

Introduction to civil Engineering

Civil engineering is the profession in which a knowledge of the mathematical and physical science gained by study, experience and practice is applied with judgement to develop ways to utilize economically the materials and forces of nature for the progressive well-being of man.

Scope of different fields of civil Engg.

- (i) Surveying (To know the relative position of various objects)
- (ii) Building material (must know the properties of all building materials)
- (iii) Construction technology (develop technology by using locally available materials)
- (iv) Structural Engineering (To give a safe and economical str^{re})
- (v) Geotechnical Engineering (Study about the load transformation safely to soil)
earthdam, canal, retaining str^{re})
- (vi) Hydraulics (Study of mechanics of water and its flow characteristics)
- (vii) Water resources and irrigation Engineering (Identifying & Planning water retaining str^{re})
- (viii) Transportation Engineering (involve design of base course, surface finishes, cross drainage)
- (ix) Environmental Engineering (Proper distribution of water, disposal of solid waste)
- (x) Architecture and town planning (Town and cities are to be planned properly)

Broad classification of Civil Engineering

Civil Engineering can be classified as,

- (i) Structural Engineering → This discipline deals with the analysis and design of concrete and steel structure such as multi-story buildings, bridges, towers etc.
→ It deals also with the study of durability and resistibility of such str^{re} for live loads, wind and earthquake.
- (ii) Water Resource and Hydraulics → It covers the basic concepts of water science and its related theorems and application.
→ This includes the methods of transporting water from sources to distribution sites through proper channels.
- (iii) Geotechnical Engineering → The study of the soil properties of the construction site and its bearing capacity.
- (iv) Environmental Engineering → The study of the necessary methods and techniques of environmental protection as well as the availability of the basic life elements such as water and air with a specific level of quality to protect the mankind health and environment.
- (v) Transportation Engineering →
- (vi) Construction Engineering and management → management of projects including planning and control of cost, time and quality.

Brick

In the world of construction, bricks play a vital role. Traditionally, the bricks were made of clay. The great wall ^{of} China was made of both burnt and sun dried bricks.

Importance of brick :-

- 1) Fire protection :- The brick do not catch fire or get affected by the heat very easily. Clay bricks have high temp. resistance upto 2000 degree Fahrenheit.
- 2) Wind Protection :- The houses made by bricks can bear stronger wind energy in comparison to houses constructed with vinyl and fiber.
- 3) Moisture Control :- If the bricks are made with perfect clay, heat and water combination, they become the best source of moisture control. These porous bricks can control moisture in the room better than any other material.
- 4) Minimal waste :- As it is mostly a just mixture of naturally occurring material, the waste product is minimal.
- 5) Countless recycling :- Bricks are used in houses and when these houses are torn down for some reason, the remaining pieces can be used as a base for the foundation of the house or of a road.

Qualities of good bricks :- A good bricks should possess the following properties.

- 1) The brick should be uniform in shape and should be of standard size.
- 2) The brick when broken should show a uniform compact and homogeneous structure free from voids.
- 3) The brick should not absorb water more than 20% of first class brick and 22% for 2nd class bricks when soaked in cold water for a period of 24 hours.
- 4) The brick should be hard enough.
- 5) The brick should not break into pieces when dropped from a height of 1m.
- 6) The brick when soaked in water for 24 hrs should not show deposits of white salts when allowed to dry in shade.
- 7) The brick should have low thermal conductivity and should be sound proof.
- 8) The crushing strength of brick should not be below 5.5 N/mm^2 .

Stones

→ stones are derived from rocks, which form the earth's crust and have no definite shape or chemical combination but are mixture of two or more minerals.

Classification :-

Rocks are classified in four different ways.

- 1) Geological Classification
- 2) Chemical Classification
- 3) Physical "
- 4) Practical "

Geological Classification

According to the mode of origin rocks are divided into three principal classes or groups.

- i) Igneous Rock
- ii) Sedimentary Rock
- iii) Metamorphic Rock

Igneous Rock

→ The molten material present ^{in the} inside portion of the earth's surface is known as magma and this magma occasionally tries to come out to the earth's surface through cracks or weak portions. This rocks which are formed by the cooling of magma are called igneous rock.

→ The igneous rock are classified into the following three types.

(i) Plutonic Rock :- Formed by the cooling of magma at considerable depth from the earth's surface.

- These are coarsely grained crystalline structure.
- Used for constⁿ
- Ex:- Granite

(ii) Hypabyssal Rock :- Formed at a relatively shallow depth.

- These are also finely grained crystalline stⁿ.
- Ex:- Dolerite

(iii) Volcanic Rock :- Solidification on or near the surface of earth.

- Cooling is very rapid.
- Ex:- Basalt

Sedimentary Rocks

→ Formed by weathering action and subsequent transportation by air or river, glacier and sea. Ex:- sandstone, limestone, gypsum

4 types

- (i) Residual Deposit :- Some portion of the products of weathering remains at the site of origin.
- (ii) Sedimentary Deposit :- Product of weathering are carried away in suspension, and when such products are deposited, they give rise to sedimentary rocks
- (iii) Chemical deposit :- Some material that is carried away in solⁿ may be deposited by some physicochemical process such as evaporation & precipitation.
- (iv) Organic deposit :- Product of weathering gets deposited through the agency of organisms.

3) Metamorphic Rocks :-

→ Formed by the change in character of the pre-existing rocks.
→ Igneous as well as sedimentary rocks change in character when they are subject to great heat and pressure. The process of change is known as metamorphism.

→ The four types of metamorphism that occur with various combination of heat, uniform pressure and directed pressure.

- (i) Thermal Metamorphism :- Heat is predominant
- (ii) Cataclastic Metamorphism :- Metamorphism is done by pressure
- (iii) Dynamo thermal metamorphism :- Heat in combination with stress brings about the changes in the rock.
- (iv) Plutonic Metamorphism :- stress is effective only up to a certain depth. Metamorphism changes at great depths are the result, brought about by uniform pressure and heat.

Ex-of metamorphic rock :- Marble, Quartzite, Slate

Chemical Classification :- On the basis of dominant chemical composition the building stone may fall into following category.

- (i) Silicious Rock :- Silica predominates, hard & durable, not easily affected by weathering agencies. Silica is a weaker mineral, may disintegrate easily.
Ex :- granite, quartzite etc.

1) Argillaceous Rocks :- clay predominates. Such rocks may be dense and compact or they may be soft. Ex- slates, laterites etc.

(ii) Calcareous Rocks :- Calcium carbonate predominates. Durability of these rocks will depend upon the constituents present in the surrounding atm. Ex → Limestone, marbles etc.

Physical Classification

classification is based on the general structure of rocks.

3 types.

1) (i) Stratified Rocks :- Rocks possess planes of stratification.

→ They can easily split up along these planes.

Ex :- Sedimentary rock.

(ii) Unstratified Rocks :- Rocks are unstratified. These str^{uc} may be crystalline granular or compact granular

→ Igneous rock

(iii) Foliated Rocks :- These rocks have a tendency to be split up in a definite dirⁿ only.

→ Metamorphic rocks. (Gneiss)

Practical Classification

→ Based on the usage.

→ These are classified as granite, basalt, laterite, marble, limestone, sandstone and slate.

Characteristics of stone :-

1) Density :- It simply refers to the wt. of a stone and is measured relative to the density of water. Most type of stone in the earth's crust have similar densities. A dense stone like granite will offer superior durability and strength. Other ex of dense stones include basalt, dolomite and slate.

2) Porosity :- Porosity is the amount of open space between mineral grains in a stone (and generally dictates permeability). A very porous stone like sandstone, will absorb liquids quickly, they are susceptible to staining, etching, spalling etc.

3) Permeability :- Permeability is the ability of liquids to move through a stone. While permeability is closely linked to porosity, a stone can have low porosity and high permeability depending on its grain str^{uc}.

- 4) Absorption :- Moisture reduces the strength of the rocks and such rocks that contain or absorb great amount of moisture show lower strength values.
- 5) Durability :- It denotes the period in years for which a stone may stand practically unaltered after being used in constⁿ.
- 6) Hardness :- For use in stⁿ subjected to very heavy loadings, such as for constructing bridges, piers and abutments are marine stⁿ and particularly where they are subjected to abrasion hardness of the stone is a necessary requirement.

Composition of stone

- ⇒ Silicate :- These stones are mostly of quartz-like particles called silica. They are very hard, durable and generally acid resistant.
Ex: - granite, sand stone, slate and quartzite.
- ⇒ Calcium Carbonate :- The minerals in these stones were formed under pressure over million years from the bodies of tiny fossilized creatures. These stones are softer, less durable.
Ex: - lime stone, marble

BRICK MASONRY

→ It is made up of brick units bonded together with mortar.

Components → Brick
Masonry

Types of mortar → Cement mortar
Lime mortar
Cement-lime
Lime-surkhi
mud

Types of brick → Traditional
Modular

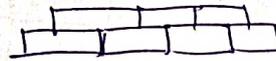
Traditional → It has not been standardized in size.
→ Dimension varies from place to place. Thickness → 7.5 cm

Width → 10-13 cm L → 20 to 25 cm.

Modular brick → Any brick which is the same uniform size
→ The nominal size → (20 x 10 x 10) cm Actual size → (19 x 9 x 9) cm

Bond in brick work →

- (a) Stretcher bond → Length of the brick is along the face of wall → Used only for those walls which have thickness of half brick.
- (b) Header bond
- (c) English bond
- (d) Flemish bond
- (e) Facing bond
- (f) Zigzag bond

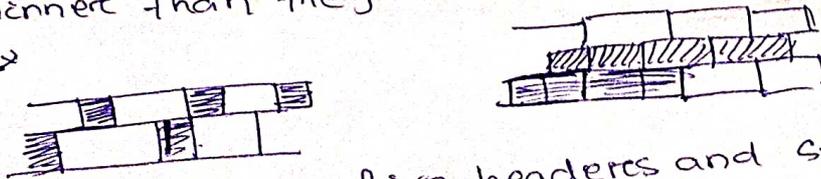


Header bond → The width of the bricks are thus along the dirⁿ of the wall used only when the wall is equal to the one brick.



English → @ commonly used → strongest bond. alternate course of st & header. Every alternate header come centrally over the joint betⁿ two stretchers, the joint in the header course are made thinner than the joints in the stretcher course.

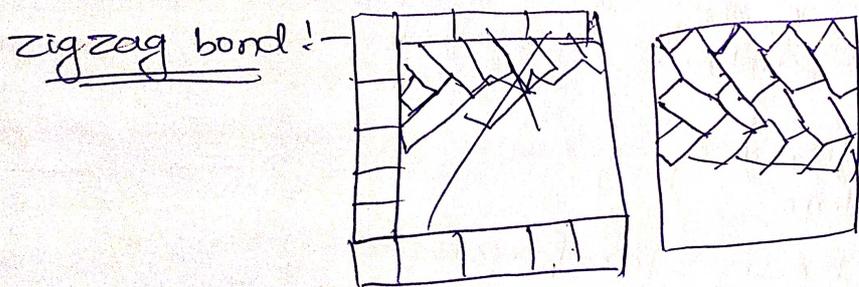
Flemish →



→ Comprised of alternative headers and stretchers.
↳ Double → Every course consist of alternatively the rest. same appearance of wall from back & front.
↳ Single → comprised of double Flemish bond bond facing an English bond. backing ?

Facing bond :- Where the bricks of diff. thickness are to be used in facing and backing of the wall. The nominal $t = 10\text{cm}$ & backing $= 9\text{cm}$. Header course provided at vertical interval of 90cm .

English ^{cross} bond :- This is the modification of English bond to improve the appearance of the wall



What is stone masonry?

The art of building a str^{ct} in the stone with any suitable masonry called stone masonry.

Different type of masonry.

- 1) Rubble masonry
- 2) Ashlar masonry

Rubble Masonry

The stone masonry in which either undressed or roughly dressed stone are laid in a suitable mortar is called rubble masonry.

⇒ In this masonry, the joints are not of uniform thickness.

3 types

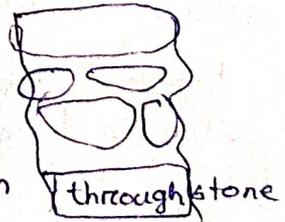
- (i) Random rubble masonry
- (ii) Squared rubble "
- (iii) Dry rubble "

⇒ Random rubble masonry :- The rubble masonry in which either undressed or hammer dressed stones are used is called random rubble masonry.

- ↳ Uncoursed
- ↳ Coursed

Uncoursed :- In which stones are laid without forming courses is known as un-coursed random r.m.

- ⇒ This is roughest and cheapest type of masonry and is of varying appearance.
- ⇒ The size of stone are different in size and shapes.
- ⇒ Used for constⁿ of walls of low height in case of ordinary buildings.
- ⇒ At the time of construction one "through stone" is used for every square meter.



• Crushed random rubble

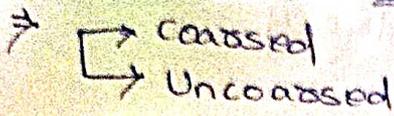
⇒ In which stones are laid in layers of each height called random masonry.

⇒ The stones are laid in some what level courses.

⇒ Used for the constⁿ of residential building, garden, boundary wall etc.

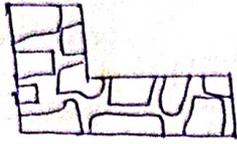


Squared Rubble Masonry → stones are squared on all joints



Coursed :- In which chisel dressed stones laid in courses is course square rubble masonry.

→ Used for construction of public buildings, hospital, schools etc.



Uncoursed :- In which hammer dressed stones are laid without making course.

→ It consists stones which are squared on all joints.

→ Used for the constⁿ of ordinary building in hilly areas.

2) Dry rubble masonry :- The masonry in which stones are laid without using any mortar is called dry r. m.

→ It is an ordinary masonry and recommended ht. for constⁿ is not more than 6m.

Ashlar Masonry :- The stone masonry in which finely dressed stones are laid in cement or lime mortar

→ In this masonry the course are uniform ht., all the joints are regular, thin and have uniform thickness.

→ This type is much costly

→ Used for heavy str, architectural building.

1) Ashlars fine or coarse ashlar masonry

2) Random course ashlar masonry → It consists of (1) but varying thickness

3) Rough tooled ashlar " → Side of the stone are rough tooled

4) Rock or quarry faced " " → Thickness is uniform but not exceed 6mm

5) Block in course masonry → The intermediate class betⁿ rubble and ashlar

6) Ashlar facing. → Best type, not commonly used throughout the wall except in works of great importance. Strength

1) Ashlar ~~random~~ fine or coarse :- Stone blocks of same size, thickness is uniform, expensive type, requires heavy labor. give satisfactory bond.