MODULE 2

SURVEYING

- *Art of determining the relative positions of points on above or beneath the surface of the earth by direct or indirect measurements of distances, directions and elevation and plotting the details on the map*
- Surveying : measurement of objects in their horizontal positions
- Levelling: measurement of objects in their vertical positions
- Any activity of measuring the position of objects and recording the same falls under surveying

IMPORTANCE OF SURVEYING

- Preparation of plans and maps of areas.
- Surveying is the first step in the execution of any engineering project.
- Survey results are a pre-requisite for the start of project.
- It is required to conduct surveys during the execution till the completion.
- For assessment of executed quantities of work or for re-establishment of certain points etc.
- As the success of any engineering project is based upon the accurate and complete survey work, the importance of surveying cannot be under-estimated.

OBJECTIVES OF SURVEYING

1. *Preparation of archeological, geological, and military maps*
2. *Establishment of boundaries of properties with reference to the available records*
3. *Plot sub divisions*
4. *Measurement of quantities in cutting and embankment*
5. *Securing data for making plans and maps*
6. *Plotting of profiles for finding capacity of reservoir, canal etc.*
7. *Measurements of distances between two points*
8. *Determination of relative positions of points*
9. *Setting out of alignment of engineering structures*
10. *Application in GIS*

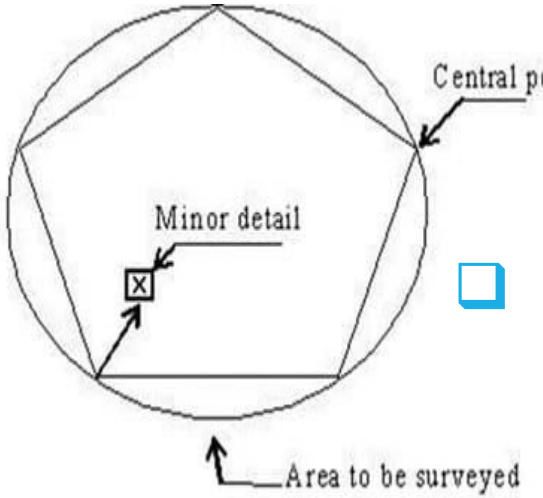
PRINCIPLES OF SURVEYING

1. Working from whole to part

2. Fixing a point with reference to other two points

PRINCIPLES OF SURVEYING

1. Working from whole to part

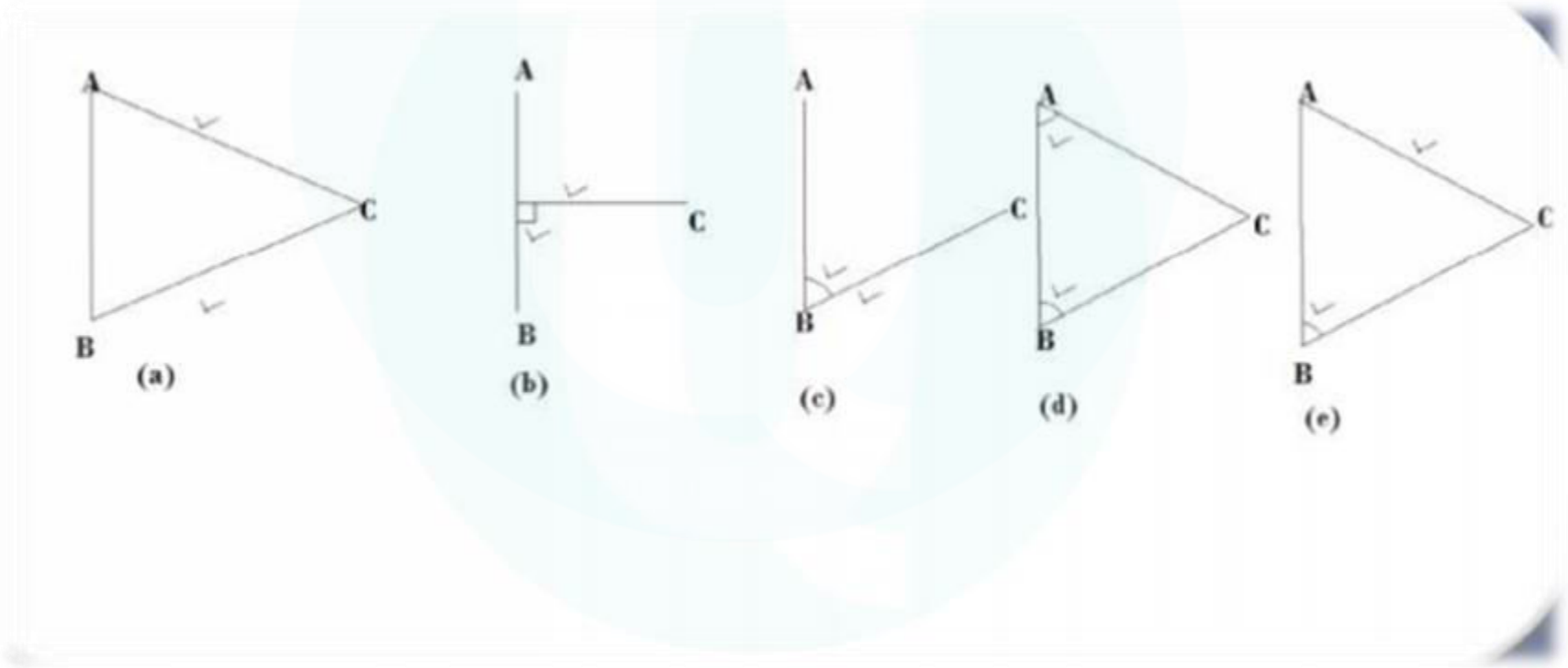


- For a given land, a set of primary control points are established with higher precision in and around the area
  - prevent accumulation of errors and localize minor errors
- Inner control points are established in between those primary central points
- Triangulation:
  - Area to be surveyed is divided into number of large triangles
  - Position of these triangles are surveyed with greater accuracy with precision instruments
  - These triangles further divided and their vertices are surveyed

PRINCIPLES OF SURVEYING

2. Fixing a point with reference to other two points

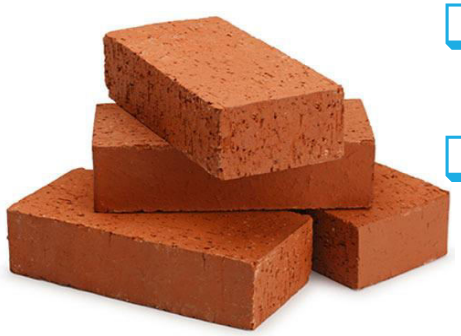
- Relative position of a point can be fixed with reference to 2 other points by means of linear and angular measurements



CONVENTIONAL CONSTRUCTION MATERIALS

Bricks, Cement, stones, sand and timber

BRICKS



- A brick is a block of ceramic (Clay) material molded to suitable shape and size and is used in masonry construction.
- It is oldest construction material used for light and heavy structures.
- It is used as a leading building material of construction because of
  - Its strength, low cost, easy availability etc
- Quality of bricks depends on the parent material, finishing and quality of burning.
- The brick is made from soil and hence the properties of bricks depend on the properties of soil

CONSTITUENTS

Alumina: 20 to 30% alumina. Imparts plasticity so that it can be moulded.

Silica: 50 to 60%. Prevents shrinking. It imparts uniform shape to the bricks.

Lime: <5%.

Oxides of Iron: Helps to bind the particles and also gives red color.

Magnesia: Present in small extent. Decreases shrinkage.

BRICKS

Properties of good Bricks

1. Colour
2. Shape
3. Size
4. Texture
5. Soundness
6. Hardness
7. Strength
8. Water adsorption

BRICKS

Properties of good Bricks

9. Efflorescence
10. Thermal conductivity
11. Sound installation
12. Fire Resistance

BRICKS

Test on Bricks

1. Crushing strength
2. Water absorption test
3. Hardness test
4. Test for presence of soluble salts
5. Shape and size
6. Soundness test
7. Toughness test
8. Structure

BRICKS

Qualities of good bricks

a) Uniform copper colour

b) Free from cracks, voids and grits

c) Even surfaces with sharp and square edge

d) Standard size

e) Sufficiently hard – When scratched with fingernail, no impression should be left on brick surface.

f) Give clear bell ringing sound when knocked with each other.

g) Should not absorb water more than 20% by weight when immersed in cold water for 24 hrs.

h) Should not break when dropped flat on hard ground from a height of 1m

i) Crushing strength should not be below 3.5N/mm2

j) Soundproof and have low thermal conductivity

USES OF BRICKS

Used for construction of walls, foundations of structures.

Used in construction of bridges and dams.

Used for paving and road works.

Firebricks are used for chimneys.

Used for ornamental works.

BRICKS

Classification of Bricks

1. **Unburnt or sundried bricks**
2. **Burned bricks**
   a) First class bricks
   b) Second class bricks
   c) Third class bricks
   d) Fourth class bricks (Over burnt bricks)

BRICKS

Classification of Bricks

1. *Unburnt or sundried bricks*

- Dried under sunlight
- Used for temporary and cheap construction
- Used for filling works

BRICKS

Classification of Bricks

2. Burnt Bricks

- After sun drying, these bricks are burnt in Kiln for certain period then cooled and removed from kiln and supplied to markets
- These bricks are stronger and have larger compressive strength than unburnt bricks.
- These bricks are classified into four types

FIRST CLASS BRICKS

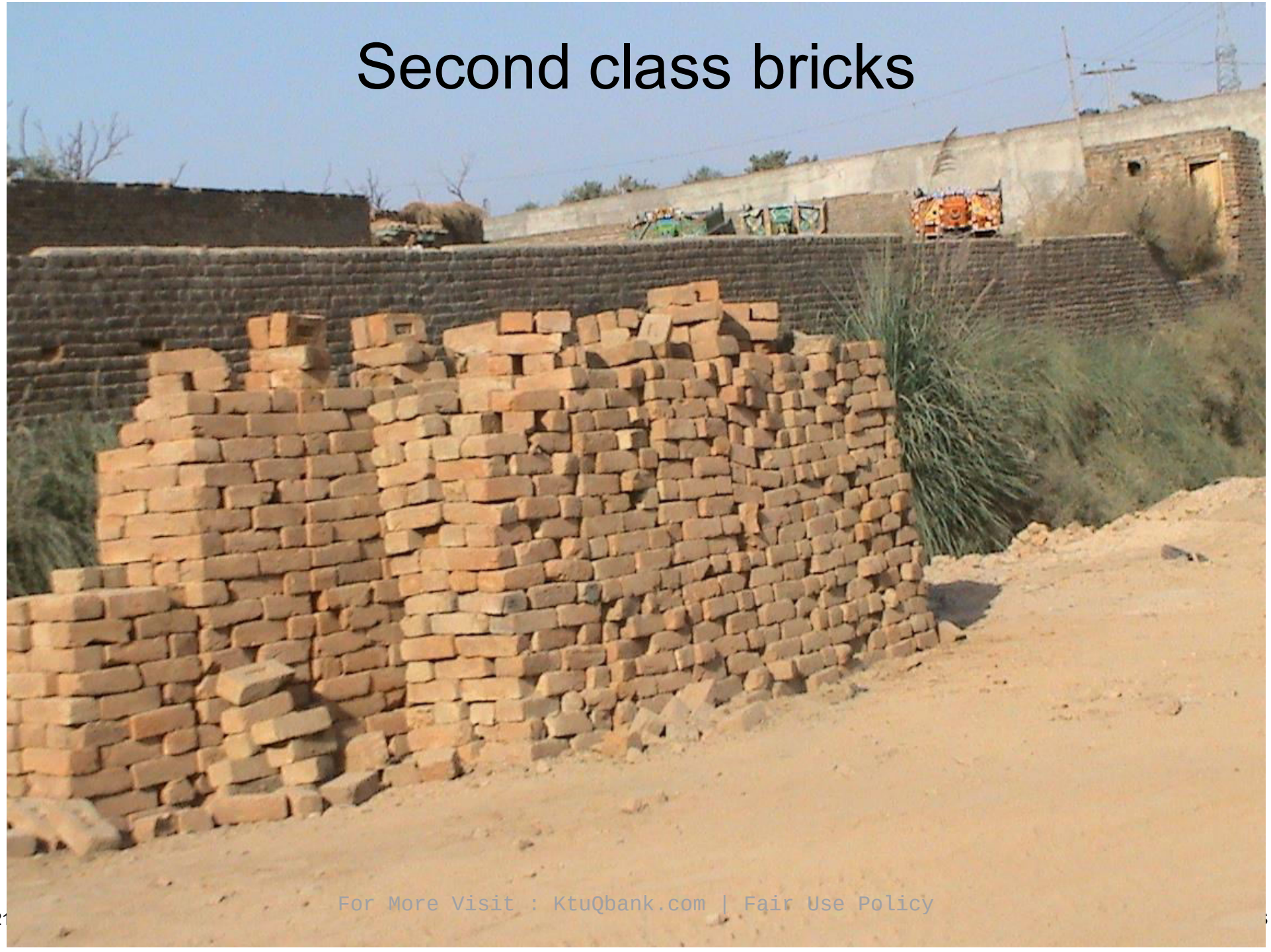
- Well burnt having smooth and even surfaces
- Machine/table moulded and burnt in Kilns
- Uniform reddish colour
- Water absorption should not be more than 20%
- Compressive strength = 10.5 N/mm2
- Should be laid with rich mortar
- Used for superior quality works , floors and reinforced brickwork

First class bricks

SECOND CLASS BRICKS

- Slightly over burnt
- Ground moulded and burnt in Kilns
- Slight irregularities in shape, size colour & surface finish
- Water absorption should not be more than 22%
- Compressive strength = 7 N/mm2
- Should be plastered and laid in mud or lime mortar
- Used for internal walls

Second class bricks



THIRD CLASS BRICKS

- Not properly burnt -Slightly under/overburnt
- Ground moulded and burnt in clamps
- Light red in colour with yellowish tint
- Water absorption should not be more than 24%
- Compressive strength = 3.5N/mm2
- Efflorescence - moderate
- Gives dull sound when struck together
- Used for unimportant and temporary structures

THIRD CLASS BRICKS

FOURTH CLASS BRICKS

- Ground moulded and burnt in clamps
- Overburnt bricks
- Irregular shape, brittle, and dark colour
- Used as aggregate for concrete in foundations floors, road works etc.

FOURTH CLASS BRICKS

STONES

- Solid non metallic mineral matter
- Obtained from rocks by cutting, drilling and by use of explosives
- Stone masonry – stone & mortar

STONES - CLASSIFICATION

Classification based on

I. *Geological origin*

II. *Physical properties*

III. *Chemical properties*

STONES - CLASSIFICATION

I. Geological Classification

1. **Igneous Rock**

   Eg: granite, basalt, pumice

2. **Sedimentary Rock**

   Eg: Laterite, Sandstone, limestone, shale

3. **Metamorphic Rock**

   Eg: marble, slate, quartzite

STONES - CLASSIFICATION

I. Geological Classification

1. **Igneous Rock** - The molten material present in the inside portion of earth's surface is known as magma and this magma occassionally come out to earth's surface through volcanoes. These rocks which are formed by cooling of magma are called igneous rocks.

   Eg: granite, basalt, pumice

2. **Sedimentary Rock –** Formed by weathering action of natural elements on the original rock and subsequent transportation by air, river, glacier and sea and deposition at a different locality.

   Eg: Laterite, Sandstone, limestone, shale

3. **Metamorphic Rock –** Formed by change in character of the existing rocks. Igneous and sedimentary rocks change in different characters when they are subjected to great heat and pressure. This process is termed as metamorphism.

   Eg: marble, slate, quartzite

STONES - CLASSIFICATION

II. *Physical Classification*

1. **Stratified Rock** – These have planes of cleavage of stratification and can be split up along these planes.

   Eg: Sedimentary Rocks

2. **Un-stratified Rock** – Crystalline granular or compact granular and no stratification.

   Eg: Igneous Rock

3. **Foliated Rock** – Have tendency to be split up in definite direction only.

   Eg: Metamorphic Rock

STONES - CLASSIFICATION

II. *Chemical Classification*

1. **Siliceous rock – Silica is predominant. Rocks are hard and durable. Not easily affected by weathering agencies.**

   Eg: Granites, quartzite

2. **Argillaceous Rock – Clay predominates. Dense and compact or may be soft.**

   Eg: Slates, laterite

3. **Calcareous Rock- Calcium Carbonate is predominant.**

   Eg: Limestone, marble

TEST ON STONES

1. Compressive strength test
2. Transverse strength test
3. Tensile strength test
4. Water absorption test
5. Shear strength test
6. Attrition test
7. Hardness test
8. Impact test

STONES – PROPERTIES (QUALITIES OF GOOD BUILDING STONES)

1. Minimum crushing/compressive strength should be 100N/mm2
2. It should have sufficient hardness(i.e. a minimum coefficient of hardness =14)
3. Should have high resistance to wear and tear(percentage of wear < 3%)
4. Specific gravity should be > 2.7
5. Should have a high impact value(i.e. toughness index should be >13)
6. It should not absorb water. After 24 hrs - Water absorption <0.6
7. Suitable texture for carving and dressing and should not contain soluble matters
8. Durable – Igneous and metamorphic stones are more durable.
9. Good crystalline structure and better appearance
10. Good resistance against weathering agencies, rain, wind, frost etc.

AGGREGATES

- Granular materials chemically inert such as natural sand, gravel, crushed stones etc.
- Filler material in concrete and mortar
- Avoid cracking and gives more strength to concrete

Classification

I. Based on nature of their formation

1. Natural aggregate
2. Artificial aggregate

II. Based on size

1. Coarse aggregate
2. Fine aggregate
3. All-in-aggregate

AGGREGATES

Classification

I. Based on nature of their formation

1. **Natural aggregate** – Obtained from natural deposits of sand and gravel or from stone quarries by breaking hard rocks.
2. **Artificial aggregate** – Obtained by breaking either bricks or blast furnace slag to the graded particles of desired size.

AGGREGATES

Classification

II. *Based on size*

1. **Coarse aggregate – Aggregates retained on 4.75mm sieve.**
2. **Fine aggregate – Aggregates which are passing through the IS: 4.75 mm sieve. eg: River sand.**
3. **All-in-aggregate – Aggregates which contain both course and fine aggregates.**

QUALITIES OF IDEAL AGGREGATES

1. Should be hard, strong and durable, free from any coating.
2. Should not react with cement or steel.
3. Should consist of natural stones, gravel and sand or in various combinations of these materials.
4. Porosity should be limited.
5. Should be angular in shape, having rough surfaces.
6. Free from organic and deleterious substances like coal, mica, clay etc.
7. Should have low thermal conductivity.

SAND

- Fine aggregate which is used in mortar and concrete
- It is a form of silica

Classification

I. Based on formation

1. **Natural sand**
   - Natural disintegration of rock and deposited in beds of streams, rivers and glaciers
2. **Crushed stone sand**
   - Made by crushing natural gravel/stones

SAND

SAND

II. Based on grain size

1. Fine sand

- Sand passing through a sieve with clear opening of 1.5875mm
- Used for plastering

2. Coarse sand

- Sand passing through a sieve with clear opening of 3.175mm
- Used for masonry sand

3. Gravelly sand

- Sand passing through a sieve with clear opening of 7.62mm
- Used for concrete work

Sand Sieve Set

SAND

III. Based on sources

1. River sand

- Obtained from riverbeds and riverbanks
- Bright, clear, and consist of sharp or rounded particles
- Best suited for making mortar, plastering works
- Interlocking value is less since it has more round corners

2. Pit sand

- Obtained from pits dug at depth of 1.5m to 2m
- Suitable for making mortar
- Particles are sharp, angular porous and free from harmful salts

3. Sea sand

- Available in seashore
- Sand is brown and consist of rounded particles
- Contain objectional salts and not recommended for construction

SAND

Test on sand- Sieve Analysis

- Determination of proportions of the particles, within certain ranges, in an aggregates
- Separation done using various sieves of different sieve opening
- A known weight of dry aggregates is sieved successively through IS sieves
- The sum of cumulative percentage of residue retained on each of IS sieve divided by 100 = fineness modulus
- An index for fineness or coarseness of aggregate
- Higher fineness modulus =>coarser the particle size

SAND – SIEVE ANALYSIS

Type	Fineness Modulus
Fine sand	2.2 to 2.6
Medium sand	2.6 to 2.9
Coarse sand	2.9 to 3.2

SAND

Properties of Sand

1. It should contain quartz of white or light grey colour and free from silt
2. It should have sharp, angular and coarse grains
3. The sand should be free from clay materials and organic matters
4. The grains should be durable minerals
5. It should be free from salts
6. Sand should be such size that it should pass through IS sieve No.480 (4.75mm) and should retain on IS No.5 (0.05mm)as Indian standard
7. It should be chemically inert
8. The loss of weight due to ignition should be less than 0.25%
9. The gradation of grain size should be such that it will give minimum voids
10. It should be strong and durable

CEMENT

- Binding material
- Forms paste with water and holds coarse aggregate & fine aggregate
- Prepared by mixing, burning and grinding of calcareous materials(chalk & limestone) and argillaceous materials(clay) with gypsum
- Cement first discovered by Joseph Aspdin in 1824
- Ordinary Portland cement

Functions:

- *Strength to masonry, Excellent binding material, Workable, Good plasticity, Stiffens or hardens early*

PROPERTIES OF CEMENT

❑ Physical properties

1. The colour of cement should be uniform and should be free from lumps
2. Cement should be uniform when touched and should be cool when felt with hand
3. If small quantity of cement is thrown into bucket of water, it should sink
4. Heat of hydration = 75cal/g after 28 days
5. Settling time: Initial settling time = 30 min & final settling time = 10hours
6. Fineness of cement < 10%
7. Soundness of cement by Le Chatelier test should be less than 10mm

PROPERTIES OF CEMENT

❑Mechanical properties

1. Average compressive strength = 16N/mm2 at the age of 3 days, 22N/mm2 at the age of 7 days
2. Average tensile strength = 2N/mm2 at the age of 3 days, 2.5N/mm2 at the age of 7 days

PROPERTIES OF CEMENT

❑Chemical properties

1. The ratio of percentage of alumina to that of iron oxide present in cement should not be less than 0.66
2. The ratio of percentage of lime to those of alumina, silica and iron oxide should be between 0.66 and 1.02 [lime saturation factor]
3. The total Sulphur content(SO_3) should be less than 4%
4. The weight of insoluble residue should be less than 1.5%
5. The total loss of ignition < 4%
6. Weight of magnesia < 5%

BOUGE'S COMPOUNDS

- C3S (Early strength) (Tri Calcium silicate)
- C2S(Late strength)(Di calcium silicate)
- C3A(Tri calcium aluminate)
- C4AF (Tetra calcium alumino ferrate)

TYPES OF CEMENT

1. **Ordinary Portland cement**
2. **Rapid hardening cement**
   - Develops strength rapidly
   - Strength obtained by such cement at the age of 3days is same as that expected of ordinary Portland cement at 7 days
   - High fineness of grinding and higher C3S and lower C2S => STRENGHT DEVELOPMENT
3. **Coloured cement**
   - Pigments with ordinary Portland cement or white cement – 5 to 10%
   - Used for floor finishing works and plastering of walls, decorative works, manufacturing of tiles and cast stones

TYPES OF CEMENT

4. Hydrophobic cement

- Ordinary cement clinker is grinded with water repelling film forming substance such as oleic acid and stearic acid
- Also called as water repellant cement
- Used where watertight conditions are predominant

5. Expansive cement

- This cement expands as it sets.
- This property is achieved by adding expanding medium like sulpho aluminate and a stabilizing agent to ordinary cement.
- This is used for filling the cracks in concrete structures.

6. Acid resisting cement

- This cement is produced by adding acid resistant aggregate such as quartz, quartzite, sodium silicate or soluble glass.
- This cement has good resistance to action of acid and water.
- It is commonly used in the construction of chemical factories

TYPES OF CEMENT

7. Quick setting cement

- Produced by reducing the percentage of gypsum and adding a small amount of aluminium sulphate during the manufacture of cement.
- Finer grinding also adds to quick setting property.
- Starts setting within 5 minutes after adding water and becomes hard mass within 30 minutes.
- Used to lay concrete under static or slowly running water.

8. Sulphate resisting cement

- sulphate attack – cracks and disruption in marine structures
- Used to resist sulphate atttack
- Percentage of C3A is made less than 5%

9. High alumina cement

- Obtained by grinding clinkers formed by calcium, bauxite and lime
- Withstand high temperature, resists action of acids, very impervious
- Slow setting but rapid hardening
- Initial setting time = 3.5hours, final setting time = 5 hours

TYPES OF CEMENT

10. White cement

- Free from colouring agents
- The raw materials used are pure limestone, chin clay, silica, fluorspar and selenite.
- Whiteness is measured by ISI scale and should be more than 70%

11. Air entraining cement

- 0.01 to 0.05% of air entraining agents are added
- Vinsol, wood resins, darex – air entraining agents
- Concrete will be more plastic, workable and causes less segregation
- Resistant to severe frost action

12. Oil well cement

- Made by adjusting the proportion of iron oxide or by adding retarders like starches, cellulose products or acids
- Used in oil well to fill gap between the steel lining tube and wall of the well

TYPES OF CEMENT

10. Super sulphate cement

- Made by grinding a mixture of blast furnace slag, burnt gypsum and Portland cement clinker in suitable proportions
- Finer and heat of hydration is less
- High resistance against chemical attack especially sulphate attack

11. Low heat Portland cement

- Heat evolved is less
- Better resistance to chemical deterioration
- Obtained by increasing C_2S , decreasing C_3S and C_3A

12. Portland slag cement

- Made by mixing clinker, gypsum and granulated furnace slag in suitable proportion and grinding
- Reduce heat of hydration
- Resistance to chemical attack, corrosion etc.

TYPES OF CEMENT

13. Portland pozzolana cement

- Made either by inter grinding Portland cement clinker and pozzolana or by uniform blending of portland cement and fine pozzolana
- Resistance to chemical attack, corrosion
- Reduced heat of hydration

TIMBER

- Wood used for construction works.
- Derived from an old english word ‘timbrian’ which means ‘to build’.
- A tree that yields good wood for construction is called ‘*standing timber*.’
- After felling a tree, its branches are cut and its stem is roughly converted into pieces of suitable length - *rough timber*.
- By sawing, rough timber is converted into various commercial sizes like planks, battens, posts, beams etc. - *converted timber*.

CLASSIFICATION OF TIMBER

Based on mode of growth

1. ***Exogeneous Trees*: These trees grow outward by adding distinct consecutive ring every year. These rings are known as annual rings. Hence it is possible to find the age of timber by counting these annual rings.**

These trees may be further divided into (1) coniferrous and (2) deciduous.

1. ***Coniferrous trees*: *ever green trees*, cone shaped leaves and fruits. The leaves do not fall till new ones are grown. They yield soft wood.**
2. ***Deciduous trees*: broad leaf trees. These leaves fall in autumn and new ones appear in springs. They yield strong wood and hence they are commonly used in building construction.**

CLASSIFICATION OF TIMBER

Based on mode of growth

2. *Endogeneous Trees*: These trees grow inwards. Fresh fibrous mass is in the inner most portion. Examples of endogenous trees are bamboo and cane. They are not useful for structural works.

CROSS-SECTION OF TIMBER

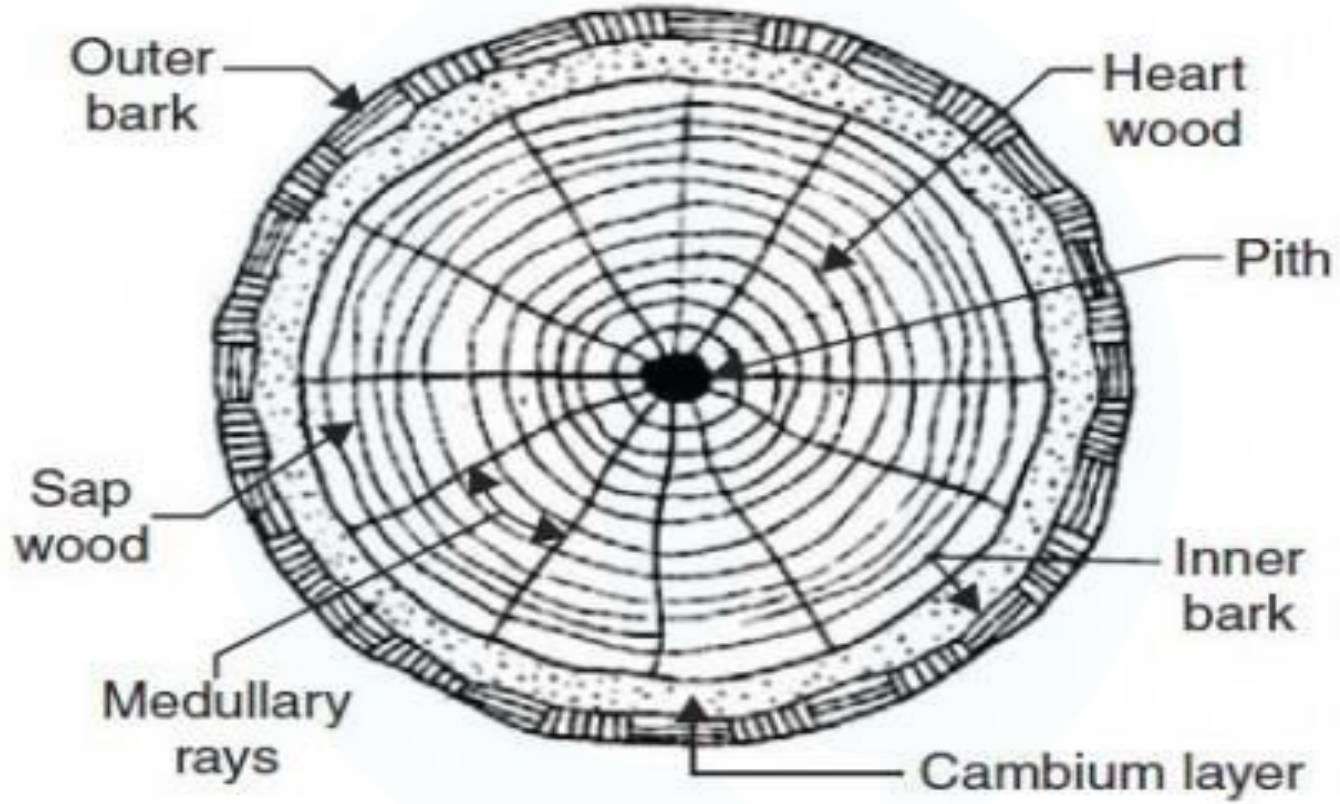


Fig. 1.7. Cross-section of exogeneous tree

PROPERTIES OF TIMBER

1. *Colour*: It should be uniform.
2. *Odour*: It should be pleasant when cut freshly.
3. *Soundness*: A clear ringing sound when struck indicates the timber is good.
4. *Texture*: Texture of good timber is fine and even.
5. *Grains*: In good timber grains are close.
6. *Density*: Higher the density stronger is the timber.
7. *Hardness*: Harder timbers are strong and durable.
8. *Warping*: Good timber do not warp under changing environmental conditions.
9. *Toughness*: Timber should be capable of resisting shock loads.
10. *Abrasion*: Good timber do not deteriorate due to wear. This property should be looked into, if timber is to be used for flooring.

PROPERTIES OF TIMBER

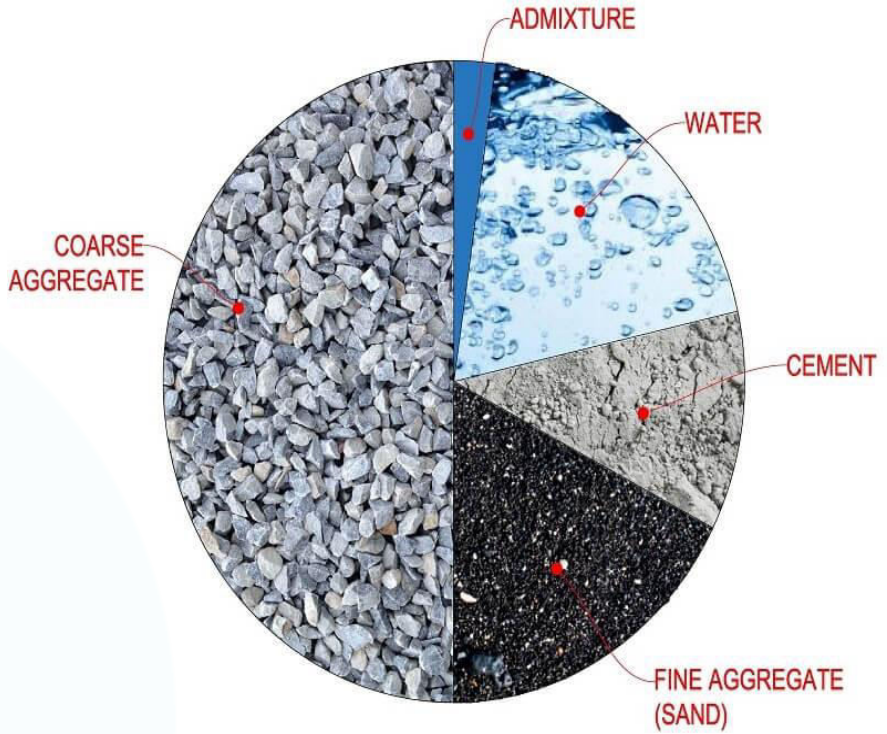
11. *Strength*: Timber should have high strength in bending, shear and direct compression.
12. *Modulus of Elasticity*: Timber with higher modulus of elasticity are preferred in construction.
13. *Fire resistance*: A good timber should have high resistance to fire.
14. *Permeability*: Good timber has low water permeability.
15. *Workability*: Timber should be easily workable. It should not clog the saw.
16. *Durability*: Good timber is one which is capable of resisting the action of fungi and insects attack
17. *Defects*: Good timber is free from defects like dead knots, shakes and cracks.

USES OF TIMBER

Purpose	Varieties of timber
Door & window frame	Indian elm, Iron wood, Rose wood, Teak, Anjily
Door & window panels	Jack, Banyan, Mango, Teak, Anjily
Furniture	Rose wood, Ben teak, Mango, Jack, Teak…
Form work	Mango, Tamarind, Coconut tree
Structural work	Anjily, Teak, Jack
Bridges	Kathal, Teak
Thatched roof	Banyan, Anjily, Palm
Railway sleepers	Iron wood, Irul, Teak
Boat building	
Beam, Rafters & post	

CONCRETE

- intimate mixture of binding material, fine aggregate, coarse aggregate and water.
- can be easily moulded to desired shape and size before it looses plasticity and hardens.
- Plain concrete is strong in compression but very weak in tension.
- The tensile property is introduced in concrete by inducting different materials



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CONCRETE

- Major ingredients of concrete are:

1. Binding material (like cement, lime, polymer)
2. Fine aggregate (sand)
3. Coarse aggregates (crushed stone, jelly)
4. Water.

- Admixtures like air entraining agents, water proofing agents, workability agents etc. - added to impart special properties.
- Depending upon the proportion of ingredient, strength of concrete varies.
- voids in coarse aggregates are filled with sand and the voids in sand are filled with cement paste.

CEMENT

- Lime was used earlier as cementing material
- Now, commonly used ordinary portland cement (OPC)
- Special types are used for certain requirements

AGGREGATES

- Forms bulk of concrete
- They are bound by cement
- Should be hard, durable and clean
- Presence of impurities reduces the adhesion of aggregates & strength of concrete
- Both coarse and fine aggregates are used

WATER

- Hydration of cement take place only in the presence of water
- Should be clean and free from impurities like oil, alkali,…
- Water fit for drinking should be used
- When sea water is used it affects strength of concrete & cause corrosion of reinforcement

PROPERTIES OF CONCRETE

1. Setting
2. Workability
3. Bleeding
4. Segregation
5. Strength


Tensile Strength of Concrete
W

bleeding. The cement slurry or cement water separates from other part of concrete called as bleeding.

Q. 5.10 Differentiate between segregation and bleeding. **(HSBTE - Dec. 2015, 4 Marks)**

OR What is the difference between segregation and bleeding? **(4 Marks)**

Ans. :

Sr. No.	Segregation	Bleeding
1.	It is the separation of concrete ingredients from each other.	It is the separation of cement water from remaining mass of concrete.
2.	It occurs due to improper mixing.	It occurs due to excessive water.
3.	It can be visualised while placing of concrete more than 1 m.	It can be visualise while excessive compaction of concrete.
4.	Segregation in concrete leads to porous concrete.	Bleeding in concrete leads to honey combing in concrete.

Q. 5.11 State various causes of segregation in concrete. **(4 Marks)**

OR Why segregation of concrete takes place ? **(4 Marks)**

Ans. : There are following reasons which results in segregation in concrete mixture.

(i) Due to high water content, concrete may undergo segregation.

(ii) If w/c ratio is not appropriate, then concrete forms showing segregation.

[illegible] concrete shows segregation in it.

TYPES OF CONCRETE

1. Reinforced cement concrete

- Plain cement concrete weak in tension
- Steel reinforcement provided to improve
- Tensile strength

2. Light weight concrete

- Coarse aggregate of light weight used
- Adding chemicals to develop foam or
- gas bubbles
- Bulk density < 1800 kg/m3

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3. No fines concrete

Only coarse aggregate used in construction

Light weight

Better insulating properties

No segregation

Economical

Used in External load bearing wall, retaining wall, damp proofing agent

4. Fibre reinforced concrete

Consist of fibres eg. Asbestos, glass, nylon, coir

Crack free structure

More durable

Thin sections can be made

More tensile and fatigue strength

5 Air entrained concrete

Air entraining cement or similar agents used

High resistance against frost action and sulphate attack

More workable, plastic , adhesive

No segregation

6. Coloured concrete

By using coloring pigments or by coloring cement

Used for ornamental finishes, underground pedestrian crossing, park lanes, seperating lines of traffic road surfaces

7. Vaccum concrete

After laying concrete extra water removed by vaccum

Water left sufficient for hardening of concrete

strong

8. Reactive powder concrete

Ultra high strength

Highly refines silica fume added

Used in chemically aggressive environments

STEEL

- Most popular and effective building material
- Steel is an alloy of iron and carbon
- Also contain other alloying elements like Sulphur, Phosphorous, manganese, silicon, chromium etc.
- Classified based on carbon content:

1. Low alloy steel
    1. Low carbon steel
    2. Medium carbon steel
    3. High carbon steel
2. High alloy steel
    1. Stainless steel
    2. Tool steel

STEEL

Properties :

- Its structure us fibrous with dark bluish colour
- It is tough, elastic than cast iron and wrought iron
- It is malleable and ductile
- Permanent magnetization is possible
- It can be easily welded, riveted and forged
- Its specific gravity is 7.8
- It is equally strong in tension, compression and in shear
- It is difficult to harden and temper

STEEL

***Mild steel*:**

Carbon content – 0.25%

Sulphur – 0.055%

Phosphorous – 0.055%

STEEL

Medium Carbon Steel:

Carbon content – 0.3% – 0.6%

Manganese – 0.6% -1.65%

High carbon steel:

Carbon content – 0.6 to 1%

Manganese – 0.3 to 1.5%

STEEL

Hot rolled Steel:

Rolling hot steel when it is in semi solid state

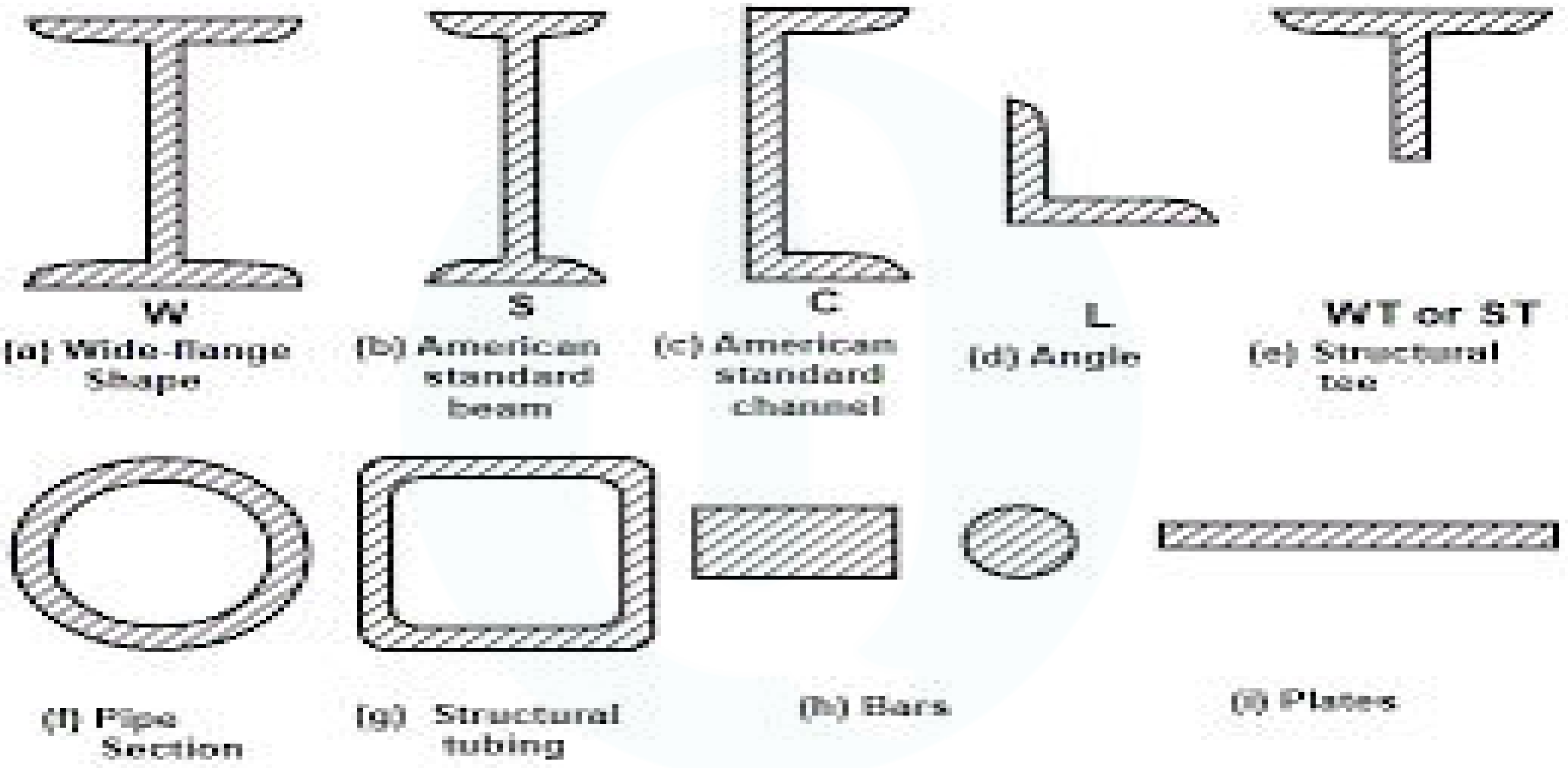
Cold rolled steel:

Formed from sheets, plates or flats in rolling machines or by press breaking

STEEL

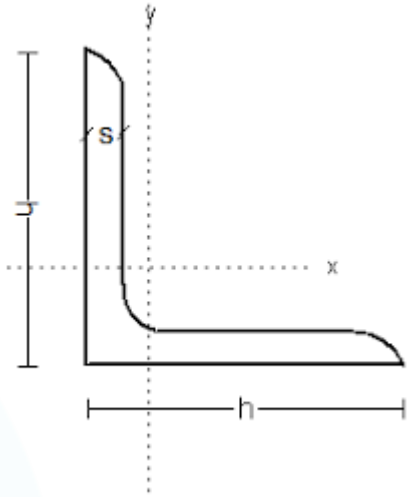
Structural/commercial/market forms of steel

1. Angle section
2. Channel section
3. I – section
4. T –section
5. Flat section
6. Steel plates
7. Corrugated sheets
8. Round bars
9. Square bars



STEEL

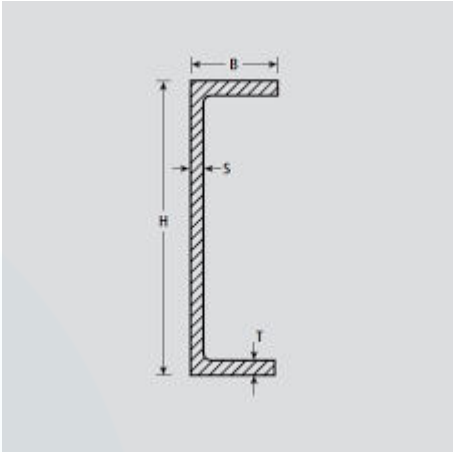
1. *Angle section*



- Consists of two legs
- Specified as ISA(Indian Standard Angle)
- Available in sizes from 20x20x3 to 200x200x25
- ISBA – Indian Standard Bulb Angle
- Used in structural steel work especially in the fabrication of steel truss

STEEL

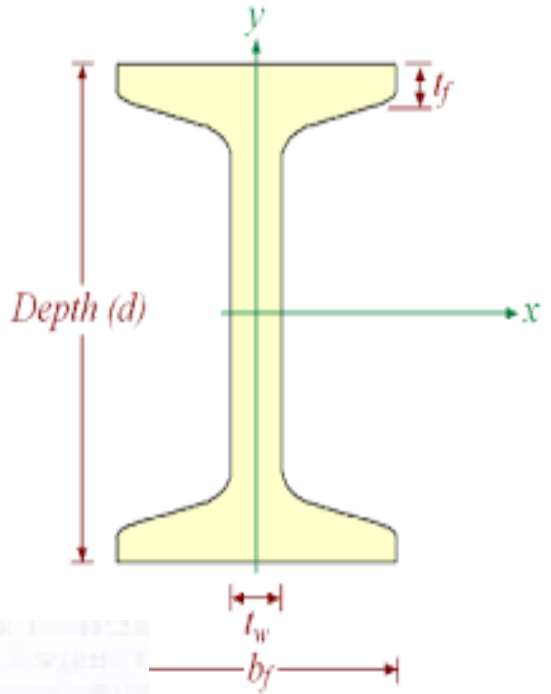
2. *Channel section*



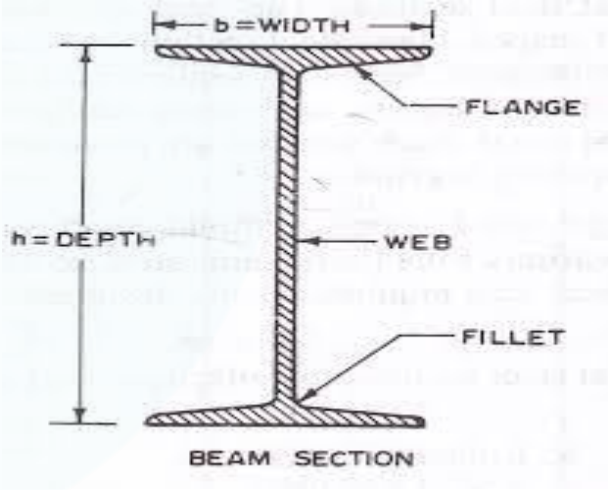
- Consists of a web with two equal flanges
- Specified as
  - ✓ISJC
  - ✓ISLC
  - ✓ISMC
  - ✓ISSC
- Available in sizes from 100mmx45mm to 100mmx100mm
- Used in structural members of steel framed structures
- Used to make built up columns and truss members

STEEL

3. *I* - section



- Consists of two flanges connected by a web
- Also known as rolled steel joist(RSJ)
- Specified as
  - ✓ISJB
  - ✓ISLB
  - ✓ISMB
  - ✓ISWB
  - ✓ISHB

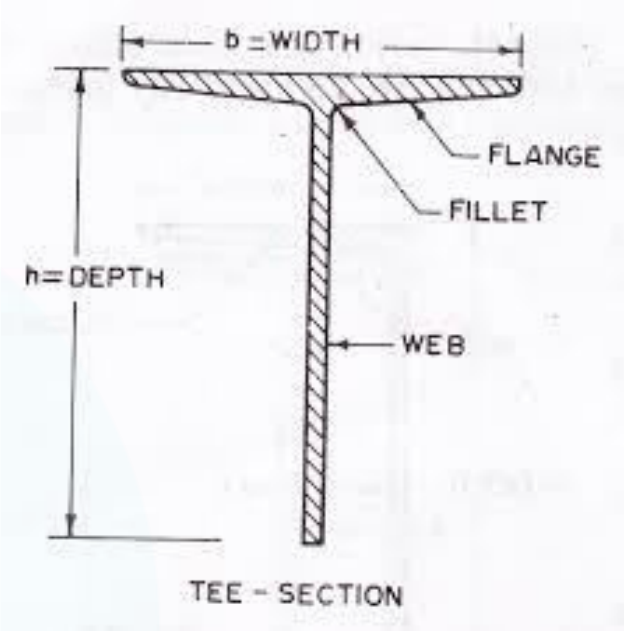


- Available in sizes from 75mmx50mm to 600mmx210mm
- Used as beams, lintels, columns and steel frames, grillage foundation.

STEEL

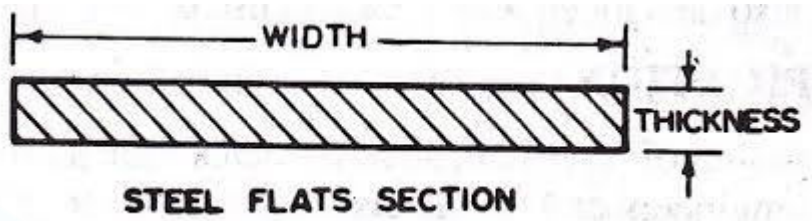
4. *T - section*

- Consists of a web and flange
- Specified as
  - ✓ISNT
  - ✓ISHT
  - ✓ISST
  - ✓ISMT
- Used as members of steel roof trusses, fabrication of water tanks



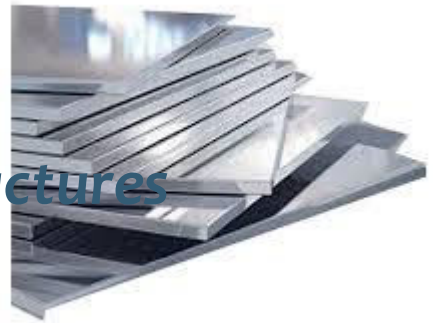
STEEL

5. *Flat section*



- Plate like sections with more length and less width
- Available from 3 to 40mm thickness & 10 to 400mm width
- Used for grill works, built up beams and columns, plate girder bridges

6. *Steel plates*

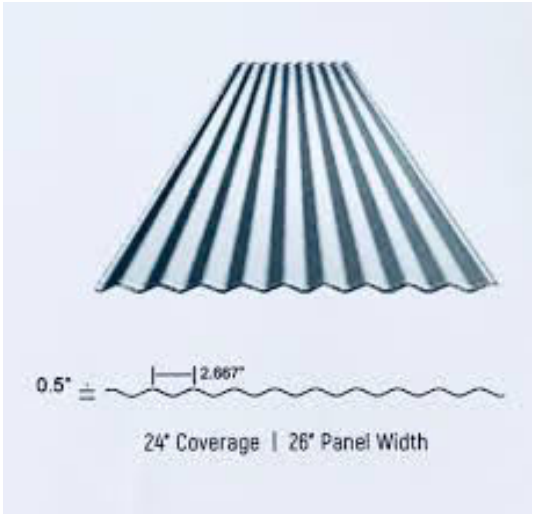


- *Specified with its thickness*
  - *5mm to 50mm thickness - used in construction of industrial structures*
  - *<5mm thickness - steel sheets*
- *Available in a maximum area of 30m2*
- *Used as column bases and flanges for columns, plate girder and gantry girders*

STEEL

7. Corrugated sheets

- Formed by passing steel sheets through grooves
- Also referred as galvanized iron sheets
- Used for roof covering and cladding



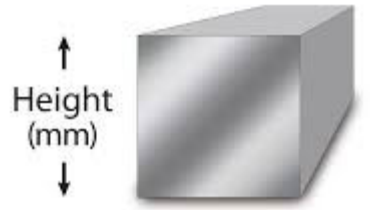
8. Round bars

- Available in circular cross sections
- Diameter varies from 5mm to 250mm
- Both solid and hollow sections are available
- Denoted by ISRO. Eg: ISRO 10
- Used as reinforcement in concrete construction of steel grillage works etc.

STEEL

9. *Square bars*

- Available in square cross section
- Both solid and hollow sections are available
- Denoted by ISSQ
- Used in the construction of steel grill works, for windows and gates



STEEL

Types of reinforcement bars

- Steel bars used in reinforcement cement concrete
- also known as rebars

1. Plane steel bars
2. High Yeild strength deformed steel bars
3. TMT steel bars

PLANE STEEL BARS

Round sections

Made up of mild steel, medium tensile steel or high tensile steel

Used in RCC

Available in 5 mm to 32 mm diameter

Nowadays Tor steel used

HIGH YIELD STRENGTH DEFORMED STEEL BARS

Tor steel bars

Cold twisted deformed

As per specifications of Tor steel research foundation of India

Have longitudinal ribs in the form of helix

High bond strength due to interlocking between steel and concrete

Sizes available: 5.5, 6,8,10,12,16,18,22,25,32,40 mm

TMT STEEL BARS

Heat treatment undergone

Hot rolling, micro alloying, controlled cooling

Thermo mechanical treatment

MODERN CONSTRUCTION MATERIALS

Architecture Glass

Glass used as building material

Transparent glazing material in building envelope, internal partitions,

Used a components for aesthetics, structural safety, sound and thermal insulation, fire safety, solar control

Normal glass, Laminated glass, Toughened glass, Heat strengthened glass, Reflective glass, Insulating glass

CERAMICS

Made from mixture of minerals – silica sand, clay binder, impurities, water

Ceramic products

A) Fire clay brick sand tiles – from fire clay, withstand higher temperature

Used for lining chimneys, boilers, fireplaces, bath tub, sink

B)Terracotta

Burnt earth

From yellow to brownish red clays

Used for flooring tiles, unglazed chimney pots, vitrified wall tiles, planters

PLASTICS

Used in various applications

Flooring, roofing, insulation, walls, wall lining, pipes, windows etc

COMPOSITE MATERIALS

Reinforced concrete and masonry

Composite wood

Fibre reinforced polymer

Ceramic matrix composites

Thermal insulating materials

Reduces heat transfer between object and thermal contact

Eg. Fiberglass, mineral wool, cellulose, polyurethane foam, polystyrene

QUESTION BANK

Building stones – classification

Surveying and levelling – principles, objectives

Properties of brick, stone,

Types of cements, uses

Components of building

Good site for residential building

ASSIGNMENT I

1. What are the major disciplines of civil engineering and explain their role in the infrastructural framework?

2. Outline the objectives, classification and types of surveying.

ASSIGNMENT II

Elaborate conventional and modern construction materials