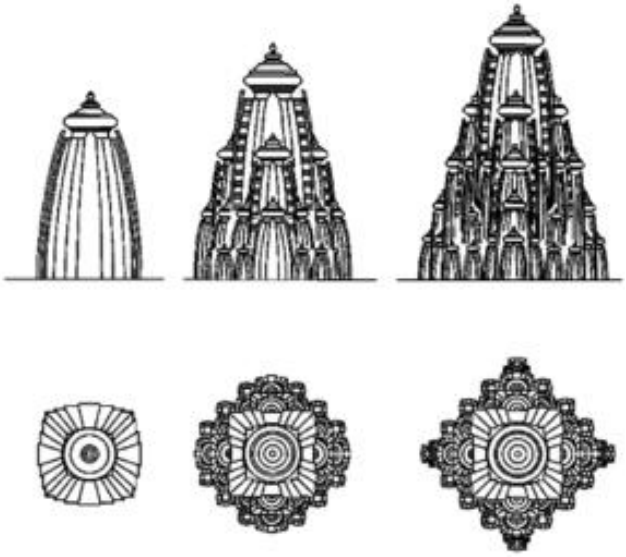
*Reference: Tessellation Unit*

### FRACTALS IN ARCHITECTURE

French mathematician Benoit Mandelbrot, who famously introduced the concept of fractals and its applications. He named the phenomenon fractal, derived from the latin word fra'ctus, meaning broken.



An aspect of fractal architecture is how it affects humans from an environmental psychological point of view. In the article Fractal Architecture Could Be Good For You (Joye, 2007) the author presents numerous architectural examples where fractal geometry plays an important role, from Hindu temples, where the self repeating and self-similar components are supposed to reflect the idea that every part of cosmos contain all information about the whole cosmos, to gothic architecture, with a high degree of self similarity and complex detailing.

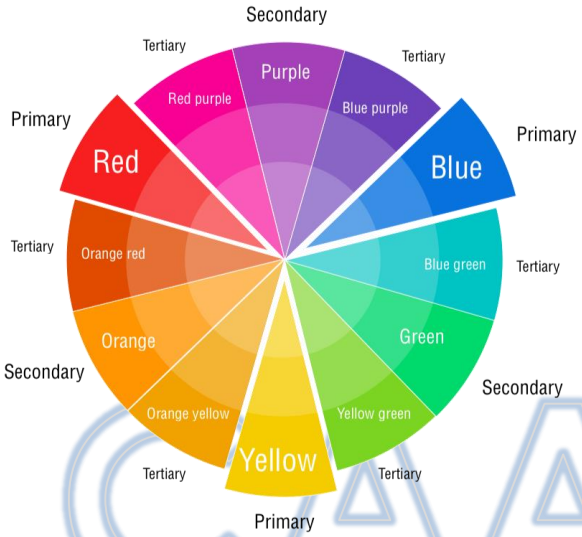


# LOGICAL DERIVATION

## INTRODUCTION TO COLOUR THEORY

A colour circle, based on red, yellow and blue, is traditional in the field of art. Sir Isaac Newton developed the first circular diagram of colours in 1666. Since then scientists and artists have studied and designed numerous variations of this concept. Colour theory is a body of practical guidance to colour mixing and the visual effects of a specific colour combination. There are also definitions (or categories) of colours based on the colour wheel: primary colour, secondary colour, and tertiary colour.

### COLOUR WHEEL




### PRIMARY COLOURS

These are the three pigment colours that cannot be mixed or formed by any combination of other colours. All other colours are derived from these three hues.

### SECONDARY COLOURS

These are the colours formed by mixing the primary colours.

### TERTIARY COLOURS

These are the colours formed by mixing a primary and a secondary colour. So it is referred as a two word name, such as blue-green, red-violet, and yellow-orange.

### WARM & COOL COLOURS

**Warm colours** , such as red, yellow, and orange evoke warmth when observed.

**Cool colours** ,such as blue, green, and purple (violet) evoke a cool feeling when observed.

### NEUTRAL COLOURS

Grey, Brown. These are not on most colour wheels, but they're considered neutral because they don't contrast with much of anything.

### TINTS, SHADES AND TONES

**Tint** – adding white to pure colour


**Shade** – adding black to pure colour


**Tone** – adding grey to pure colour


### COLOUR SCHEME/HARMONY

**Complimentary *colours***

Red and Green, Blue and Orange, Purple and Yellow - located directly opposite to each other on the colour wheel.

**Analogous Colours**

Red and Orange, Blue and Green, etc. – located right next to each other on the colour wheel.

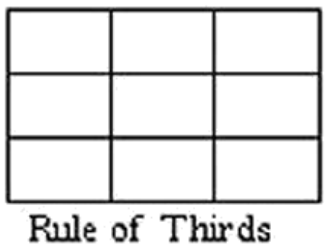
**Triad Colours**

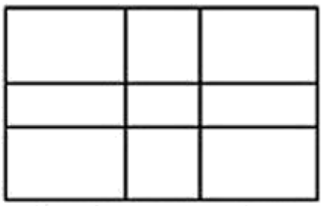
Uses colours that are evenly spaced around the colour wheel.

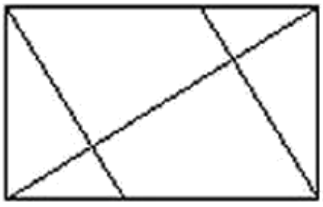
# LOGICAL DERIVATION

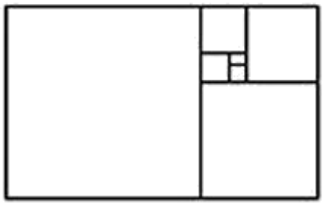
## COMMON METHODS OF VISUAL COMPOSITION

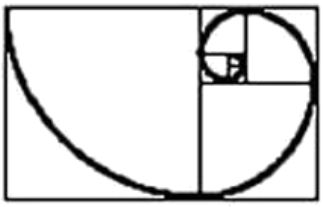
### GOLDEN PROPORTIONS


Rule of Thirds

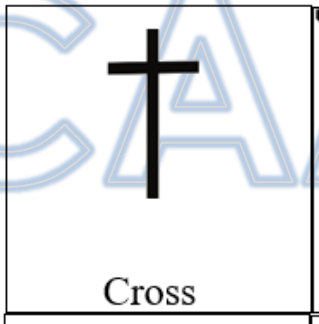

Golden Section

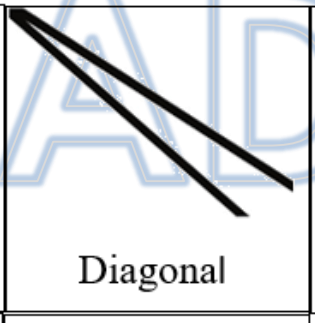

Golden Triangles


Spiral Section


Golden Spiral


Harmonious Triangles


Cross


Diagonal


Compound curve


Focal mass


Radial


Pyramid


V- arrangement


L- arrangement

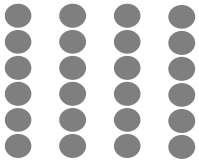

Circular

# LOGICAL DERIVATION

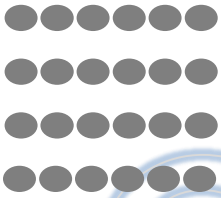
## INTRODUCTION TO GESTALT'S THEORY

**LAW OF PROXIMITY:**

The closer objects are to each other, the more likely they are to be perceived as a group.



*The above image is perceived as columns rather than rows*



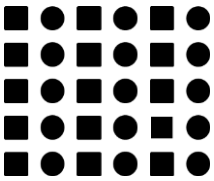
*The above image is perceived as rows rather than columns*

**LAW OF GOOD PRAGNANZ:**

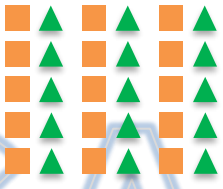
"Prägnanz means, in simple terms, "good form" and refers to organizing shapes to simple forms. Figures are seen as their simple elements instead of complicated shapes." Prägnanz is a German word that directly translates to mean "pithiness" and implies the ideas of salience, conciseness and orderliness

**LAW OF SIMILARITY:**

The principle of similarity states that things which share visual characteristics such as shape, size, color, texture, value or orientation will be seen as belonging together (form groups).



*This image is grouped together by shapes*



*This image is grouped together by colours*

**LAW OF FIGURE – GROUND:**

Figure and Ground explains how different elements are put together to make one scene or a whole image. "Figure" is the more dominant shape. "Ground" can be referred to as the background. Once the figure is identified, the rest of the image becomes the ground.

**LAW OF CLOSURE:**

In perception there is the tendency to complete unfinished or partially obscured objects. (If a large pattern is with missing components, the eye tends to fill in the missing parts to create the actual image

*The eye perceives the square*

**LAW OF SYMMETRY**

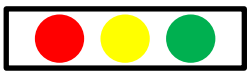
The human brain perceives symmetrical objects as parts of the same group. They create an impression of stability and order.

**LAW OF GOOD CONTINUATION:**

Objects will be grouped as a whole if they are co-linear, or follow a direction. Objects arranged in either a straight line or a smooth curve tends to be seen as an unit. In cases where there is an intersection between objects, individuals tend to perceive the two objects as two single uninterrupted entities.

**LAW OF COMMON FATE**

It states that humans perceive visual elements that move in the same speed and/or direction as parts of a single stimulus. A common example of this is a flock of birds.



**LAW OF PAST EXPERIENCE**

Elements or objects frequently seen together in the past experience of a person are perceived to be as a group or in one single entity. The below three colours are perceived as traffic lights

**FIGURE-GROUND PERCEPTION**

Figure-ground perception refers to the tendency of the visual system to simplify a scene into the main object that we are looking at (the figure) and everything else that forms the background (or ground).

# LOGICAL DERIVATION

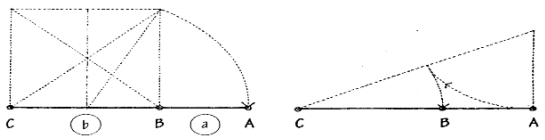
## SCALE AND PROPORTION

### PROPORTION

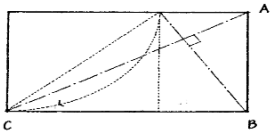
Proportion is a central principle of architectural theory and an important connection between mathematics and art. It is the visual effect of the relationships of the various objects and spaces that make up a structure to one another and to the whole.

### GOLDEN SECTION

A proportion between two dimensions of a plane figure or two divisions of a line, in which the ration of the smaller to the larger is the same as the ratio of the larger to the whole: a ratio of approx. 0.618 to 1.000.




The geometric construction of the Golden Section, first by extension, and then by division.




$AB = a$

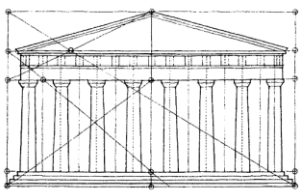
$BC = b$

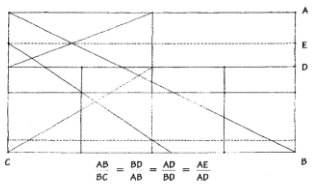
$\emptyset$ = Golden Section

$$\emptyset = \frac{a}{b} = \frac{b}{a+b} = 0.618$$

A rectangle whose sides are proportioned according to the Golden Section is known as a Golden Rectangle.

If a square is constructed on its smaller side, the remaining portion of the original rectangle would be a smaller but similar Golden Rectangle.



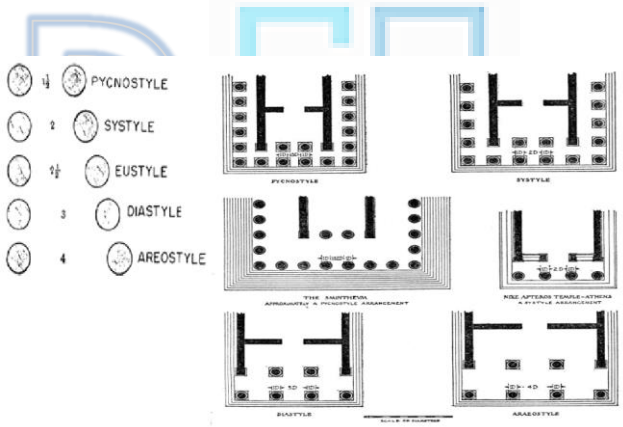



### CLASSICAL ORDERS

To the Greeks and Romans, the Orders represented in their proportioning of elements the perfect expression of beauty and harmony.

The basic unit of dimension was the diameter of the column. From this module were derived the dimensions of the shaft, the capital, as well as the pedestal and the entablature above, the spacing between two adjacent columns, down to the smallest detail. INTERCOLUMNIATION is the system of spacing between columns, which is also based on the diameter of the column.

Standardized by Marcus Vitruvius Polio during the reign of Augustus in his "The Ten Books on Architecture." Vignola remodified these rules for the Italian Renaissance and his forms for the Orders are probably the best known today.




### RENAISSANCE THEORIES

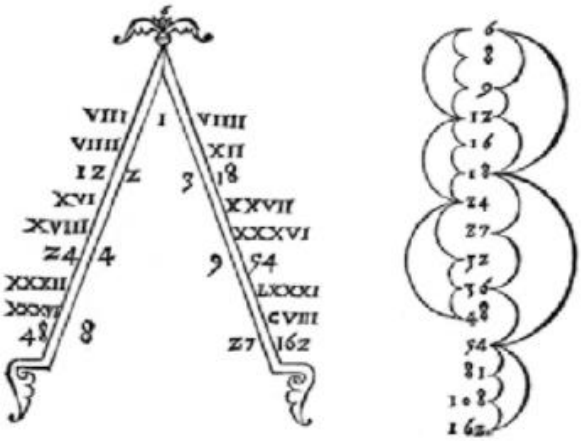
The architects of the Renaissance, believing that their buildings had to belong to a higher order, returned to the Greek mathematical system of proportions. The Pythagorean creed was " Everything is arranged according to numbers." The Greeks conceived music to be geometry translated into sound, Renaissance architects believed that architecture was mathematics translated into spatial units.

*Reference:* Summary of D.K.Ching book by Arch. Janice Ma.

# LOGICAL DERIVATION

## SCALE AND PROPORTION

Renaissance architects applied PYTHAGORAS'S THEORY OF MEANS to the ratios of the intervals of the Greek musical scale, and soon developed an unbroken progression of ratios that formed the basis for the proportions of their architecture.



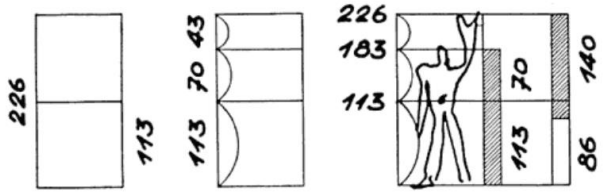
Series of interlocking ratios that results form applying Pythagoras theory of means to the intervals of the Greek musical scale.

**MODULOR**

Le Corbusier's own proportioning system developed in 1942 published as: The Modular: A Harmonious Measure to the Human Sale Universally Applicable to Architecture and Mechanics. : to order "the dimensions of that which contains and that which is contained."

He saw the measuring tools of the Greeks, Egyptians, and other high civilizations as being "infinitely rich and subtle because they formed part of the mathematics of the human body, gracious, elegant, and firm, the source of that harmony which moves us, beauty."

He based the Modular on both mathematics (the aesthetic dimension of the Golden Section and the Fibonacci Series), and the proportions of the human body (functional dimensions).



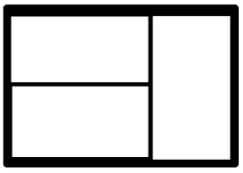

113, 70, 43 cm
43 + 70 =113
113 + 70 = 183
113 + 70 + 43 = 226(2x113)

**KEN**

The traditional Japanese unit of measure, the shaku, was originally imported form China.

Originally used simply to designate the interval between two columns and varied in size, it was soon standardized for residential architecture and became an absolute measurement.

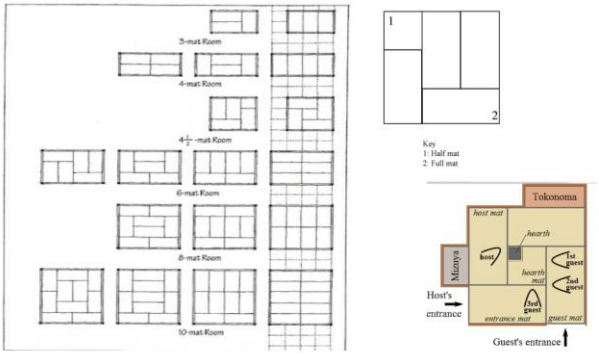
Aside as a measurement system, it evolved into an aesthetic module that ordered the structure, materials, and space of Japanese architecture.



Two methods of designing with the Ken modular method:

**Inaka-ma Method**

The ken grid of 6 shaku determined the center-to-center spacing of columns. Therefore, the standard tatami floor mat (3 x ^ shaku or ½ x 1 ken) varied slightly to allow for the thickness of the columns.




*Reference:* Summary of D.K.Ching book by Arch. Janice Ma.

# LOGICAL DERIVATION

## SCALE AND PROPORTION

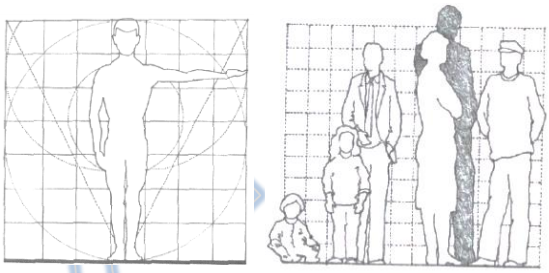
**Kyo-ma Method**

The floor mat remained constant (3.15 x 6.30 shaku) and the column spacing (ken module) varied according to the size of the room and ranged from 6.4 to 6.7 shaku.

**ANTHROPOMETRICS**

The measurement of the size and proportions of the human body. Its applicability to the design process is seen in the physical fit, or interface, between the human body and the various components of space.

anthro=man, pometry=measure

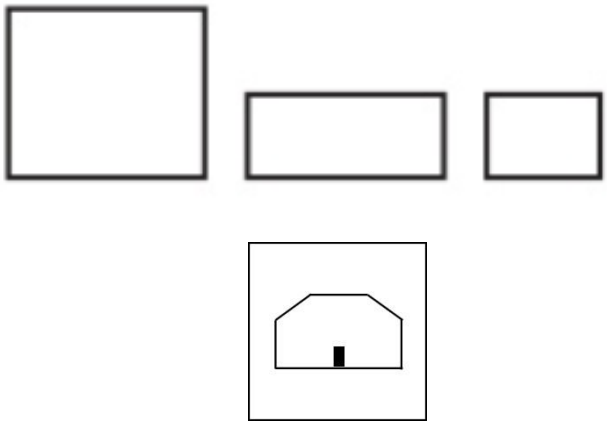


**SCALE**

Refers to how we perceive or judge the size of something in relation to something else.

The entity of a space or object is being compared to may be an accepted unit or standard of measurement.

In drawing, we use scale to specify the ratio that determines the relationship between the illustration it represents



**Mechanical Scale**

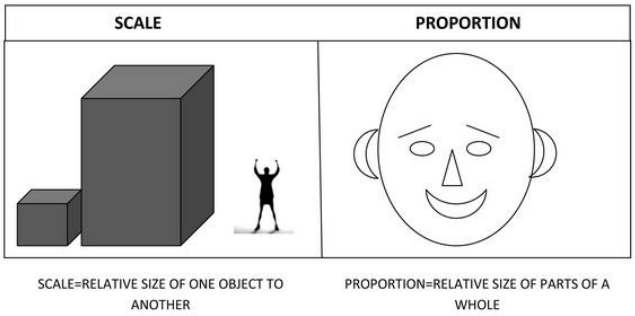
The size or proportion of something relative to an accepted standard of measurement.

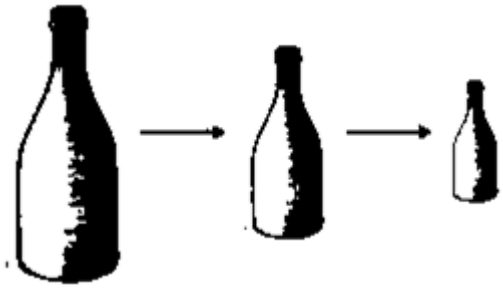
**Visual Scale**

The size or proportion an element appears to have relative to other elements of known or assumed size.

**Human Scale**

Based on the dimensions & proportions of the human body



Scale

Proportion

*Reference:* Summary of D.K.Ching book by Arch. Janice Ma.

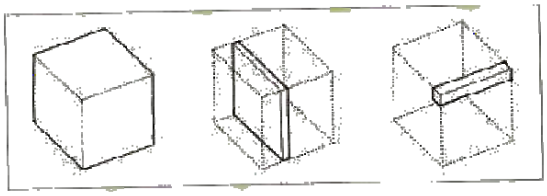
# LOGICAL DERIVATION

## TRANSFORMATION OF FORM

Form can be transforms in three ways:

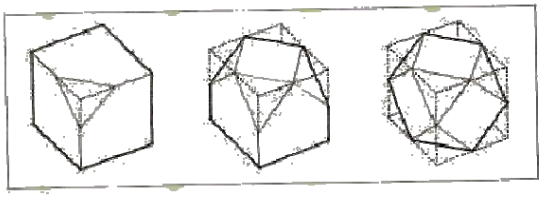
### DIMENSIONAL TRANSFORMATION

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.



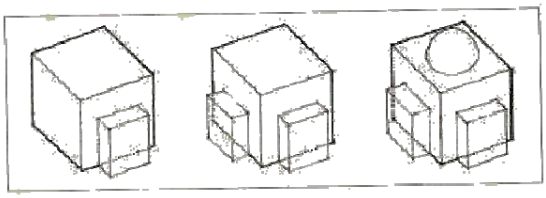
### SUBTRACTIVE TRANSFORMATION

A form can be transformed by subtract in 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.



### ADDITIVE TRANSFORMATION

A form can be transformed by the addition of elements tom 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.



### FORMAL COLLASION OF GEOMETRY

When two forms differing in geometry or orientation collide and interpenetrate each other's boundaries, each will vie for visual supremacy and dominance. In these situations, the following forms can evolve:

The two forms can subvert their individual identities and merge to create a new composite form.

One of the two forms can receive the other totally within its volume.

The two forms can retain their individual identities and share the interlocking portion of their volumes.

The two forms can separate and be linked by a third element that recalls the geometry of one of the original forms.

*Reference: Architecture Form, Space and Order - FRANCIS D.K CHING*