BUILDING MATERIALS, CONSTRUCTION AND PLANNING
(ACEB02)
B.TECH III SEMESTER

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MODULE-I
STONES, BRICKS AND AGGREGATES

ROCKS

ROCK:

A rock is an aggregation of different mineral constituents which form the earth's crust.

The classification of rocks based on different factors.

Classification of Rocks

Rocks are classified based on three major factors as follows :

- Geological classification
- Physical classification
- Chemical classification

1. **Geological classification**

Rocks are classified into three types based on their geological formation and they are :

- Sedimentary rocks
- Igneous rocks
- Metamorphic rocks

Sedimentary rocks:

Sedimentary rocks are formed by the deposition of sediments obtained by the weathering of pre-existing rocks and these sediments are transported by various agents such as water, wind, frost, gravity, etc. These transported sediments form layered structures and give rise to the sedimentary deposits.

- If the sediments remain at the place of origin then the formed deposits are known as residual deposits.
- Some sediments formed by various chemical reactions such as decomposition, precipitation, evaporation, etc. give rise to the formation of chemical deposits.
- Similarly, the sediments formed by the action of various organisms such as plants and animals are known as Organic deposits.

Examples: Sandstone, lime stone, lignite, etc.

Sedimentary Rock

Lime stone

Igneous rocks

Igneous rocks are formed by the solidification of magma below the earth's surface. When the magma is unable to erupt through the earth surface during its upward journey, it is held up below the earth's surface and unable to descend. This magma cools down gradually and solidifies into igneous rocks.

- The structure of igneous rocks varies according to the depth at which magma solidified.
- If the magma hardens at a significant depth from the earth surface, then the rocks possess coarsely grained crystalline structure and these rocks are known as plutonic rocks.

Granite is the best example of plutonic rock.

Granite

- Similarly, if magma hardens at shallow depth from the earth's surface, the finely grained crystalline structure of rock will be obtained. These rocks are called as hypabyssal rocks.

  Dolerite is an example of a hypabyssal rock.

- If the solidification of the rock occurs near to the earth surface, then the rocks obtained are known as volcanic rocks. These rocks possess extremely fine-grained structure.

  Basalt is an example of volcanic rock.

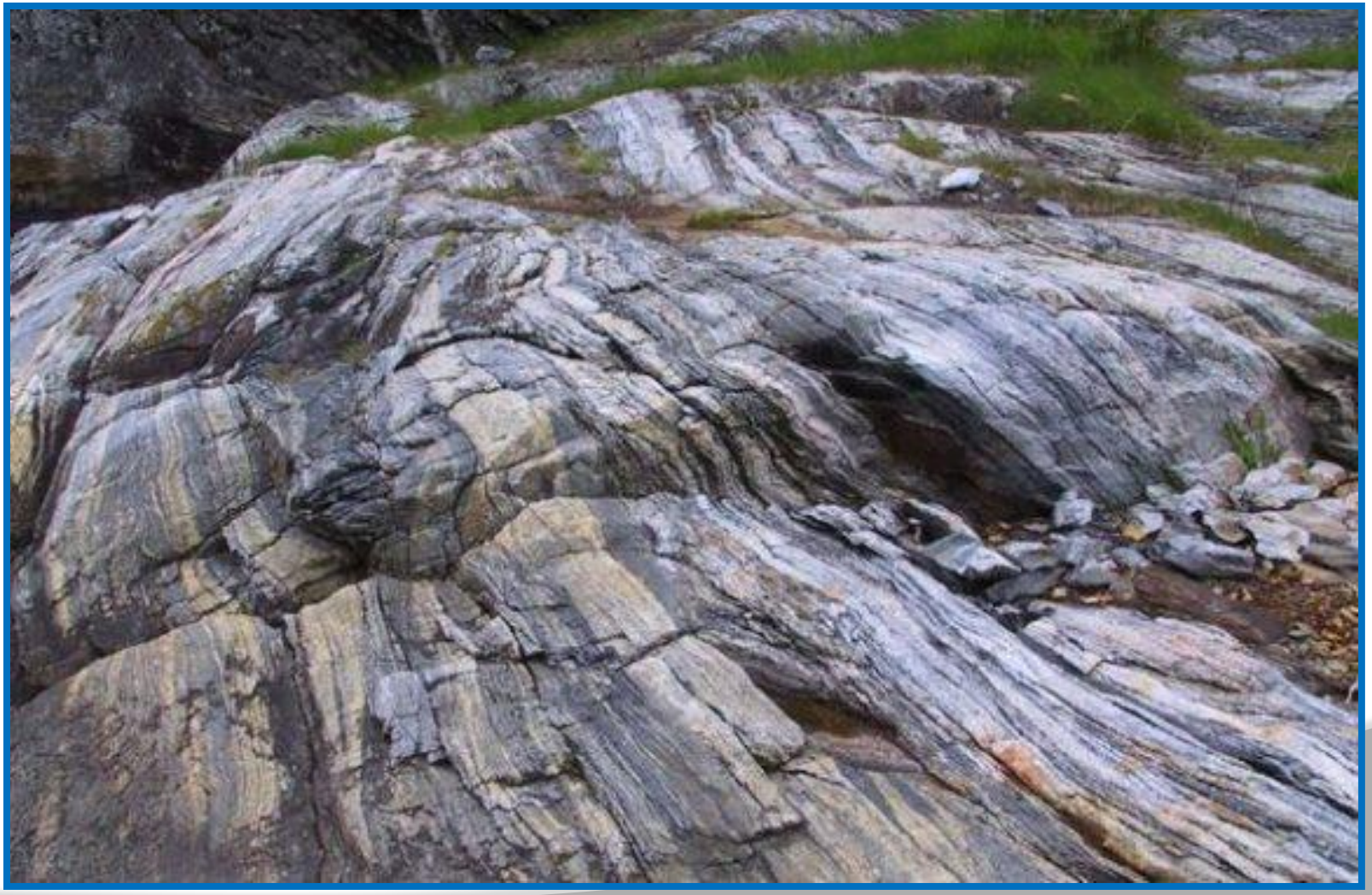
Metamorphic rocks

Metamorphic rocks are formed by the metamorphism process. Metamorphism is the process of changing the characteristics of the pre-existing rocks under the influence of heat and pressure. The pre-existing rocks may be of the sedimentary or igneous type of rocks.

Examples: Slate, Gneiss, Schist, marble, soapstone etc.

Metamorphic Rock

Gneiss



Physical classification

Rocks are classified physically into three types as follows :

- Stratified rocks
- Unstratified rocks
- Foliated rocks

Stratified rocks

- Stratified rocks consist of different layers in its structure and these layers are separated by planes of stratification. These planes are also called cleavage planes or bedding planes. These rocks can easily split up along these bedding planes. Most of the sedimentary rocks such as sandstone, limestone, shale, etc. are the best examples of stratified rocks.

Stratified Rock

Unstratified rocks

The structure of unstratified rocks is crystalline or compact granular. They possess a similar kind of structure throughout their whole body. Most of the igneous rocks and some sedimentary rocks come under unstratified rocks. Granite, marble, trap are few examples of Unstratified rocks.

Foliated rocks

Foliated rocks possess a layered or banded structure which is obtained by exposure of pressure and heat. Unlike the stratified rocks, these rocks can split up in a certain direction only. Most of the metamorphic rocks formed by metamorphism come under foliated rocks. Some examples are gneiss, schist, slate etc.

Chemical classification

Rocks are classified into three types based on their chemical composition and they are as follows :

- Argillaceous rocks
- Calcareous rocks
- Siliceous rocks

Argillaceous rocks

The word Argil means clay. Hence, the rocks in which clay content is predominant are called argillaceous rocks. These rocks are soft in nature and with the presence of water they can be crumbled easily. In the dry state, these rocks can be crushed easily because of their brittleness. Shale, slate, laterite, etc. are some of the argillaceous rocks.

Argillaceous Rock – Laterite

Calcareous rocks

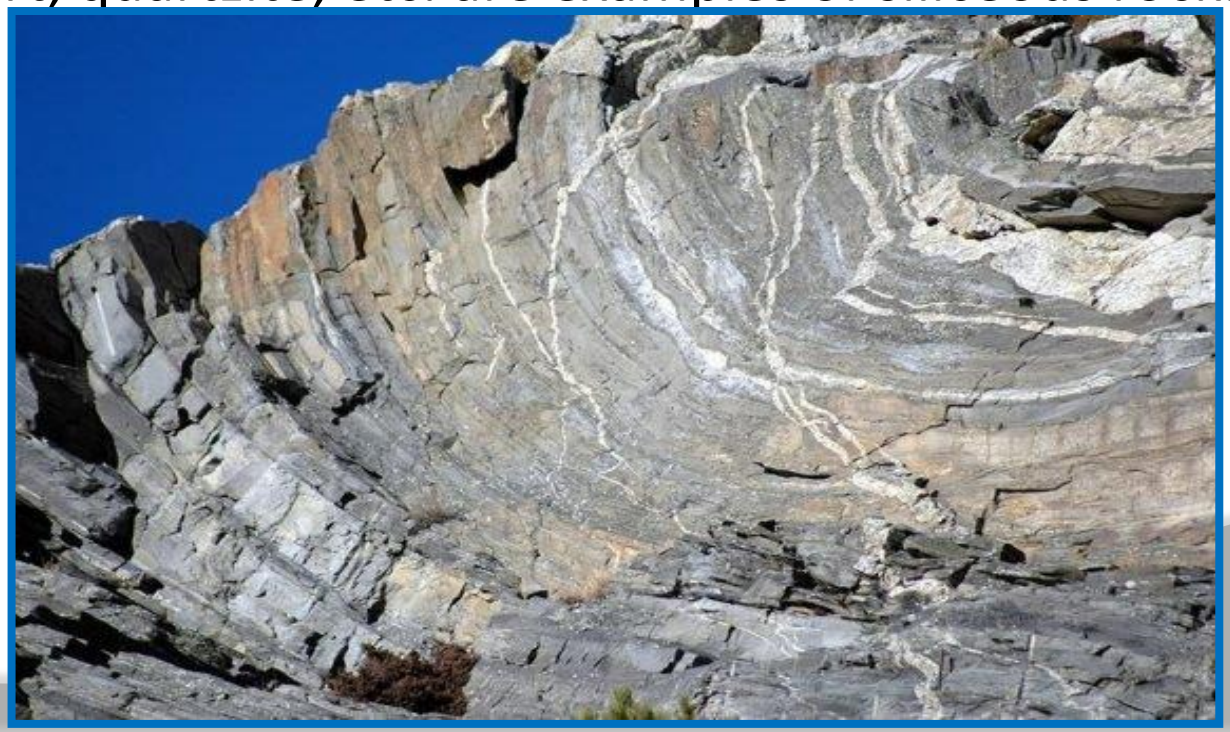
The rocks in which calcium carbonate is the major ingredient are known as calcareous rocks. These are generally hard but their durability is dependent on surrounding constituents which may react with calcium and affect the durability of rock. Marble, limestone, dolomite, etc. are some of the calcium predominant rocks.

Calcareous Rock – Dolomite

Siliceous rocks

The rocks which contain silica in predominant amount are called as siliceous rocks. Presence of a large amount of free silica makes them harder and durable. It also provides strong resistance to weathering.

Granite, chert, quartzite, etc. are examples of siliceous rocks.



QUARRYING OF STONES

Definition:

Stones occur in the form of natural rock masses or layers on the surface. The process of extraction of suitable stones from their natural rock beds or layers is commonly called Quarrying of Stones.

A quarry is a place where different types of stones are extracted.

Site Selection for Quarrying of Stones

The quarry should be selected based on some conditions as follows.

- The site should be near to human living areas where labor and tools are always available, required materials also should be available.
- At least one of type transportation facilities (road or railway or port or all) should be available.
- Clean water source should be available near the quarry site.
- Good quality and quantity of stone should be available.

- The site should be far from permanent structures like bridges, dams etc. because the vibrations due to blasting in the site may cause harm to them.
- Non-living area should be available to dump the refuse obtained in quarrying.
- Proper drainage facility should be available.
- Geological information of site should be read.

Methods of Quarrying of Stones

Quarrying can be done by three methods as follows:

- Hand tools
- Machine quarrying
- Blasting

Quarrying of Stones using Hand Tools

In case of soft stones or for smaller works, quarrying is done by using hand tools. There are various ways to quarry using hand tools and they are:

- Excavating
- Heating
- Wedging

Excavating

Excavating is preferred in case of soft stone surfaces. Hammers, pick axes, shovels are used to excavate the stones.

Heating

The top surface of rock is heated by placing wood with fuel on it. The fire will be allowed for some hours and the top surface gets heated and separates from the rock.

This separated portion is removed by pick axes, crowbars etc.

Wedging

- This method is applicable when the rock contains cracks or joints in it. Steel wedges or steel points are put in these cracks or fissures and hit them with hammer.
- Then the rock portion separates from parent rock. If natural cracks are there, then artificial holes are drilled in the rock and wedging is done.

Machine Quarrying of Stones

- Machine quarrying is done by using channeling machines in the site. This type of machine is driven by steam, compressed air or electricity.

- A groove is made using this machine around the rock and the horizontal holes are drilled underneath the block. Hence, the block gets separated from its bed.
- A large groove of 24-meter length and 50 to 75 mm width and with a depth about 2 to 3.7 meter can be made using channelling machine. So, larger blocks of stones can be obtained using this method.

Marbles, lime stones, etc. are quarried using machine quarrying.

Blasting for Quarrying of Stones

In this method explosives are used to separate the stones from parent rock. This process is applied in case of hard stone or hard rock which does not contain any cracks or fissures.

- The holes are drilled in the rock and explosives are arranged in the holes and blasted with proper safety measures. The stones obtained through this process are not larger in size.
- So, the main purpose of blasting is to obtain small stones which are used as ballast for railway works, aggregate in concrete works etc..

Manufacturing process of bricks

There are four different operations are involved in the process of manufacturing of bricks:

- Preparation of clay
- Molding
- Drying
- Burning

Preparation of clay for brick manufacturing:

Preparation of clay for bricks manufacturing is done in six steps:

1. Unsoiling of clay
2. Digging
3. Cleaning
4. Weathering

5. Blending

6. Tempering

Molding of clay for brick manufacturing

In the molding process, prepared clay is mold into brick shape (generally rectangular). This process can be done in two ways according to scale of project.

1. Hand molding (for small scale)
   - Ground molded bricks
   - Table-molded bricks
2. Machine molding (for large scale)

AGGREGATES

Aggregates are the important constituents of the concrete which give body to the concrete and also reduce shrinkage. Aggregates occupy 70 to 80 % of total volume of concrete.

Classification of Aggregates:

- Classification of Aggregates Based on Shape:
- Rounded aggregates
- Irregular or partly rounded aggregates
- Angular aggregates
- Flaky aggregates
- Elongated aggregates
- Flaky and elongated aggregates

Classification of Aggregates Based on Size:

- Fine aggregate
- Coarse aggregate

Fine Aggregate

When the aggregate is sieved through 4.75mm sieve, the aggregate passed through it called as fine aggregate.

Coarse Aggregate

When the aggregate is sieved through 4.75mm sieve, the aggregate retained is called coarse aggregate.

MODULE-II
CEMENT AND ADMIXTURES

Types of cement

Different types of cements

- Ordinary Portland Cement (OPC)
- Portland Pozzolana Cement (PPC)
- Rapid Hardening Cement
- Quick setting cement
- Low Heat Cement
- Sulphates resisting cement
- Blast Furnace Slag Cement
- High Alumina Cement
- White Cement
- Air Entraining Cement

Ordinary Portland Cement (OPC)

In usual construction work, Ordinary Portland Cement is widely used. The composition of Ordinary Portland Cement:

- Argillaceous or silicates of alumina (clay and shale)
- Calcareous or calcium carbonate (limestone, chalk, and marl)
- Uses of Ordinary Portland Cement
- It is used for general construction purposes.
- It is also used in most of the masonry works.

Portland Pozzolana Cement (PPC)

Pozzolanas are natural or synthetic materials that contain silica in reactive forms. It reacts with calcium hydroxide generated by hydrating cement to form additional cementations materials when it is finely divided.

The composition of Portland Pozzolana Cement:

- OPC clinker
- Gypsum
- Pozzolanic Materials (Fly ash, volcanic ash, and Calcined clay or silica fumes.)

Uses of Portland Pozzolana Cement

- PPC is usually used in hydraulic structures, marine structures, construction near the seashore, dam construction etc.
- It is also used in pre-stressed and post-tensioned concrete members.
- As it gives a better surface finish, it is used in decorative and art structures.
- It is also used in the manufacture of precast sewage pipes.

Rapid Hardening Cement

When finely grounded Tri-calcium silicate (C3S) is present in OPC with higher content, it gains strength more quickly than OPC. This type of OPC is called Rapid Hardening Cement. It's initial Setting Time 30 minutes and Final Setting Time 600 minutes.

Uses of Rapid Hardening Cement

- Rapid hardening cement is mostly used where rapid construction is needed like the construction of pavement.
- It also gives high strength.

Quick Setting Cement

Quick setting cement is the cement which sets in a very short time. The initial setting time is 5 minutes and the final setting time is 30 minutes. The composition of Quick Setting Cement:

- Clinker
- Aluminium sulphate (1% to 3% by weight of clinker)
- The aluminium sulphte increase the hydration rate of silicate.

Uses of Quick Setting Cement

- It is used in underwater construction.
- It is also used in rainy & cold weather conditions.
- It is used a higher temperature where water evaporates easily.
- Used for anchoring or rock bolt mining and tunneling

Low Heat Cement

It is a spatial type of cement which produce low heat of hydration during setting. Some chemical composition of Ordinary Portland Cement is modified to reduce the heat of hydration.

The chemical composition of low heat cement:

- A low percentage (5%) of tricalcium aluminate (C3A)
- A higher percentage (46%) of declaim silicate (C2S).
- Uses of Low Heat Cement
- It is used for the construction of dam's large footing, large raft slabs, and wind turbine plinths.
- It is also used for the construction of chemical plants.

Sulphates resisting cement

Sulphate resisting cement is used to resist sulphet attacks in concrete. Due to the lower percentage of Tricalcium aluminate, the production of calcium sulpho-aluminates gets reduced.

Uses of Sulphates resisting Cement

- Construction in contact with soils or groundwater having more than 0.2% or 0.3 % g/l sulphate salts respectively.
- Concrete surfaces subjected to alternate wetting and drying such as bridge piers, concrete surface in tidal zone, apron, Building near seacoast.
- Effluent treatment plans, Chimney, Chemical industries, water storage, sumps, drainage works, Cooling towers, Coastal protective works such as sea walls, breakwaters, tetrapods etc.

High Alumina Cement

High Alumina cement is obtained by mixing calcining bauxite (it's an aluminium ore) and ordinary lime with clinker during the manufacture of OPC. In which the total amount of alumina content should not be lesser than 32% and it should maintain the ratio by weight of alumina to the lime between 0.85 to 1.30.

Uses of High Alumina Cement

- It is used where concrete structures are subjected to high temperatures like workshop, refractory, foundries etc
- It also used where the concrete is subjected to frost and acidic action.

Air Entraining Cement

Air-entraining cement is a spatial type of cement which entrains tinny air bubbles in concrete. When water in concrete get frizzed due to low temperature, it expands. When air-entraining cement, the air voids in concrete provides space for water to expand without cracking concrete. But this type cement does not provide high strength in concrete.

Uses of Air-Entraining Cement

- Spatially it is used in areas where the temperature is very low.
- It also resists Sulphet attack.
- It is used where the de-iceing chemical is used.

Ingredients of concrete

Concrete is a composite material with changeable properties. The ingredients mixing ratio of concrete is variable and depends on the properties of ingredients and mix design.

A popular measuring method of concrete ingredients during mixing is by volume. But the weight measuring method is more accurate. However, concrete is prepared by mixing three basic ingredients.

1. Binding material – cement, lime
2. Aggregate, and
3. Water.

Binding material: Most commonly used binding material for concrete is Portland cement. Other binding materials used for this purpose, are lime, fly ash, silica fume etc. The selection of cement for concrete depends on the “cement properties“.

- **Aggregate**: Two types of aggregates are used in concrete. Coarse aggregate and Fine aggregate.
- **Coarse aggregate:** Big sizes aggregates in concrete are coarse aggregates. The size of it varies between 1/2″ to 1.5″ depending on concrete mix design. Generally, crushed stone or brick chips are used as coarse aggregate.

- **Fine aggregate:** The smaller size aggregates in concrete are Fine aggregates. The FM (Fineness Modulus) of fine aggregates can be between 1.2 to 2.5 depending on mix design. We use sand as fine aggregate in concrete.

Water: The most important concrete ingredient is water. Water can decrease and increase the concrete strength. Water just starts and continues the chemical reaction of cement. The high water content in the concrete mix increases the workability of concrete but decreases the strength. On the contrary, low water content increases the concrete strength but makes concrete less workable.

Other than these, there are some other ingredients used in the concrete mix such as Admixture. Those are secondary ingredients and added to give concrete a certain property.

Admixtures

Definition:

Concrete Admixture is defined as a material other than water, aggregates and hydraulic cement and additives like Pozzolana or slag and fiber reinforcement, used as on ingredient of concrete or mortar and added to the batch immediately before or during its mixing to modify one or more of the properties of concrete in the plastic or hardened state.

Reasons for Using Admixtures

Admixtures are used to modify the properties of concrete or mortar to make them more suitable for the work at hand or for economy or for such other purposes as saving energy.

Some of the important purposes for which admixtures are used are:

fresh concrete

- Increase workability without increasing water content or decrease water content at the same workability.
- Retard or accelerate time of initial setting.
- Reduce or prevent settlement.
- Modify the rate or capacity for bleedings.
- Reduce segregation.
- Improve pumpability.
- Reduce the rate of slump loss.

Hardened concrete

- Retard or reduce heat evaluation during early hardening.
- Accelerate the rate of strength development at early ages.
- Increase strength (compressive, tensile or flexural).
- Increase durability or resistance to severe condition of exposure.
- Decrease permeability of concrete.
- Control expansion caused by the reaction of alkalis with certain aggregate constituents.
- Increase bond of concrete to steel reinforcement.
- Increase bond between existing and new concrete.
- Improve impact resistance and abrasion resistance.
- Inhibit corrosion of embedded metal.
- Produce colored concrete or mortar

Types of Admixtures of Concrete

- Chemical admixtures - Accelerators, Retarders, Water-reducing agents, Super plasticizers, Air entraining agents etc.
- Mineral admixtures - Fly-ash Blast-furnace slag, Silica fume and Rice husk Ash etc

MODULE-III
BUILDING COMPONENTS AND FOUNDATIONS

LINTEL

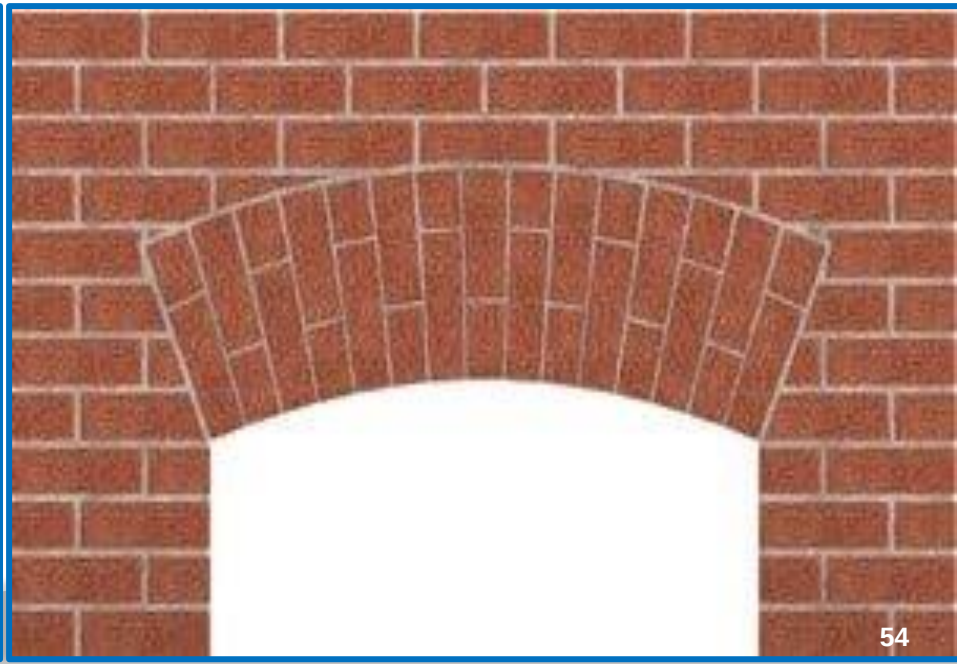
A lintel is a beam placed across the openings like doors, windows etc. in buildings to support the load from the structure above. The width of lintel beam is equal to the width of wall, and the ends of it is built into the wall. Lintels are classified based on their material of construction.

Bearing of Lintel

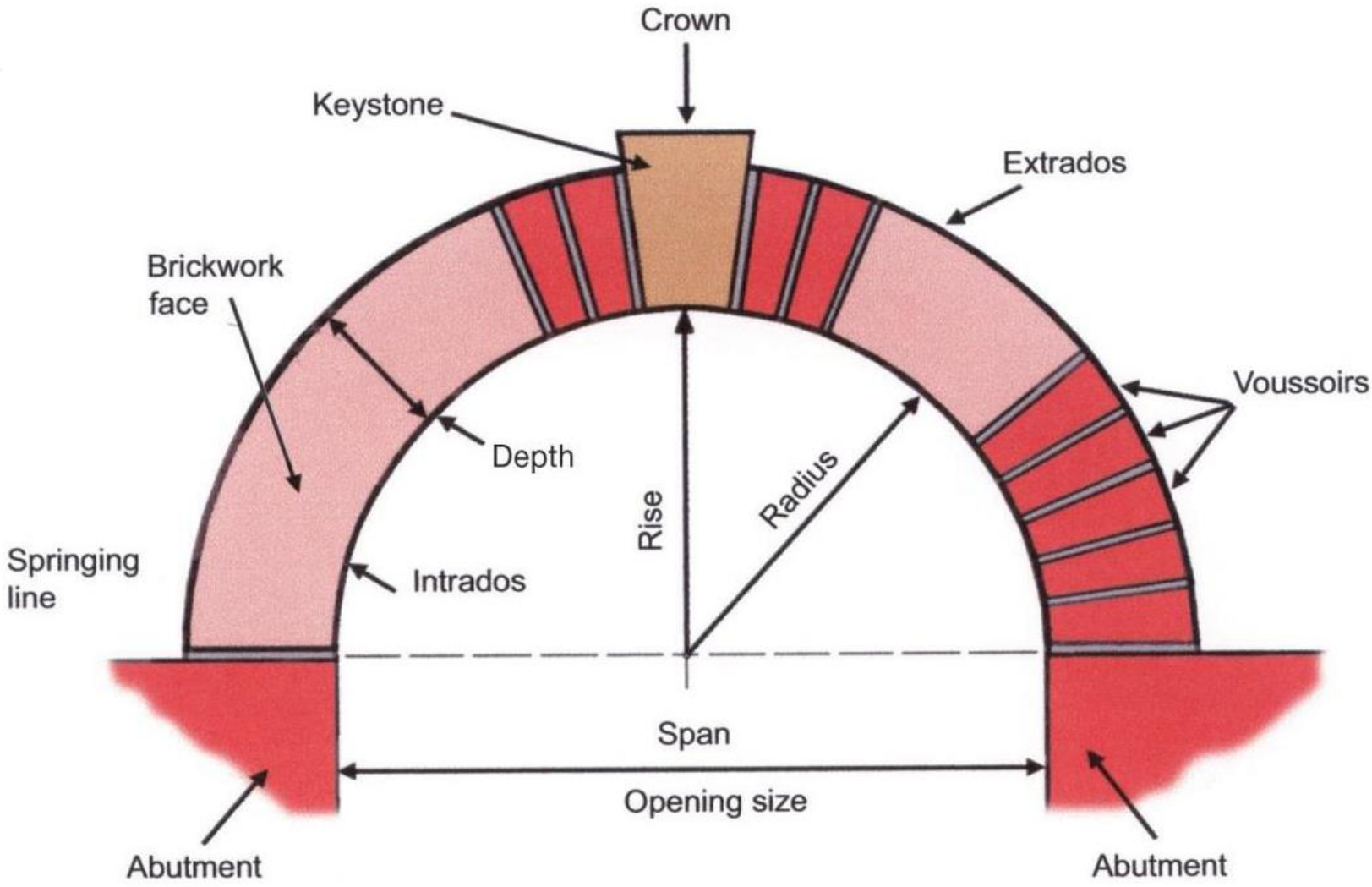
- The bearing provided should be the minimum of following 3 cases.
- 10 cm
- Height of beam
- $1/10^{th}$ to $1/12^{th}$ of span of the lintel.

ARCH

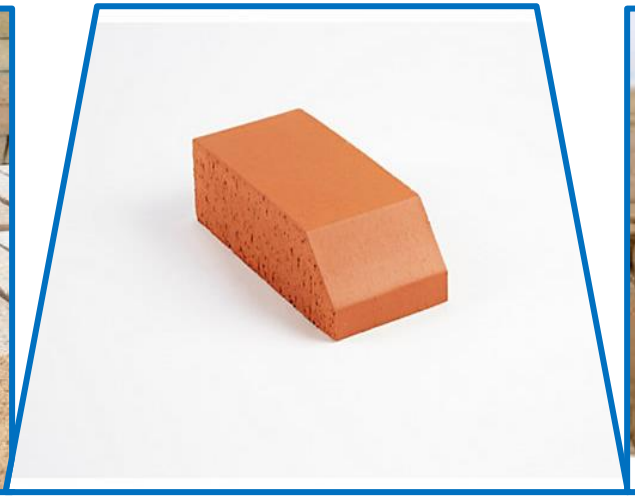
An arch is a structure constructed in curved shape with wedge shaped units (either bricks or stones), which are jointed together with mortar, and provided at openings to support the weight of the wall above the openings along with other superimposed loads.



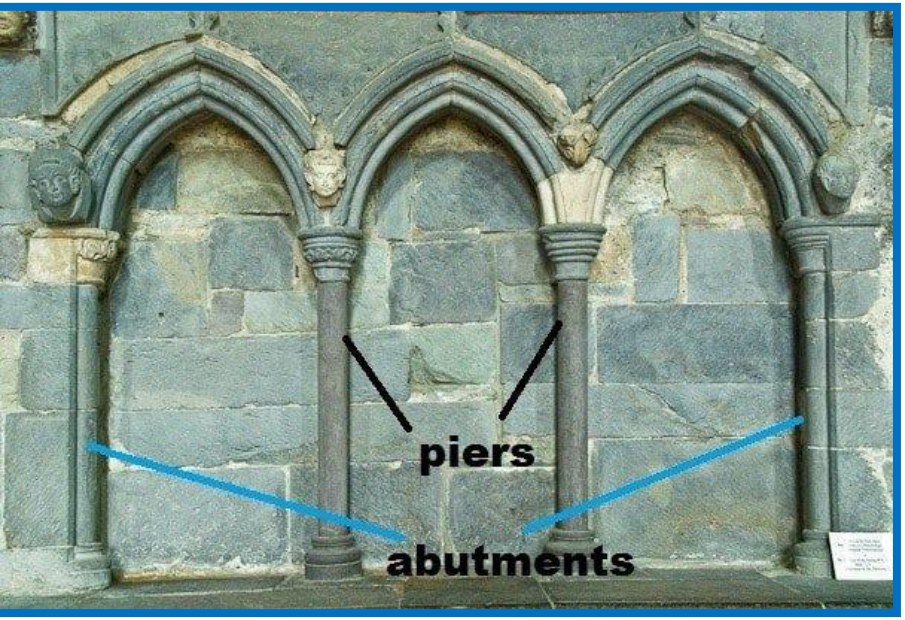
COMPONENTS

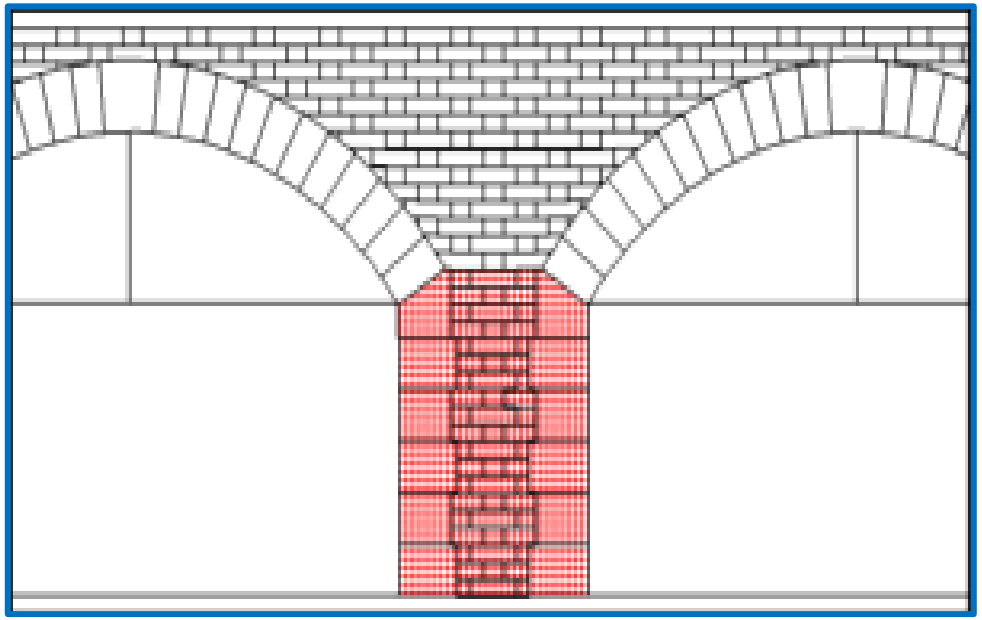

Crown
Keystone
Extrados
Brickwork face
Voussoirs
Depth
Rise
Radius
Springing line
Intrados
Span
Opening size
Abutment
Abutment

Wedge shaped bricks and stones



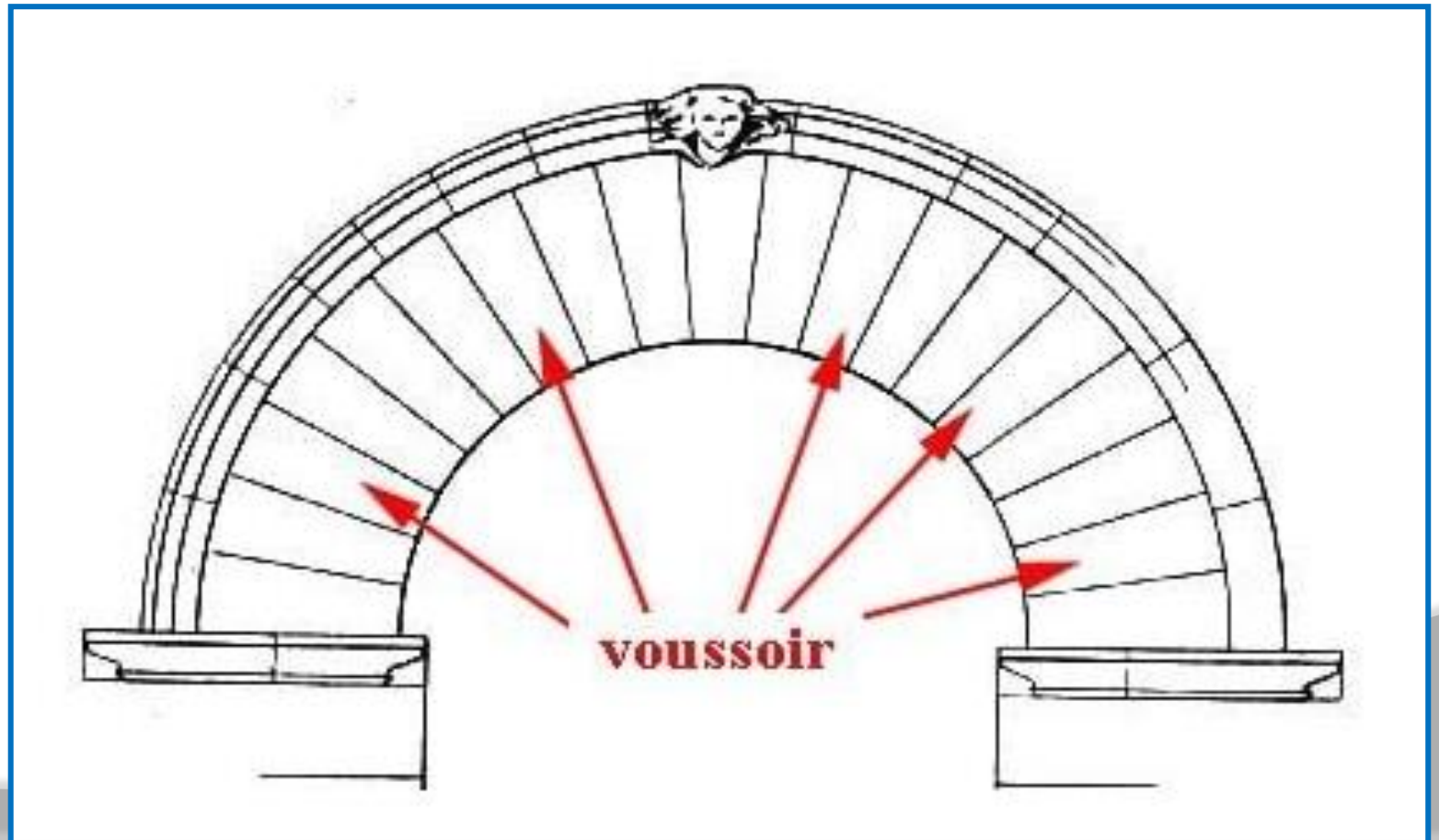
Abutments and piers





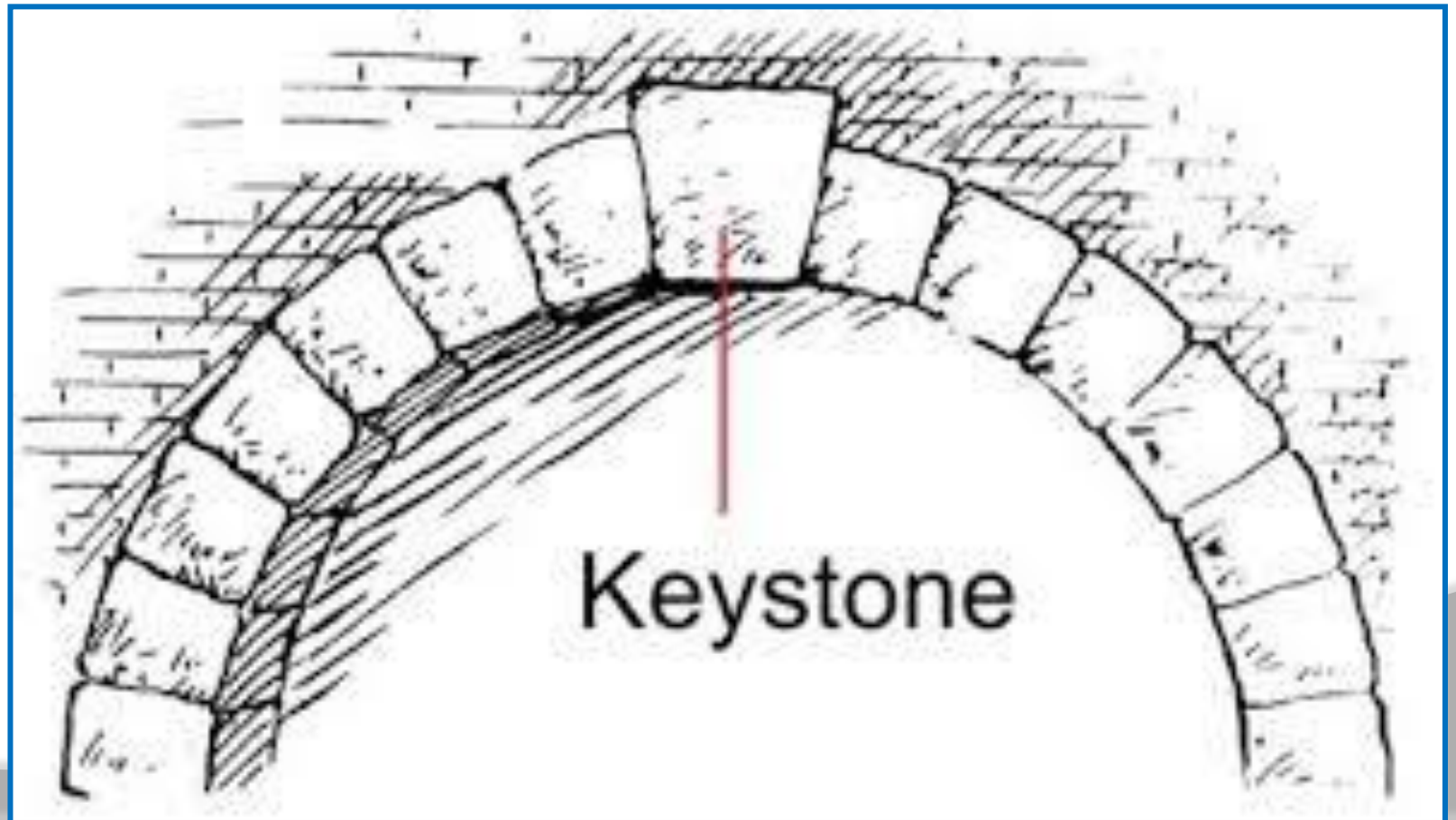
voussoirs

The wedge-shaped units of masonry which are forming an arch is called as voussoirs.



Keystone

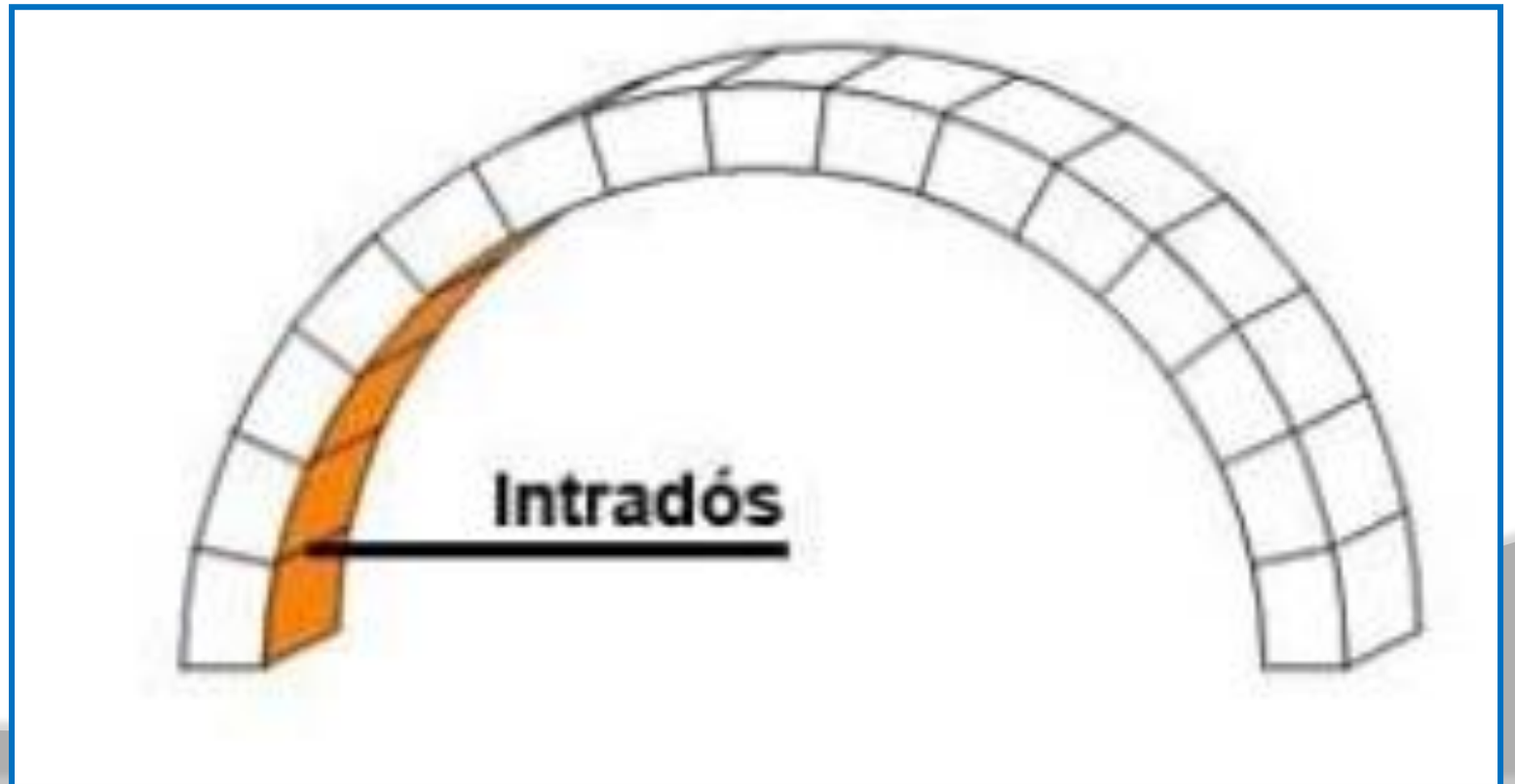
The voussoir located at the crown of the arch. Also called the key.



Intrados and Soffit

The curve which bounds the lower edge of the arch OR The inner curve of an arch is called as intrados.

The distinction between soffit and intrados is that the intrados is a line, while the soffit is a surface.



Extrados

The outer curve of an arch is termed as extrados.

a floor is the 'lower horizontal surface of any space in a building, including finishes that are laid as part of the permanent construction.

A floor typically provides:

- Structural support for the contents of the room, its occupants, and the weight of the floor itself.
- Resistance to the passage of moisture, heat and sound.
- A surface finish which may contribute to the look, feel and acoustics of a space.

Different types of flooring materials generally used in building construction works

- Cement or lime concrete
- Bricks
- Flagstones
- Marble
- Glass
- Ceramic
- Rubber
- Plastic
- Mud and murram
- Wood
- Cork
- Linoleum
- Asphalt

Foundations

Types of Foundation and their Uses

Shallow foundation

- Individual footing or isolated footing
- Combined footing
- Strip foundation
- Raft or mat foundation

Deep Foundation

- Pile foundation
- Drilled Shafts or caissons

Individual Footing or Isolated Footing

- Individual footing or an isolated footing is the most common type of foundation used for building construction. This foundation is constructed for single column and also called as pad foundation.
- The shape of individual footing is square or rectangle and is used when loads from structure is carried by the columns.

Combined Footing

- Combined footing is constructed when two or more columns are close enough and their isolated footings overlap each other. It is a combination of isolated footings, but their structural design differs.

Spread footings or Strip footings and Wall footings

- Spread footings are those whose base is more wider than a typical load bearing wall foundations.

Raft or Mat Foundations

- Raft or mat foundations are the types of foundation which are spread across the entire area of the building to support heavy structural loads from columns and walls.

Pile Foundations

- Pile foundation is a type of deep foundation which is used to transfer heavy loads from the structure to a hard rock strata much deep below the ground level.

Drilled Shafts or Caisson Foundation

- Drilled shafts, also called as caissons, is a type of deep foundation and has action similar to pile foundations discussed above, but are high capacity cast-in-situ foundations.
- It resists loads from structure through shaft resistance, toe resistance and / or combination of both of these. The construction of drilled shafts or caissons are done using an auger.

MODULE-IV
WOOD, ALUMINUM AND GLASS

WOOD

Wood is one of the most used natural building materials in the world. A number of valuable properties such as low heat conductivity, small bulk density, relatively high strength, amenability to mechanical working etc. makes wood as famous building material.

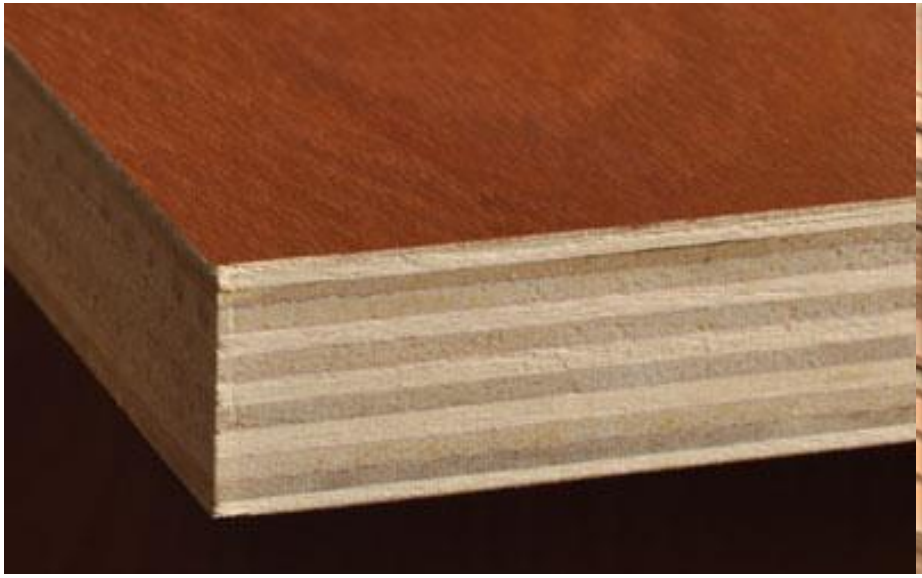
TYPES OF WOOD

1. Natural

   Ex: Timber, lumber

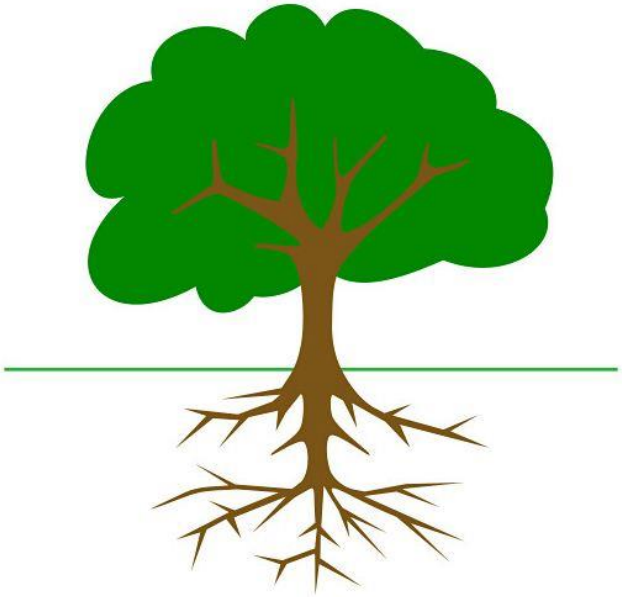
2. Man made

   Ex: Plywood, fibre boards, chip boards, compressed wood



ADVANTAGES

- Availability
- Transport and handling
- Thermal insulation
- Sound absorption
- Electrical resistance
- Good absorber of shocks



Source of wood

TREE

CLASSIFICATION OF TREES

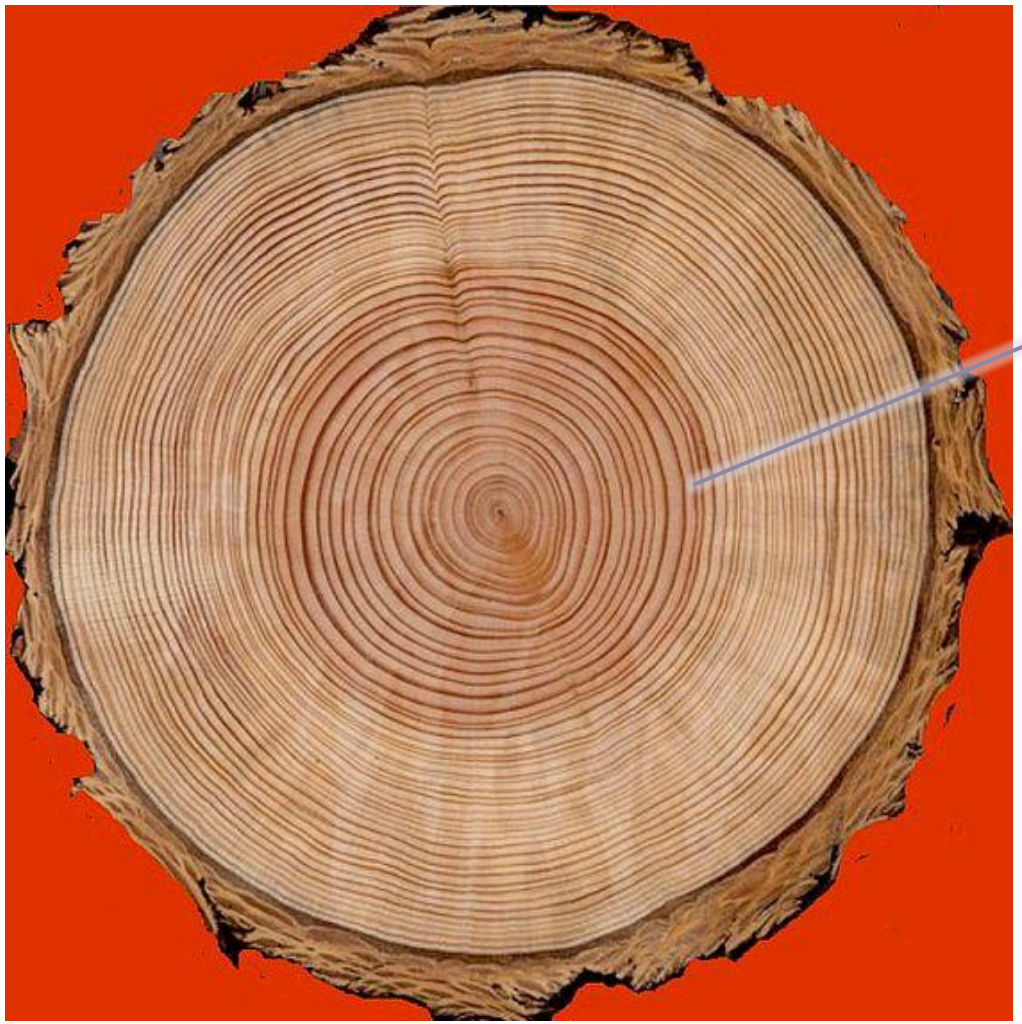
Based on mode of growth

1. Exogenous trees

   Ex: Sal, Teak

Exogenous trees are outward growing trees.

Horizontal section of such tree contains several rings which are nothing but annual rings. These rings can be used to predict the age of tree.



Annual rings

Classification of exogenous trees

1. Conifers

Soft wood producing trees, also called as ever green trees Small needle like leaves

2. Deciduous

Deciduous trees are hard wood producing trees. The leaves of this type of trees are generally broad in size and they fall in autumn and grow in spring.

Endogenous tree

Endogenous trees are inward growing trees which contains fibrous mass in their longitudinal section.

Ex: bamboo, palm, cane etc.

Bamboo tree

Palm tree

Cross section of Endogenous tree

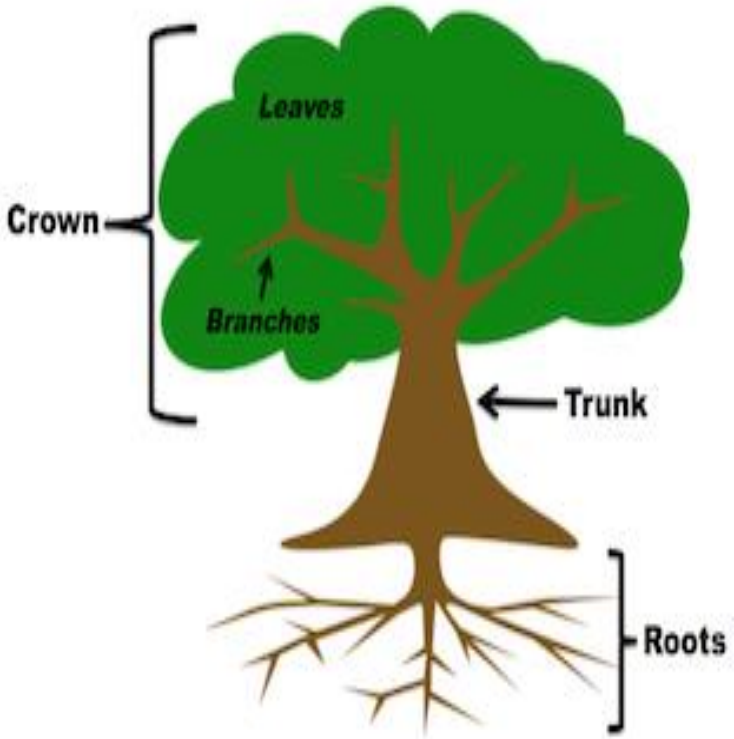
Cross Section of a coconut palm trunk

Parts of tree

Crown: consists of leaves and branches

Roots: Absorbs water, nutrients from soil and gives stability against wind and impacts

Trunk: transport system for between crown and roots. It stores sap and provides rigidity.



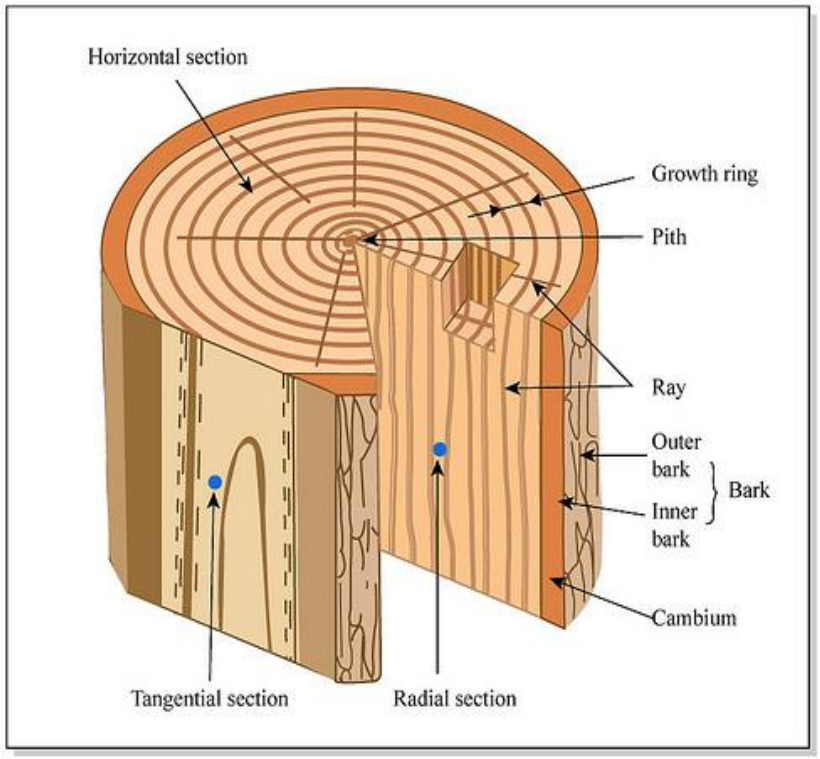
STRUCTURE OF TIMBER

1. Macro structure

2. Micro structure

1. Macro structure 

1. Cross section
2. Radial section
3. Longitudinal section


Horizontal section
Growth ring
Pith
Ray
Outer bark
Inner bark
Bark
Cambium
Tangential section
Radial section

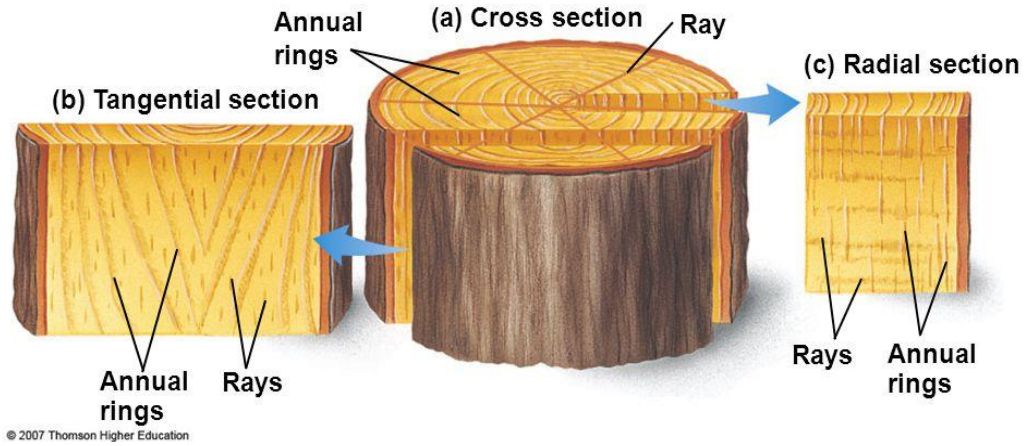

Annual rings
(a) Cross section
Ray
(c) Radial section
(b) Tangential section
Annual rings
Rays
Rays
Annual rings
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Fig. 7-13, p. 144

COMPONENTS OF TREE

Pith

Heartwood

Sap wood

Cambium layer

Bark

Medullary rays

Classification of timber (Based on IS:399)

1. Position

i. Standing timber

ii. Rough tree

iii. Converted tree

2. Grading

a) Structural or stress grading

i. based on known efects of defects and estimating value

ii. Machine grading

b) Commercial or utility grading

i. Grade A: Dimensions and general appearance

ii. Grade B: Ultimate use of material

iii. Grade C: evolution of defects and rough estimate of utilizable material

iv. Grade D: Evolution of units of defects and fixing permissible number of standard volume of material or area

3. Modulus of elasticity

i. Group A: E >12.5 kN/mm^2

ii. Group B: E = 9.8- 12.5 kN/mm^2

iii. Group C: E = 5.6- 9.8 kN/mm^2

4. Availability

i. X- Most common, 1415 m3 or more per year

ii. Y- Common, 355 m3 to 1415 m3 per year

iii. Z- Less common, less than 355 m3 per year

5. Durability

i. High durability:- Avg life more than 120 months

ii. Moderate durability:- 60-120 months

iii. Low durability:- <60 months

GLASS

- Glass is an inorganic product of fusion, which has been cooled to a solid state condition without crystallizing
- slow cooling process leads to formation of crystal nuclei and crystallization takes place.
- If the cooling rate is fast, leaving no time to the formation of crystal nuclei, structure of super cooled liquid state turns to rigid and forms a glass.

PROPERTIES

- Hard and brittle
- appearance
- glass can absorb, refracts or transmits light.
- Glass transmits up to 80% of available natural day light in both directions
- The glass is fully weather resistance
- Melting point 1400 to 1500 degree c.

CLASSIFICATION

- Soda-lime glass.
- Potash-lime glass.
- Potash – Lead glass.
- Common glass.

USES:

Soda lime glass: It is used in the manufacture of glass tubes, laboratory apparatus, plate glass, window glass etc.

Potash lime glass: It is used in the manufacture of glass articles, which have to with stand high temperatures.

Potash – Lead glass: It is used in the manufacture of artificial gems, electric bulbs, lenses, prisms etc.

Common Glass: It is mainly used in the manufacture of medicine bottles.

Commercial forms or special types of glass

- Fibre glass
- Float glass
- Ground glass
- Laminated glass
- Wired glass
- Optical glass

Manufacture of glass

1. Batching of fret mixing
2. Furnace melting
   a. initial stage
   b. second stage
   c. third stage
3. Drawing
4. Annealing
5. Cutting

MASONRY

Definition:

The art of building a structure in stone with any suitable masonry is called stone masonry.

Basic Types of Stone Masonry

There are two types of stone masonry namely

1. Ashlar Masonry
2. Rubble Masonry

Ashlar Masonry

Ashlar are those stones that are finely dressed in a square or rectangular shape i.e. free from any irregularity or defects. Care must be taken while dressing the stone so their sizes and dimensions must be in accordance with the thickness of wall and a height of course.

The joints in this type of masonry are finely made with thickness of around 3 mm or so. In most of the cases the ashlar masonry is carried out in cement mortar or in some cases lime mortar.

This type of stone masonry is costly and time taking as it involves extensive dressing work

Types of Ashlar Masonry

1. Ashlar Rough Tooled
2. Ashlar fine Masonry
3. Ashlar Chamfered
4. Ashlar Rock Quarry Faced
5. Ashlar Facing
6. Ashlar Block in Course

Rubble Masonry

- Unlike ashlar masonry, this types of stone masonry involves laying of rough undressed stones irregularly

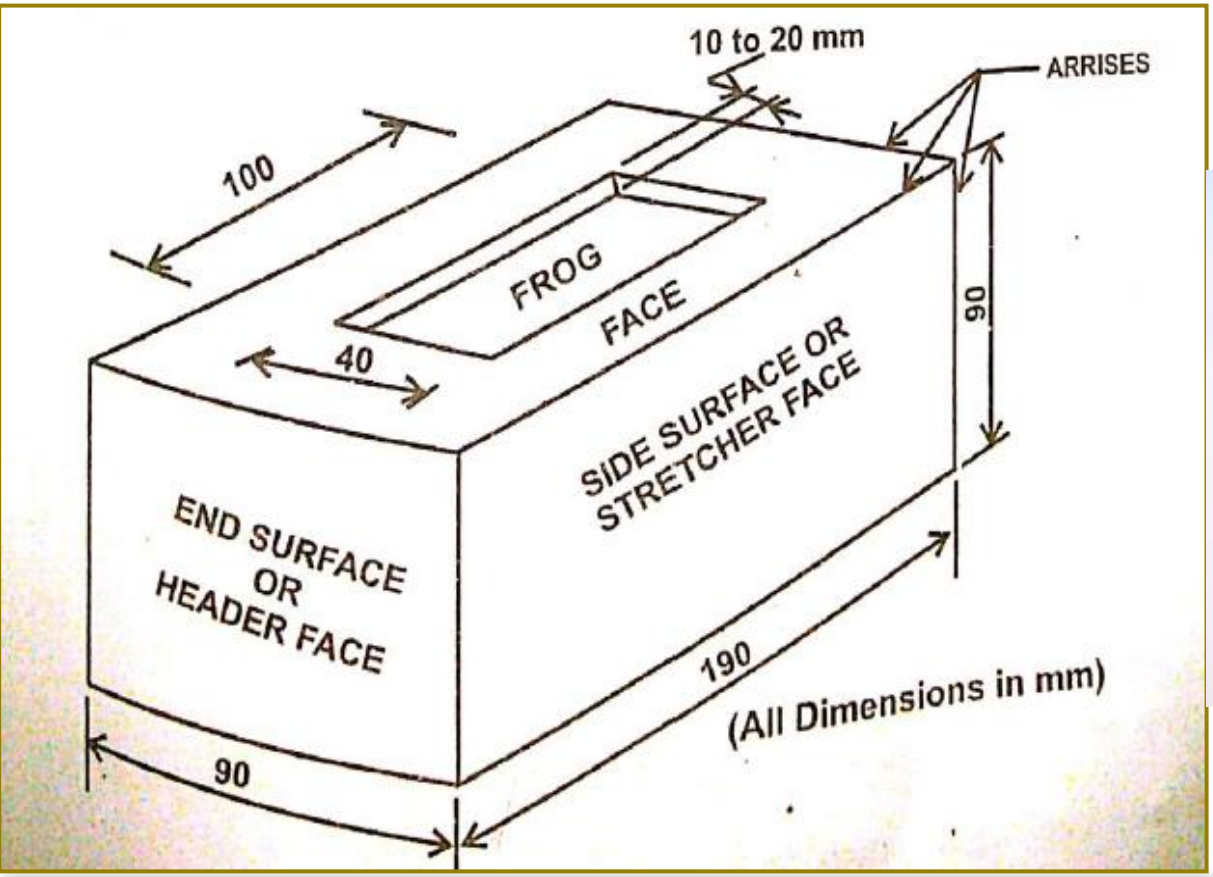
  i.e. the courses in rubble masonry are not defined and the size of shape is also not uniform.
- This type of stone masonry is very cheap and is useful for areas of low income for constructing traditional huts and mud houses especially in villages.
- But sometimes, the architect, in order to render some traditional look of the building, prefer to use rubble wall look.

Types of Rubble Masonry

Following are the types of rubble masonry :

- Dry Rubble Masonry
- Un-coursed Rubble Masonry
- Un-coursed Random Rubble Masonry
- Un-coursed Squared Rubble Masonry
- Coursed Random Rubble

BRICK


10 to 20 mm
ARRISES
100
FROG
FACE
40
90
SIDE SURFACE OR
STRETCHER FACE
END SURFACE
OR
HEADER FACE
190
90
(All Dimensions in mm)

Types of brick bonds

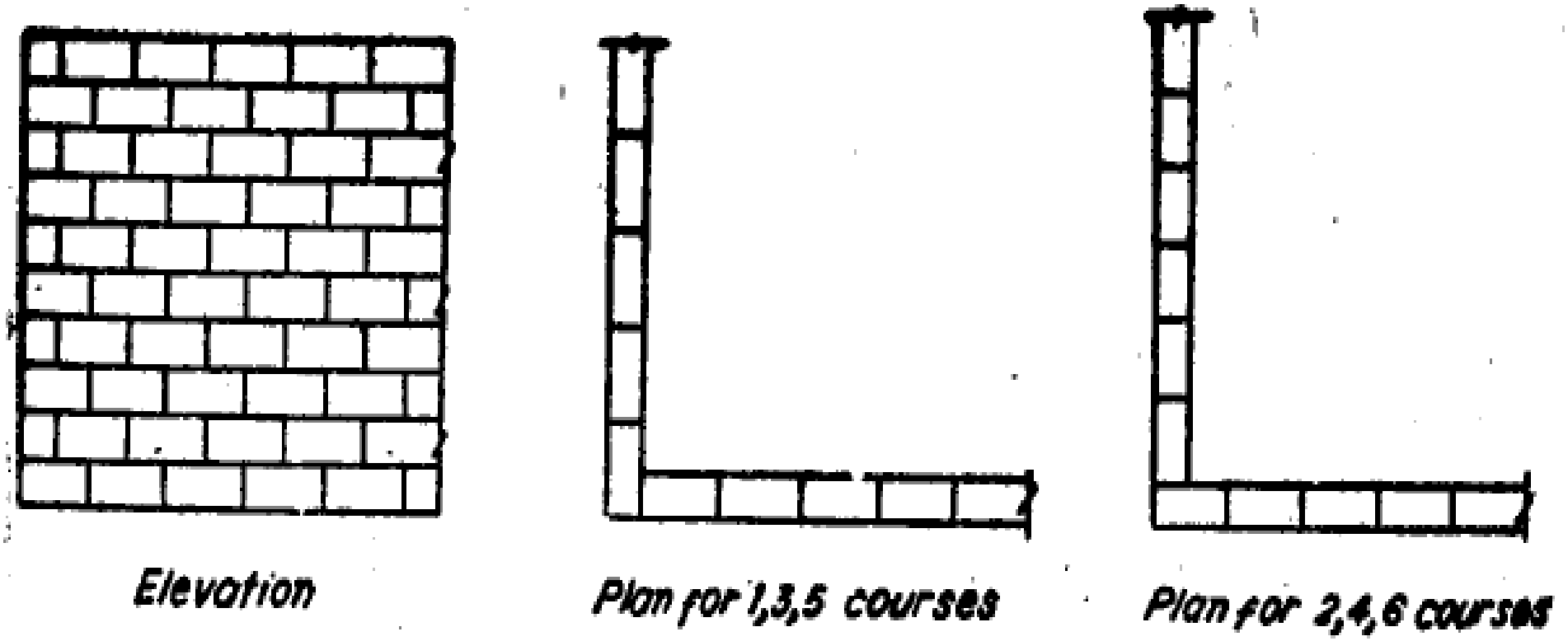
1. Stretcher bond
2. Header bond
3. English bond and
4. Flemish bond

Other Types of bonds are:

1. Facing bond
2. Dutch bond
3. English cross bond
4. Brick on edge bond
5. Raking bond
6. Zigzag bond
7. Garden wall bond

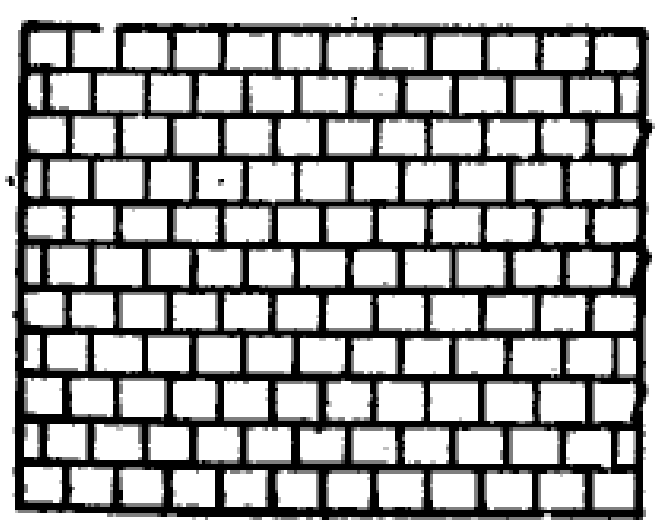
Stretcher bond

Longer narrow face of the brick is called as stretcher as shown in the elevation of figure below. Stretcher bond, also called as running bond, is created when bricks are laid with only their stretchers showing, overlapping midway with the courses of bricks below and above.

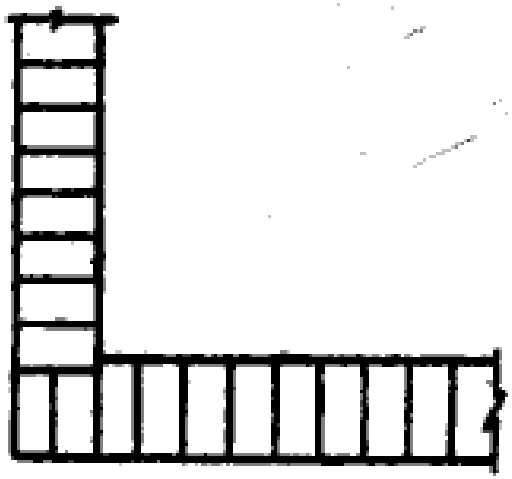


Header bond

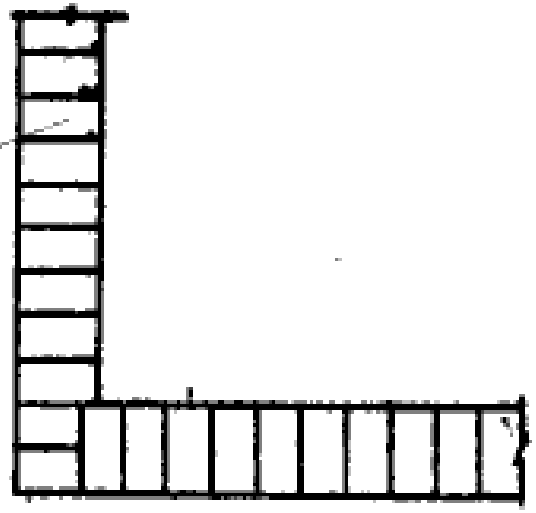
Header is the shorter square face of the brick which measures 9cm x 9cm. Header bond is also known as heading bond. In header bonds, all bricks in each course are placed as headers on the faces of the walls.



Elevation



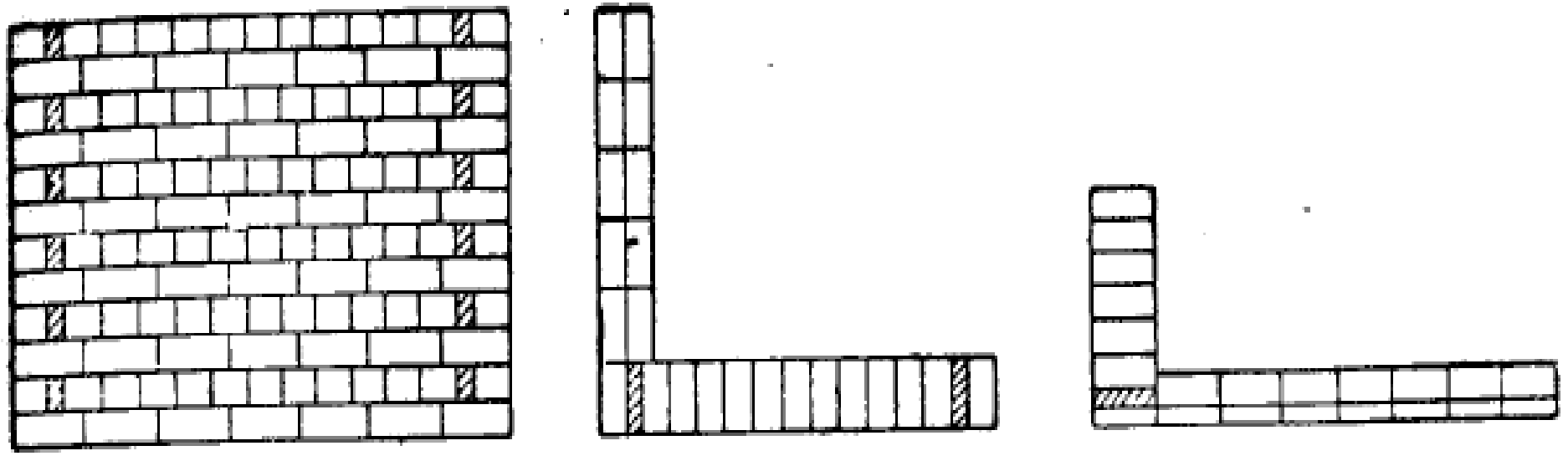
Plan for 2,4,6 courses



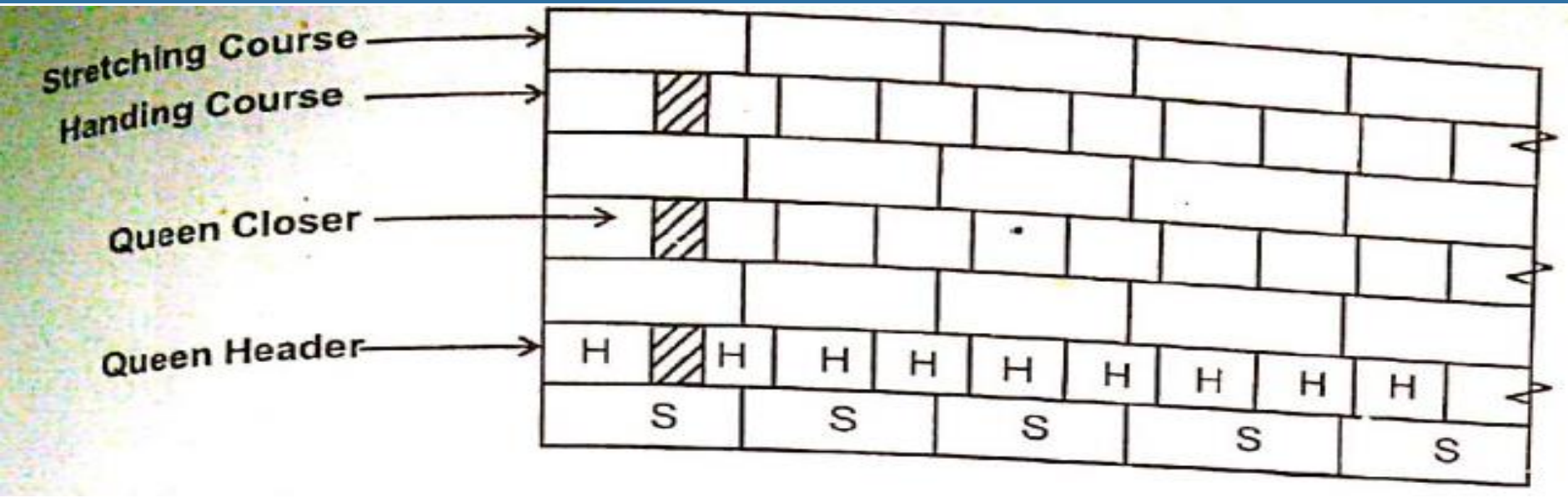
Plan for 1,3,5 courses

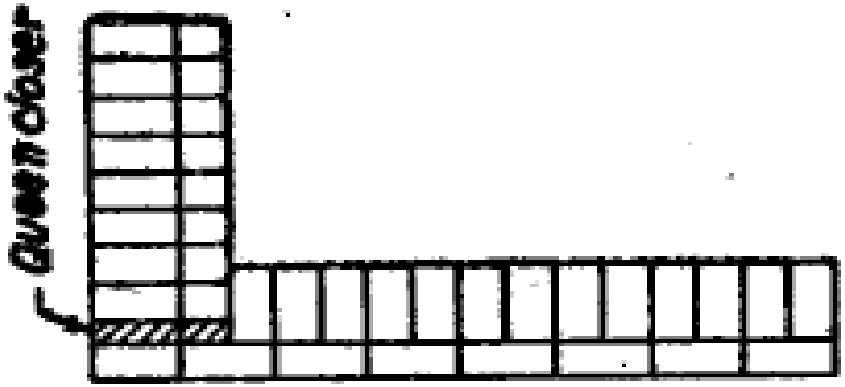
English bond

English bond in brick masonry has one course of stretcher only and a course of header above it, i.e. it has two alternating courses of stretchers and headers. Headers are laid centered on the stretchers in course below and each alternate row is vertically aligned.

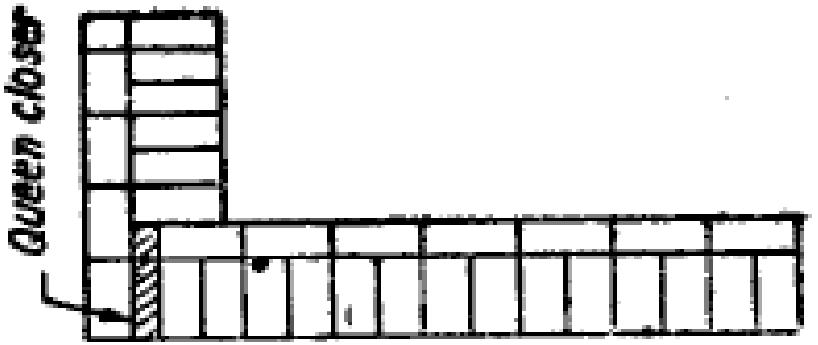


One-brick wall English bond





Plan for 2, 4, 6 courses

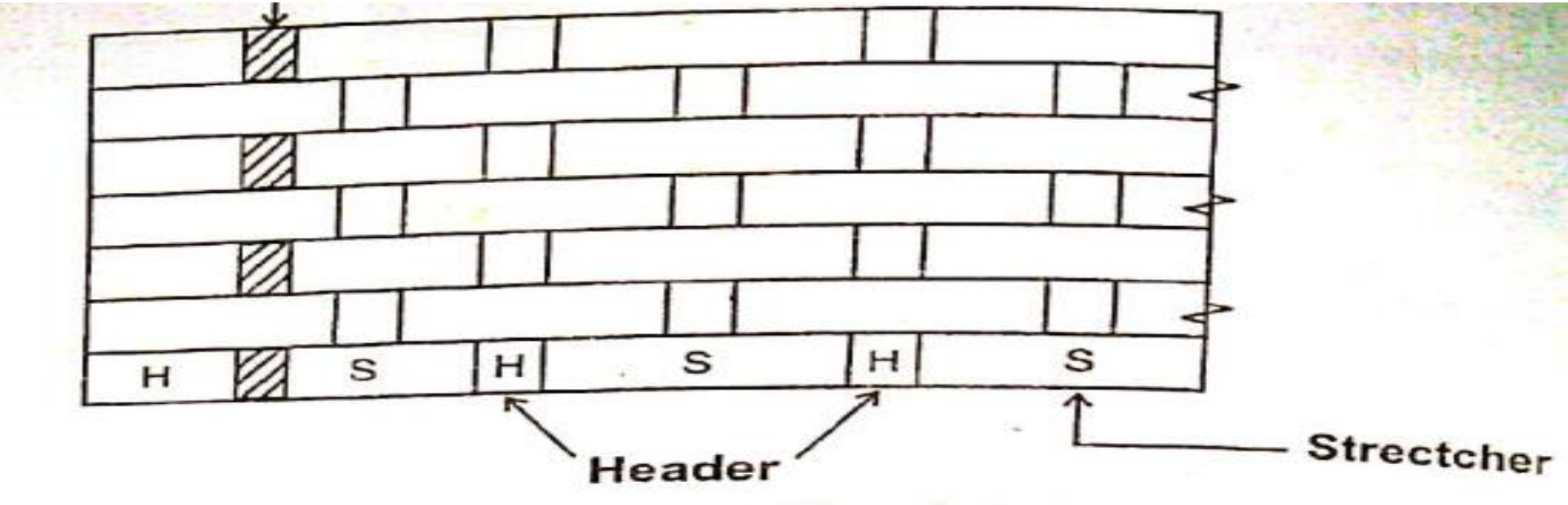


Plan for 1, 3, 5 courses

One-and-a-half-bricks wall English bond.

Flemish bond

Flemish bond, also known as Dutch bond, is created by laying alternate headers and stretchers in a single course. The next course of brick is laid such that header lies in the middle of the stretcher in the course below, i.e. the alternate headers of each course are centered on the stretcher of course below. Every alternate course of Flemish bond starts with header at the corner.



MODULE-V
STAIRS AND STAIR CASES

TERMINOLOGY

Step

This is a portion of stair which permits ascending or descending from one floor to another. It is composed of a tread and a riser. A stair is composed of a set of steps.

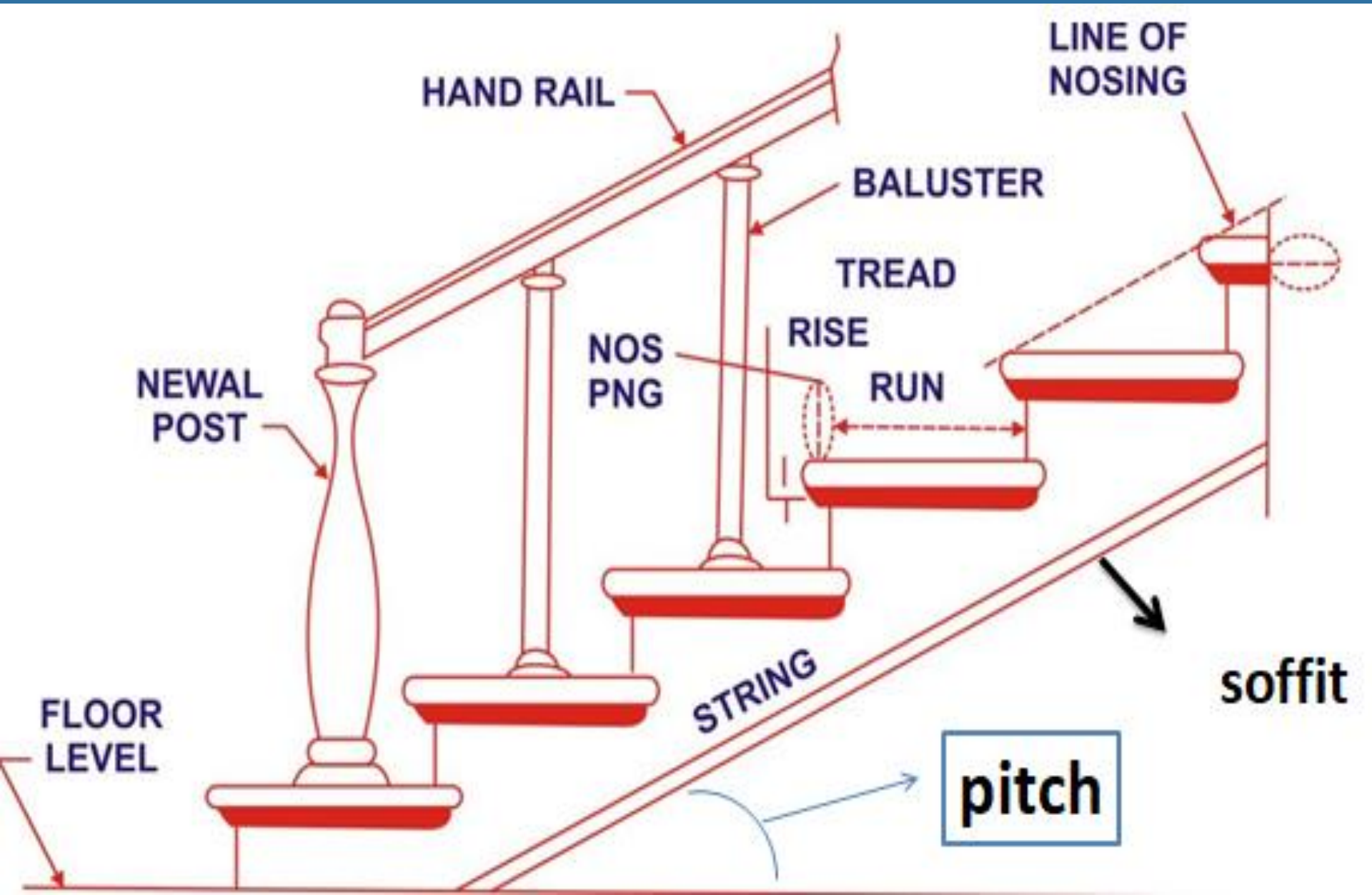
Tread

It is the upper horizontal portion of a step upon which the foot is placed while ascending or descending a stairway.

Flight

The steps between levels including landings.

Terminology



Landing

An area at the top or part way up the stair that either acts as a resting place, a change of direction or is the end of the stair.

Nosing

The front edge of the step or tread that

Going

The measured horizontal distance between nosings.

Riser

The distance between each step. I.e. the vertical space between each step.

Rise

The actual or measured distance between treads.

Total Rise

The total vertical distance from floor to floor.

Total Going

The total horizontal distance of the stair.

Pitch Line

An imagined line that stretches from nosing to nosing for the length of the stair.

Pitch

The angle that the flight of stairs is built at.

Headroom

This is the distance from the pitch line to the next surface above it. E.g. the ceiling or soffit above. The normal minimum is two metres.

String

The angled beam or member at each side of the stair that supports the treads.

REQUIREMENTS OF GOOD STAIRS

Location

It should preferably be located centrally, ensuring sufficient light and ventilation.

Width of Stair

The width of stairs must be uniform.

Length

The flight of the stairs should be restricted to a maximum of 12 and minimum of 3 steps.

Pitch of Stair

The pitch of long stairs should be made flatter by introducing landing. The slope should not exceed 40 degrees and should not be less than 25 degrees.

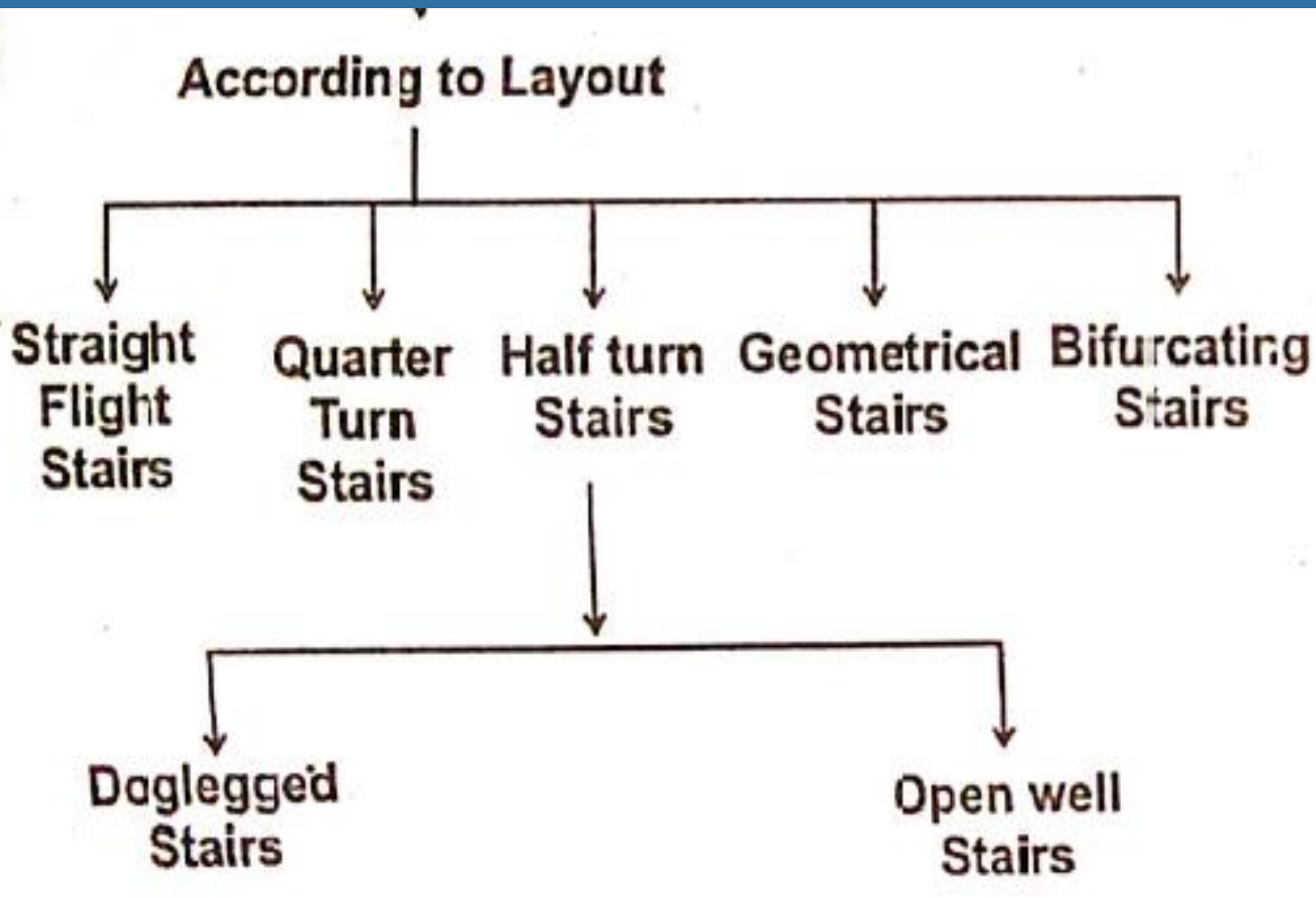
Head Room

The distance between the tread and soffit of the flight immediately above it, should not be less than 2.14 to 2.3 m..

Materials

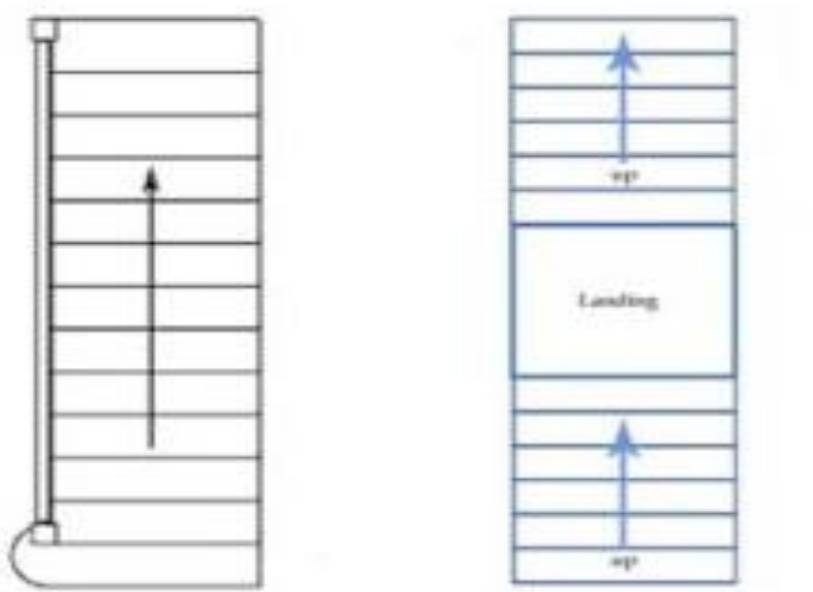
Stairs should be constructed using fire resisting materials. Materials also should have

CLASSIFICATION OF STAIRS



STRAIGHT FLIGHT STAIRS

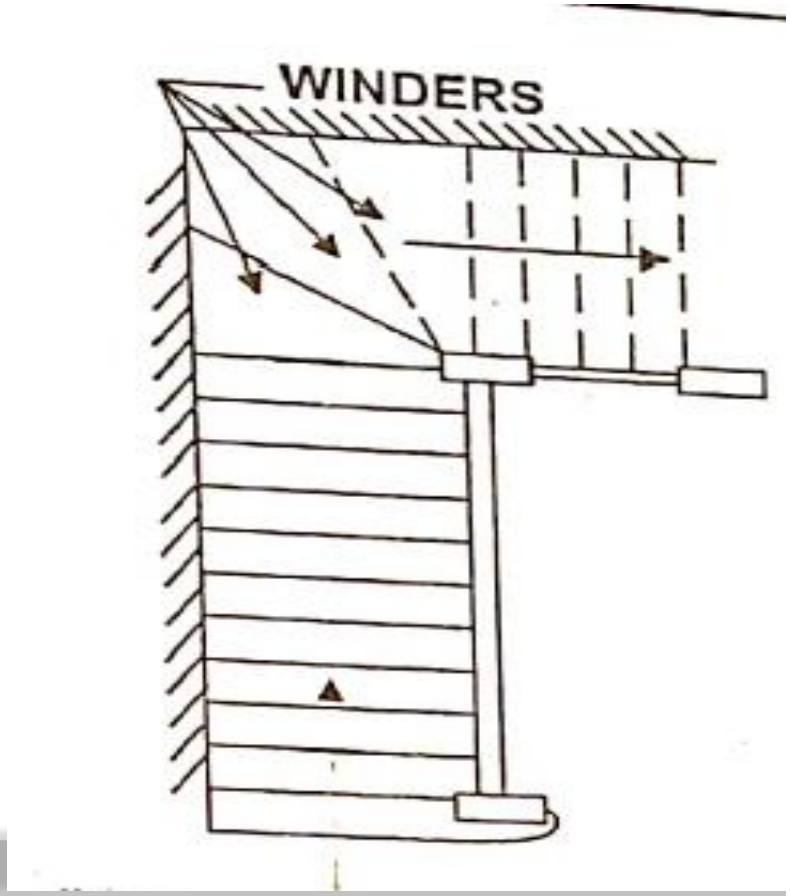
In this stair, all the steps are arranged continuously along in one direction.

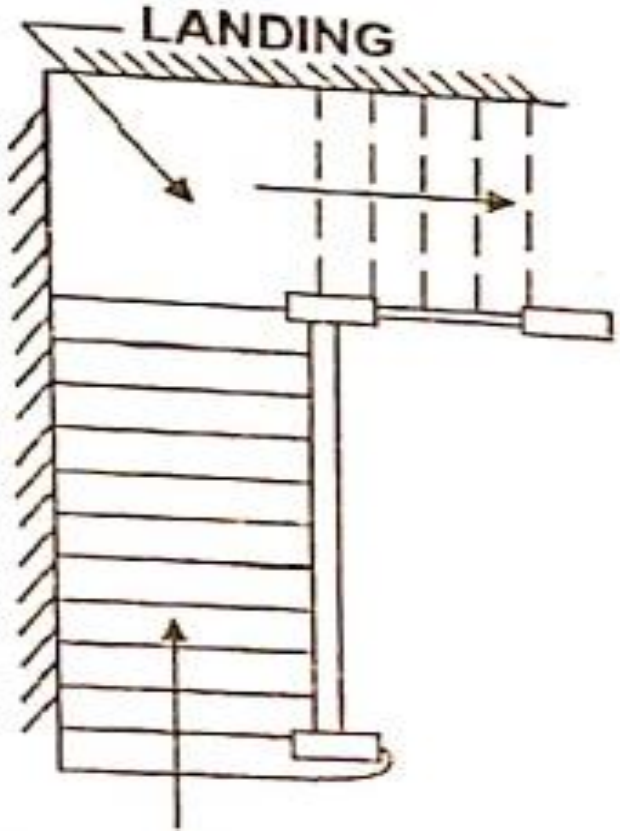


Straight Stair

QUARTER TURN STAIRS

- A quarter turn stair is the one which changes its direction either to the right or to the left





HALF TURN STAIRS

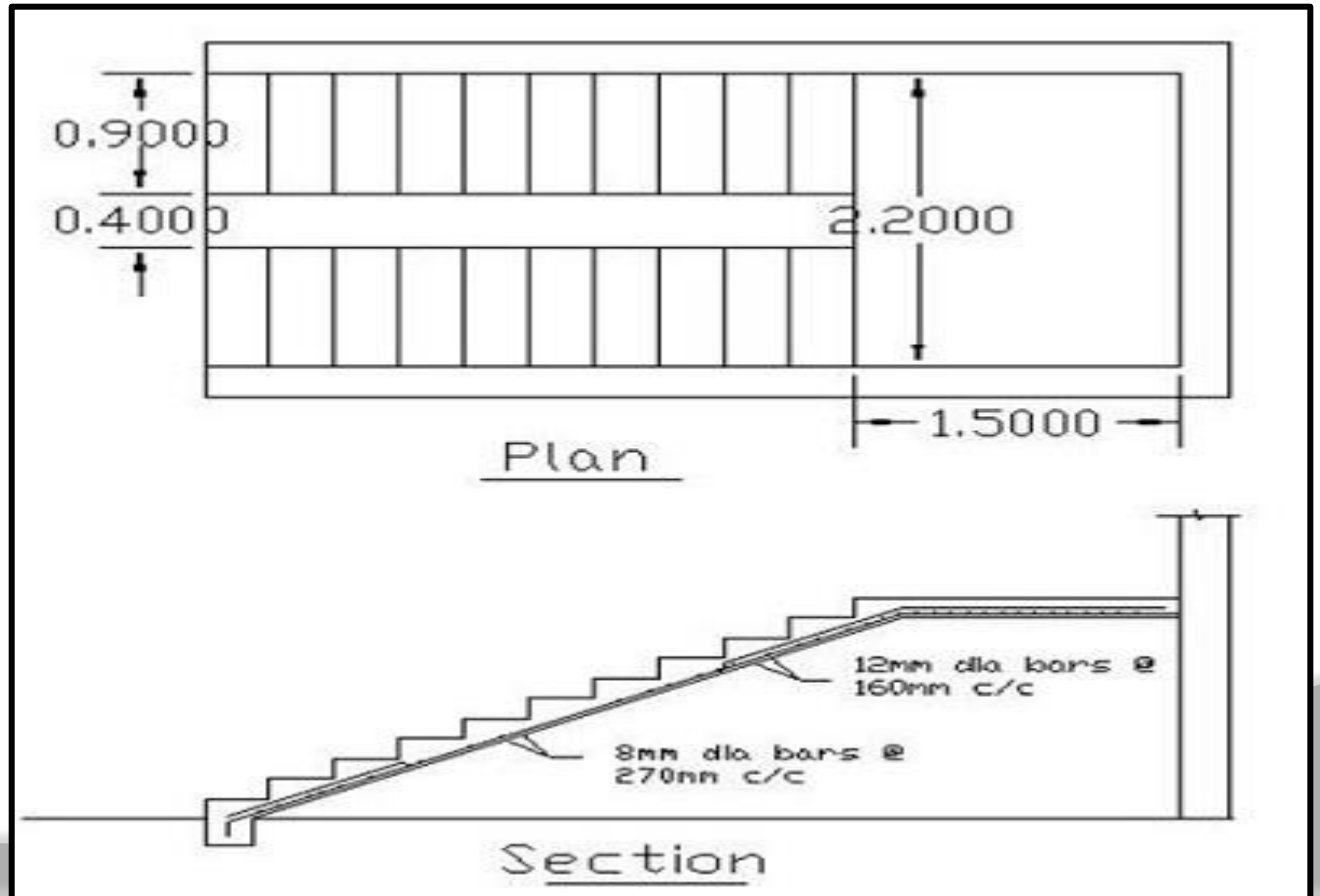
Half turn stairs are those which reverse direction or change direction to 180°.

1. Dogged-legged Stair
2. Open well Stair

In case of dog legged stairs the flights are in opposite directions and no space is provided between the flights in plan. On the other hand in open newel stairs, there is a well or opening between the flights and it may be used to accommodate a lift. These stairs are used at places where sufficient space is available.

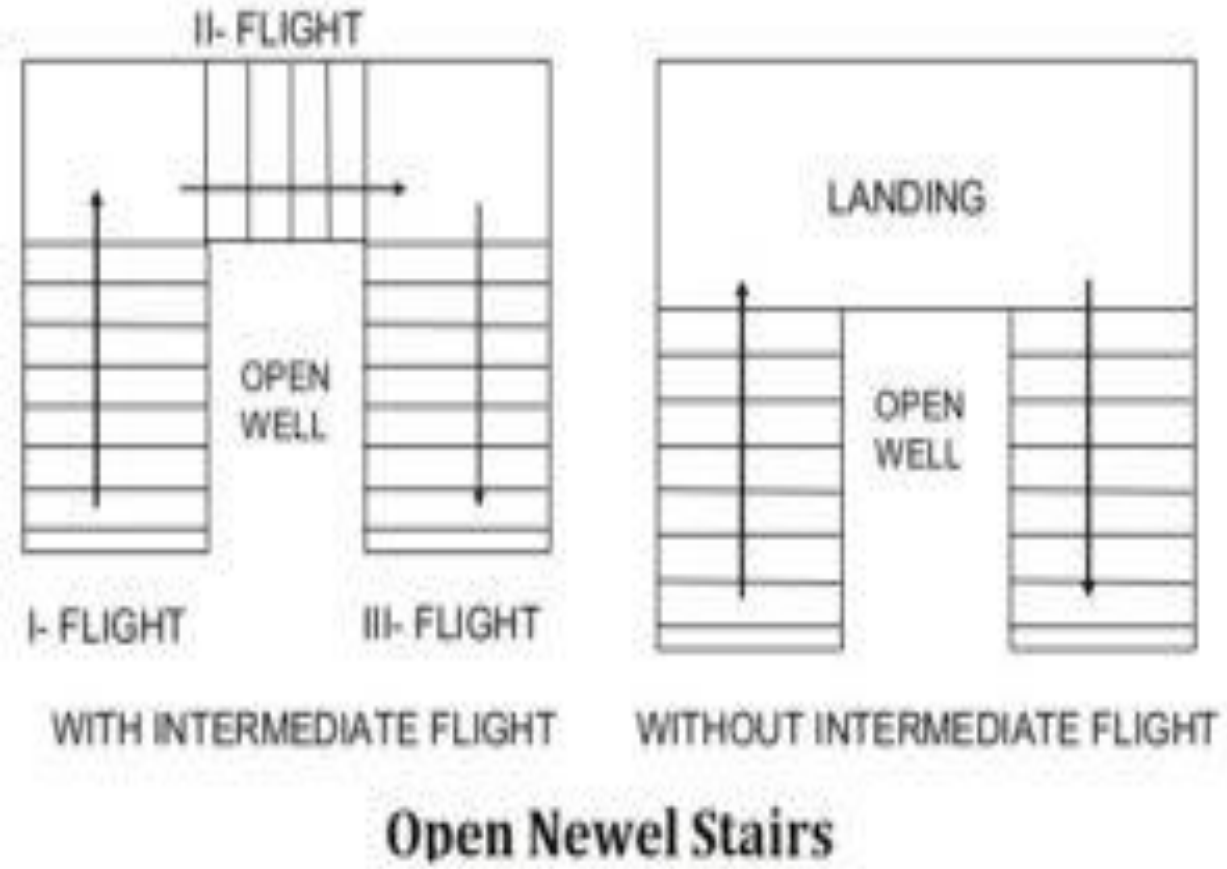
DOGGED-LEGGED STAIR

Dog-legged or newel half turn stairs the name is due to its sectional appearance. The newel posts are provided at the beginning and end of each flight.



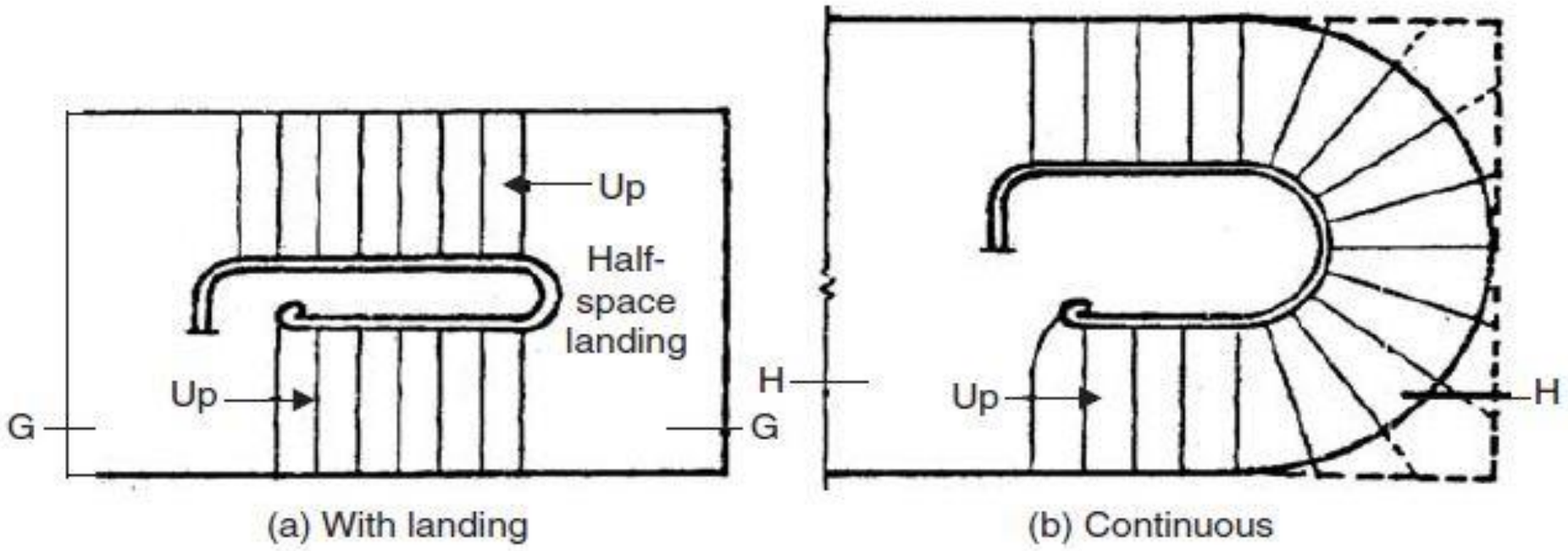
OPEN WELL STAIR

This type of stair consists of two or more flights arranging a well or opening between the backward and forward flights.



GEOMETRICAL STAIR

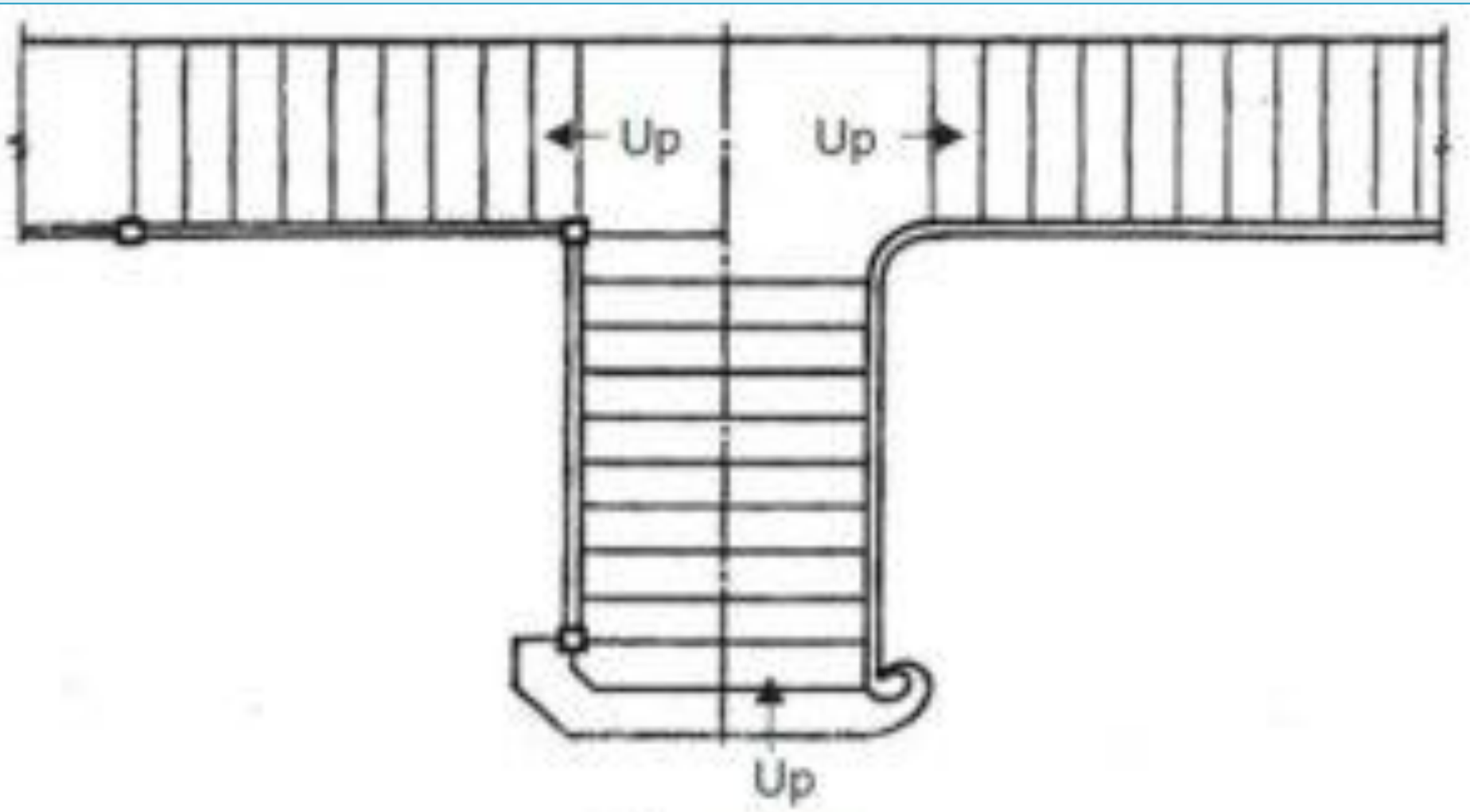
This is another type of open newel stair where the open well between the forward and the backward flight is curved.



Geometrical stairs

Circular stairs

Bifurcated stair



Bifrucated Stair

PRINCIPLES OF BUILDING PLANNING

- An engineer or architect should prepare the building plan according to the demand, economic status & taste of the owner and also the purpose of the building is to be built whether residential, commercial etc.
- The design of the building should be compatible with the surrounding structures & the weather.
- Sufficient air and sunlight should be allowed to the building for healthy building environment.

SELECTION OF SITE

- The site should be preferably be situated on an elevated and levelled ground. It should not be located in a flood-prone area.
- The soil at site should not be of black cotton soil and should have good value of bearing capacity.
- The water table of ground at the site should not be high.
- The site should not be irregular in shape or have sharp corners. The site should preferably be rectangular or a square in shape.

PRINCIPLES OF BUILDING PLANNING

- Aspect
- prospect
- Furniture requirements
- Roominess
- Grouping
- Circulation
- Privacy
- Sanitation
- Elegance
- Economy
- Flexibility
- Practical considerations.

ASPECT

- Aspect means the peculiarity of the arrangement of doors and windows in the external walls of a building which permits the occupants to enjoy the gifts of nature viz sun, breeze, outside scenery etc.

- This provision is necessary to ensure proper comfort conditions in the room and it also helps in providing hygienic conditions in the room as the sun rays destroy the insects and also impart cheerful living conditions in the room.

PROSPECT

- Prospect is the term used to highlight the architectural treatment given to a building so as to make it aesthetically pleasing from outside and arranging external doors and windows in such a manner that the occupants are able to enjoy the desired outside views from certain rooms.
- Prospect is basically governed by the peculiarities of the selected site. Hence like aspect, prospect of a building also require the deposition of external doors and windows in a building at particular places and in particular manner so as to expose the notable and pleasant features of the openings in the external facade of the building and concealing the undesirable views in a given site.

Grouping

Grouping consists in arranging various rooms in the layout plan of the building in such a manner that all the rooms are placed in proper co-relation to their functions and in proximity with each other.

Privacy

Privacy may be one part to another part of the same building or it may be the privacy of all parts of the building from neighboring buildings, public streets or bye ways etc.

Furniture Requirements

The furniture requirements of a room or an important depends upon the functions required to be performed there in.

Roominess

The effect produced by deriving the maximum benefit from the minimum dimensions of a room is termed as roominess.

CLASSIFICATION OF BUILDINGS

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

The classification of buildings by types of construction

Based on the type of construction buildings are classified into five categories.

- Fire resistive buildings (Type 1A, 1B)
- Non-Combustible buildings (Type 2A, 2B)
- Ordinary Buildings (Type 3A, 3B)
- Heavy timber buildings (Type 4)
- Wood framed buildings (Type 5A, 5 B)

BUILDING BYE LAWS

The rules and regulation framed by town planning authorities covering the requirements of building, ensuring safety of the public through open spaces, minimum size of rooms and height and area limitation, are known as building bye-laws.

Rules and regulations which largely regulate the building activity should be formulated to get disciplined growth of building and the better planned development of towns and cities

OBJECTIVE OF BUILDING BYE-LAWS

- pre-planning of building activity.
- allow orderly growth and prevent haphazard development.
- Provisions of by-laws usually afford safety against fire, noise, health hazard and structure failure.
- Provide proper utilization of space to achieved maximum efficiency in planning.
- They provide health, safety and comfort to the people who live in building.
- Due to these bye-laws, each building will have proper approaches, light, air and ventilation.