MODULE IV
BUILDING MATERIALS

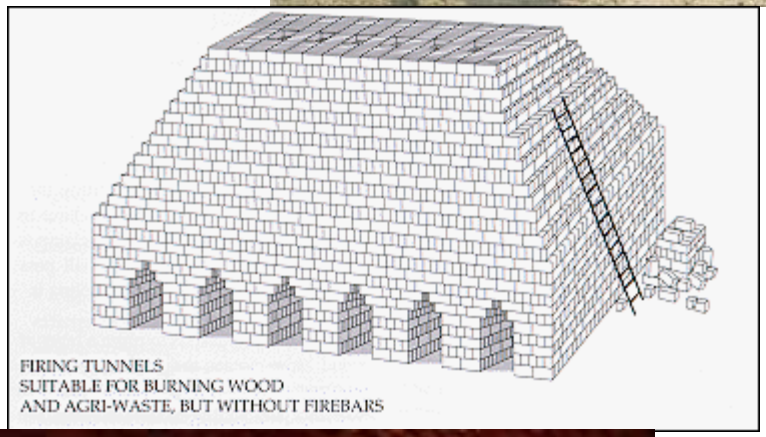
BRICKS

CONSTITUENTS OF BRICK EARTH

- Alumina
- Silica
- Lime
- Oxides of iron
- Magnesia

MANUFACTURE OF BRICKS

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



CLASSIFICATION OF BRICKS

- Unburnt or sundried bricks
- Burnt bricks
  - First class bricks
  - Second class bricks
  - Third class bricks
  - Fourth class bricks

PROPERTIES OF BRICKS

1) Uniform copper colour
2) Free from cracks, voids and grits
3) Even surfaces with sharp and square edges
4) It should be of standard size
5) Bricks when broken show homogeneous structure
6) Bricks should be sufficiently hard

PROPERTIES OF BRICKS

7) Soundness
8) Water absorption
9) Should not break when dropped flat on hard ground from 1m height
10) Crushing strength
11) Sound proof and low thermal conductivity

CEMENT

ORDINARY PORTLAND CEMENT (OPC)

- Siliceous materials
- Argillaceous materials
- Calcareous materials

INGREDIENTS OF ORDINARY PORTLAND CEMENT

- Lime (60 – 67 %)
- Silica (17 – 25%)
- Alumina (3 – 8%)
- Calcium sulphate
- Iron oxide (0.5 – 6%)
- Magnesia (0.1-4%)
- Sulphur (1 – 2.5%)
- Alkalies (0.5%)

Ingredients	Functions	If excess
Lime	Imparts strength	Makes cement unsound – expand and disintegrate while setting
Silica	Imparts strength	Increases strength of cement, but at the same time setting time is prolonged
Alumina	Acts a flux, lowering clinkering temperature	Weakens strength of cement
Calcium sulphate	Retarding setting time of cement	
Iron oxide	Imparts gray colour	
Magnesia	Imparts hardness and colour	Makes cement unsound
Sulphur	Making cement sound	Makes cement unsound
Alkalies		Efflorescence, staining

PROPERTIES OF CEMENT (OPC)

- Uniform color
- Free from lumps
- Should be cool when felt with hand
- Should sink
- Compressive strength
- Tensile strength
- Initial and final setting time
- Fineness of cement
- Heat of hydration should not be more than 75cal/gm after 28 days.

SPECIFICATIONS OF ORDINARY PORTLAND CEMENT

Fineness	2250 kg/cm^2
Setting time Initial Final	 Not less than 30min Not more than 600 min
Compressive strength 3 days 7 days	 11.5 N/mm^2 25 N/mm^2

GRADES OF CEMENT

Grade of cement	Details
33 grade	• For general construction works in normal environmental conditions • Can not be used where higher grade of concrete above M20 is required
43 grade	• Widely used for general construction purposes – suitable for applications RCC, plastering and masonry •For construction of residential, commercial and industrial buildings, roads, bridges, fly overs, irrigation projects etc
53 grade	• For high rise buildings, bridges, flyovers, chimneys, prestressed structures •Used for making higher grade of concrete, above M30

PORTLAND POZZOLANA CEMENT

- Made by inter grinding portland cement clinkar and pozzolana or uniform blending of portland cement and fine pozzolana.
- Pozzolana – natural material like volcanic ash or fly ash
- Properties:
  - Higher resistance to chemical agencies
  - Lower heat of evolution
  - More resistance to the attack of sea water
  - It gives better workability during preparation of concrete

PORTLAND POZZOLANA CEMENT

This cement is recommended for

- Marine structures
- Sewer and sewerage disposal works
- Hydraulic structures like dams, reservoirs, canals
- For mass structures like bridge piers and thick foundations

TYPES OF CEMENT

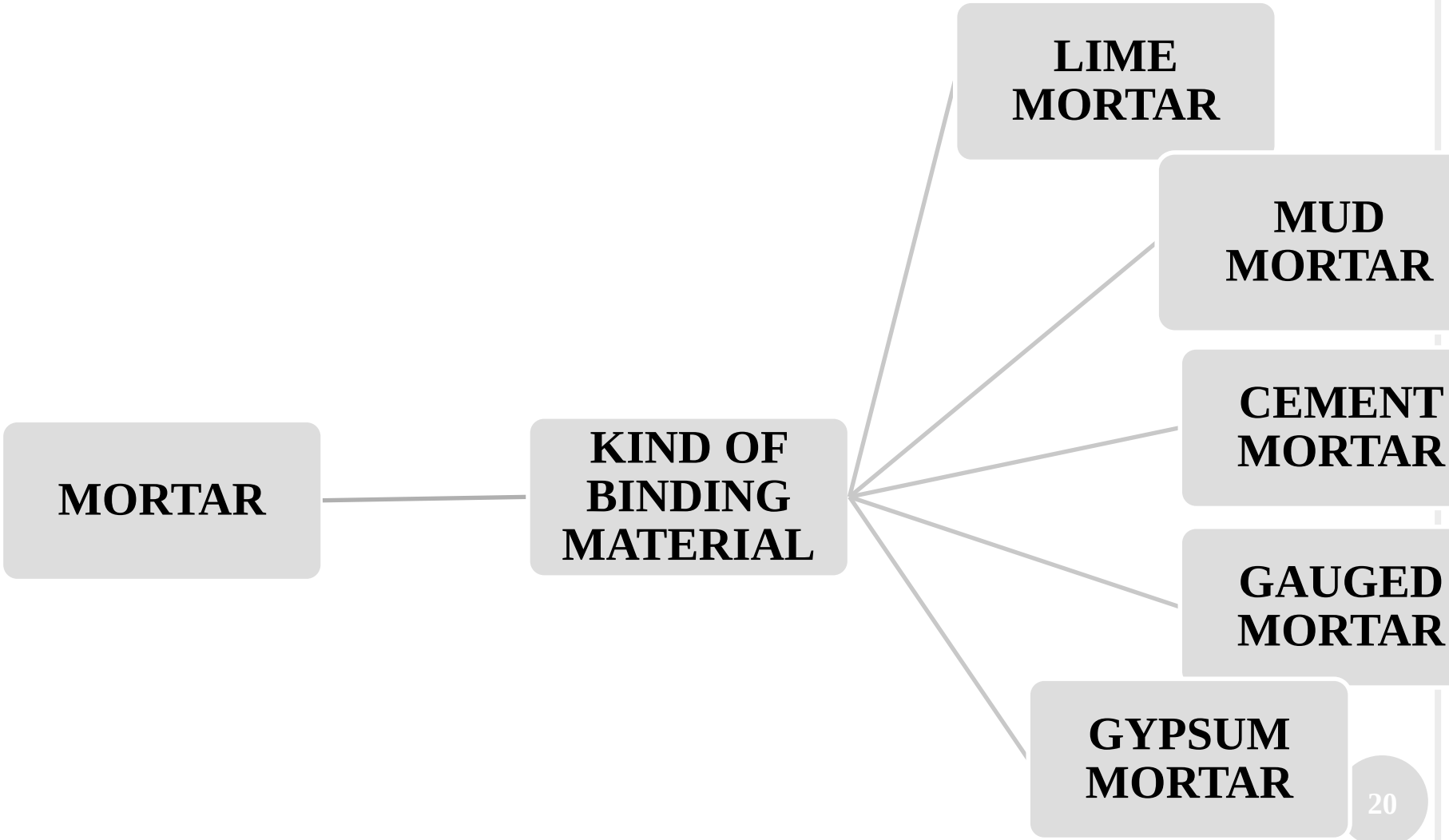
- Ordinary Portland cement
- Rapid hardening cement
- Low heat cement
- Quick setting cement
- High alumina cement
- Coloured cement
- Expanding cement
- Hydrophobic cement
- Air entraining cement
- White cement

CEMENT MORTAR

CEMENT MORTAR

Mortar may defined as workable paste formed by mixture of cementing materials, fine aggregate (sand) and water.

CLASSIFICATION OF MORTAR



Properties of mortar

- Workability
- Good adhesion and bonding efficiency
- Compressive strength
- Durability
- Reaction with other materials
- Resists the water penetration
- Strong and capable of resisting cracks
- It should be cost effective

USES OF CEMENT MORTAR

- Binding masonry units
- Manufacturing of hollow cement blocks
- Pointing of masonry joints
- Plastering
- Finishing to concrete work
- Water proofing
- Filling of cracks
- To hide open joints of brick work and stone work
- To form joints of pipes

CEMENT CONCRETE

CEMENT CONCRETE

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

PROCESS OF MAKING CONCRETE

1. Batching
2. Mixing of concrete
    - Hand mixing
    - Machine mixing
3. Transporting of concrete.
4. Placing of concrete.
5. Compacting of concrete.
6. Curing of concrete.

GRADES OF CONCRETE

As per Indian standard IS 456-2000

Ordinary concrete - M10,M15,M20

Standard concrete - M10,M15,M20,M25,M30,M35,M40,M45,M50,M55

High strength cement - M60,M65,M70,M75,M80

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

PROPERTIES OF CONCRETE

Fresh concrete/green concrete

- Workability
- Segregation
- Bleeding
- Consistency

Hardened concrete

- Strength
- Shrinkage
- Creep
- Thermal expansion
- Durability
- Imperviousness

APPLICATIONS OF CONCRETE

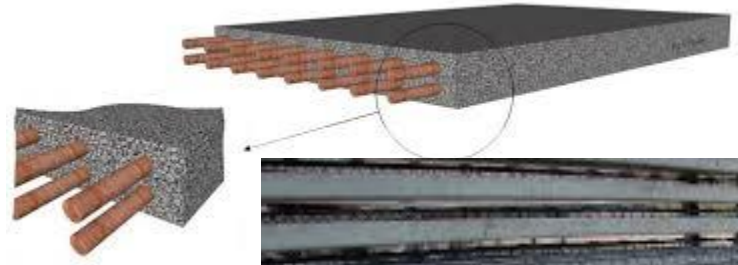
Dams, Bridges , RCC buildings, swimming pools, homes, streets, basements, balustrades, plain cement tiles, mosaic tiles, pavement blocks, lamp-posts, drain covers, benches.

Other Applications

- Beams, drain tiles, piers, steps
- Post, Beam and Deck
- Pilasters and round column forms
- High Performance Admixtures
- Soil solidification
- Insulating Concrete Form
- Motorways/roads, overpasses and parking structures
- Brick/block walls and bases for gates, fences and poles
- Building structure, fences and poles

REINFORCED CEMENT CONCRETE

RCC is a concrete combined with steel in such a way that the compressive strength of concrete and tensile strength of steel are used to the best advantage.



ADVANTAGES OF RCC

- Reinforced Cement Concrete has good compressive stress (because of concrete).
- RCC also has high tensile stress (because of steel).
- It has good resistance to damage by fire and weathering (because of concrete).
- RCC protects steel bars from buckling and twisting at the high temperature.
- RCC prevents steel from rusting.
- Reinforced Concrete is durable.
- The monolithic character of reinforced concrete gives it more rigidity.
- Maintenance cost of RCC is practically nil.

DISADVANTAGES OF RCC

- The tensile strength of reinforced concrete is about one-tenth of its compressive strength.
- The main steps of using reinforced concrete are mixing, casting, and curing. All of this affect the final strength.
- The cost of the forms used for casting RC is relatively higher.
- For multi-storied building the RCC column section is larger than steel section as the compressive strength is lower in the case of RCC.
- Shrinkage causes crack development and strength loss

Uses of RCC

Beams, Floor slabs, Columns, Walls,
Foundations, Arches, Staircases,
Water tanks, Pipes, chimneys, Retaining,
Bridge girders, Culvurts.

STEEL

STEEL

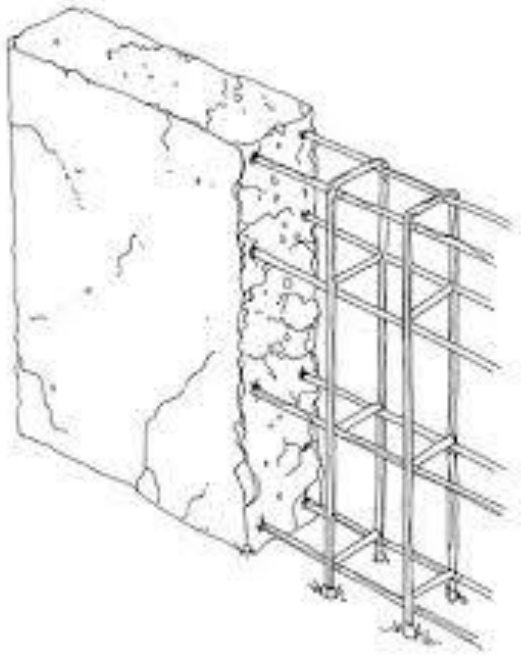
Uses of steel

- As structural material in trusses , beams etc
- As non structural material for grills, doors, windows etc
- In steel pipes,tanks etc
- In sanitary and sewer fittings,rain water goods, etc
- Corrugated sheets
- As reinforcement in concrete

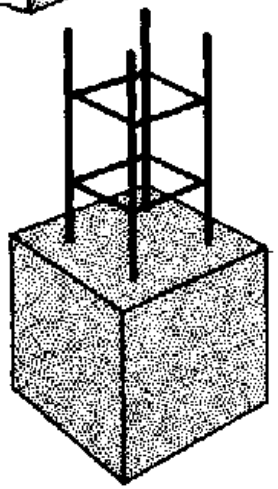
CLASSIFICATION OF STEEL

- Mild steel
- Medium carbon steel
- High carbon steel or hard steel

STEEL AS REINFOR

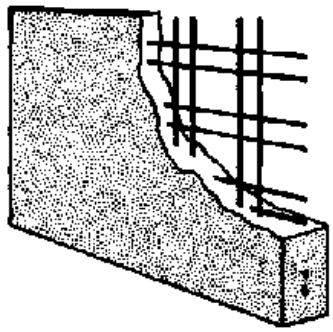


foundations;

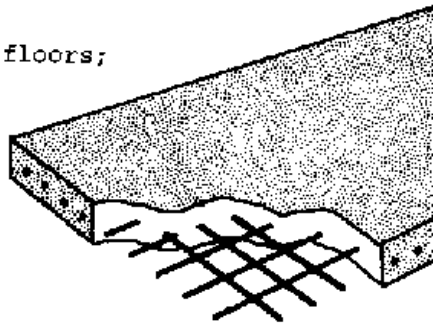


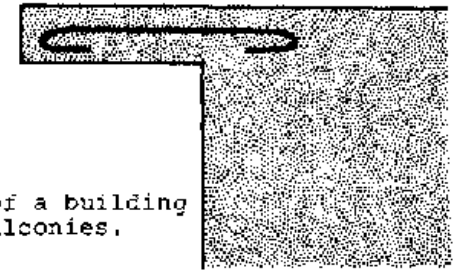
columns to support walls and ceilings;

walls;



floors;





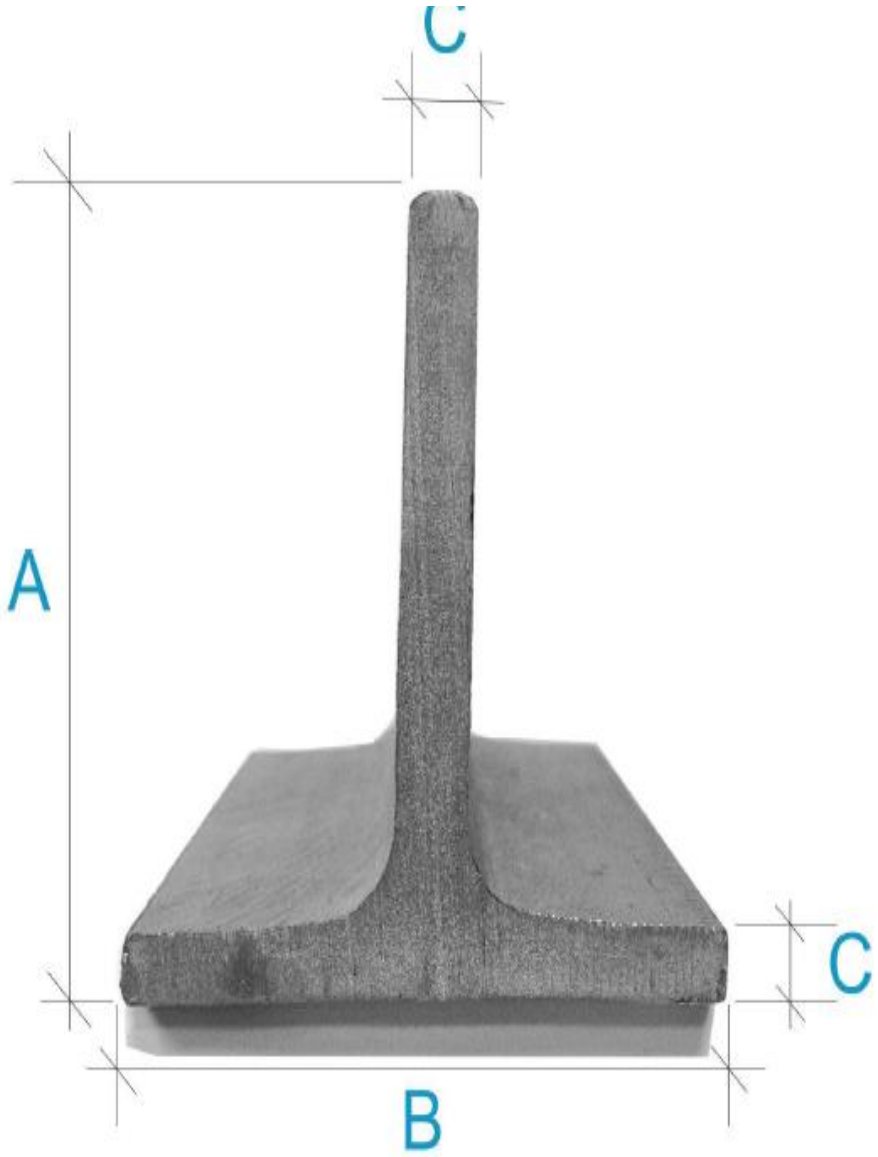
un-supported sections of a building such as overhangs or balconies.

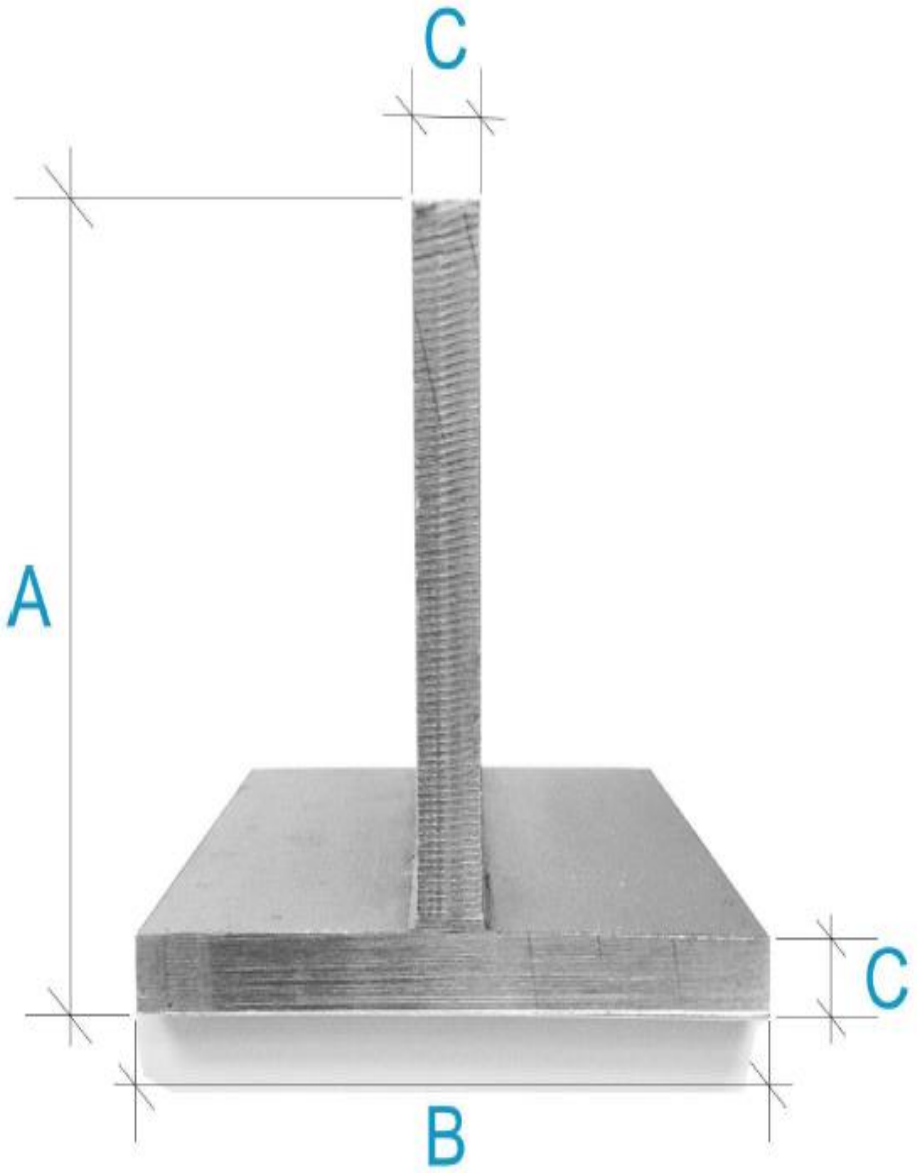
Different market forms of steel

Steel trusses

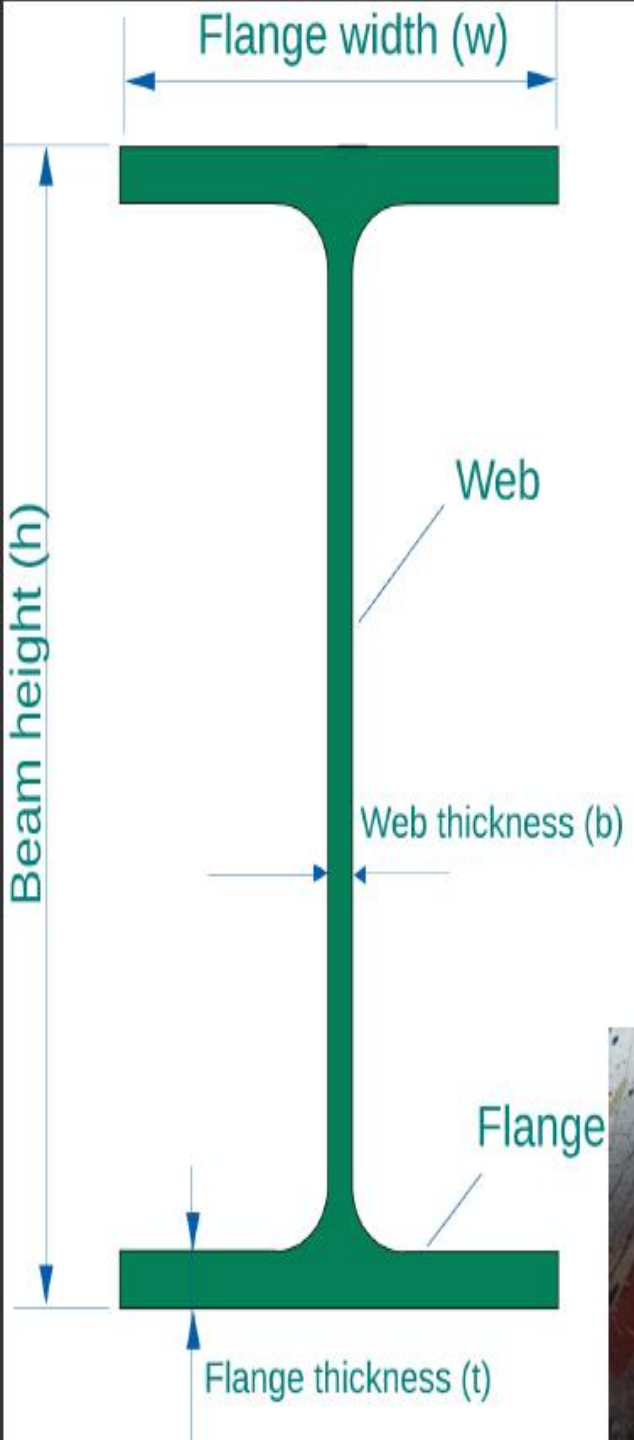
- **Steel trusses**
- **Structural member of steel framed structures**

Steel trusses
Fabrication of water tank





I - Section



Beam, lintel, columns
Steel frames
Grillage foundations


Flat Bars
Grill works, plate girder bridges

Square Bars

Grill works, windows and gates

Round Bars

Steel grill works

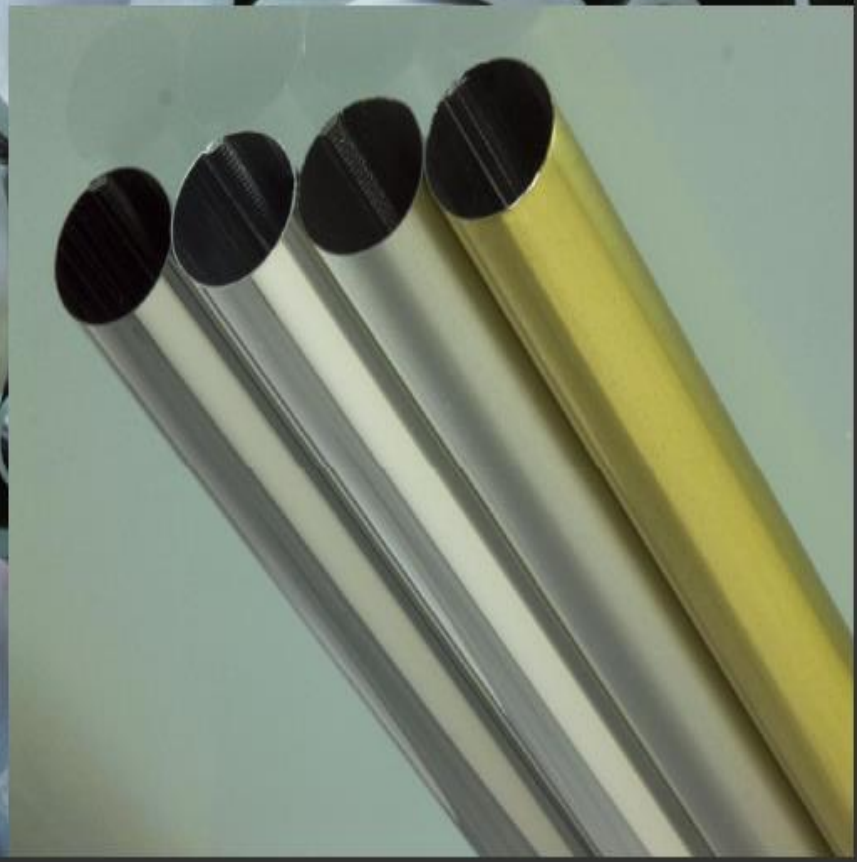


Plate girder bridges


Corrugated Sheets