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# NATA 2020 Reading Material Revised PCQ/MCQ Questions

PREPARED BY

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EXPLANATORY  
NOTES  
ATTACHED BELOW  
WILL HELP YOU  
SOLVE SIMILAR  
MCQ/PCQ  
QUESTIONS

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**B.Arch.,**

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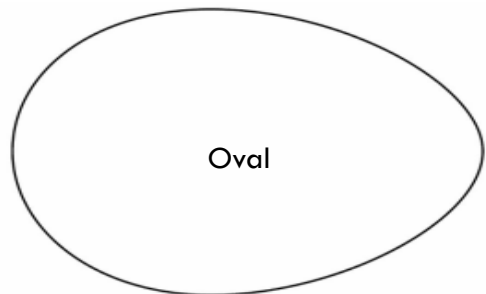
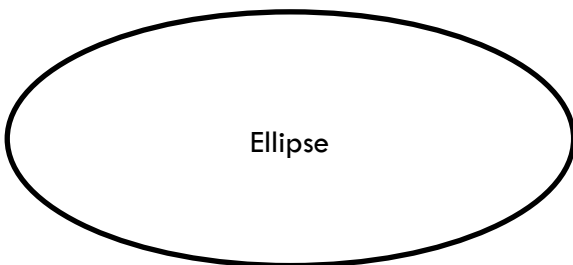
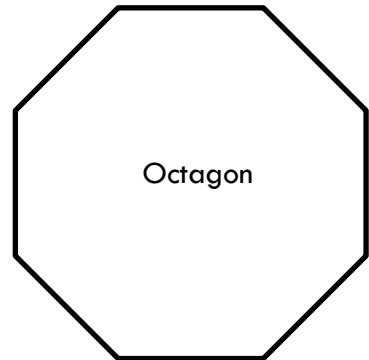
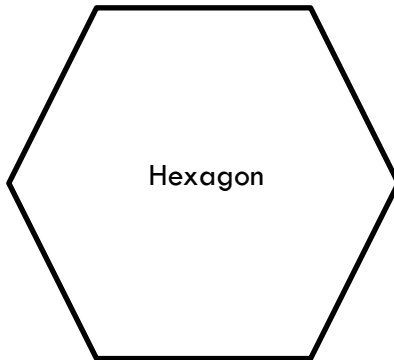
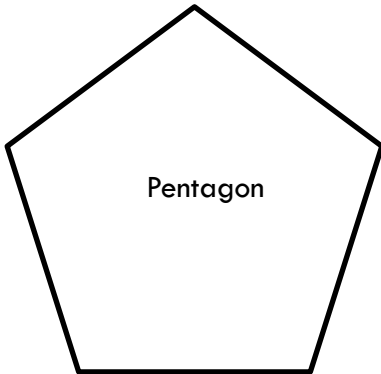
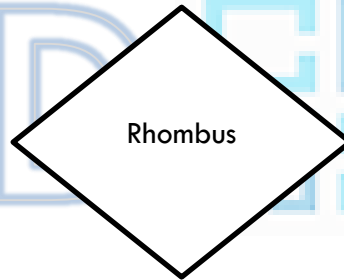
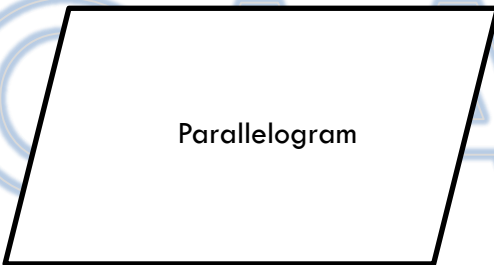
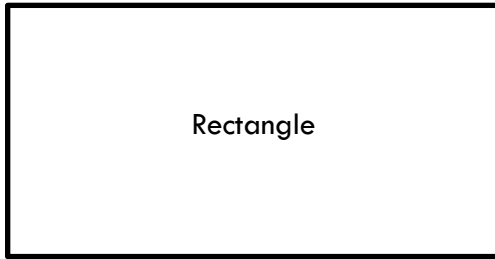
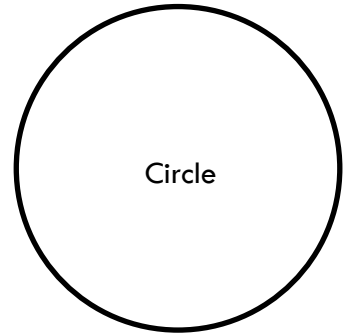
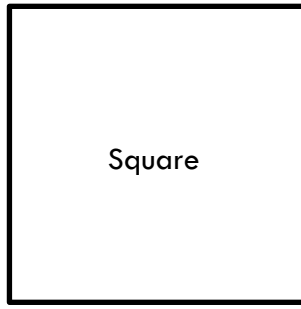
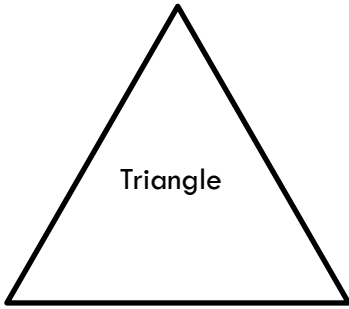
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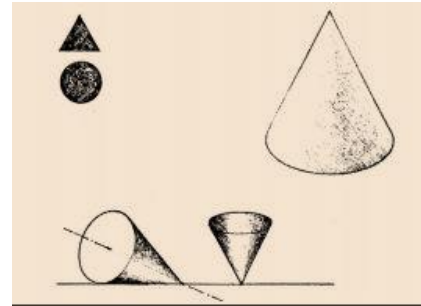
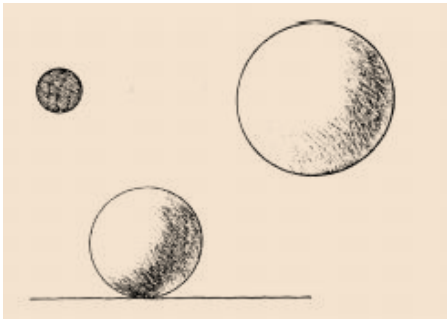
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INTRODUCTION TO BASIC SHAPES

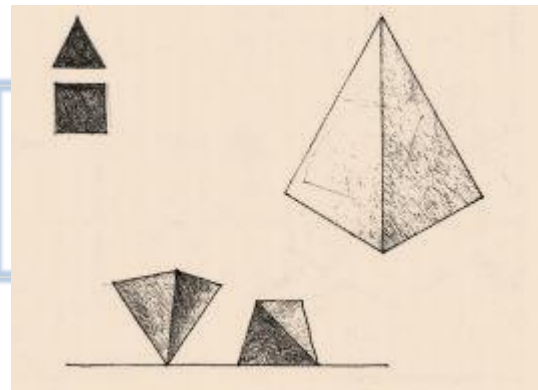


**INTRODUCTION TO PRIMARY SOLIDS****SPHERE**

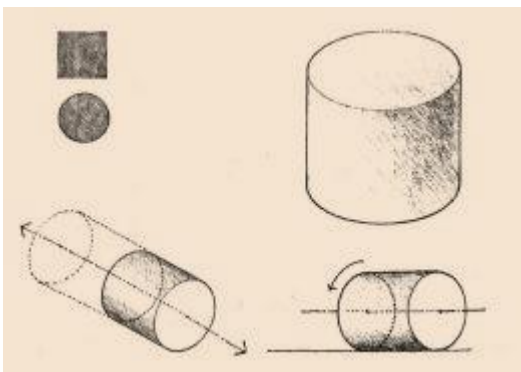
A solid generated by the revolution of a circle about its diameter. It has no directional quality, neither horizontal nor vertical, but simply static. A sphere is a centralized and highly concentrated form. It is self-centred & normally stable in its environment. In any point it retains its circular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

**PYRAMID**

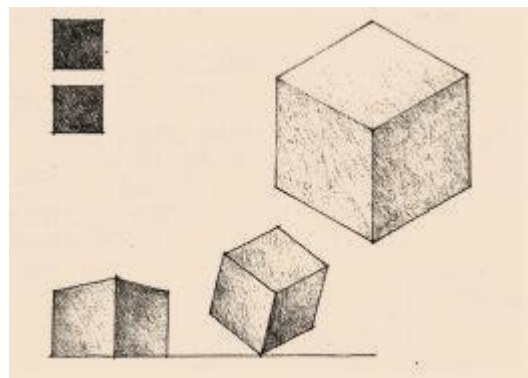
A polyhedron having a polygonal base and triangular faces meeting at a common point or vertex. The pyramid has properties similar to those of the cone. Because all of its sides are flat planes. However its stable on all its faces.

**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 it 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**

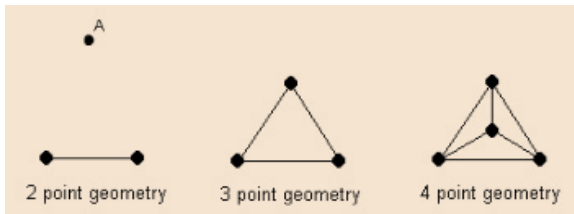
A solid generated by the revolution of a right triangle about one of its sides. Like the cylinder, the cone is a highly stable form when resting on its circular base. It can also rest on its apex in a precarious state of balance.

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

**INTRODUCTION TO ELEMENTS IN ARCHITECTURE**

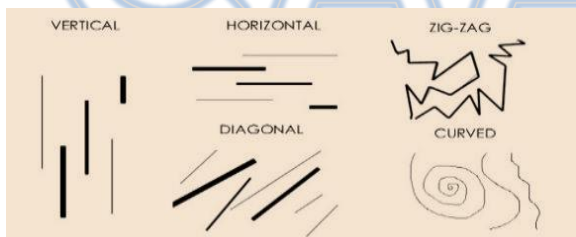
**POINT**

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.



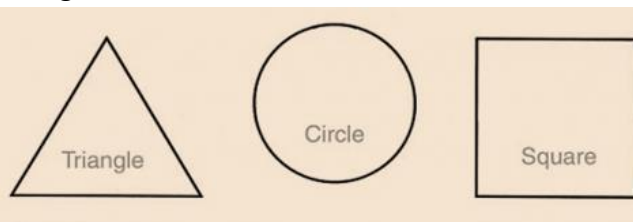
**LINE**

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.



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

**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**

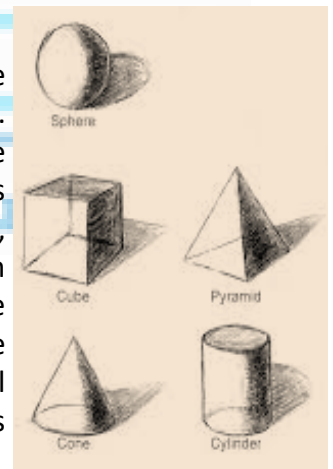
Colour adds the magic element to a design. Each colour has a mood, an emotion and different levels of significance.

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.



**INTRODUCTION TO PRINCIPLES IN ARCHITECTURE**

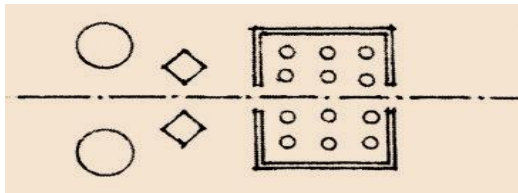
**AXIS**

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



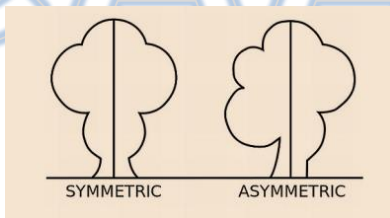
**SYMMETRY**

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



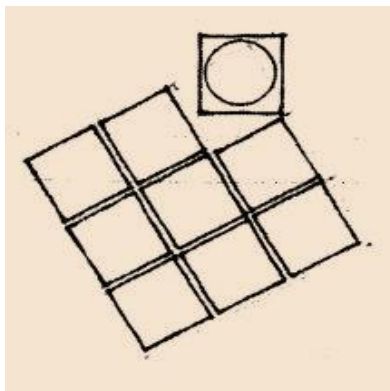
**ASYMMETRY**

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



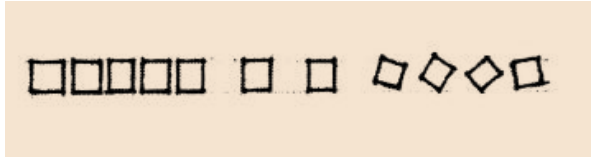
**HIERARCHY**

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



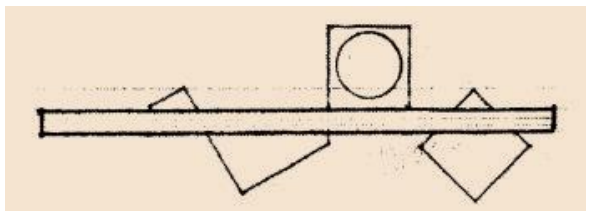
**RHYTHM**

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



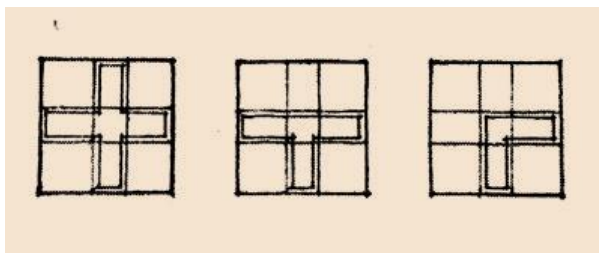
**DATUM**

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



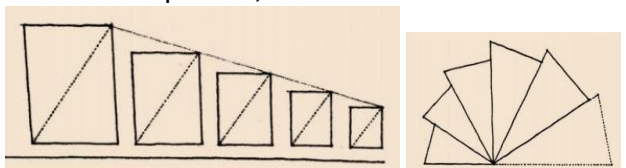
**TRANSFORMATION**

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

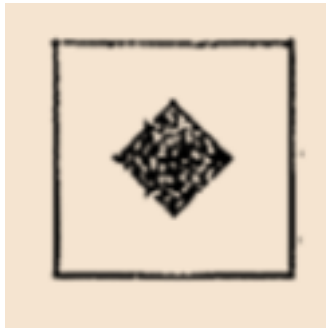


**REPETITION**

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



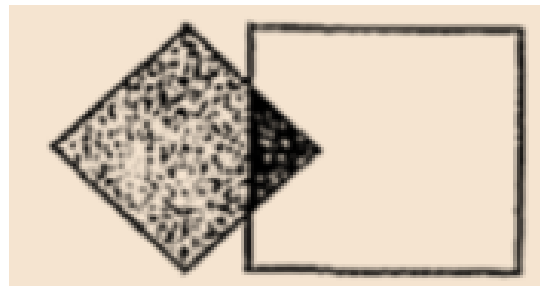
Reference: Architecture Form, Space and Order - FRANCIS D.K CHING

**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**

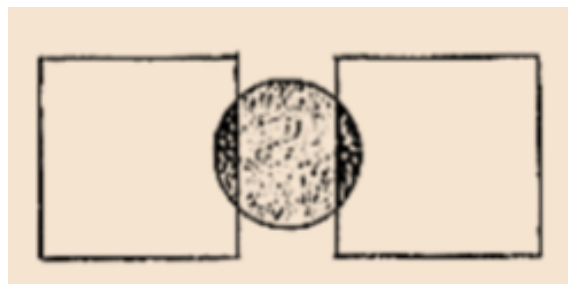
An interlocking spatial relationship results from the overlapping of two spatial fields and the emergence of a zone of a shared space. Each space interlocking retains its identity. But the intersection of two spaces is subjected to a number of interpretations

**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.



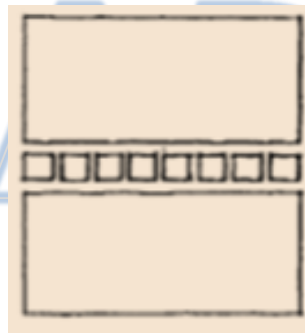
Reference: Architecture Form, Space and Order - FRANCIS D.K CHING

**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**

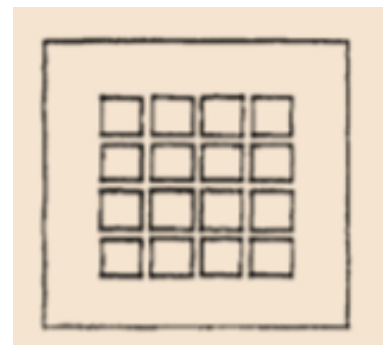
A radial organization of space combines elements of both centralized and linear organizations. It consists of a dominant central space from which a number of linear organizations extend in a radial manner. Whereas a centralized organization is an introvert scheme that focuses inward on its central space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



**TESSELLATIONS AND PATTERN & FRACTALS**

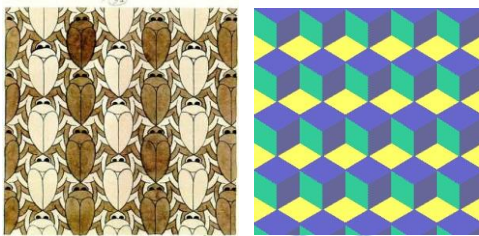
"Filling two-dimensional planes has become a real mania to which I have become addicted and from which I sometimes find it hard to tear myself away."

- M. C. Escher

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

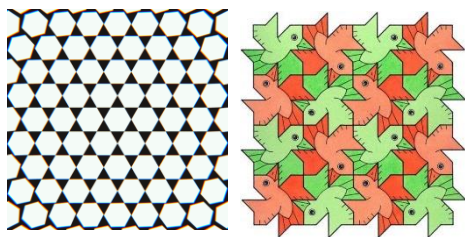
**TRANSLATION**

A Tessellation which the shape repeats by moving or sliding.



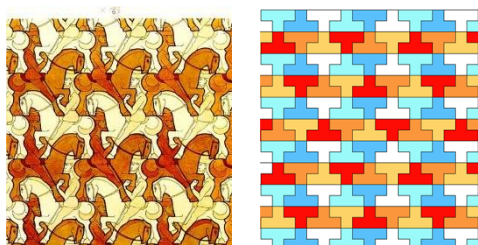
**ROTATION**

A Tessellation which the shape repeats by rotating or turning.



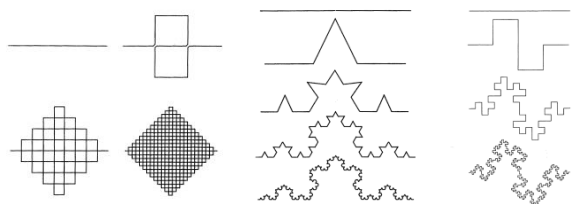
**REFLECTION**

A Tessellation which the shape repeats by reflecting or flipping.

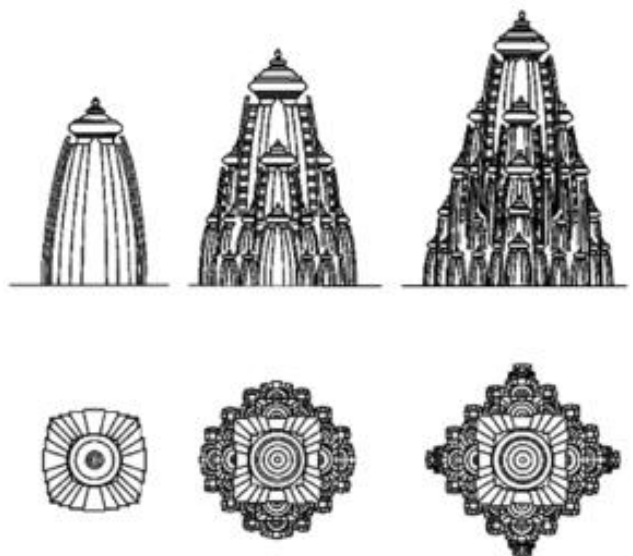


**FRACTALS IN ARCHITECTURE**

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.

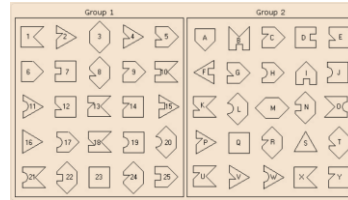


Reference: Tessellation Unit

**INTRODUCTION TO SPATIAL ABILITY ASSESSMENT (Few Samples)**

**01. SHAPE MATCHING (TWO DIMENSIONAL)**

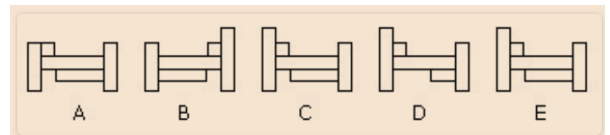
In this method, two groups of simple, flat objects are given and the question is to match the pairs by same size and shape. Each drawing in the first group is exactly the same as a drawing in the second group. The objects in the second group may have been moved and some may have been rotated.



Answers: 1. X; 2. P; 3. M; 4. V; 5. G; 6. A; 7. D; 8. T; 9. C; 10. B; 11. W; 12. E; 13. U; 14. Y; 15. F; 16. S; 17. H; 18. K; 19. J; 20. L; 21. O; 22. N; 23. Q; 24. R; 25. I

**02. VISUAL COMPARISON (TWO DIMENSIONAL)**

Several objects will be grouped together in the question and the identical pair has to be marked out.

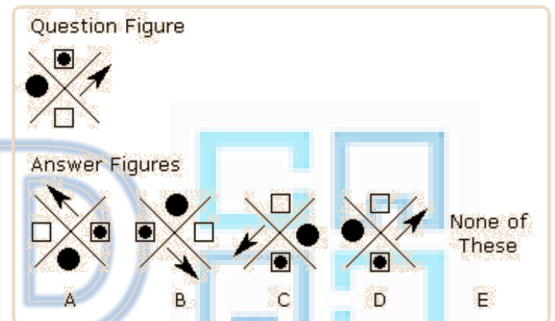


Answer: C and E are the only two pictures that are identical

**03. GROUP ROTATION (TWO DIMENSIONAL)**

In this method, the task is to identify the choices to the original shape/pattern. The multiple choices comprise of the original shape/pattern after single/multiple rotations.

**Key Strategy - Choose the asymmetrical shape in the group and determine how the shape would look when rotated clockwise or anticlockwise.**

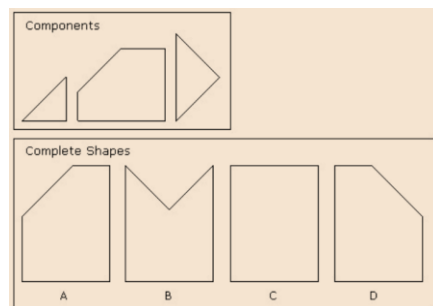


Answer: C

**04. COMBINING TWO-DIMENSIONAL SHAPES**

In this pattern, question comprise of series of two dimensional shapes which are cut from a parent shape. The question is to identify the parent shape.

**Key Strategy: Observe parent shape from the choices and look for distinct features that matches with the element. Also parent shape does not have elements sticking out.**

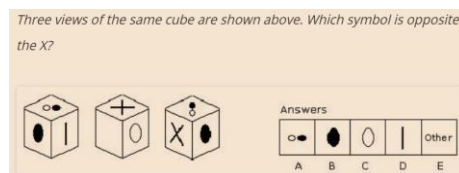


Answer: B

**05. CUBE VIEWS IN THREE DIMENSIONS**

These questions comprise of different views of a patterned cube. Question will be to identify the pattern on a particular face of the cube.

**Key Strategy: Use the process of elimination**



Answer: D

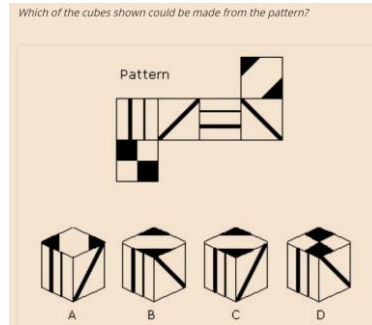
Reference: www.wikijob.co.uk.

**INTRODUCTION TO SPATIAL ABILITY ASSESSMENT**

**06. CUBES IN TWO & THREE DIMENSIONS**

These type of questions have the layout of the cube in two dimension and is to identify the right cube when the layout is folded. The question can be vice-versa too.

**Key Strategy - Mark the faces of the cube as Front, Back, Top, Bottom, Right side and Left side in the layout and work on the cube formation.**

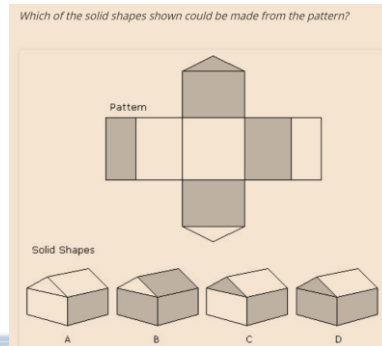


Answer: A

**07. OTHER SOLIDS IN TWO & THREE DIMENSIONS**

These questions use irregular solid shapes as a layout and the question is to identify the three dimensional form arrived at by folding. This is similar to cube exercise (Point no 6)

**Key strategy - Use the process of elimination. Consider the connection between four visible faces and look out for patterns / shades.**



Answer: D

**08. TWO-DIMENSIONAL MAPS**

Simple two-dimensional maps will be given in the question to test the ability to follow instructions and visualizing a route.

**Key Strategy - Basic sense of direction and imagine yourself following the instructions.**



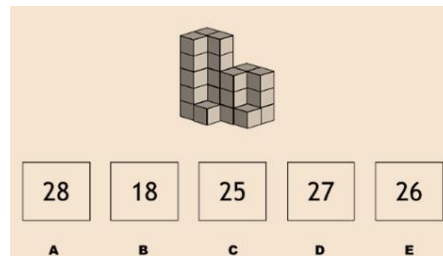
Answer: B

Officer Wilkinson is in Depp St and can see the Town Hall to her right. What direction is she facing?

**09. BLOCK COUNTING IN THREE DIMENSIONS**

This type of question will be having a three dimensional form made up of multiple units/ blocks, some of which may be hidden. The question will be to quantify the hidden elements that comprise the three-dimensional form.

**Key Strategy - Count the number of units as rows and columns and calculate the hidden blocks numerically.**



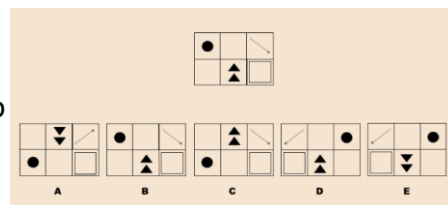
Answer: E

How many blocks make up the shape below?

**10 TWO -DIMENSIONAL MIRROR REFLECTIONS**

This question presents an image and will be asked to identify its mirror image.

**Key Strategy - Use the process of elimination**



Answer: D

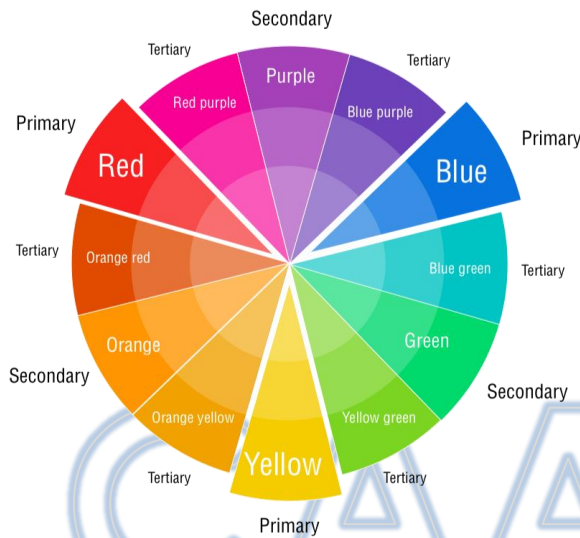
Which answer shows a reflection of the image below?

Reference: www.wikijob.co.uk.

**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**



**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



**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.

**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.

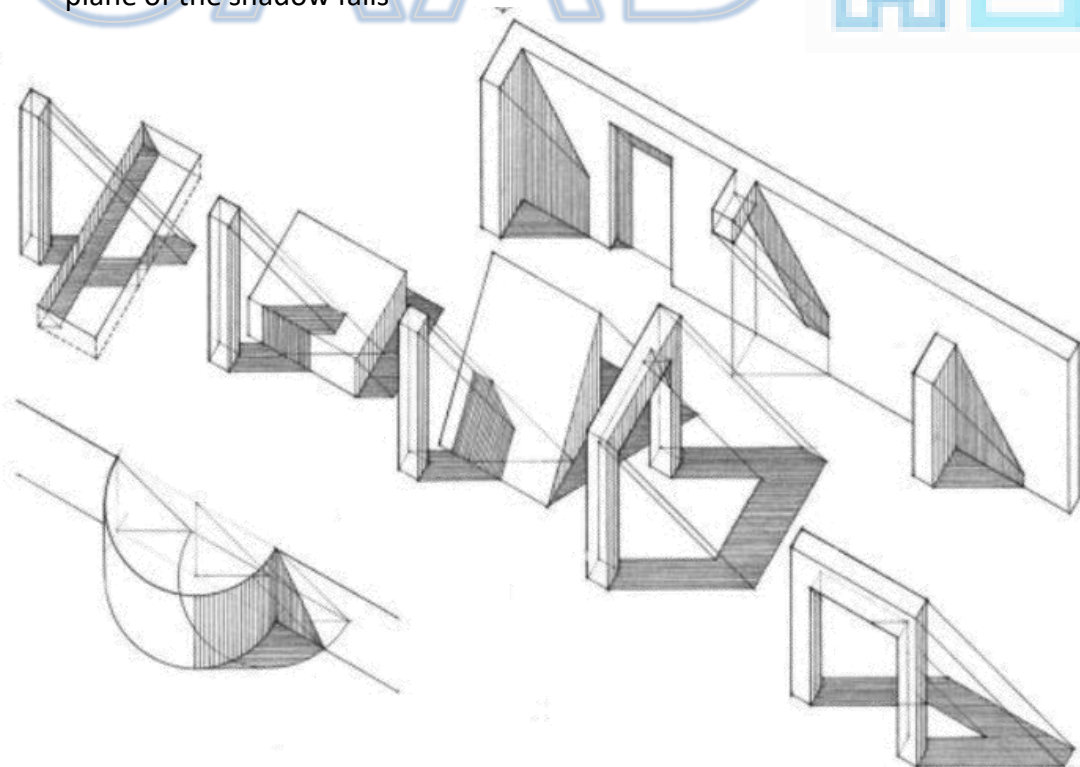
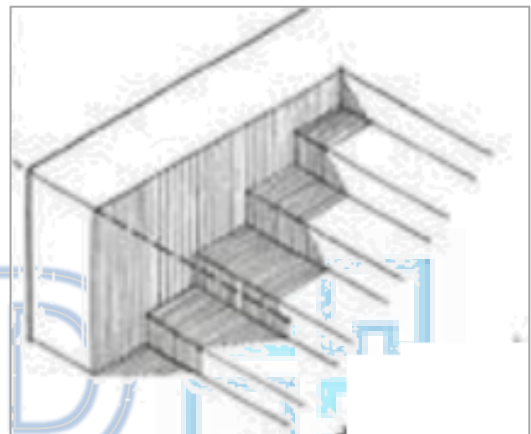
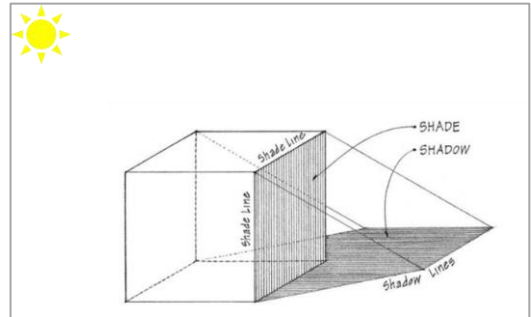


## INTRODUCTION TO SCIOGRAPHY (SHADE & SHADOWS)

Scigraphy is a science of perspective dealing with the projection of shadows or delineation of an object in perspective with its gradations of light and shade.

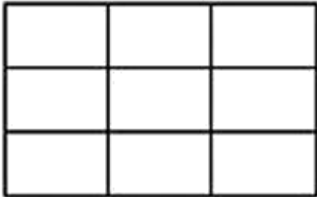
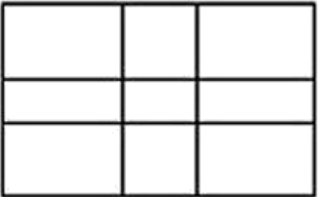

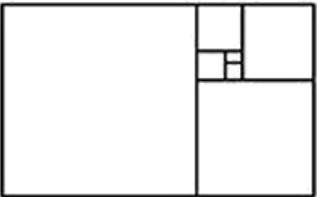
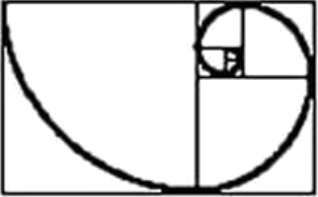

### SHADE & SHADOWS:










- Shade refers to the relatively dark area on those parts of a solid that are tangent to or turned away from a light source.
- Shadows are the relatively dark figures cast upon a surface by an opaque body or part of a body intercepting the rays from a light source.
- A shade line or casting edge separates an illuminated surface from one in shade.
- A shadow line is the shadow cast by a shade line on a receiving surface
- The shape of the shadow is dependent on
  - The position of shade line
  - The position of the observer
  - The direction of the light and
  - The form of the surfaces on which the plane of the shadow falls



**COMMON METHODS OF VISUAL COMPOSITION**

**GOLDEN PROPORTIONS**

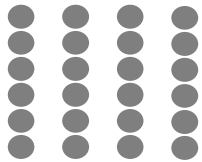
		
Rule of Thirds	Golden Section	Golden Triangles
		
Spiral Section	Golden Spiral	Harmonious Triangles

		
Cross	Diagonal	Compound curve
		
Focal mass	Radial	Pyramid
		
V- arrangement	L- arrangement	Circular

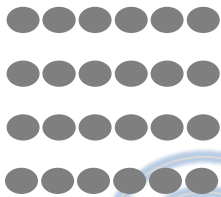
**INTRODUCTION TO GESTALT'S THEORY**

**LAW OF PROXIMITY:**

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



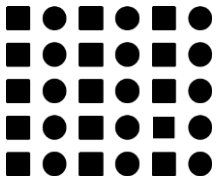
The above image is perceived as columns rather than rows



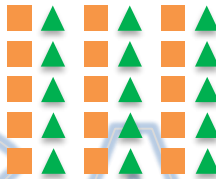
The above image is perceived as rows rather than columns

**LAW OF 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).



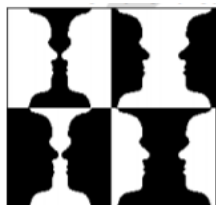
This image is grouped together by shapes



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:**

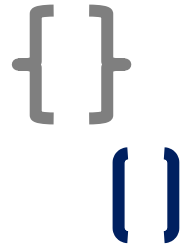
In perception there is the tendency to complete unfinished or partially obscured objects. (If a large pattern is with missing components, the eye tends to fill in the missing parts to create the actual image)



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.



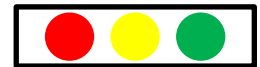
**LAW OF COMMON FATE**

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 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 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).

**SCALE AND PROPORTION**

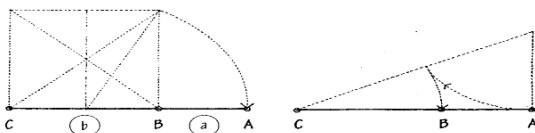
**PROPORTION**

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.

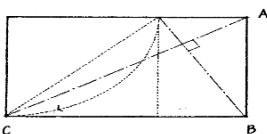


**GOLDEN SECTION**

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.

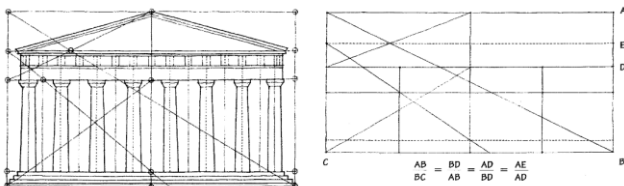


AB = a  
 BC = b  
 φ = Golden Section  

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

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.



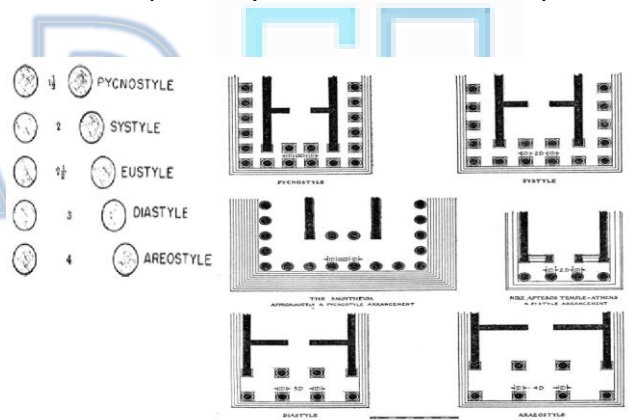
Reference: Summary of D.K.Ching book by Arch. Janice Ma.

**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.



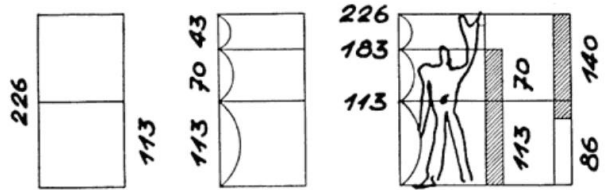
**RENAISSANCE THEORIES**

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.



**SCALE AND PROPORTION**

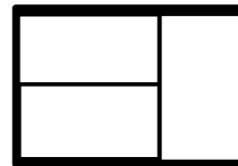
Renaissance architects applied PYTHAGORAS’S THEORY OF MEANS to the ratios of the intervals of the Greek musical scale, and soon developed an unbroken progression of ratios that formed the basis for the proportions of their architecture.



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

**KEN**

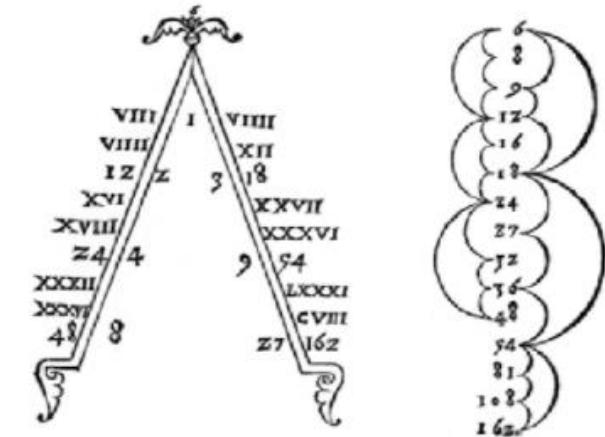
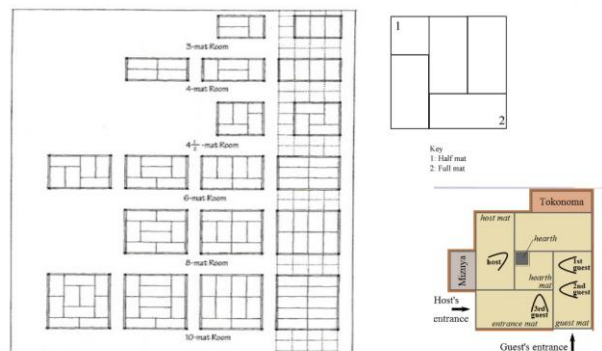
The traditional Japanese unit of measure, the shaku, was originally imported from China. Originally used simply to designate the interval between two columns and varied in size, it was soon standardized for residential architecture and became an absolute measurement. Aside as a measurement system, it 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 6 shaku or 1/2 x 1 ken) varied slightly to allow for the thickness of the columns.



Series of interlocking ratios that results from 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 Modulor: A Harmonious Measure to the Human Scale 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 Modulor on both mathematics (the aesthetic dimension of the Golden Section and the Fibonacci Series), and the proportions of the human body (functional dimensions).

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

**SCALE AND PROPORTION**

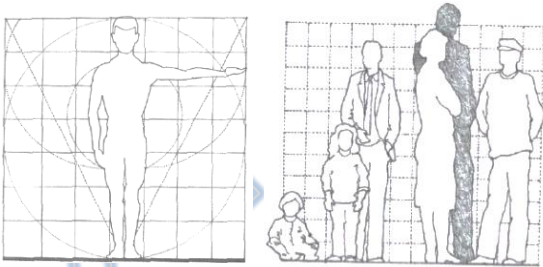
**Kyo-ma Method**

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

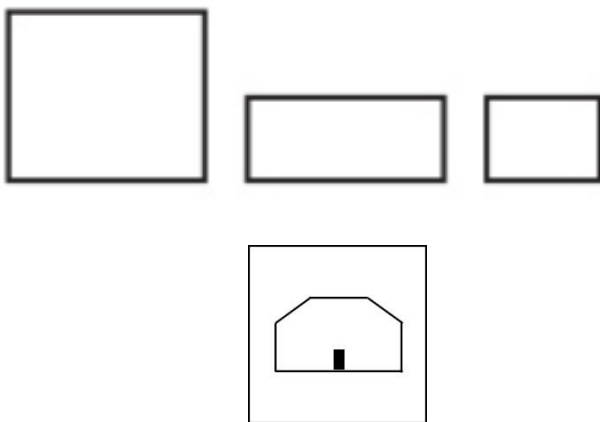


**SCALE**

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**

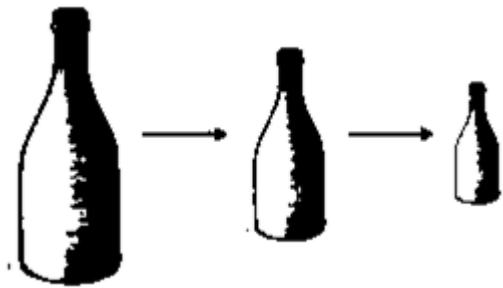
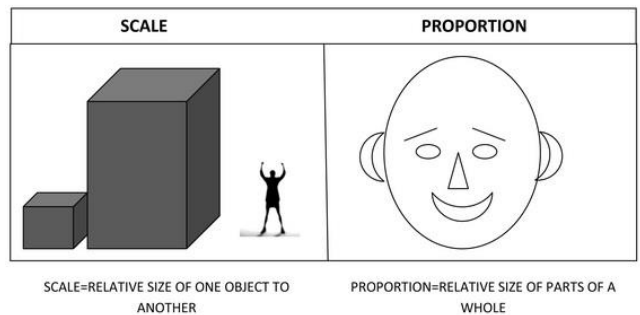
The size or proportion of something relative to an accepted standard of measurement.

**Visual Scale**

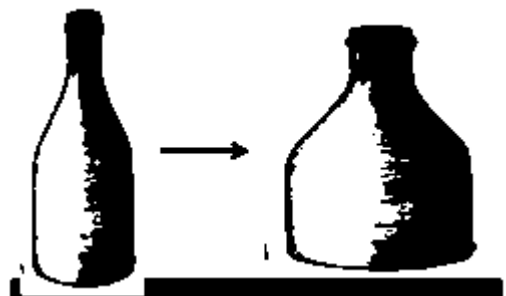
The size or proportion an element appears to have relative to other elements of known or assumed size.

**Human Scale**

Based on the dimensions & proportions of the human body



Scale



Proportion

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

## INTRODUCTION TO PERSPECTIVES

The way one sees the world is driven by rules of perspective. Perspective in sketching is a tool to create a realistic illusion of three-dimensional space. Everything that is drawn, from an apple to a spaceship, needs to follow the rules of perspective in order to look realistic.

### ONE-POINT PERSPECTIVE:

One-point perspective (frontal or central perspective) has only one vanishing point on the horizon line located somewhere within the picture plane (PP) and all the planes converge towards it.

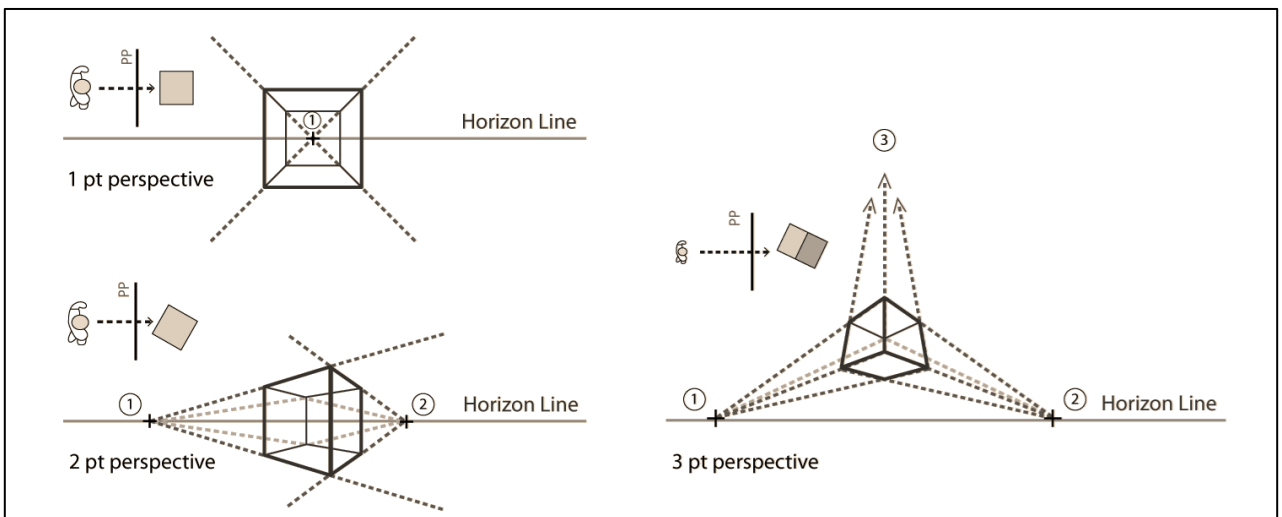
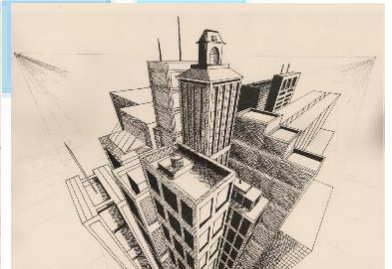
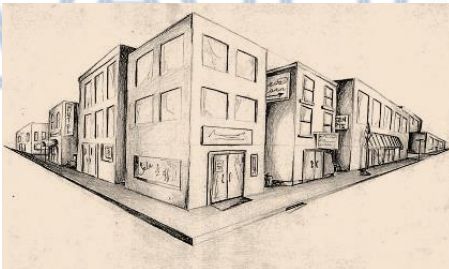
### TWO-POINT PERSPECTIVE:

Two-point perspective (angular perspective) has two vanishing points on the horizon line, which do not necessarily need to be within the picture plane (PP)

### THREE-POINT PERSPECTIVE:

Three-point perspective uses three vanishing points where two of them are on the horizon line and the third is either high above the horizon line or below it. There are two basic types of three-point perspective based on the position of the horizon line:

- Worm’s Eye View  
The view perceived when a person looking high up, the horizon line is situated very low.
- Bird’s Eye View  
The view perceived when a bird views over a city and looking down, the horizon line is situated above.



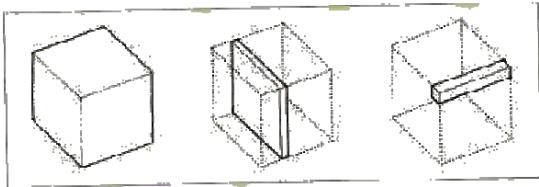
# TRANSFORMATION OF FORMS & PATTERNS

## TRANSFORMATION OF FORM

Form can be transformed in three ways:

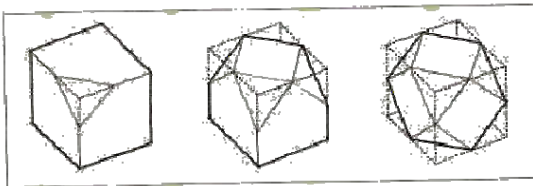
### DIMENSIONAL TRANSFORMATION

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.



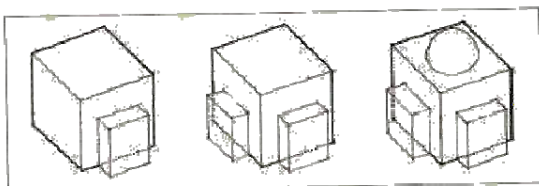
### SUBTRACTIVE TRANSFORMATION

A form can be transformed by 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.



### 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.



### 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.



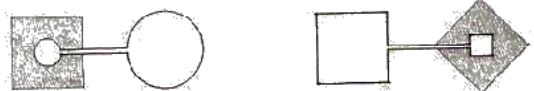
One of the two forms can receive the other totally within its volume.



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

**ELEMENTS OF BUILDING**

The following are the basic elements of a building:

1. Foundation
2. Plinth
3. Walls and columns
4. Sills, lintels and chejjas
5. Doors and windows
6. Floors
7. Roofs
8. Steps, stairs and lifts
9. Finishing work
10. Building services.

**1. FOUNDATION:**

Foundation is the most important part of the building. Building activity starts with digging the ground for foundation and then building it. It is the lower most part of the building. It transfers the load of the building to the ground. Its main functions and requirements are:

- Distribute the load from the structure to soil evenly and safely.
- To anchor the building to the ground so that under lateral loads building will not move.
- It prevents the building from overturning due to lateral forces.
- It gives level surface for the construction of super structure.

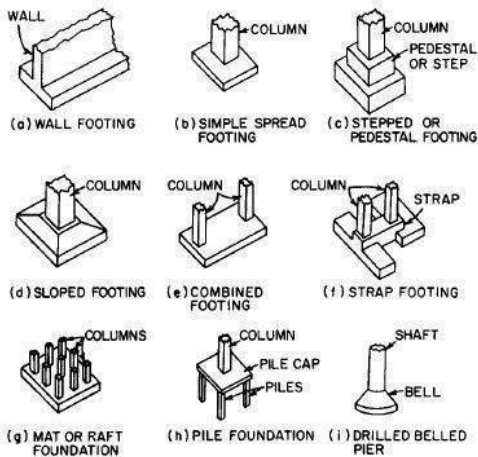
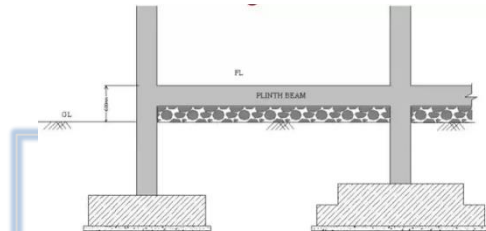


FIGURE 9.41 Common types of foundations for buildings.

**2. PLINTH:**

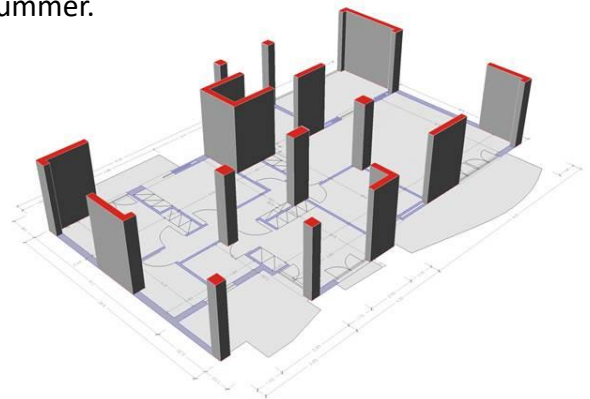
The portion of the wall between the ground level and the ground floor level is called plinth. It is usually of stone masonry. If the foundation is on piles, a plinth beam is cast to support wall above floor level. At the top of plinth a damp proof course is provided.

It is usually 75 mm thick plain concrete course. The function of the plinth is to keep the ground floor above ground level, free of dampness. Its height is not less than 450 mm. It is required that plinth level is at least 150 mm above the road level, so that connections to underground drainage system can be made.



**3. WALLS AND COLUMNS:**

The function of walls and columns is to transfer the load of the structure vertically downwards to transfer it to foundation. Apart from this wall performs the following functions also: It encloses building area into different compartments and provides privacy. It provides safety from burglary and insects. It keeps the building warm in winter and cool in summer.

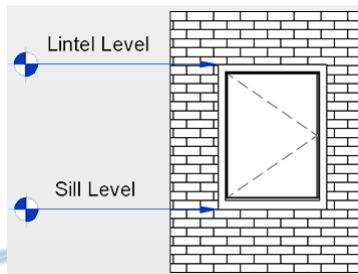


Reference: <https://www.civilengineeringx.com/building-planning/elements-of-a-building/>

## ELEMENTS OF BUILDING

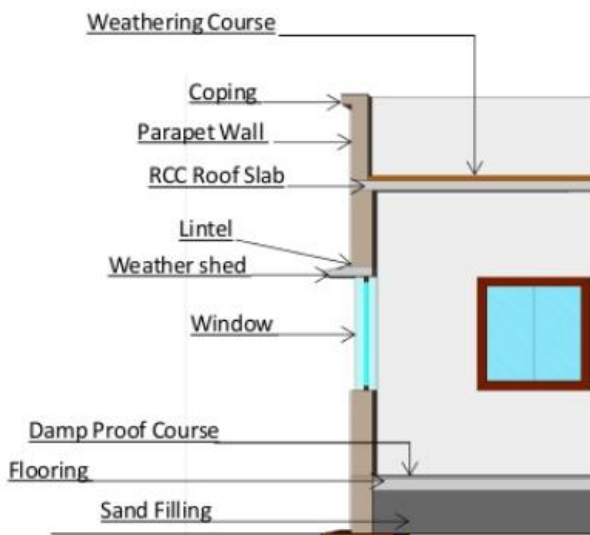
### 4. SILLS, LINTELS AND CHEJJAS:

A window frame should not be directly placed over masonry. It is placed over 50 mm to 75 mm thick plain concrete course provided over the masonry. This course is called as sill. Lintels are the R.C.C. or stone beams provided over the door and window openings to transfer the load transversely so as to see that door or window frame is not stressed unduly. The width of lintels is equal to the width of wall while thickness to be provided depends upon the opening size.



Chejja is the projection given outside the wall to protect doors and windows from the rain. They are usually made with R.C.C. In low cost houses stone slabs are provided as chejjas.

The projection of chejja varies from 600 mm to 800 mm. Sometimes drops are also provided to chejjas to improve aesthetic look and also to get additional protection from sun and rain.



### 5. DOORS AND WINDOWS:

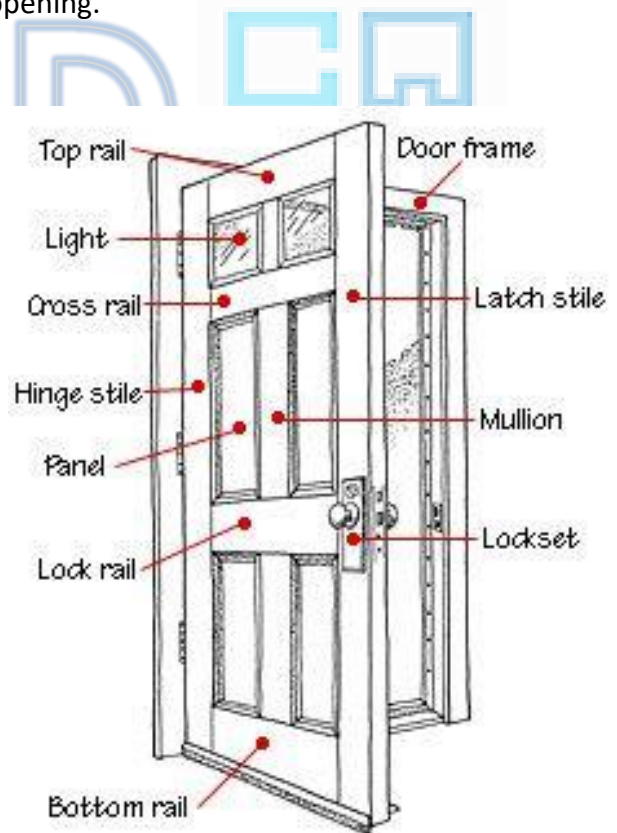
The function of a door is to give access to different rooms in the building and to deny the access whenever necessary.

Number of doors should be minimum possible. The size of the door should be of such dimension as will facilitate the movement of the largest object likely to use the door.

Windows are provided to get light and ventilation in the building.

They are located at a height of 0.75 m to 0.9 m from the floor level. In hot and humid regions, the window area should be 15 to 20 per cent of the floor area.

Another thumb rule used to determine the size and the number of windows is for every 30 m<sup>3</sup> of inside volume there should be 1 m<sup>2</sup> window opening.



Reference: <https://www.civilengineeringx.com/building-planning/elements-of-a-building/>

**ELEMENTS OF BUILDING**

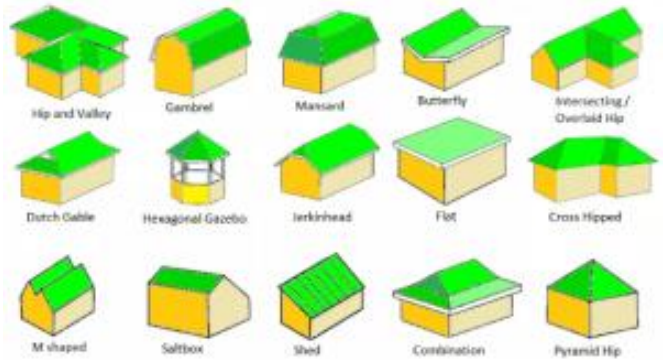
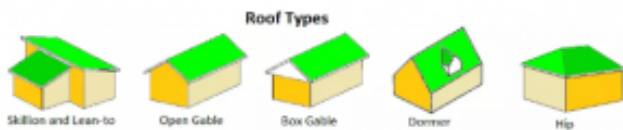
**6. FLOORS**

Floors are the important component of a building. They give working/useful area for the occupants. The ground floor is prepared by filling brick bats, waste stones, gravel and well compacted with not less than 100 mm sand layer on its top. A lean concrete of 1 : 4 : 8, 100 mm thick is laid. On this a damp proof course may be provided. Then floor finishing is done as per the requirement of the owner. Cheapest floor finish for a moderate house is with 20 to 25 mm rich mortar course finished with red oxide. The costliest floor finish is mosaic or marble finishing. Other floors are usually of R.C.C. finished as per the requirements of the owner.



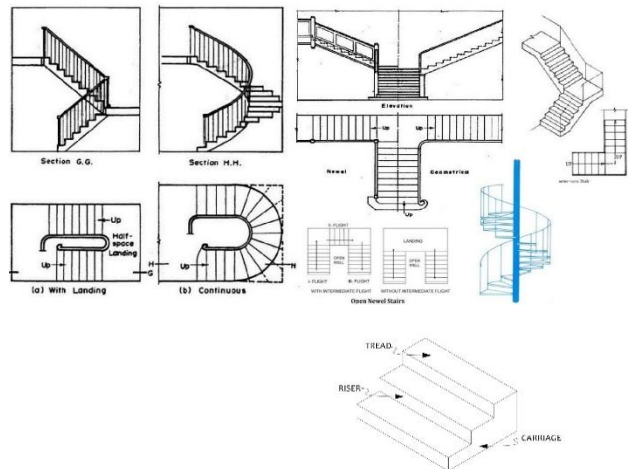
**7. ROOF:**

Roof is the top most portion of the building which provide top cover to the building. It should be leak proof. Sloping roof like tiled and A.C. sheet give leak proof cover easily. But they do not give provision for the construction of additional floor. Tiled roof give good thermal protection. Flat roofs give provision for additional floors. Terrace adds to the comfort of occupants. Water tanks can be easily placed over the flat roofs.



**8. STEP, STAIRS AND LIFTS:**

Steps give convenient access from ground level to ground floor level. They are required at doors in the outer wall. 250 to 300 mm wide and 150 mm rise is ideal size for steps. In no case the size of two consecutive steps be different. Number of steps required depends upon the difference in the levels of the ground and the floor. Stairs give access from floor to floor. They should consists of steps of uniform sizes. In all public buildings lifts are to be provided for the conveniences of old and disabled persons. In hostels G + 3 floors can be built without lifts, but in residential flats maximum floors permitted without lifts is only G + 2. Lift is to be located near the entrance. Size of the lift is decided by the number of users in peak hours. Lifts are available with capacity 4 to 20 persons.



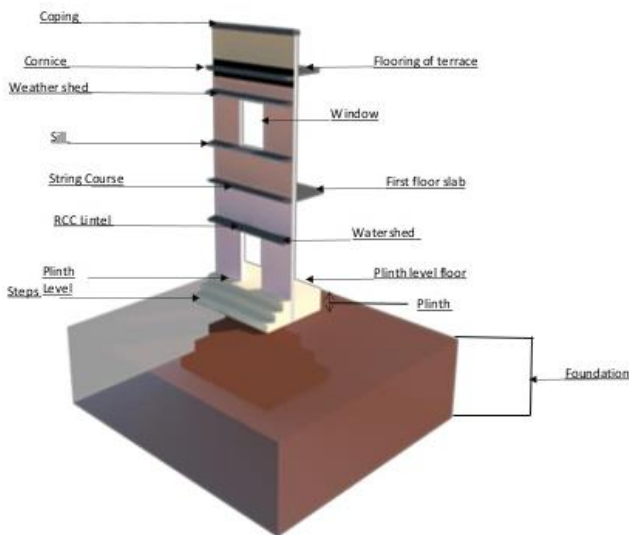
Reference: <https://www.civilengineeringx.com/building-planning/elements-of-a-building/>

## ELEMENTS OF BUILDING

### 9. FINISHING:

Bottom portion of slab (ceiling), walls and top of floor need smooth finishing with plaster. Then they are provided with white wash, distemper or paints or tiles. The function of finishing work is:

- Give protective cover
- Improve aesthetic view
- Rectify defective workmanship
- Finishing work for plinth consists in pointing while for floor it consists in polishing.



### 10. BUILDING SERVICES:

Water supply, sanitation and drainage works, electric supply work and construction of cupboards and show cases constitute major building services. For storing water from municipal supply or from tanker a sump is built in the house property near street. From the sump water is pumped to over head tanks placed on or above roof level so as to get water all the 24 hours. Plumbing work is made so as to get water in kitchen, bathrooms, water closets, sinks and garden taps.

For draining rain water from roofs, down take pipes of at least 100 mm diameters should be used. Proper slopes should be given to roof towards down take pipe. These pipes should be fixed at 10 to 15 mm below the roof surface so that rain water is directed to the down take pipe easily. The sanitary fittings are to be connected to stone ware pipes with suitable traps and chambers.

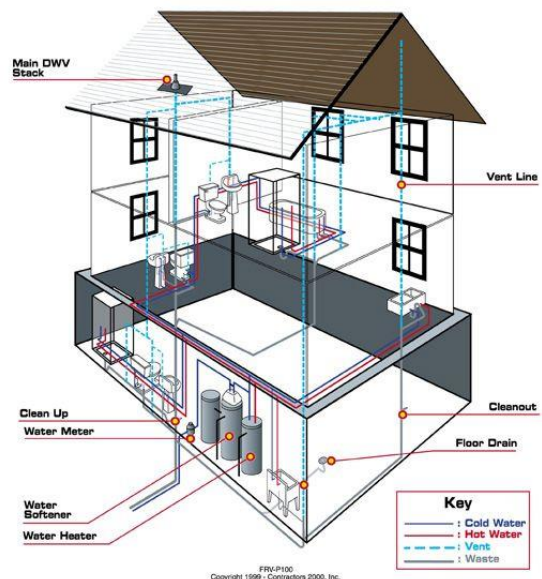
Stone ware pipes are then connected to underground drainage of municipal lines or to the septic tank.

Many carpentry works are required for building service. They are in the form of showcases, cupboards, racks etc.

Electric supply is essential part of building services. The building should be provided with sufficient points for supply of lights, fans and other electric gadgets.

## **HOUSE PIPING SYSTEM**

Water Supply Household DWV



Reference: <https://www.civilengineeringx.com/building-planning/elements-of-a-building/>



**BUILDINGS**

**BUILDING TYPOLOGY**

A building structure is a man-made structure with a roof and walls standing more or less permanently in one place, such as a house or factory.

**BASED ON THE OCCUPANCY**

Every building or portion of land shall be classified according to its use or the character of its occupancy as a building of Occupancy. They are categorized into the following types.

- 1) Agricultural buildings
- 2) Commercial buildings
- 3) Residential buildings
- 4) Educational buildings
- 5) Government buildings
- 6) Industrial buildings
- 7) Military buildings
- 8) Religious buildings
- 9) Transport buildings
- 10) Power plants

**1) Agricultural buildings**

They are the structures designed for farmers and for agricultural practices, for growing and harvesting crops, and to raise live stock.



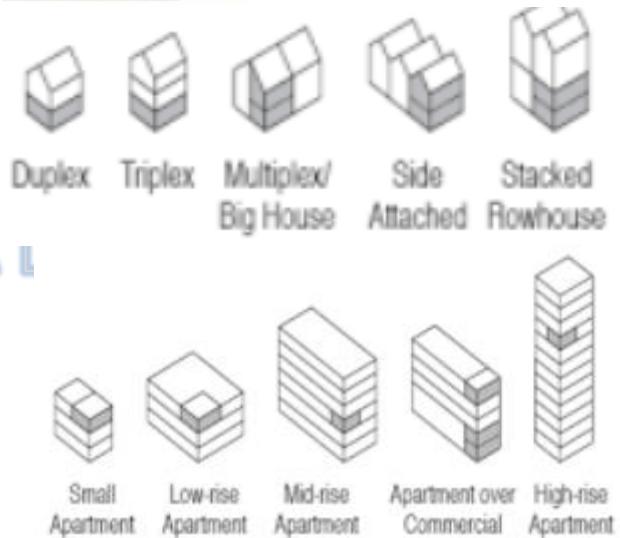
**2) Commercial buildings**

They are the buildings, which are used exclusively for commercial use.



**3) Residential buildings**

A Residential building is that, in which housing predominates, as opposed to industrial and commercial areas. building may vary significantly between, single-family building, multi-family building, or mobile homes.



**4) Educational buildings**

This occupancy type shall include any building or portion thereof in which education, training and care are provided to children or adults.



Reference: Building-typology-adapted-from-Hecht

**BUILDINGS**

**BUILDING TYPOLOGY**

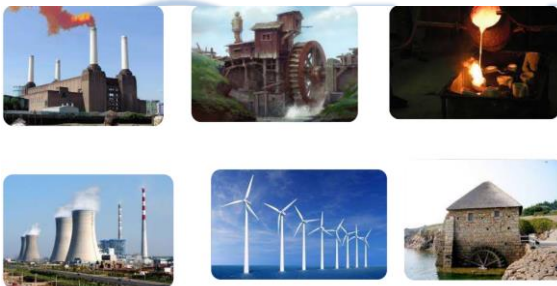
**5) Government buildings**

It is a building that houses a branch of government.



**6) Industrial Buildings**

These buildings are designed to house industrial operations and provide the necessary conditions for workers, and for the operation of industrial equipment.



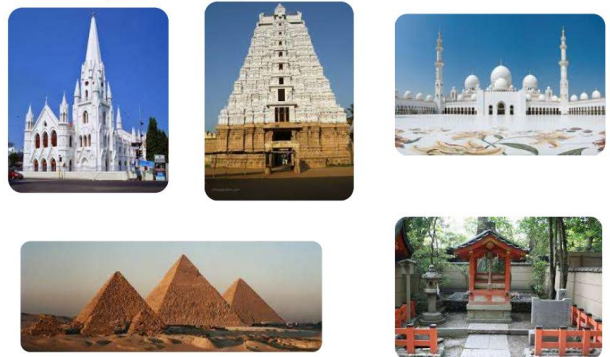
**7) Military Buildings**

This building is a structure designed to house the functions, performed by a military unit.



**8) Religious Buildings**

These are the buildings for religious purposes, with a large open interior or other monumental qualities. They often have spires, towers, domes rising above the main structure.



**9) Transport Buildings**

This is a structural building which consists of the means of equipment necessary for the movement of passengers or goods on land, water, and air ways



**10) Power plants**

These buildings serve as the industrial facility to generate electric power



Reference: Building-typology-adapted-from-Hecht

## THE ELEMENT OF RELIGIOUS BUILDINGS

### BASIC FORM OF A HINDU TEMPLE

Hindu Temple's were a gradual evolution starting from the rock cut- cave temples to monolithic rathas which finally culminated in structural temples. The basic form of a Hindu structural temple consists of the following.

#### 1. GARBHAGRIHA:

- It literally means 'womb-house' and is a cave like a sanctum.
- In the earliest temples, it was a small cubical structure with a single entrance.
- Later it grew into a larger complex.
- The Garbhagriha is made to house the main icon (main deity) which is itself the focus of much ritual attention.

#### 2. MANDAPA:

- It is the entrance to the temple.
- It may be a portico or colonnaded (series of columns placed at regular intervals) hall that incorporates space for a large number of worshippers.
- Dances and such other entertainments are practiced here.
- Some temples have multiple mandapas in different sizes named as Ardhamandapa, Mandapa, and Mahamandapa.

#### 3. Shikhara or Vimana:

- They are mountain like the spire of a free-standing temple.
- Shikhara is found in North Indian temples and Vimana is found in South Indian temples.
- Shikhara has a curving shape while vimana has a pyramidal-like structure.

#### 4. AMALAKA:

- It is a stone disc like structure at the top of the temple and they are common in North Indian temples.

#### 5. KALASHA:

- It is the topmost point of the temple and commonly seen in North Indian temples.

#### 6. ANTARALA (VESTIBULE):

- Antarala is a transition area between the Garbhagriha and the temple's main hall (mandapa).

#### 7. JAGATI:

- It is a raised platform for sitting and praying and is common in North Indian temples.

#### 8. VAHANA:

- It is the mount or vehicle of the temple's main deity along with a standard pillar or Dhvaj which is placed axially before the sanctum.

### CLASSIFICATION OF INDIAN TEMPLES

Indian temples can be classified into two broad orders as

- **Nagara** (in North India)
- **Dravida** (in South India)
- At times, the **Vesara** style of temples as an independent style created through the mixing of Nagara and Dravida orders.

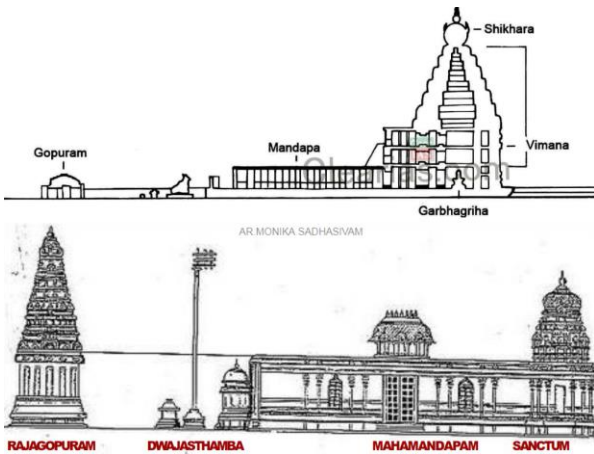


**Nagara** (in North India)

Reference: Temple Architecture and Sculpture – Hindu, Buddhist and Jain (Indian Culture Series – NCERT)

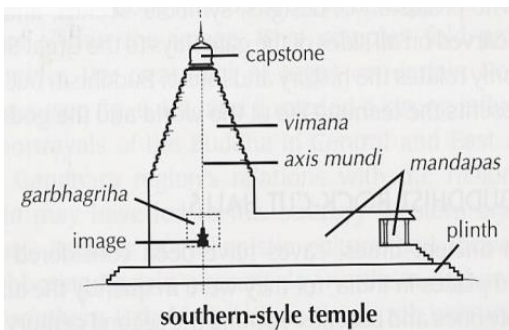
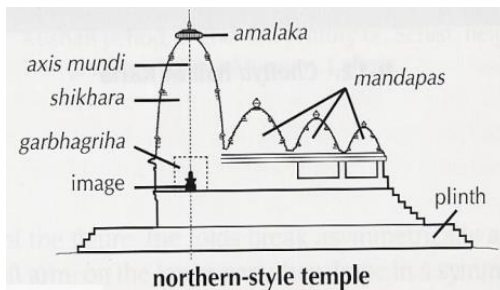
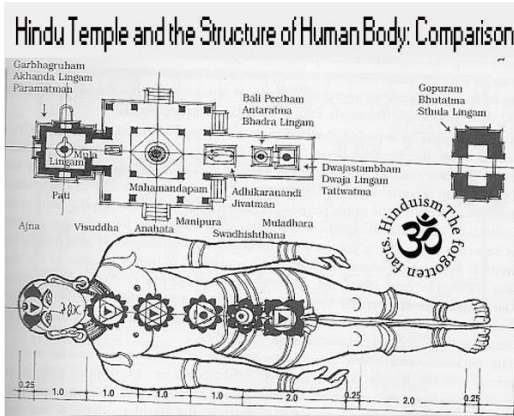
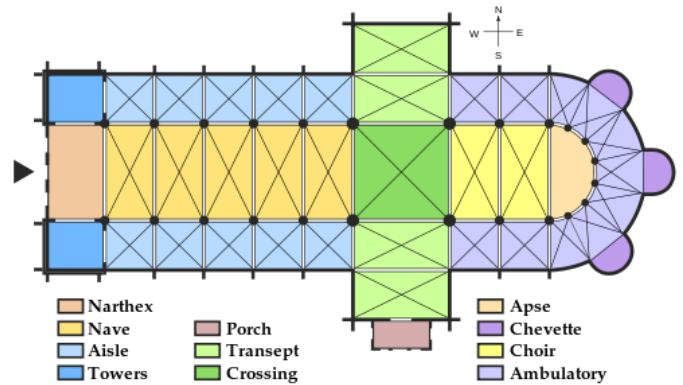
**BUILDINGS**

**THE ELEMENT OF RELIGIOUS BUILDINGS**



**Dravidian ( South Indian)**

**CHURCH ARCHITECTURE**



**PROPYLAEUM**

The entrance building of a sacred precinct, whether church or imperial palace.

**ATRIUM**

In early Christian, byzantine, and medieval architecture, the forecourt of a church; as a rule enveloped by four colonnaded porticoes.

**NARTHEX**

The Entrance hall or porch proceeding the nave of a church.

**NAVE**

The great central space in a church. In longitudinal church, it extends from the entrance to the apse ( or only to the crossing if the church has one ) and is usually flanked by side aisles.

**SIDE AISLE**

One of the corridors running parallel to the nave of a church and separated from it by an arcade or colonnade.

Reference: Temple Architecture and Sculpture – Hindu, Buddhist and Jain (Indian Culture Series – NCERT)

**BUILDINGS**

**THE ELEMENT OF RELIGIOUS BUILDINGS**

**CROSSING**

The area in a church where the transept and the nave intersect.

**APSE**

A recess, sometimes rectangular but usually semicircular, in the wall at the end of a Roman basilica or Christian church. The apse in the Roman basilica frequently contained an image of the Emperor and was where the magistrate dispensed laws. In the Early Christian basilica, the apses contained the “Cathedra” or Throne of the bishop and the altar.

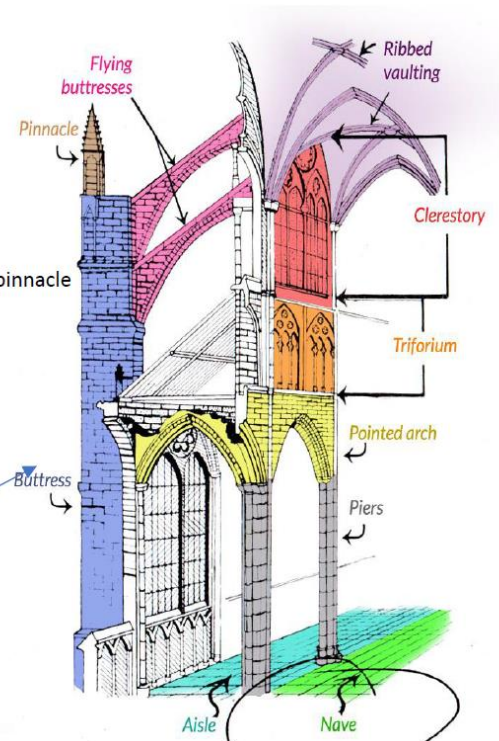
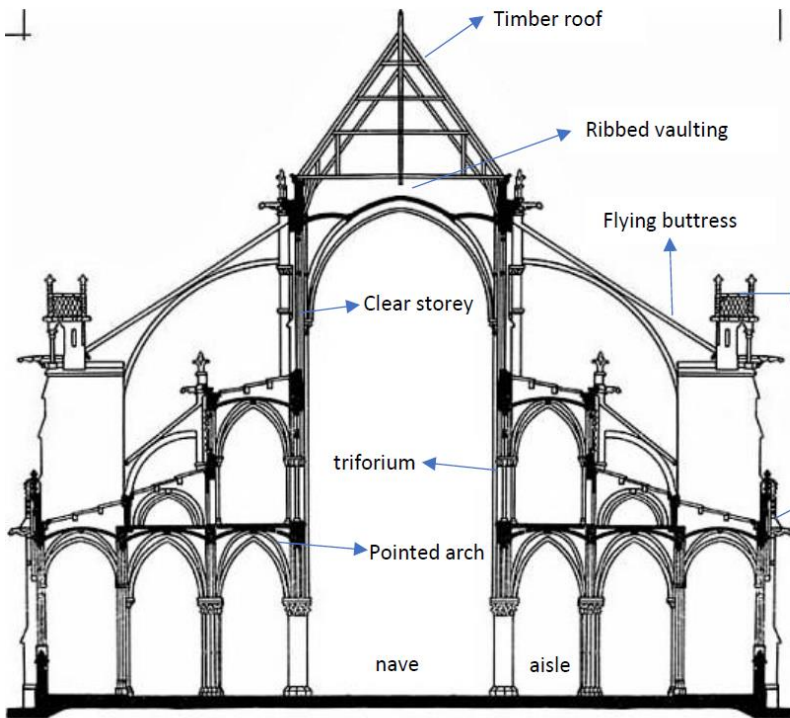
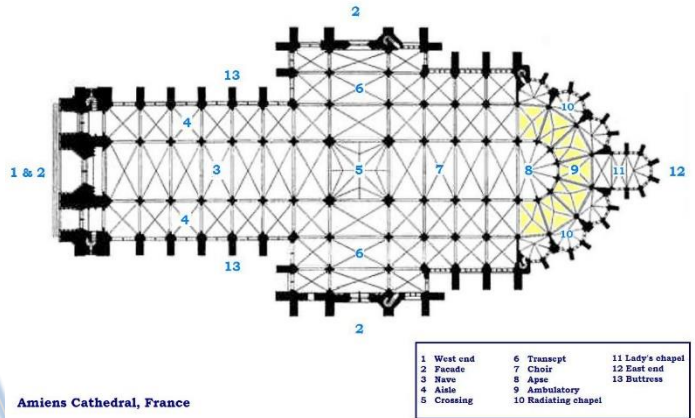
**CHOIR**

Area of the church where the priest performs the mass.

**TRANSEPT**

In a cruciform church, the whole arm set at right angles to the nave.

*NOTE: The Transept appears infrequently in Early Christian churches. The Transept became a standard component of the Christian church until the Carolingian period.*



Reference: Architecture\_of\_cathedrals\_and\_grand\_churches

## THE ELEMENT OF RELIGIOUS BUILDINGS

### ISLAMIC BUILDINGS

The major building types during the Islamic period were:

- The Mosque
- The Tomb
- The Madrasa
- Caravanserai
- Wells
- Gardens
- Market – places
- Palaces and forts

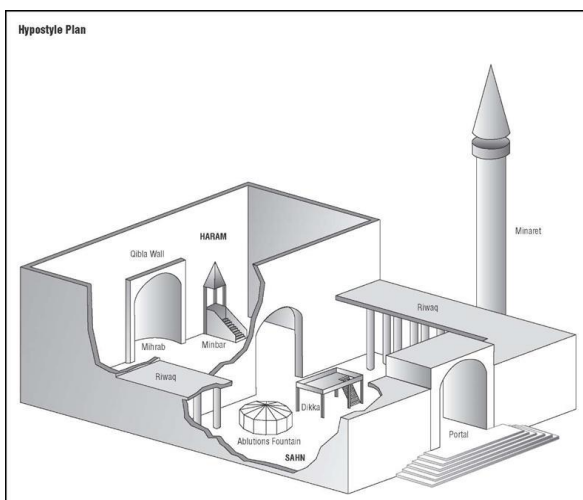
### ESSENTIAL PARTS OF A MOSQUE:

Two ancillary structure are necessary for Islamic worship : the minaret, from which the muezzin gives the call to prayer, and a fountain for ablution.

The courtyard afforded an opportunity for architectural display, which the ottoman the safavids and especially the mughals seized with enthusiasms. In India the courtyard of the 'Jami Masjid' is surrounded by finely sculptured arches.

Ablution tank can be at the middle of the courtyard.

Inside the mosque, the chief feature is the mihrab, a niche, in the centre of the qibla wall to define the direction of Mecca.



Reference: Islamic Architecture – Form, Function, and Meaning by R Hillenbrand

On the right side of the mihrab stands the 'mimbar' or pulpit. The top step of the mimbar is reserved for the prophet, the imam stands for the second step of the mimbar and uses the top one as a seat.

A portion of the sanctuary is screened off into a compartment for women - maqsura screen.

### MIHRAB

The pillared hall which forms the sanctuary with the wall at the back containing an elegant arched shaped niche called "mihrab" which shows the Qibla.

Qibla - prayer side or Mecca side.

### MIMBAR - Imam stands to deliver sermons.

**Pulpit** – present at the right side of the mihrab

**Dikka** - The reading desk in mimbar.

**Zenana** - Woman's compartment.

**Maqsura** - A screen of arches.

### MINARET

A raised structure for a person to stand to make the call for the prayer.

**Iman** – belief-in god – his unity

**Ibadat** – religious obligation

**Ihsan** –right doing.

### TOMB

It usually consist of a single compartment or tomb- chamber, know as 'huzrah'or 'estanaah' , in the centre of which is the cenotaph or 'zarih' that is a raised platform to indicate position of burial.

The whole structure is roofed over by a dome.

In the ground, underneath this building , resembling a crypt , is the mortuary chamber called the 'maqbarah or takhana' , with the grave or 'qaba' in the middle.

## THE ELEMENT OF RELIGIOUS BUILDINGS

### RAUZA – TOMB COMPLEX

The tomb along with the garden enclosure is called 'RAUZA'.

### MAUSOLEUM

mosque + tomb. Eg: Taj Mahal.

### DARGAH

These are the important tombs of nodes and are occasionally called as "Dargah". Derived from a Persian word – meaning court palace.

### MADRASSAH

Educational complex

It's a **collegiate mosque** which has Lecture halls

### KHANS (SERIAS) : Caravanserai

Travelers bun-glow.

These are **the inns** where the travelers took rest.

This is generally a two storied building, the ground floor for stable camels or horses and the first floor for residences/rest houses for the travelers.

### FORTS / FORTRESSES :

The cities were **fortified** with tall spreading **bastions** at frequent intervals.

Generally, the fort walls had **gateway on all the four cardinal, direction – forming an axis.**

The fortress housed a number of **imperial building , edifices such as the emperor's palace , audience halls , mosque , tombs.** Eg – Forts in Agra, Delhi etc.

### PALACES, CITADELS & FORTIFICATION

A gate serves to **admit and to exclude.**

It is also a symbol of **strength , of security and of wealth.**

The expression of power is in many ways an automatic attribute of **monumental architecture.**

Three consistent components of Islamic military and defensive architecture are – **wall and towers , gates , citadels.**

### BAUDIS OR WELLS

These are the **common utilitarian structures.**

It had **large rectangular tank** which is enclosed within high walls.

There were **rest houses** on the either side of the entrance towers.

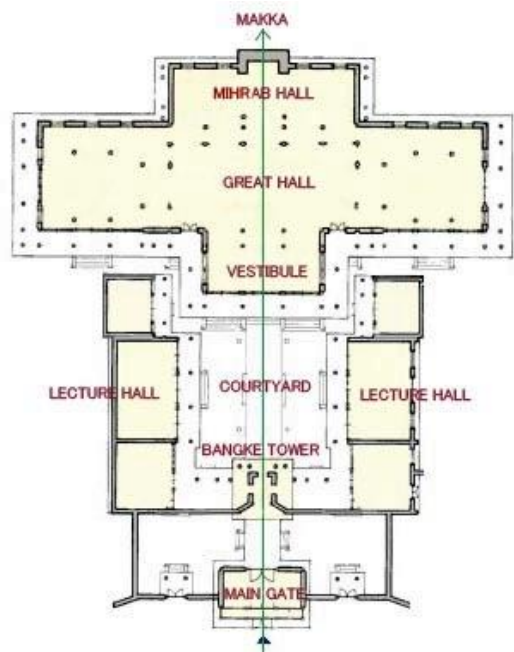
There was a common landing with passage ways on either sides which can be descended stages to the level of water.

### CHARBAGH :

The garden was divided into **4 quadrants** which was spilt by the water flow.

The principal axis is formed by a **waterway** which had **coniferous trees** along the length which emphasized it.

Eg : **Shalimar Gardens , Nishak Gardens etc,**

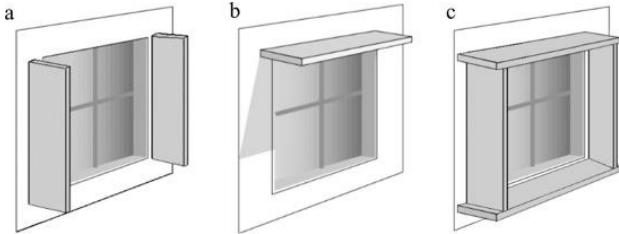


Reference: Islamic Architecture – Form, Function, and Meaning by R Hillenbrand

**CLIMATE ORIENTED ARCHITECTURE**

**TYPES OF SHADING DEVICES**

- Vertical devices
- Horizontal devices
- Egg-crate devices



**FENESTRATIONS**

**Prime Parameters:**

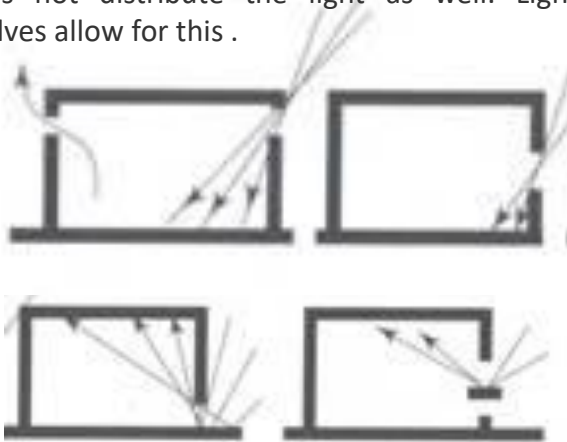
- Air movement
- Day light

Effect of window position on light and ventilation.

High windows act as ventilation points and also allow for the best distribution of light from overcast skies.

Low windows do not allow much ventilation but allow an even distribution of ground reflected light.

Middle windows allow for even ventilation but does not distribute the light as well. Light shelves allow for this .



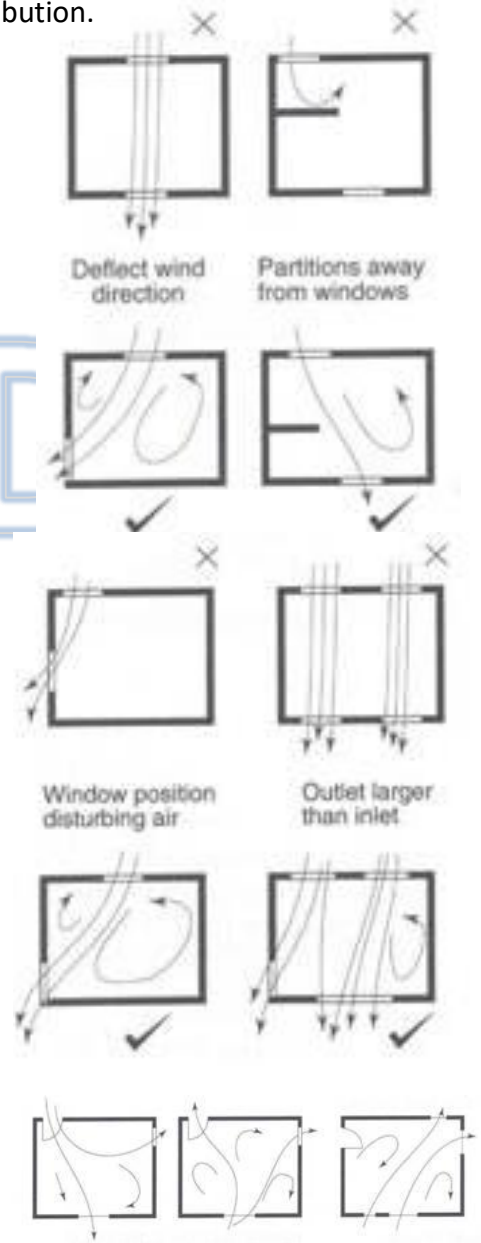
**AN IDEAL CASE FENESTRATION POSITIONING:**

Openings (windows), are placed on two external walls with the door on one internal wall.

If air is incident on any of the external windows, then the fenestration configuration not only ensures a good distribution of air but also has a larger outlet area than inlet area.

If the air is incident on any of the other walls then the door could act as the inlet into the room.

Once again the outlet would be larger than the inlet and the configuration would allow good air distribution.

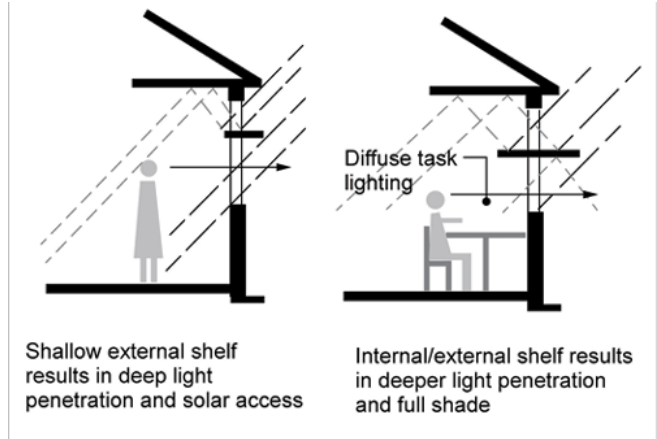
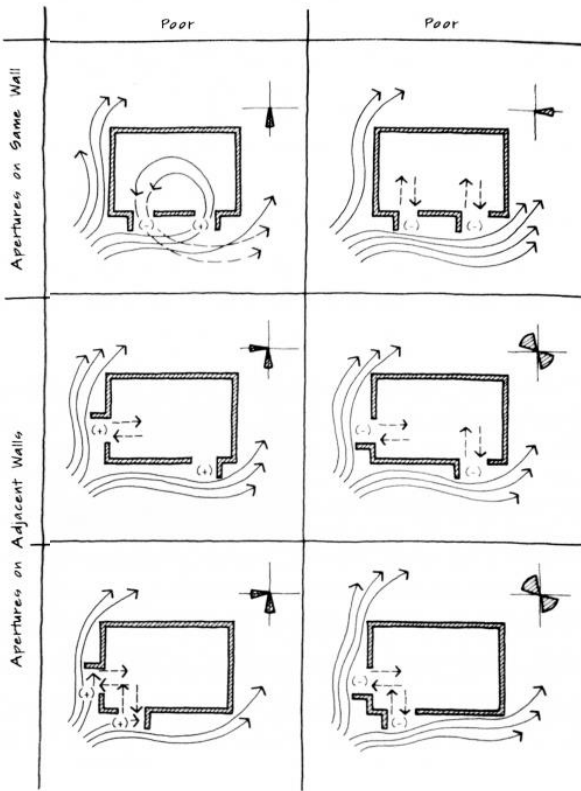


Reference: Koenisberger, Manual of tropical Housing

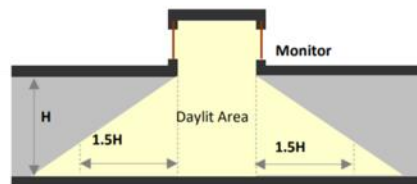
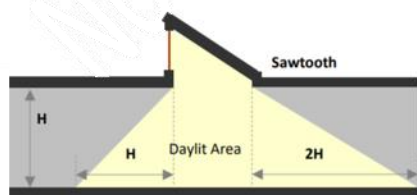
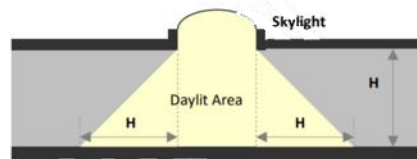
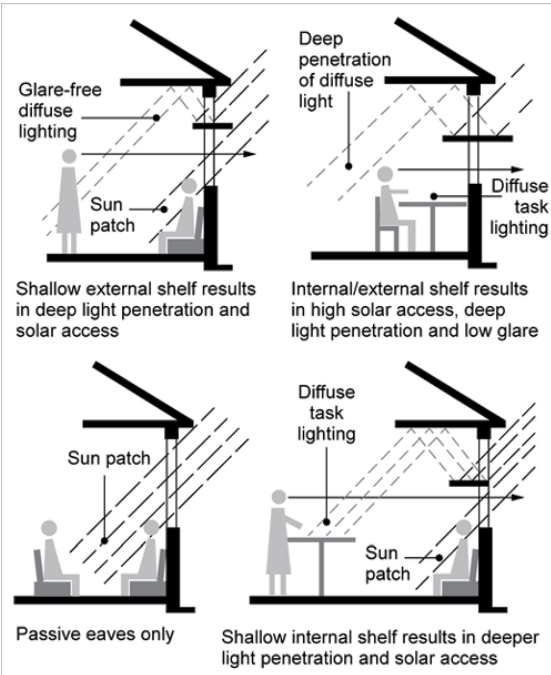
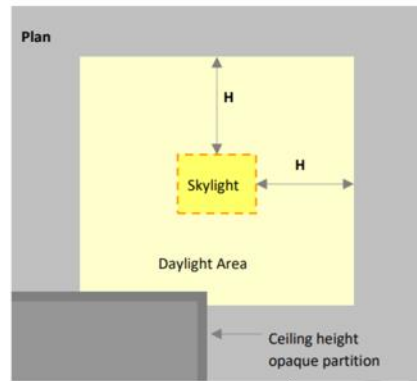


CLIMATOLOGY

CLIMATE ORIENTED ARCHITECTURE



WINDOW/ DOOR POSITIONS FOR GOOD LIGHTING



Reference: Koenisberger, Manual of tropical Housing

**CLIMATE ORIENTED ARCHITECTURE****ROOF TYPES FOR DIFFERENT CLIMATIC CONDITIONS****Roofs for Warm Humid Climates**

Sloped roofs with wide overhanging eaves are ideal to facilitate rapid rainwater run-off and to protect and shade outer walls and openings. Horizontal valley and internal gutters should be avoided, as these accumulate dirt and water.

**Roofs for Hot Dry Climates**

As rainwater run-off is no major requirement, flat roofs are most common, providing space for outdoor activities and sleeping. Vaults and dome shaped roofs are also common, providing good thermal comfort.

**Roofs for Composite climates**

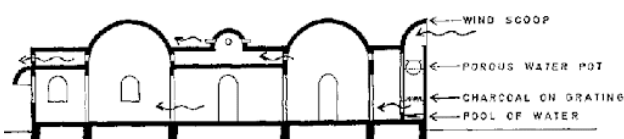
Flat roofs with good drainage are common in composite and upland climates with warm dry seasons, which permit activities and sleeping on roofs.

**Roofs for cold climates**

Deep pitched roofs to drain the snow.



HOT-DRY CLIMATE



Reference: Koenisberger, Manual of tropical Housing