MODULE 2

- SURVEYING
- CONSTRUCTION MATERIALS,
- CEMENT CONCRETE:
- MODERN CONSTRUCTION MATERIALS

SURVEYING

- The art of determining the relative position of points above, on, or beneath the surface of the earth, by direct or indirect measurement of distances ,directions and elevations and plotting the details on the map
- Surveying is the measurements of object in their horizontal positions where as levelling is the measurement of objects in vertical positions
- Modern instruments like GPS receiver and total station measurements becomes easier

IMPORTANCE OF SURVEYING

- The planning and design of all civil engineering projects such as construction of highways, bridges, tunnels, dams etc. are based upon surveying measurements.
- Moreover, during execution, project of any magnitude is constructed along the lines and points established by surveying.
- Thus, surveying is a basic requirement for all civil engineering projects.
- Success of any engineering project is based upon accurate and complete survey work

OBJECTIVES OF SURVEYING

- To prepare a topographical map which shows hills, valleys, rivers, forests, villages, towns etc.
- To prepare a cadastral map which shows the boundaries of fields, plots, houses and other properties..
- To prepare an engineering map which shows the position of engineering works such as buildings, roads, railways, dams, canals.
- Plot subdivisions
- Measurement of quantities in cutting and embankment using contours
- Plotting of profiles for finding capacity of reservoir, canals etc.
- Determination of relative position and distance between the points
- Setting out alignment of engineering structures
- Application in GIS

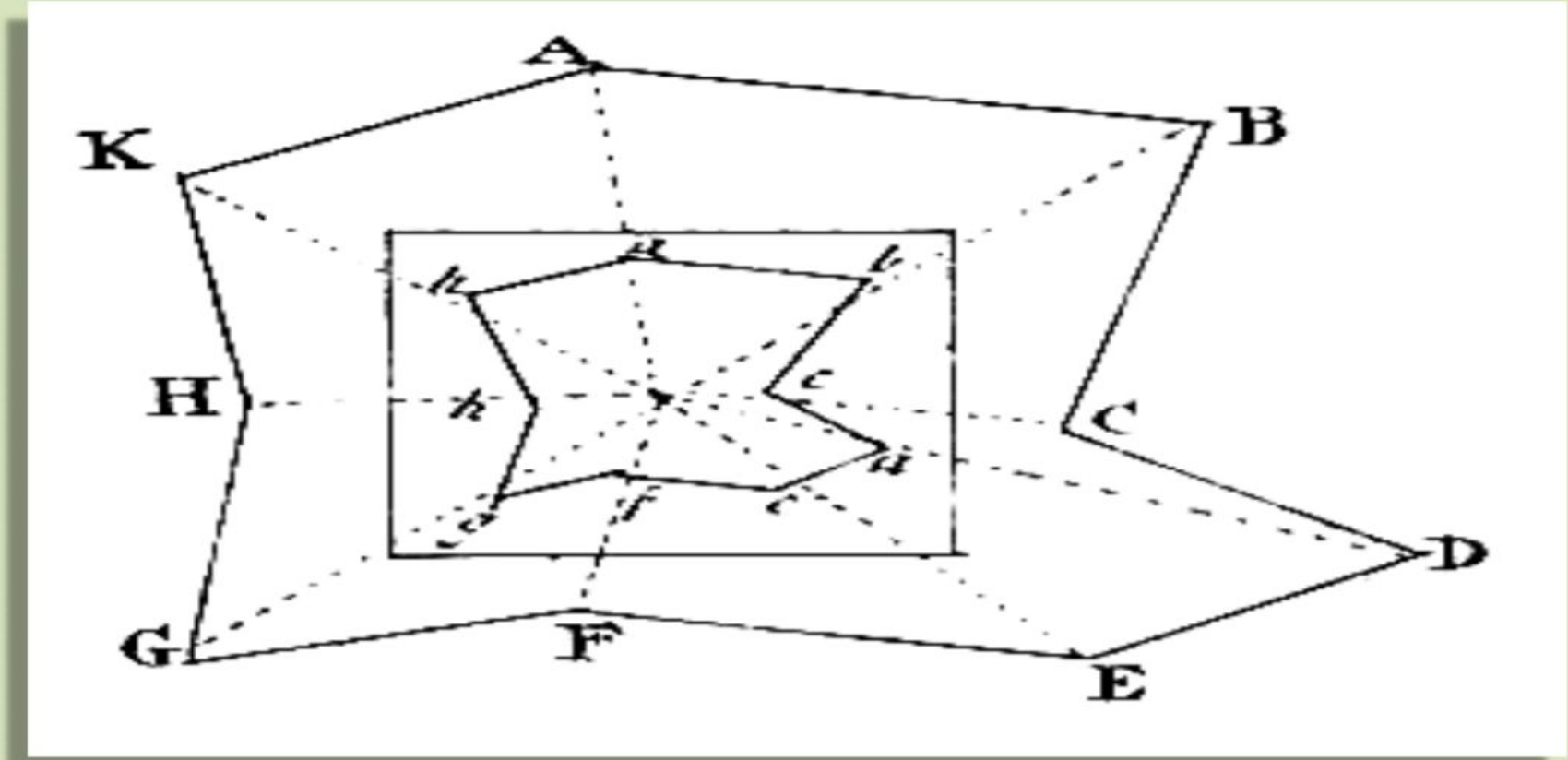
FUNDAMENTAL PRINCIPLES OF SURVEYING

- Two basic principles of surveying are:
- Always work from **whole to the part**, and
- To locate **a new station by at least two measurements** (linear or angular) from fixed reference point

WORK FROM WHOLE TO THE PART

- According to the first principle, the whole survey area is first enclosed by main stations (i.e.. Control stations) and main survey lines.
- The area is then divided into a number of divisions by forming well conditioned triangles.
- The main survey lines are measured very accurately with precise survey instruments. The remaining sides of the triangle are measured.
- The purpose of this method of working is to control accumulation of errors. During measurement, if there is any error, then it will not affect the whole work, but if the reverse process is followed then the minor error in measurement will be magnified.
- Principle of working from whole to part is triangulation

Work from Whole to the Part



TO LOCATE A NEW STATION BY AT LEAST TWO MEASUREMENTS

- According to the second principle the points are located by linear or angular measurement or by both in surveying. If two control points are established first, then a new station can be located by linear measurement.
- Let a & b are control points, a new point c can be established by
- (A) taking linear measurement from A and B for C.
- (B) taking linear measurement of perpendicular from d to c.
- (C) taking one linear measurement from b and one angular measurement as < ABC
- (D) Taking two angular measurement at A & B as angles < CAB and < ABC.
- (E) Taking one angle at B as < ABC and one linear measurement from A as AC.

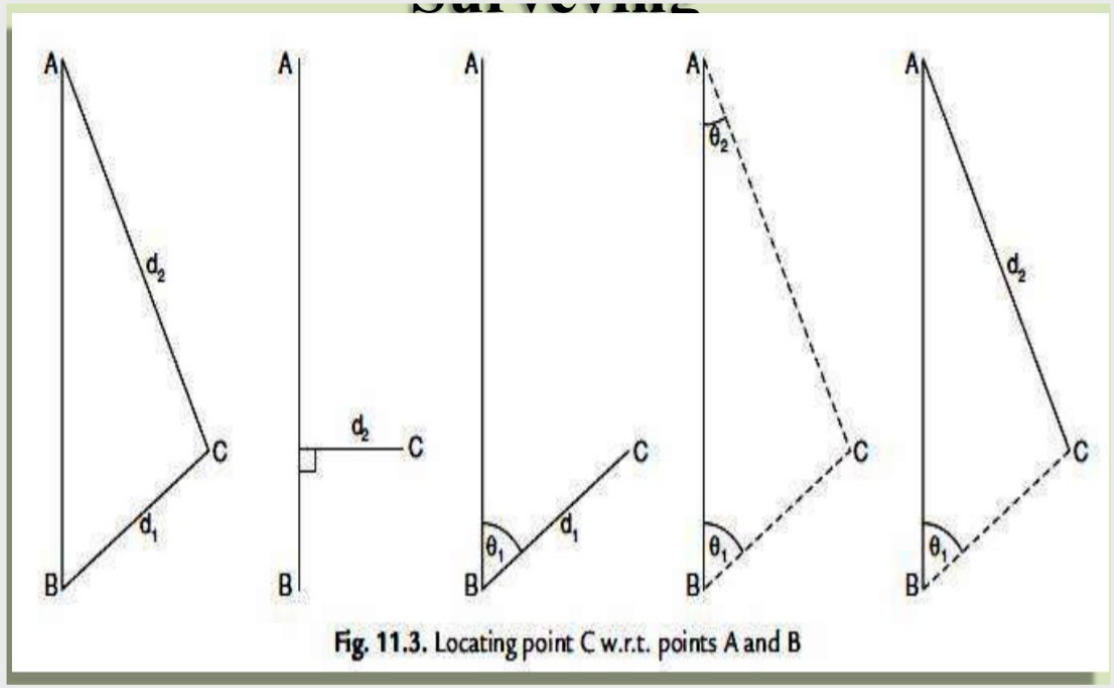


Fig. 11.3. Locating point C w.r.t. points A and B

PRIMARY DIVISIONS OF SURVEYING

- We know that the shape of the earth is spheroidal. Thus the surface is obviously curved. Surveying is primarily divided into two types considering the curvature of the earth's surface.
- A) plane surveying
- B) geodetic surveying
- The plain surveying is that type of surveying in which earth surface is considered as a plane and the curvature of the earth is ignored.
- In such surveying a line joining any two stations is considered to be straight.
- The triangle formed by any three points is considered as a plane triangle, and the angles of the triangle are considered as plain angles.
- Surveying is carried out for a small area of less than 250 km2 & it is carried out by local or state agencies like R & B department, irrigation department, railway department.

- The geodetic surveying is that type of surveying in which the curvature of the earth is taken into account.
- It is generally extended over larger areas.
- The line joining any two stations is considered as curved line.
- The triangle formed by any three points is considered to be spherical and the angles of the triangle are considered to be spherical angles.
- Geodetic surveying is conducted by the survey of India department and is carried out for a larger area exceeding 250 km2

Plain Surveying Vs Geodetic Surveying

No.	Plain Surveying	Geodetic Surveying
1	The earth surface is considered as plain Surface.	The earth surface is considered as Curved Surface.
2.	The Curvature of the earth is ignored	The curvature of earth is taken into account.
3	Line joining any two stations is considered to be straight	The line joining any two stations is considered as spherical.
4.	The triangle formed by any three points is considered as plain	The Triangle formed by any three points is considered as spherical.
5.	The angles of triangle are considered as plain angles.	The angles of the triangle are considered as spherical angles.
6.	Carried out for a small area < 250 km^2	Carried out for a small area > 250 km^2

CLASSIFICATION OF SURVEYING

Classification Based on Instruments.	Classification based on Purpose	Classification based on Nature of field
• Chain Survey • Compass Survey: • Theodolite Survey: • Plane Table Surveying • Theodolite Survey • Tachometry Survey: • Levelling Survey: • Photogrammetric Survey • EDM Survey	• Geological Survey: • Mine Survey • Military Survey • Archaeological Survey	• Land Survey • Hydrological Surveying • Astronomical Survey • Aerial Survey

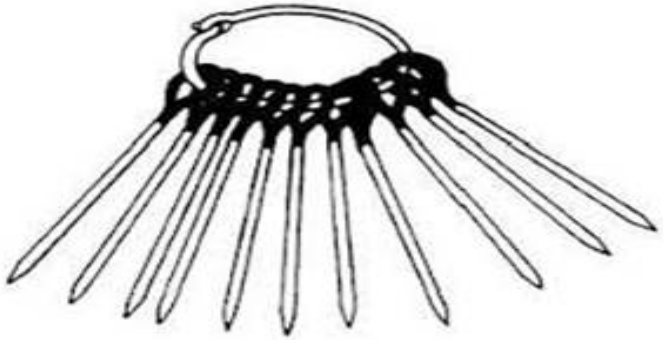
- BASED ON INSTRUMENTS USED
  - CHAIN
  - COMPASS
  - PLANE TABLE
  - THEODOLITE
  - TACHEOMETRIC
  - TOTAL STATION
  - PHOTOGRAPHIC

CHAIN SURVEY

- SIDES OF TRIANGLES ARE MEASURED DIRECT
- ONLY LINEAR MEASUREMENTS
- INSTRUMENTS
  - PEG
  - ARROWS
  - CHAIN

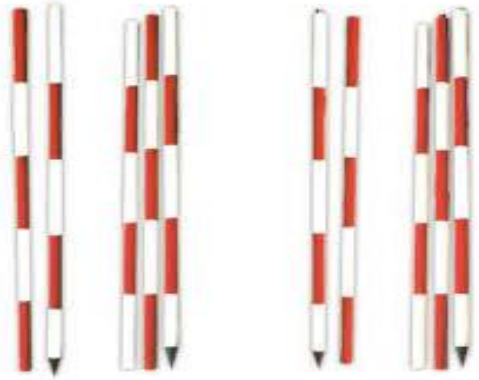
Instruments for Surveying

chain



Pins

Pegs

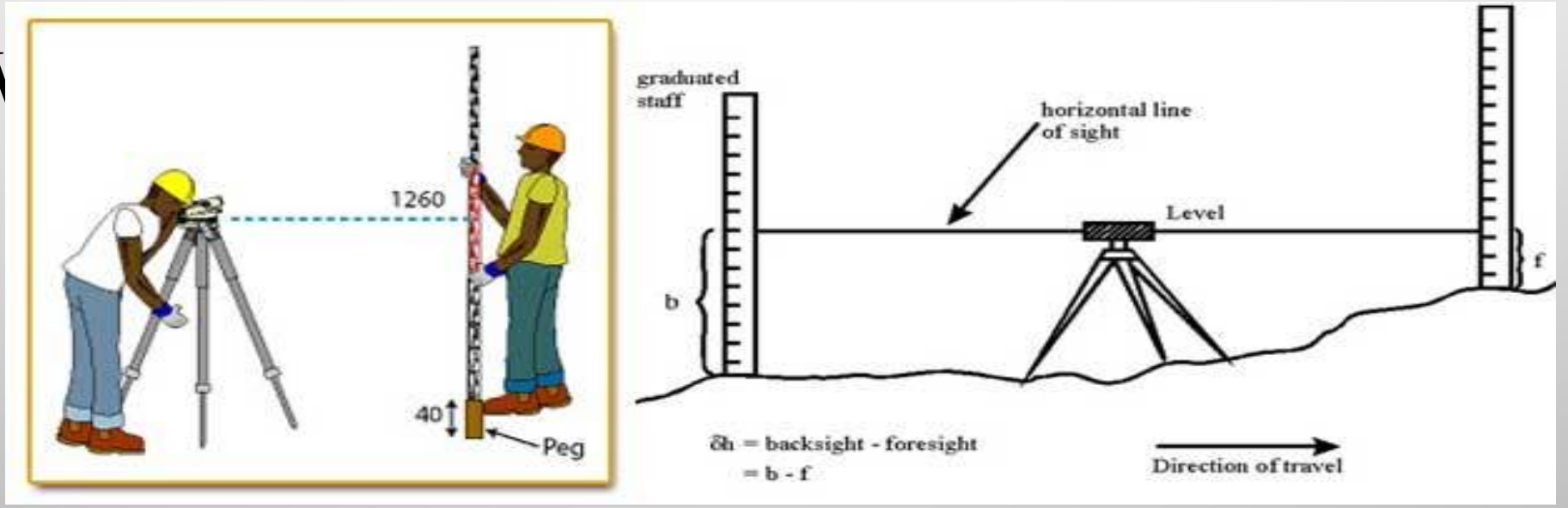


Ranging Rods

Plumb Bobs

LEVELLING

- ART OF FINDING RELATIVE HEIGHTS AND DEPTHS OF THE OBJECTS
- MEASUREMENT IN VERTICAL PLANE
- HIGHV



INSTRUMENTS

- LEVEL

- LEVELLING STAFF

BRICKS

- Bricks are prepared by moulding clay in rectangular blocks of uniform size and then drying and burning these blocks.
- **Constituents of good brick earth**
- **silica**
- brick earth should contain about 50 to 60 % of silica.
- It prevents cracking, shrinking and warping of bricks.
- **Alumina**
- good brick earth should contain about 20% to 30% of alumina.
- It imparts plasticity to earth, for moulding operation.
- If present in excess, then the raw brick shrink and warp during drying.

- **Lime**
- the percentage of lime should be in the range of 5% to 10% in a good brick earth.
- It causes silica in clay to melt on burning and thus helps to bind it.
- **Iron oxide**
- A good brick earth should contain about 5% to 7% of iron oxide.
- It imparts red color to the bricks.
- It improves impermeability & gives hardness

SIZE OF BRICK

- Conventional / traditional bricks: size 23 cm x 11.4 cm x 7.6 cm.
- Standard / modular: size: 19 cm x 9 cm x 9 cm.
- With mortar joints the size of these bricks will be 20cmx 10cmx 10cm.

MANUFACTURE OF BRICKS

- Preparation of clay
- Moulding of bricks
- Drying of bricks
- Burning of bricks

CLASSIFICATION OF BRICK

- Bricks, which are used in construction works, are **burnt bricks**.
- **Unburnt bricks** (dried in sunlight) used for filling works
- Burnt bricks are classified into four categories
- **FIRST CLASS BRICKS**:
- These bricks are table moulded and of standard shape and they are burnt in kilns.
- The surface and edges of the bricks are sharp, square, smooth and straight.
- These bricks have uniform reddish colour
- Water absorption not more than 20%
- A clear metallic ring sound when struck with another brick
- Should not leave any mark when scratched by fingers
- Minimum compressive strength is 10.5N/mm^2

• SECOND CLASS BRICKS:

- These bricks are ground moulded & they are burnt in kilns.
- The surface of these bricks is rough and shape is slightly irregular.
- May have hair cracks and their edges may not be sharp & uniform.
- Water absorption not more than 22%
- Minimum compressive strength is 7 N/mm^2
- These are used for internal walls and plastering is must for these bricks

• THIRD CLASS BRICK

- These bricks are ground moulded & they are burnt in clamps.
- They have rough surfaces with irregular & distorted edges.
- They are used for temporary structures & at places where rainfall is not heavy.
- Water absorption not more than 24%
- Minimum compressive strength is 3.5N/mm^2

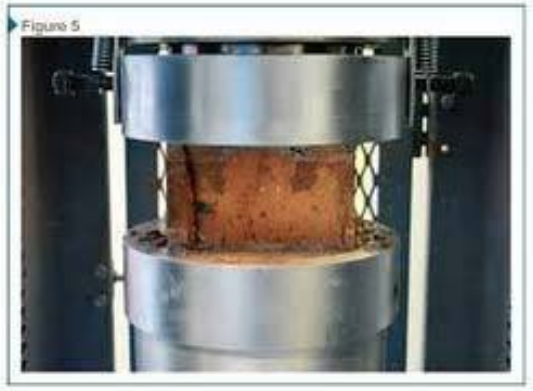
- **FOURTH CLASS BRICK**
- These are over burnt bricks with irregular shape and dark color.
- These bricks are used as aggregate for concrete in foundations, floors, roads due to the fact that the over burnt bricks have compact structure

PROPERTIES OF GOOD BRICKS

- Uniform copper colour
- Free from cracks, voids, etc.
- Even surfaces and sharp edges
- Standard size
- Sufficiently hard; resist scratching
- Clear ringing sound on striking with each other

GENERAL QUALITIES OF GOOD BRICK

- FREE FROM CRACKS WITH SHARP AND SQUARE EDGES
- SIZE:
  - STANDARD SIZE OF MODULAR BRICK:190MM* 90MM*90MM
  - NOMINAL SIZE OF MODULAR BRICK: 200MM*100MM*100MM (WITH MORTAR)
- AVERAGE WEIGHT 3-3.5KG
- CLEAR METALLIC SOUND UPON RINGING
- WATER ABSORPTION NOT MORE THAN 20% FOR FIRST CLASS BRICK AND 22% FOR SECOND CLASS
- SHOULD NOT BREAK INTO PIECES WHEN DROPPED FROM 1M HEIGHT
- SHOULD NOT LEAVE A MARK WHEN SCRATCHED WITH FINGER NAIL
- LOW THERMAL CONDUCTIVITY AND SOUND PROOF
- MINIMUM EFFLORESCENCE
- MINIMUM COMPRESSIVE STRENGTH: AS PER CLASSIFICATION (NOT BELOW 3.5 MPA)



TESTS ON BRICKS

1. COMPRESSIVE STRENGTH/ CRUSHING STRENGTH
   - USING CTM
   - BRICK PLACED OVER THE PLATFORM
   - APPLY LOAD; NOTE MAXIMUM LOAD
   - LOAD/ AREA GIVES THE COMPRESSIVE STRENGTH
   - MINIMUM 3.5N/MM^2

2. WATER ABSORPTION TEST

- GIVES THE AMOUNT OF WATER ABSORBED BY THE BRICKS
- DRY AND WEIGH THE BRICK
- IMMERSE FOR 24 HRS IN WATER; WEIGH AGAIN
- CHANGE IN WEIGHT EXPRESSED AS %
- LIMITED TO 20%

3.HARDNESS TEST

- SCRATCHING BY FINGERNAILS

4. PRESENCE OF SOLUBLE SALTS

- FIND THE EFFLORESCENCE IN BRICKS
- SUNDRIED AFTER IMMERSION IN WATER FOR 24 HRS
- THIN LAYER OF WHITE POWDER ON SURFACE INDICATES SOLUBLE SALTS
- EXTEND DEPENDS ON THE COVERAGE

% of white layer	Efflorescence
10%	Slight
50%	Moderate
>50%	Heavy

5. SHAPE AND SIZE

- 20BRICKS OF STANDARD SIZE AND SHAPE STACKED AND MEASURED

Length = 3680 mm to 3920 mm
Width = 1740 mm to 1860 mm
Height = 1740 mm to 1860 mm

6. SOUNDNESS TEST

- TAKE TWO BRICKS AND STRUCK WITH EACH OTHER.
- THE BRICK SHOULD NOT BREAK AND GIVE CLEAN RINGING SOUND.

7.TOUGHNESS TEST: DROPPING FROM 1M HEIGHT

8. STRUCTURE : BROKEN SURFACE SHOULD BE HOMOGENOUS

STONES

STONES

- OBTAINED FROM ROCKS
- BASIC CLASSIFICATION OF ROCKS
  - IGNEOUS ROCKS - GRANITE, BASALT
  - SEDIMENTARY ROCKS - LATERITE, SANDSTONE, LIMESTONE
  - METAMORPHIC ROCKS - SLATE, QUARTZITE, MARBLE

STONES

ROCKS: CHEMICAL CLASSIFICATION

- SILICEOUS ROCKS
- ARGILLACEOUS ROCKS
- CALCAREOUS ROCKS

ROCKS: PHYSICAL CLASSIFICATION

- STRATIFIED ROCKS
- UN-STRATIFIED ROCKS
- FOLIATED ROCKS

QUARRYING

- THE PROCESS OF TAKING OUT STONES FROM THE NATURAL BED
- QUARRYING- METHODS
  - DIGGING
  - HEATING
  - BLASTING
  - WEDGING

QUALITIES OF GOOD BUILDING STONES

- Crushing strength> 100N/mm^2
- Sufficient hardness
- Resistance to wear and tear
- Specific gravity > 2.7
- High impact value ; toughness index >13
- Water absorption should be less (< 0.6)

QUALITIES OF GOOD BUILDING STONES CONTD.

- Suitable texture for carving and dressing
- Durable
- Good crystalline structure and appearance
- Resistance to weathering by rain, wind, frost, etc.

COMMON BUILDING STONES AND USES

Stone	Features	Uses
1. Granite 	•Igneous •Hard, durable •High strength •Resistance to weathering	•Facing work •Walls •Bridges •Heavy and durable works

2. Laterite 	•Sedimentary •Formed by weathering •Contains Fe, Al , quartz, etc. •Reddish colour •1.8 to 3.2 N/mm^2	•Masonry works

Stone	Features	Uses
3. Limestone 	• Sedimentary •$CaCO_3$ •Not building stone	•Floors •Cement

CEMENT

CEMENT

- One material which has completely revolutionized the construction industry is cement.
- It was in 1824, a mason of england by name **joseph aspidin** developed cement by burning at high temperature a mixture of lime and clay and then grinding it into fine powder.
- This is known as ordinary portland cement.
- It is **called portland cement** because its color resembled the stone quarried on the isle of **portland** off the british coast.

CEMENT

- Any binding or cementitious material providing adhesion or cohesion to different combining particles
- Main components lime, silica, alumina
- Used as cement mortar or cement concrete
- Different types most common is *OPC –ordinary portland cement*

ORDINARY PORTLAND CEMENT (OPC)

- PRINCIPAL COMPONENTS:
    - SILICEOUS MATERIALS
    - ARGILLACEOUS MATERIALS
    - CALCAREOUS MATERIALS
- MOST WIDELY USED 80-90% OF WORKS
- BASIC PROCEDURE: PROPORTIONED MIX OF SILICEOUS, ARGILLACEOUS AND CALCAREOUS MATERIALS ARE MIXED WITH WATER AND CALCINED AT HIGH TEMPERATURES AND CRUSHED TO FORM **“ CLINKER”** ABOUT 4 % GYPSUM ADDED TO CLINKER GROUND TO REQUIRED FINENESS

INGREDIENTS OF ORDINARY PORTLAND CEMENT

- LIME – CAO(60 – 67 %)
- SILICA – SI O_2 (17 – 25%)
- ALUMINA AL_2O_3 (3 – 8%)
- CALCIUM SULPHATE - CA SO_4 (3-5%)
- IRON OXIDE- FE_2O_3 (0.5 – 6%)
- MAGNESIA-MGO (0.1-4%)
- SULPHUR TRIOXIDE- SO_3 (1 – 3%)
- ALKALIES(SODA AND POTASH) (0.5-1.3%)

Ingredients	Functions	If excess
Lime	Imparts strength	Free lime Makes cement unsound – expand and disintegrate while setting
Silica	Silicious compounds imparts strength	Increases strength of cement, but at the same time setting time is prolonged
Alumina	Reacts with water and helps setting of cement	Acts as flux, lowering the clinker temperature Weakens strength
Calcium sulphate	Retarder- increases setting time of cement (for workability)	
Iron oxide	Imparts grey colour and hardness Reduces calcination temp. Imparts strength	
Magnesia	Imparts hardness and colour	Makes cement unsound ; increases setting time
SO_3	Making cement sound	Makes cement unsound
Alkalies		Efflorescence, staining

QUALITIES OF GOOD CEMENT

- Uniform colour
- Free from lumps
- Cool and uniform to touch
- If thrown into water, should not sink
- Compressive strength- >16N/mm^2 (3days)

  > 22N/mm^2 (7days)

- Tensile strength > 2N/mm^2 (3 days)

  >2.5 N/mm^2 (7 days)
- Heat of hydration < 75 cal/ gm after 28 days
- Initial setting time < 30 minutes

  Final setting time 10 hrs
- Fineness modulus <10%
- Soundness < 10mm

PROPERTIES OF CEMENT CONT..

1. **PHYSICAL PROPERTIES:**
   - FINENESS:
   - SETTING TIME
   - SOUNDNESS
   - COMPRESSIVE STRENGTH
   - HEAT OF HYDRATION
   - SPECIFIC GRAVITY

2. CHEMICAL PROPERTIES:

- LOSS OF IGNITION
- INSOLUBLE RESIDUE

PROPERTIES OF CEMENT CONT..

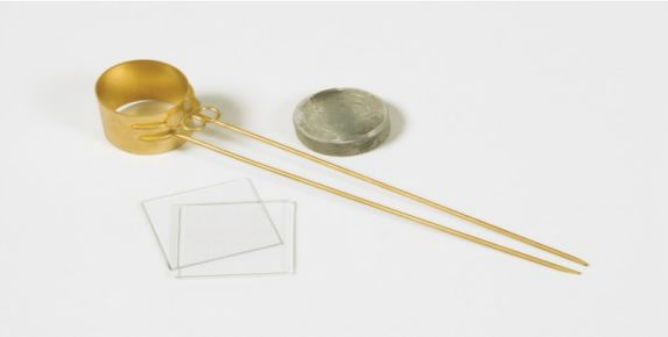
- **Fineness:** it is a measure of size of particles of cement.
  - It is an important factor to decide the rate of gain of strength and uniformity
  - In general, finer the grains higher the surface area
  - Higher will be the rate of hydration with increase in fineness of cement
  - As per IS specification the residue of cement should not exceed 10% when sieved through a 90-micron sieve

- **Setting time:** setting time is generally divided into initial setting time and final setting time
  - Initial setting time is regarded as the time when the cement paste loses its elasticity
  - The final setting time is the time elapsed between the time of water addition to the cement to the time when the paste as completely lost its elasticity and become plastic
  - For OPC the initial setting time should not less than 30minutes and final setting time not more than 600 minutes

Vicat apparatus

PROPERTIES OF CEMENT CONT..

- **Soundness:** cement which has less expansive qualities when mixed with water is termed as soundness
  - The soundness is affected by the undesirable expansion of some of its constituents which could happen even after setting; which tends to cracking
  - The unsoundness can be controlled by
    - Limiting the MgO content to less than 0.5%
    - Fine grinding
    - Thorough mixing



Le Chateliers apparatus

- **Compressive strength:** the strength is generally assessed from compression tests on cement mortar cubes (1:3) with an area of 5000 mm^2.
  - For OPC the compressive strength at 3 and 7 days shall not be less than 16 MPa and 22 MPa respectively

PROPERTIES OF CEMENT CONT..

- **Heat of hydration:** the reaction of silicates and aluminates of cement with water forms a binding medium which solidifies into hardened mass which is termed as hydration
- The heat of hydration is defined as the quantity of heat liberated on complete hydration at a particular temperature
  - For OPC it should be between 37 cal/g at 5^0C to 80 cal/g at 40^0C

- **Specific gravity:**
  - For OPC the specific gravity is around 3.15

PROPERTIES OF CEMENT CONT..

- **Loss of ignition:** due to ignition of cement at high temperatures, loss in weight occurs due to the evaporation of moisture and carbon dioxide which are present in combination with free lime or magnesia
- Not more than 5%

- **Insoluble residue:**
  - An inactive part of cement is called the insoluble residue.
  - Minimum the percent of residue better is the cement.
  - The maximum allowable value is 0.85%

SPECIFICATIONS OF ORDINARY PORTLAND CEMENT (OPC)

Fineness	**225 m^2 /Kg**
Soundness	Not more than 10 mm by Le Chateliers test Not more than 0.8 % in Autoclave test
Setting time Initial Final	 Not less than 30min Not more than 600 min
Specific gravity	3.15
Bulk density	830-1650 Kg/m^3
Compressive strength 3 days 7 days 28 days	 16 ,23 and 27 N/mm^2 respectively as per Grade 22, 33 and 37 N/mm^2 respectively 33,43 and 53 N/mm^2 respectively
Loss on ignition	Not more than 5%
Lime saturation factor	0.66-1.02% for OPC 33 and 43 grade 0.8-1.02 % for 53 Grade

GRADES OF CEMENT

- Indicates the compressive strength (MPa) of concrete made from the cement after 28 days of setting

Grade of cement	Details
33 grade	•Minimum compressive strength 33 Mpa at 28 days •For general construction works in normal environmental conditions • Can not be used where higher grade of concrete above M20 is required
43 grade	•Minimum compressive strength 43Mpa at 28 days •Widely used for general construction purposes – suitable for applications *RCC, plastering and masonry* •For construction of residential, commercial buildings etc.
53 grade	•Minimum compressive strength 53Mpa at 28 days •For high rise buildings, bridges, flyovers, chimneys, prestressed structures •Used for making higher grade of concrete, above M30

Type	Features	Uses
1. OPC		• For normal works
2. PPC	•Adding pozzolana with cement clinker •Greater resistance to chemicals •Resist seawater attack	•Marine structures •Sewers •Hydraulic structures •Bridge
3.Coloured cement	•Add pigments with OPC	•Decorative works •Tiles •Floor and wall finishes

•4. Rapid Hardening Cement	•Rapid strengthening •High fineness •High C3S; Low C2S	•Pre-fabricated works •Road construction •Cold weather
•5.Hydrophobic cement or water repellent cement	•Oleic acid or steric acid to repel water •Long term storage and transportation	•Water tight works
•6. Expansive cement	•Low volume change	•Machine foundations •Repair works

7.Acid resisting cement	•Resist acid attack •Contains quartz, sodium silicates	•Factory floors
8.Quick setting cement	•Sets in 5 min •Low gypsum content	•Underwater construction
9.Sulphate resisting cement	•$C_3A < 5\%$	•Marine structures •Sewer and treatment structures •Foundation in sulphate infested soil

10. High Alumina Cement	•Grinding clinkers with bauxite •Withstands high temperature •Slow setting, rapid hardening	•Water retaining structures •Furnace lining
11.White cement	•Free from iron oxides, magnesia, etc	•White washing, Plastering •Tiles
12.Air entraining cement	•Vinsol, wood resins •More workable concrete	•Cold climates

SAND

SAND

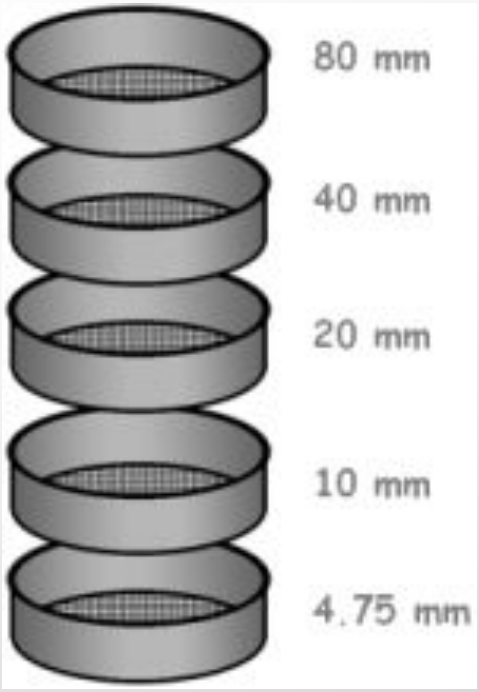
- Sand is fine aggregate which is used in mortars and concrete
- Aggregate: the granular materials chemically inert such as natural sand, gravels, crushed stones are called aggregates. Theses are used as filler material in concrete and mortar for economy in construction. These are also known as inert fillers.
  - Coarse aggregates: the aggregates retained on is 4.75 mm sieve
  - Fine aggregates: the aggregates, which are passing through IS 4.75 mm sieve

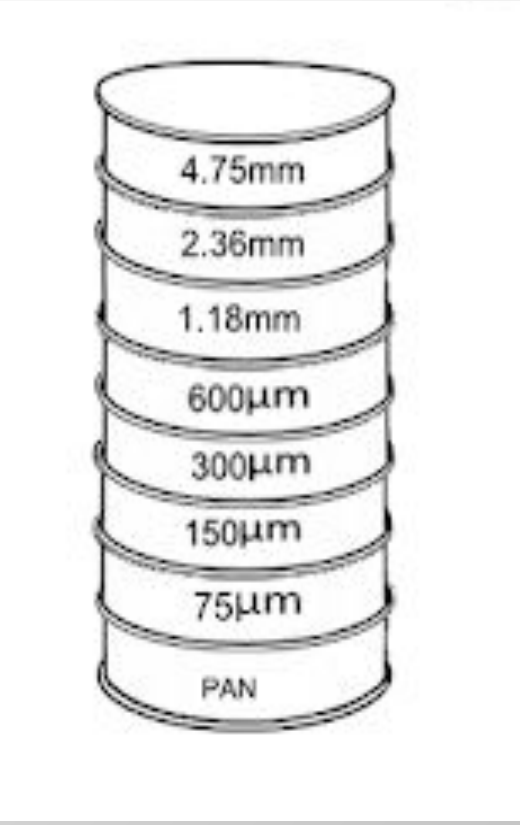
SAND

- Sand sources:
  - River sand: obtained from river bed
  - Pit sand: obtained from pits dug at depth of 1.5 m to 2m in the soil
  - Sea sand: sand available at seashores

SAND

- SAND TYPES:
  - NATURAL SAND: Fine aggregates formed by natural disintegration of rocks and deposits in the bed of river, streams and glaciers are called natural sand
  - CRUSHED STONE SAND: The fine aggregates made by crushing gravels


80 mm
40 mm
20 mm
10 mm
4.75 mm


4.75mm
2.36mm
1.18mm
600µm
300µm
150µm
75µm
PAN

SIEVE ANALYSIS

Table 4.1 Calculation of fineness modulus

I.S Sieve	Weight retained gm	% of weight retained	Cumulative % of weight retained
80 mm	-		
40 mm	-		
20 mm	-		
10 mm	-		
4.75 mm	30	3.0	3.0
2.36 mm	80	8.0	11.0
1.18 mm	100	10.0	21.0
600 micron	125	12.5	33.5
300 micron	200	20.0	53.5
150 micron	385	38.5	92
Total	80	8.0	100
	1000	100	314

Fineness Modulus = 314/100 = 3.14

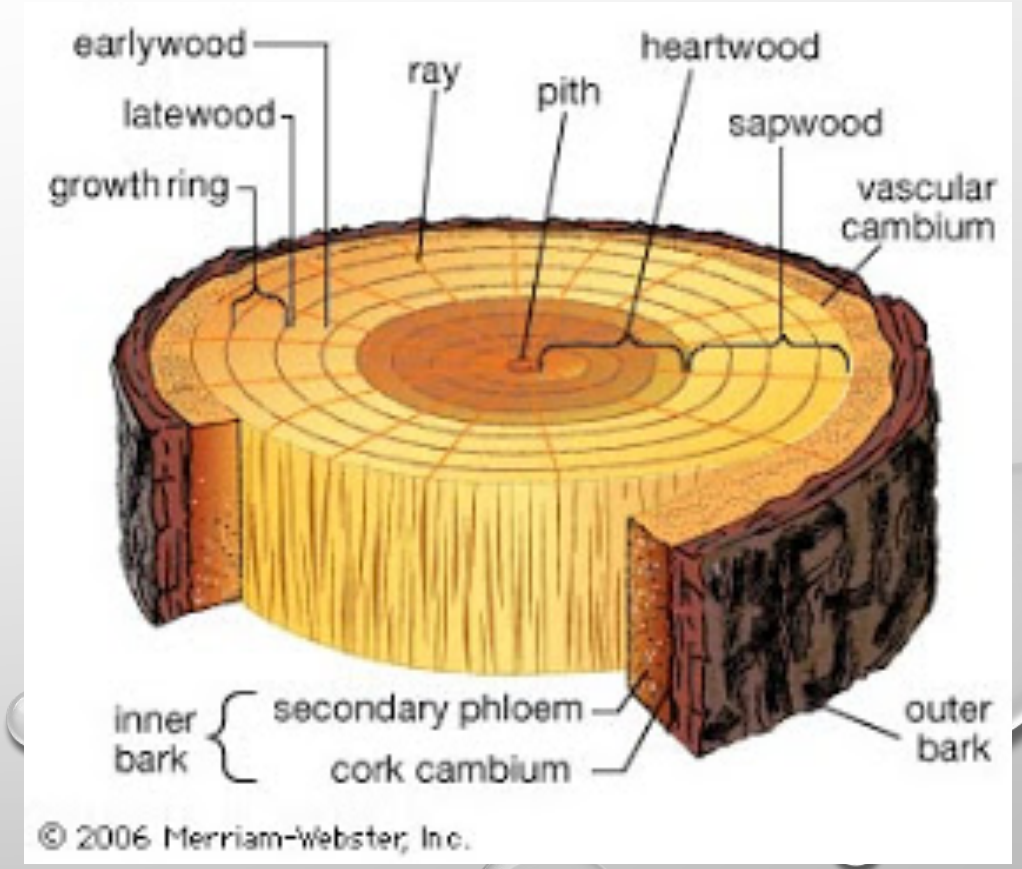
SIEVE ANALYSIS

- Fineness modulus gives the fineness or coarseness of the aggregate
- Higher the fineness modulus, coarser the particle size
- Based on fineness modulus sands are classified as;
  - Fine sand: 2.2 to 2.6
  - Medium sand: 2.6 to 2.9
  - Coarse sand: 2.9 to 3.2

TIMBER

TIMBER

- One of the oldest material used in construction
- Timber is obtained form tress
- Classification of tress
  - Exogenous trees
    - E.G. Teak, deodar
  - Endogenous trees
    - E.G. Bamboo, palm



SEASONING

- Process of drying the timber
- The moisture content is removed under controlled conditions
- Should be uniform

OBJECTIVES

- To impart hardness, stiffness, strength and electrical resistance
- Maintain shape and size of the products
- Decrease weight of timber
- Make suitable for painting
- Safety from attack by fungi and insects
- Safe from shrinking, warping,etc.

MARKET FORMS OF TIMBER

- LOG

- BAULK
  - Roughly square shaped
  - C/s dimension
    - One side > 50mm
    - Other side> 200 mm

- POLE
  - Logs with dia<200mm
  - Columns,truss,etc.

- PLANKS
  - Thickness<50mm
  - Width>50mm
  - Thatched roof, truss

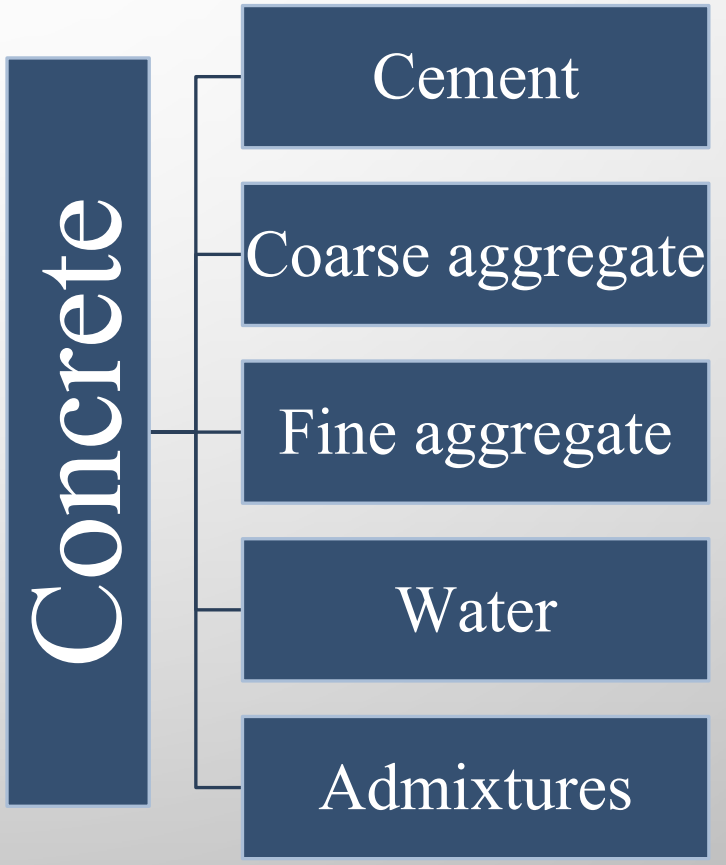
- BATTEN
  - Breadth and thickness < 50 mm

- BOARD
  - Width >150mm
  - Thickness < 50mm

CONCRETE

CEMENT CONCRETE

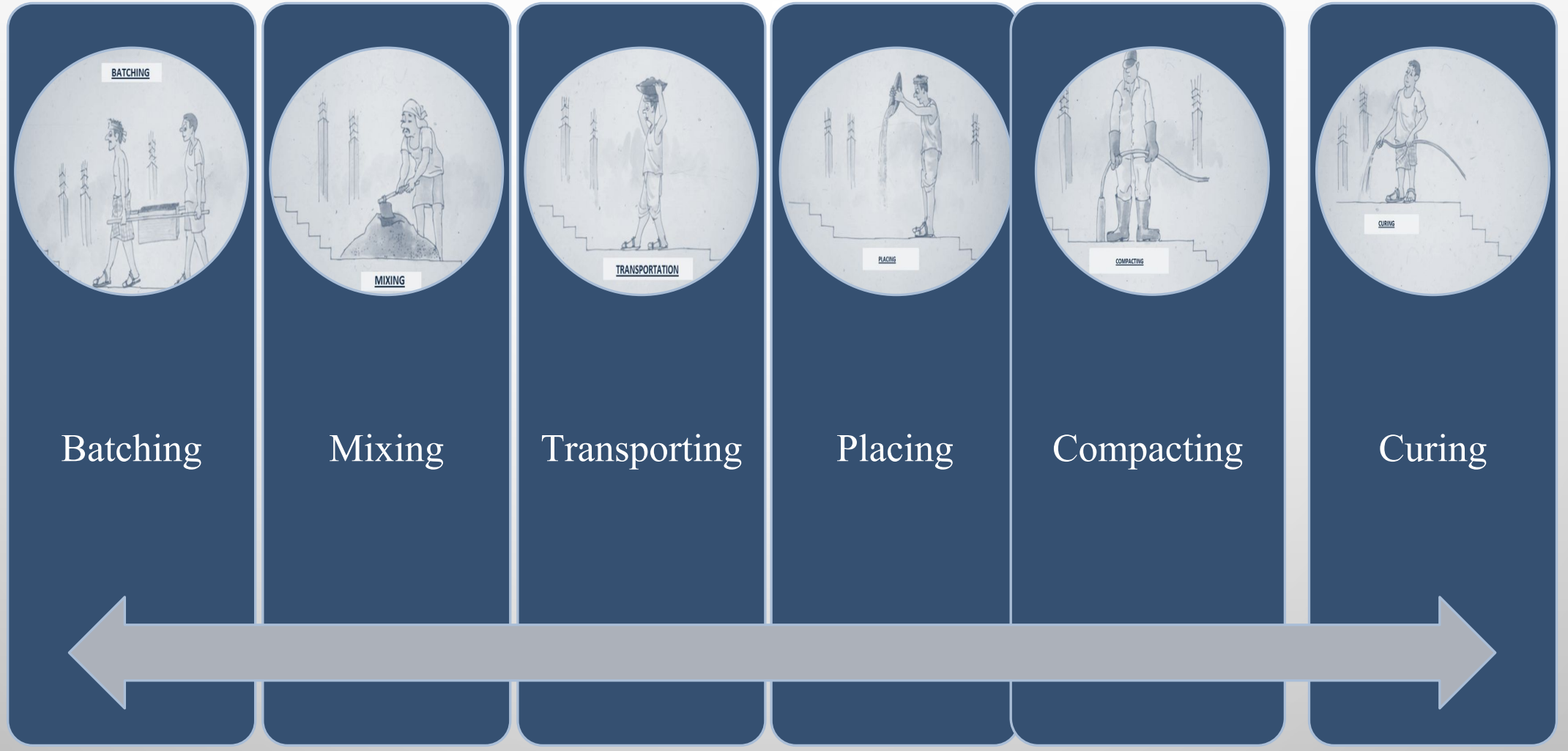
Mixture of binding materials, fine aggregate and coarse aggregate and water



PROPERTIES OF CONCRETE

- Concrete has relatively high compressive strength, but significantly lower tensile strength.
- The elasticity of concrete is relatively constant at low stress levels but starts decreasing at higher stress levels as matrix cracking develops.
- Concrete has a very low coefficient of thermal expansion, and as it matures concrete shrinks.
- All concrete structures will crack to some extent, due to shrinkage and tension.
- Concrete can be damaged by fire, aggregate expansion, sea water effects, bacterial corrosion, leaching, physical damage and chemical damage (from carbonation, chlorides, sulfates).

PROCESS OF MAKING CONCRETE



BATCHING

- Batching is the process of measurement of specified quantity of ingredient in correct proportion batching is done by two process.
- 1. By volume batching : • batching by volume means measuring ingredient of concrete by its volume.
- 2 . by weigh batching : • batching is done according to the weight of ingredients.
- It is preferable method to volume batching.

MIXING

• The aim of mixing of concrete is to produce homogenous, consistent and uniform colored concrete.

Mixing action of CONCRETE involves 2 operation.

A general blending of different particles size of the ingredients to be uniformly distributed throughout the concrete mass.

A vigorous rubbing action of cement paste on to the surface of aggregate particles.

- There are 2 methods1. Hand mixing 2. Machine mixing.
- Hand mixing• for small and unimported jobs concrete is mixed by hand using shovels.
- As mixing of concrete is not efficient thoroughly ,it is advisable to add 10 percent cement extra
- For hand mixing a brick platform is prepared by laying the bricks on the ground.
- It must be 2 m wide and 3.5 m long. Following operations are involved

- Measured quantity of sand is spread evenly on platform.
- Spread the measured quantity of cement on this sand and mix it till the color of concrete mixture is uniform.
- Spread the measured quantity of coarse aggregate on the platform with sand and cement.
- Now spread the mixture of cement and sand on the stack of aggregate and mix it at least 3 times.
- Make the hollow of mixed pile. Add 3 quarters of total quantity of water required and turn the material towards the center with spades.

- Machine mixing- it is adopted for big projects where large quantity of aggregate is required .
- It is also economical.
- Concrete mixers are classified as under-
- According to the operating conditions-1. Batch mixers ,2. Continuous mixers.
- According to the principal of mixing-1. Gravity type 2. Type with forced mixing
- According to the condition of use1. Stationary concrete mixers,2. Portable concrete mixers.

- Batch mixers- the mixers are charged with materials in batches
- Batch mixers are classified in further 3 types
- 1. Tilting type
- 2. Non-tilting type
- 3. Reversing type.

Tilting type

- It consist a conical drum which rotates on an inclinable axis.
- It has only one opening.
- The drum charged directly and discharged by tilting and reversing the drum

20/14CFT (Two Bag) Capacity Non-Tilting Type Concrete Mixer Machine

Non-tilting type

- The mixing drum is cylindrical in shape and revolves two – horizontal axis.
- It has opening on both sides.
- The ingredients are charged in from one opening.
- For discharging concrete chute is introduced into other opening by operating a lever.

TYPES OF CONCRETE MIXER

1. Continuous Mixer

2. Baich Mixers or Drum Mixers

Tilting Mixer

Non-tilting Mixer

Revering Drum Mixer

Pan Type Mixer

Grades of Concrete

AS PER IS : 456 – 2000, THERE ARE FIFTEEN GRADES OF CONCRETE,

Type of work	Recommended mix	Application
Ordinary Concrete	M10, M15, M20	Mass concrete structures
Standard Concrete	M25, M30, M35, M40, M45, M50, M55	High rise buildings,
High Strength Concrete	M60, M65, M70, M75, M80	Pre Stressed concrete

“M” stands for mix and number stands for compressive strength of 15cm cube after 28days of curing in N/mm2. Min. Grade for RCC is M20.

NOMINAL PROPORTIONS

M5	1:5:10	Mass concrete works for strong walls and foundations
M10	1:3:6	Flooring
M15	1:2:4	Plain cement concrete
M20	1:1.5:3	RCC
M25	1:1:2	Water retaining structures, precast products
M30 onwards	Design mix	Heavily loaded RC columns and arches, prestressed concrete

GENERAL APPLICATIONS OF CONCRETE

- Slab, beam and columns
- Footings
- Roofs
- Pavements
- Hydraulic structures
- Drainage structures
- Soil solidification
- Retaining walls and abutments
- Bridges

TYPES OF CONCRETE

- PCC
  - Weak in tension; strong in compression
  - Unit weight 2400kg/m^3
- RCC
  - Steel reinforcing bars
  - Beams columns, etc.

TYPES OF CONCRETE

- LIGHT WEIGHT CONCRETE
  - Unit weight-1800kg/m3
  - To reduce dead weight of the structure
- NO FINES CONCRETE
  - Resists drying, shrinkage and capillary action
  - Used for external walls, damp proofing, etc.

TYPES OF CONCRETE

- FIBRE REINFORCED CONCRETE

TYPES OF CONCRETE

- PRE-STRESSED CONCRETE:
  - Tensioned wires are used instead of reinforcements
  - Bridge, pole, railway sleepers, etc.
  - Thin sections can take more load

TYPES OF CONCRETE

- Air entrained concrete
- Vacuum concrete
  - Extra water removed by vacuum
- Coloured concrete
- Reactive powder concrete
  - Silica fumes are used
  - Chemical resistant

STEEL

A pure form of iron containing carbon up to a maximum of 1.5% together with other elements like silica, Sulphur, phosphorous and manganese in minute quantities

STEEL

- **STEEL** is an alloy made by combining iron and other elements, the most common of these being carbon (0.15% to 1.5%).

USES OF STEEL IN BUILDING WORKS

- As a structural material in trusses, beams etc.
- As reinforcement for concrete
- As non structural material for grills, door, windows etc.
- In steel pipes, tanks etc.
- In sanitary & sewer fittings,
- As roof covering material

TYPES OF STEEL

Steel can be classified by different systems depending upon:

1. Composition
    a) Plain carbon steel
    b) Alloyed steel
    c) Stainless steel
    d) Tool steel
2. Product shape (market forms)
3. Finishing method
4. Manufacturing method
5. Microstructure
6. Heat treatment

1. TYPES OF STEEL BASED ON COMPOSITION

1.A plain carbon steel

- Carbon is the major constituent which controls the properties
- No alloying element is added
- Based on carbon content it is classified into
  - Mild steel (0.15% to 0.25%)
  - Medium carbon steel (0.25% to 0.6%)
  - High carbon steel (0.6% to 1.5%)

TYPES OF STEEL BASED ON COMPOSITION CONTD.

	Properties	Uses
Mild steel (0.15% to 0.25%)	Can be magnetized permanently • Readily forged, riveted and bolted • Easily hardened or tempered • Malleable and ductile • Specific gravity 7.8 • Melting point – above 1400°C	• Used as steel reinforcements • Mild steel tubes are used in construction • Mild steel sheets for roof coverings • Used in manufacture of various tools, machinery and other equipments
Medium carbon steel (0.25% to 0.6%)	• Granular structure • More tough & elastic than M.S. • Easier to harden & to temper • More difficult to forge and to weld • Stronger in compression than in tension or in shear • Withstands shocks and vibrations better	• For making tools such as files, chisels • Used for making those parts that are hard , tough and durable and capable of withstanding shocks and vibrations
High carbon steel (0.6% to 1.5%)	• Increased tensile strength leads to less weight of it being used as compared to M.S. • Structure becomes lighter • Resists corrosion better • Tougher and more elastic • More brittle and less ductile than mild steel	• In reinforcing prestressed concrete structures

TYPES OF STEEL BASED ON COMPOSITION CONTD.

1.B alloyed steel

- Elements like tungsten, nickel, chromium etc. Are added in select proportions to get desired qualities like- hardness, corrosion resistance and retention of strength & hardness.
- Example
  - Chromium – wear resistant
  - Manganese – surface hardness
  - Nickel – strength
  - Vanadium – toughness

TYPES OF STEEL BASED ON COMPOSITION CONTD.

1.C stainless steel

- Most widely used because of its corrosive resistant property. Contains 18% of chromium & 8% of nickel.
- The corrosion resistance is due to the presence of chromium

1.D tool steel

- Tool steels contain tungsten, molybdenum, cobalt and vanadium in varying quantities to increase heat resistance and durability, making them ideal for cutting and drilling equipment.

2. TYPES OF STEEL BASED ON PRODUCT SHAPE (MARKET FORMS OF STEEL)

Following are the various forms in which steel is available in market.

a) Angle sections

b) Channel sections

c) I sections

d) T-sections

e) Flat sections

f) Steel plates

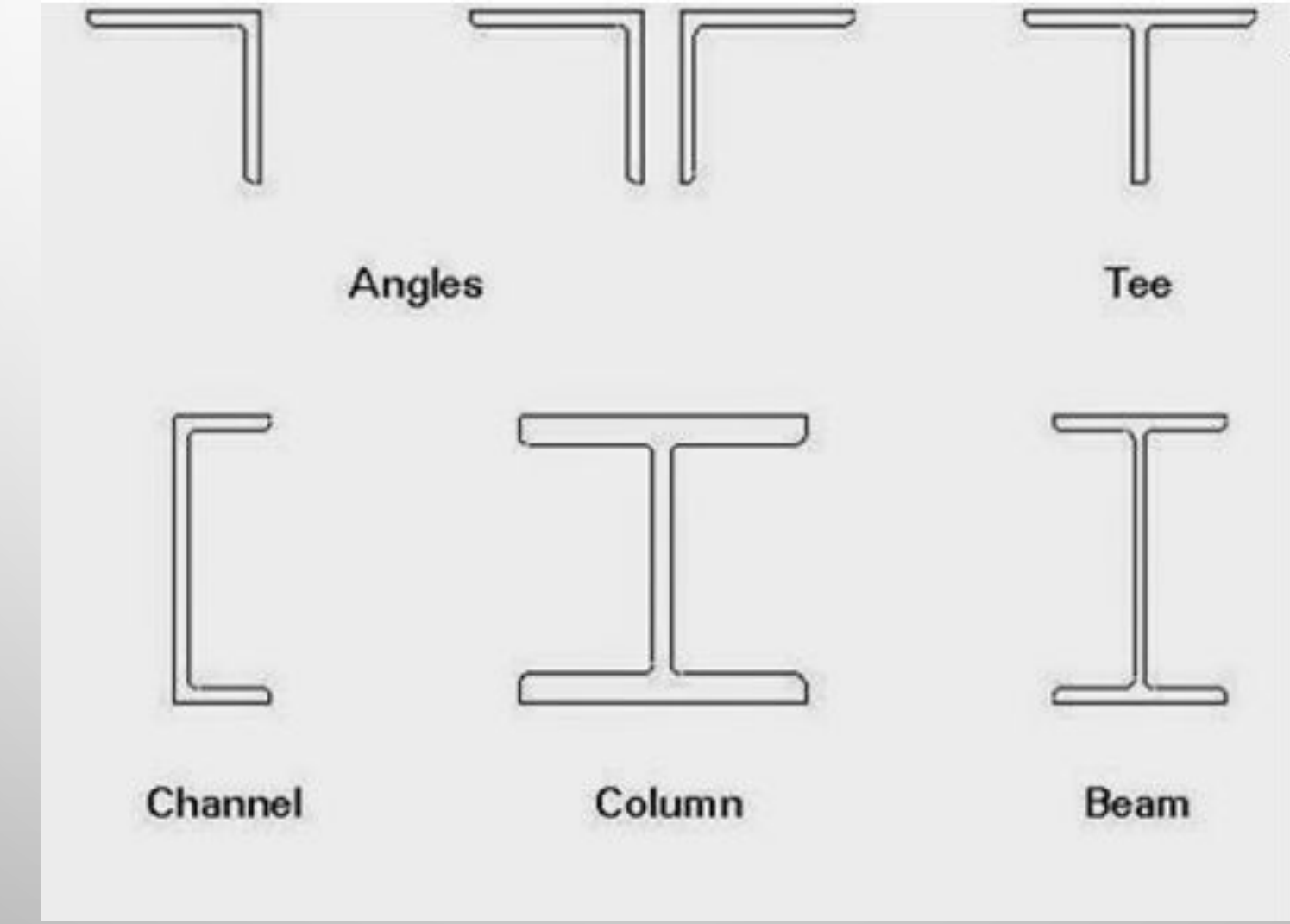
g) Corrugated sheets

h) Round bars

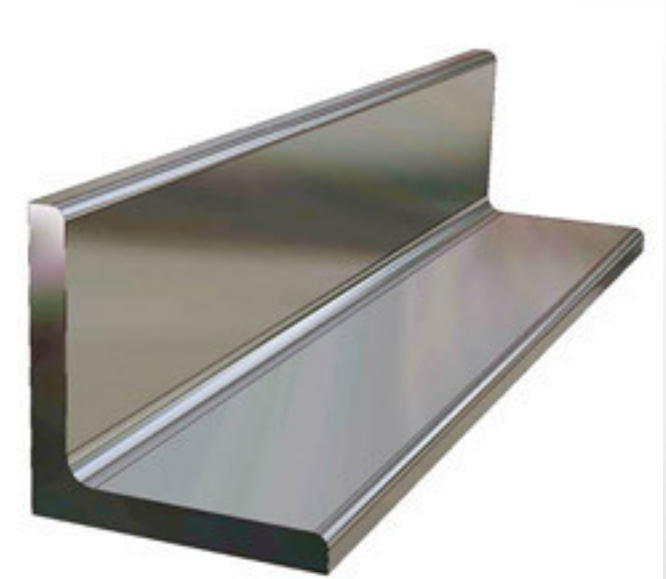
i) Square bars

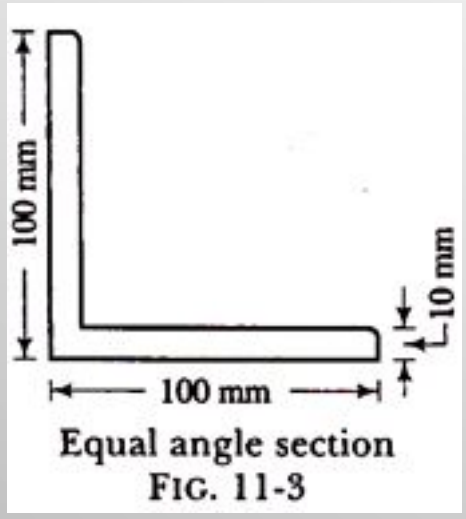
j) Tubular sections

STRUCTURAL STEEL SECTIONS

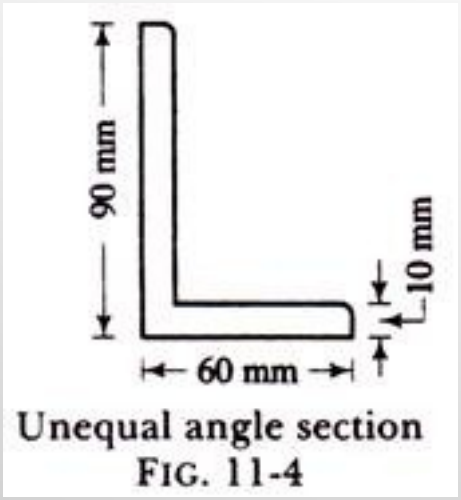


- ANGLE SECTIONS
  - TWO LEGS
  - ISA 100X100X3
  - TRUSSES



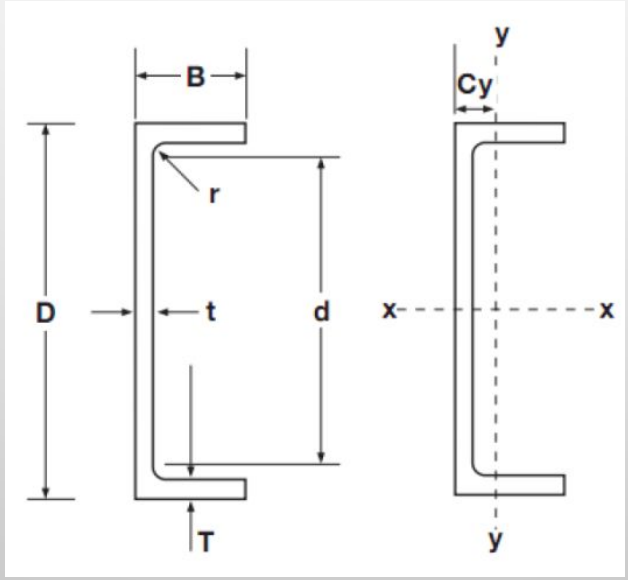


Equal angle section
FIG. 11-3



Unequal angle section
FIG. 11-4

- CHANNEL SECTIONS
  - WEB AND FLANGE
  - DESIGNATED BY HEIGHT OF THE WEB AND WIDTH OF THE WIDTH OF FLANGE
  - TRUSS, FRAMES



- I SECTIONS
  - ROLLED STEEL JOIST
  - DESIGNATED BY OVERALL DEPTH, WIDTH OF FLANGE & WEIGHT/M
  - ISLB,ISJB,ETC.
  - BEAMS,LINTELS, COLUMNS,ETC

Section	Designation	Application
T section (ISNT, ISHT,etc.)	Overall dimensions & thickness	Steel truss, built up sections
Flat sections	Width & thickness	Grill work, built up sections, columns
Corrugated sheets	GI Sheets	Roof
Round bars (ISRO)	Diameter	Reinforcement
Square bars(ISSQ)	Side length	Windows, gates

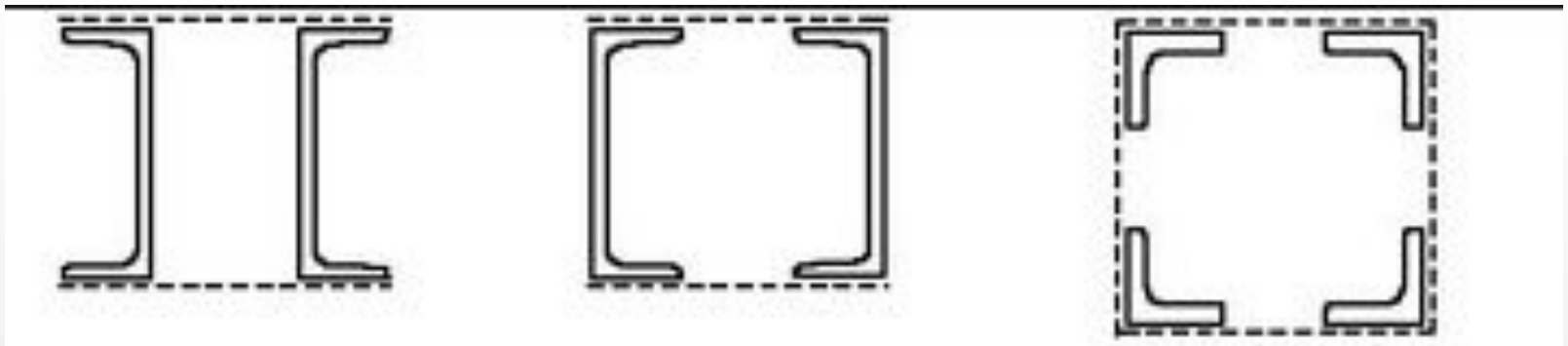
REINFORCING BARS

- PLANE STEEL BAR
  - ROUND SECTIONS
  - RARE

- HIGH STRENGTH DEFORMED STEEL BAR
  - TOR STEEL
  - LONGTITUDINAL & TRANSVERSE RIBS
  - BETTER BONDING
  - RCC WORKS

BUILT-UP SECTIONS

- COMBINATION OF DIFFERENT SECTIONS
- WELDING OR RIVETING



U or angle sections used as main components

I or H-sections as main components

- TWO CHANNELS

COLUMNS & TRUSSES

- I SECTION
  - BEAMS AND GIRDERS
- BUILT-UP COLUMN SECTIONS
  - ANGLES, CHANNELS, I SECTION

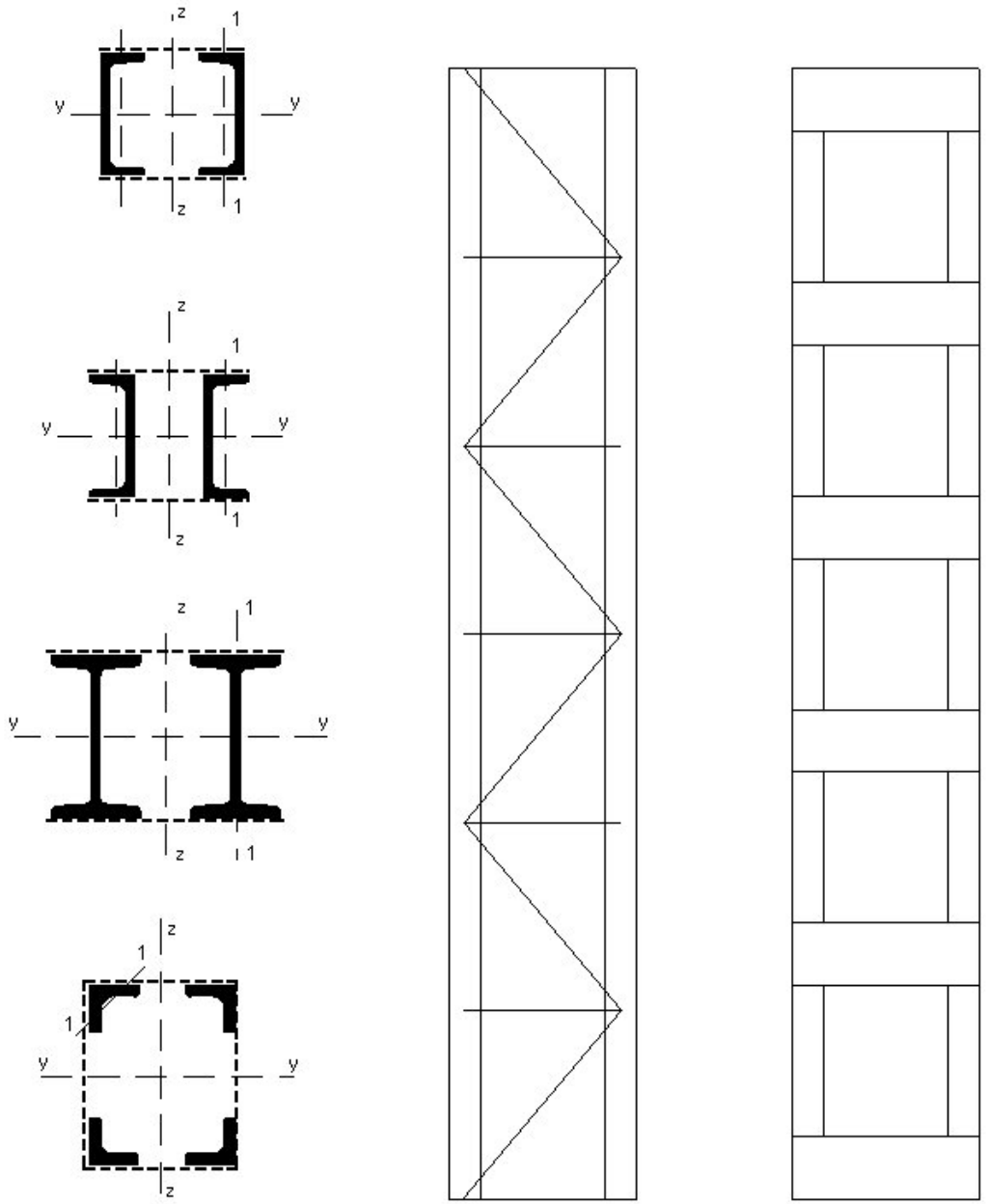


Figure 1 Built-up columns