

YOUTH COMPETITION TIMES

RRB JE

2nd Stage (CBT-II)

CAPSULE

**CIVIL & ALLIED
ENGINEERING**

Study Material & Question Bank

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Syllabus for Civil & Allied Engineering

Exam Group - JE

S.N.	Subject
1.	Engineering Mechanics- Force (resolution of force, moment of force, force system, composition of forces), Equilibrium, Friction, Centroid and Center of gravity, Simple machines.
2.	Building Construction- Building components (substructure, superstructure), type of structure (load bearing, framed and composite structures).
3.	Building materials- Masonry materials (stones, bricks, and mortars), Timber and miscellaneous materials (glass, plastic, fiber, aluminium steel, galvanized iron, bitumen, PVC, CPVC, and PPF).
4.	Construction of substructure- job layout, earthwork, foundation (types, dewatering, coffer dams, bearing capacity).
5.	Construction of superstructure- stone masonry, brick masonry, Hollow concrete block masonry, composite masonry, cavity wall, doors and windows, vertical communication (stairs, lifts, escalators), scaffolding and shoring.
6.	Building finishes- Floors (finishes, process of laying), walls (plastering, pointing, painting) and roofs (roofing materials including RCC).
7.	Building maintenance- Cracks (causes, type, repairs- grouting, guniting, epoxy etc.), settlement (causes and remedial measures), and re-baring techniques.
8.	Building drawing- Conventions (type of lines, symbols), planning of building (principles of planning for residential and public buildings, rules and byelaws), drawings (plan, elevation, section, site plan, location plan, foundation plan, working drawing), perspective drawing.
9.	Concrete Technology- Properties of various types/grades of cement, properties of coarse and fine aggregates, properties of concrete (water cement ratio, properties of fresh and hardened concrete), Concrete mix design, testing of concrete, quality control of concrete (batching, formwork, transportation, placing, compaction, curing, waterproofing), extreme weather concreting and chemical admixtures, properties of special concrete (ready mix, RCC, pre-stressed, fiber reinforced, precast, high performance).
10.	Surveying- Types of survey, chain and cross staff survey (principle, ranging, triangulation, chaining, errors, finding area), compass survey (principle, bearing of line, prismatic compass, traversing, local attraction, calculation of bearings, angles and local attraction) leveling (dumpy level, recording in level book, temporary adjustment, methods of reduction of levels, classification of leveling, tilting level, auto level, sources of errors, precautions and difficulties in leveling), contouring (contour interval, characteristics, method of locating, interpolation, establishing grade contours, uses of contour maps), area and volume measurements, plane table survey (principles, setting, method), theodolite survey (components, adjustments, measurements, traversing), Tacheometric survey, curves (types, setting out), advanced survey equipment, aerial survey and remote sensing.
11.	Computer Aided Design- CAD Software (AutoCAD, Auto Civil, 3D Max etc.), CAD commands, generation of plan, elevation, section, site plan, area statement, 3D view.

12.	Geo Technical Engineering- Application of Geo Technical Engineering in design of foundation, pavement, earth retaining structures, earthen dams etc., physical properties of soil, permeability of soil and seepage analysis, shear strength of soil, bearing capacity of soil, compaction and stabilization of soil, site investigation and sub soil exploration.
13.	Hydraulics- properties of fluid, hydrostatic pressure, measurement of liquid pressure in pipes, fundamentals of fluid flow, flow of liquid through pipes, flow through open channel, flow measuring devices, hydraulic machines.
14.	Irrigation Engineering- Hydrology, investigation and reservoir planning, percolation tanks, diversion head works.
15.	Mechanics of Structures- Stress and strain, shear force and bending moment, moment of inertia, stresses in beams, analysis of trusses, strain energy.
16.	Theory of structures- Direct and bending stresses, slope and deflection, fixed beam, continuous beam, moment distribution method, columns.
17.	Design of Concrete Structures- Working Stress method, Limit State method, analysis and design of singly reinforced and doubly reinforced sections, shear, bond and development length, analysis and design of T Beam, slab, axially loaded column and footings.
18.	Design of Steel Structures- Types of sections, grades of steel, strength characteristics, IS Code, Connections, Design of tension and compression members, steel roof truss, beams, column bases.
19.	Transportation Engineering- Railway Engineering (alignment and gauges, permanent way, railway track geometrics, branching of tracks, stations and yards, track maintenance), Bridge engineering (site selection, investigation, component parts of bridge, permanent and temporary bridges, inspection and maintenance), Tunnel engineering (classification, shape and sizes, tunnel investigation and surveying, method of tunneling in various strata, precautions, equipment, explosives, lining and ventilation).
20.	Highway Engineering- Road Engineering, investigation for road project, geometric design of highways, construction of road pavements and materials, traffic engineering, hill roads, drainage of roads, maintenance and repair of roads.
21.	Environmental Engineering- Environmental pollution and control, public water supply, domestic sewage, solid waste management, environmental sanitation, and plumbing.
22.	Advanced Construction Techniques and Equipment- Fibers and plastics, artificial timber, advanced concreting methods (under water concreting, ready mix concrete, tremix concreting, special concretes), formwork, prefabricated construction, soil reinforcing techniques, hoisting and conveying equipment, earth moving machinery (exaction and compaction equipment), concrete mixers, stone crushers, pile driving equipment, working of hot mix bitumen plant, bitumen paver, floor polishing machines.
23.	Estimating and Costing- Types of estimates (approximate, detailed), mode of measurements and rate analysis.
24.	Contracts and Accounts- Types of engineering contracts, Tender and tender documents, payment, specifications.

CHARACTERISTICS OF A FORCE

In order to determine the effects of a force acting on a body, we must know—

- Magnitude of the force (i.e. 100 N, 50 N, 20 N etc.)
- Line of action of the force (i.e. along OX, OY, at 30° north etc.)
- Nature of the force (i.e. push or pull).

- **Composition of Forces :** The process of finding out the resultant force, of a number of given forces is called composition of forces.

Method for the resultant force :

- **Parallelogram law of forces :**

$$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2 \cos \theta}$$

$$\tan \alpha = \frac{F_2 \sin \theta}{F_1 + F_2 \cos \theta}$$

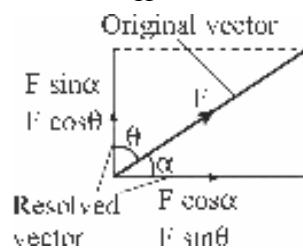
$\theta = 0^\circ$	Force act along the same line.
$\theta = 90^\circ$	Force act at right angle.
$\theta = 180^\circ$	Force act along same line but in opposite directions.

- **Resolution of forces :** The process of splitting up the given force into number of components without changing its effect on the body.

Note : In general, the forces are resolved in the vertical and horizontal direction.

$$\text{Resultant force } (R) = \sqrt{(H)^2 + (V)^2}$$

$$\tan \theta = \frac{V}{H}$$



- **Systems of Forces-**

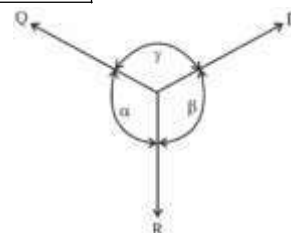
Force system	Definition
Coplanar forces	The forces, having lines of action lie on the same plane.
Collinear forces	Line of action of forces lie on the same line.
Concurrent forces	When the forces meet at single point or line of action of all forces passes through a single line

Coplanar concurrent forces	Line of action lies in a same plane and meets at a single point to each other.
Coplanar non-concurrent forces	The forces, whose lines of action lie on the same plane but do not meet at a single point.
Non-coplanar concurrent forces	Line of action does not lie on the same plane but meet at a single point.
Non-coplanar non-concurrent forces	The forces, whose lines of action do not lie on the same plane and do not meet at single point.
Non-concurrent forces	Line of action of all forces do not pass through a single point.
Collinear forces	Line of action of all forces passes through a single line.
Parallel forces	Line of action of all forces are parallel to each other.
(a) Like parallel forces	Line of action of all forces are parallel to each other in same direction.
(b) Unlike parallel forces	Line of action of all forces are parallel to each other in different direction.
Non-parallel forces	Line of action of all forces are not parallel each other.

- **Equilibrium of force :**

- If the resultant of a number of forces acting on a particle is zero, the particle will be in equilibrium.
- **Condition of equilibrium :**
- The horizontal component of all the forces (ΣH) and vertical component of all the forces (ΣV) must be zero. $\Sigma H = 0$ and $\Sigma V = 0$.
- The resultant moment of all the forces (ΣM) must be zero. ($\Sigma M = 0$).
- **Lami's theorem—** It states that if three forces coplanar and concurrent forces acting at a point be in equilibrium, then each force is proportional to the sine of the angle between the other two forces.

$$\frac{P}{\sin \alpha} = \frac{Q}{\sin \beta} = \frac{R}{\sin \gamma}$$



Note-

- Lami's theorem is applicable only for coplanar, concurrent, non-linear and radial forces.
- When applied force on body is in equilibrium then angle formed at joint should be 120° .

■ Moment of force :

• Introduction -

Rotational tendency of a force about of fixed point is called moment.

Moment, $M = \text{Force} \times \text{Perpendicular distance of force from fixed point}$

Unit- N-m

• Varignon's theorem-

"The algebraic sum of the moment of a resultant of two forces, about a point lying in the plane of the forces, is equal to the algebraic sum of moments of these two forces about the same point."
The force system may be either coplanar or spatial, but it must be concurrent.

$$\sum M_{\text{Forces}} = M_{\text{Resultant}}$$

- Principle of moments is the extension of Varignon's theorem.

• Couple -

It is a pair of two equal and opposite forces acting on a body in a such way that the lines of action of the two forces are not in the same straight line.

Ex.-Twisting a screw driver, Turning the cap, Opening or closing a water tap

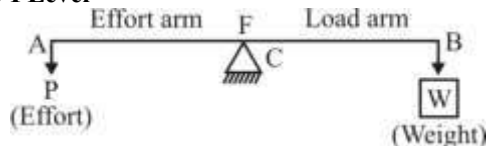
• Lever-

It is consisting of a beam or rigid rod pivoted at a fixed hinge, or fulcrum about which it can rotate.

- "It works on the principle of moments."

• Class of lever-

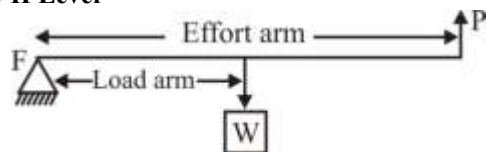
Class-I Lever-



Ex. - A pair of Scissors, Crowbar, Beam balance, Hand pump.

- Mechanical Advantage, $M.A. \geq 1$

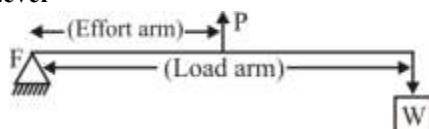
Class-II Lever-



Ex.- Nut-crackers, Wheel barrow, Paper sheet cutter, Bottle openers, Weight lifting rod

- $M.A. > 1$ (Always)

Class-III Lever-



Ex.-Fishing rod, Tongs, Human forearm, Forceps, Shovel, Knife

- $M.A. < 1$ (Always)

Mechanical Advantage (M.A.)-

$$M.A. = \frac{\text{Effort arm}}{\text{Load arm}} = \frac{\text{Load}}{\text{Effort}} = \frac{W}{P}$$

FRICTION

- **Static friction :** It is the friction experienced by a body when it is at rest or it is the friction when the body tends to move.

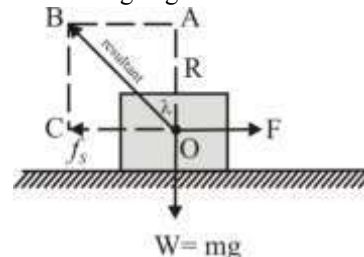
- **Dynamic friction :**

Sliding friction	It is the friction, experienced by a body when it slides over another body.
Rolling friction	The friction resisting the motion of a rolling body on another surface is known as rolling friction.

- **Limiting friction :** The max. friction force, when a body just begins to slide over the another surface of body is called limiting friction. At this condition the body just start moving.

Limiting friction > Static friction > Dynamic friction.

- **Angle of friction :** Angle between normal reaction R and resultant force is called angle of friction. It is also called limiting angle of friction.



$$\therefore \mu_s = \tan \lambda$$

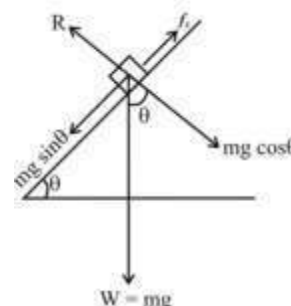
Static co-efficient of friction is equal to the tangent of friction angle.

$$\lambda = \tan^{-1}(\mu_s)$$

- **Coefficient of friction :**

$$\mu = \frac{\text{limiting friction (F)}}{\text{normal friction (R)}} = \tan \phi \text{ or } F = \mu R$$

- **Angle of repose(φ) :** Minimum angle of a inclined plane with the horizontal on which a body can slip is called angle of repose.



Angle of repose = Angle of friction

$$\tan \phi = \mu_s$$

CENTROID AND CENTRE OF GRAVITY

Centroid	It is a point through which the entire line, area or volume is assumed to be concentrated.
Centre of Gravity	Point where entire weight of the body is assumed to be concentrated. ➤ It depends upon shape of the body.

Note :

- ✗ Centre of gravity of uniform rod is at its middle point.
- ✗ Centre of gravity of a cube is at a distance of $l/2$ from every face.
- ✗ Centre of gravity of sphere is at a distance of $d/2$ from every point.
- ✗ Centre of gravity of hemisphere is at a distance of $3r/8$ from its base, measured along the vertical radius.
- ✗ The centre of gravity of right circular solid cone is at a distance of $h/4$ from its base, measured along vertical axis.

Centroid of regular plane figure-

Lamina	Area	$\bar{x}$	$\bar{y}$
Triangle	$\frac{1}{2}bh$	$\frac{b}{3}$	$\frac{h}{3}$
Rectangle	$b.h$	$\frac{b}{2}$	$\frac{h}{2}$
Circle	πr^2	r	r
Semicircle	$\frac{1}{2}\pi r^2$	r	$\frac{4r}{3\pi}$
Quadrant Circle	$\frac{1}{4}\pi r^2$	$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$
Three quadrant circle	$\frac{3}{4}\pi r^2$	$\frac{4r}{9\pi}$	$\frac{4r}{9\pi}$

■ Projectile Motion-

Height	$h = \frac{u^2 \sin^2 \theta}{2g}$	$h_{\max.} = \frac{u^2}{2g}, (\theta = 90^\circ)$
Time period	$T = \frac{2u \sin \theta}{g}$	$T_{\max.} = \frac{2u}{g}, (\theta = 90^\circ)$
Range	$R = \frac{u^2 \sin 2\theta}{g}$	$R_{\max.} = \frac{u^2}{g}, (\theta = 45^\circ)$

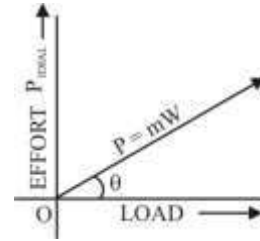
SIMPLE MACHINE

It is a device, which enables us to do some useful work at some point or to overcome some resistance, when an effort or force is applied on it, at some other convenient point.

● Law of machine-

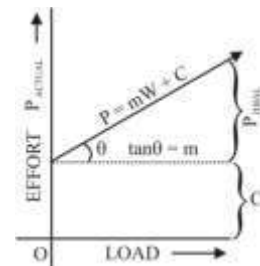
It is relationship between the effort applied and the load lifted.

- For an ideal machine the straight line will pass through the origin.



$$P = mW$$

- For an actual machine straight line will have an intercept at C.
- The intercept C is the amount of effort required by the machine to overcome the friction.



$$P = mW + C$$

Where,

P = Applied effort to lift the load.

m = Slope of graph = $\tan \theta$ (constant)

W = Lifted load

C = Constant (machine friction)

TECHNICAL TERMS USED IN MACHINES-

(i) Effort (P)-

The force which is applied to lift a load is called effort.

(ii) Mechanical advantage -

$$M.A. = \frac{\text{Lifted Load}}{\text{Applied Effort}} = \frac{W}{P}$$

(iii) Velocity Ratio -

$$V.R. = \frac{\text{Displacement of the effort}}{\text{displacement of the load}} = \frac{y}{x}$$

(iv) Efficiency of a machine -

$$\eta = \frac{\text{Output of the machine}}{\text{Input to the machine}} = \frac{w.x}{P.y}$$

(v) Relation b/w M.A., V.R. and η of a machine -

$$\eta = \frac{M.A.}{V.R.}$$

(a) If $\eta = 100\%$ then, $M.A. = V.R.$

(b) For Ideal machine $M.A. = V.R.$

(c) For Practical machine $M.A. < V.R.$

(vii) Ideal machine or perfect machine -

- (a) If no frictional losses, then
 $\eta = 100\%$ or 1 (Frictionless Machine)
- (b) If friction losses consider
 $\eta < 100\%$ or 1

Note-

- ✗ Non-reversible machine also called self-locking machine.
- ✗ A screw jack used for lifting the loads is a non-reversible machine.
- ✗ The velocity ratio of first system pulley is 2^n .
- ✗ The velocity ratio of second system pulley is n .

Questions Asked in Previous Years

1. How many methods can be used to find the resultant of parallel force?
- (a) Three (b) Four
(c) Two (d) Five

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Ans (c) : The process of finding out the resultant force of a number of given forces are called composition of forces. There are two methods to find resultant of forces.

(i) Analytical method :- The analytical method can be sub-divided into parallelogram law of forces and method of resolution

(ii) Graphical method

2. How many force/forces are replaced in the process of resolution?
- (a) One (b) Two
(c) Four (d) Three

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Ans (a) : Composition and Resolution of forces:-

Forces can be combined to provide a single resulting force. The process of combining forces is called the composition of forces. A single force can also be separated into two perpendicular Components. The process breaking one force into two is called resolution of forces.

3. The forces whose lines of action do not lie in one plane and they do not meet at one point are known as _____.
- (a) Non- coplanar and concurrent forces
(b) Coplanar and Non- concurrent forces
(c) Non-coplanar and Non-concurrent forces
(d) Coplanar and concurrent forces

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Ans. (c) : Non-coplanar and Non-concurrent forces-
The forces which do not meet at one point and their lines of action do not lie on the same plane are called non-coplanar non-concurrent forces.

4. The process of finding out the resultant force of a given forces is called
- (a) Net force
(b) Transmissibility

- (c) Resolution forces
(d) Composition of forces

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Ans. (d) : Composition of Forces:-

The process of finding out the resultant force of numbers of given forces is called composition of forces or compounding of forces.

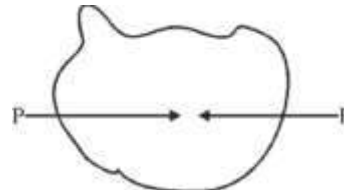
Resultant force:-

If a number of forces are acting simultaneously on a particle, then it is possible of find out a single force which could replace them, i.e., which would produce the same effect as produced by all the given forces. This single force is called resultant force and the given forces are called component forces.

5. The sum of all the forces acting on a body is Zero. The inference that can be deduced from it is:
- (a) The body may be in equilibrium provided the forces are parallel
(b) The body may be in equilibrium provided the forces are concurrent
(c) The body cannot be in equilibrium
(d) The body must be in equilibrium

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Ans. (b) : If the sum of all forces on the body is zero. It means the body may be in equilibrium provided the forces are concurrent.



If two equal and opposite forces act at a point or concurrent, the torque produced will be zero. The body will not have translational and rotational motion and will be in equilibrium.

6. Which of the following branches of mechanics deal with the equilibrium of the bodies under the effect of the forces?
- (a) Kinetics (b) Kinematics
(c) Statics (d) Dynamics

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Ans. (c) : Statics- It is that branch of mechanics which deals with the action of forces on bodies in equilibrium.

Dynamics- It is that branch of mechanics which deals with the action of forces in motion.

Kinetics- It deals with the problems which require the determination of the effect of forces on the motion of a body or conversely the forces causing a certain motion.

7. The unit of moment of force is :

- (a) N/m (b) Nm (c) N/m² (d) Nm²

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Ans. (b) : The turning effect produced by a force on a rigid body fixed about a point is called moment of a force or torque.

Moment of force = force $\times$ perpendicular distance of given of action of force from axis of rotation

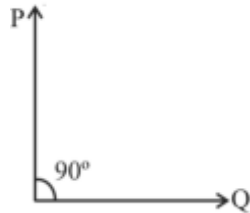
$$\tau = F \times d \text{ (N-m)}$$

8. If P and Q two forces are perpendicular to each other, then what will be resultant force R?

- (a) $R = \frac{P}{Q}$ (b) $R = P^2 + Q^2$
(c) $R = \sqrt{P^2 + Q^2}$ (d) $R = P + Q$

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Ans. (c) :



$$\theta = 90^\circ$$

Resultant formula-

$$R = \sqrt{P^2 + Q^2 + 2PQ \cos \theta}$$

$$R = \sqrt{P^2 + Q^2 + 2PQ \cos 90^\circ}$$

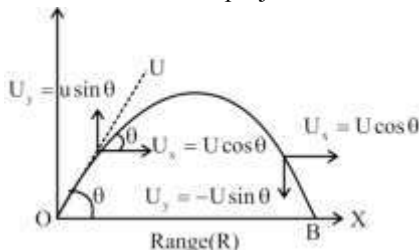
$$R = \sqrt{P^2 + Q^2}$$

9. What should be the angle of projection for a projectile so that the attained range is maximum for a given initial velocity?

- (a) 30° (b) 45°
(c) 90° (d) 60°

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Ans. (b) : **Projectile motion**- When a particle is projected parabolically near the earth surface, It moves simultaneously in horizontal and vertical direction. This type of motion is called projectile motion.



$$\text{Range of projectile} = \frac{u^2 \sin 2\theta}{g}$$

Where, u = Projected speed

θ = angle at which an object is thrown from the ground

g = acceleration due to gravity = 9.81 m/s^2

Range will be maximum when $2\theta = 90^\circ$ or $\theta = 45^\circ$

$$R_{\max} = \frac{u^2}{g}$$

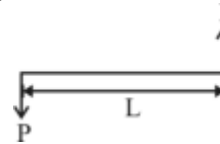
10. Which of the following statements is true about a couple?

- (a) It is a single force
(b) It produces translational motion

- (c) It consists of two parallel forces of equal magnitude but opposite direction
(d) It does not produce any moment

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Ans. (c) : **Couple**-When a pair of equal parallel forces that are opposite in direction is applied on a body, then it rotate about a point or axis is called a couple.



11. The relationship between force, mass and acceleration is given by :

- (a) Force = Mass $\times$ Acceleration
(b) Force = Mass - Acceleration
(c) Force = Mass - Acceleration
(d) Force = Mass / Acceleration

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Ans (a) : **Acceleration**:-

The rate of change of velocity of a body is called acceleration. It is a vector quantity denoted by 'a' and its SI unit is m/s^2 .

$$\therefore \text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time interval}}$$

$$a = \frac{\Delta v}{\Delta t}$$

Force:- As per Newton's 2nd law-

Change in momentum with respect to time is called force.

Mathematically:-

$$\begin{aligned} F &= \frac{\Delta P}{\Delta t} \\ &= \frac{P_{\text{final}} - P_{\text{initial}}}{\Delta t} \quad [\because P = mv] \\ &= \frac{mv - mu}{\Delta t} \\ &= \frac{m(v - u)}{\Delta t} \end{aligned}$$

$$F = m.a \quad (\text{in a given direction})$$

Impulse:- If a large force is acting on a body for a very short time, then the product of this large force (F) and time (Δt) is known as impulse and large force itself is called impulsive force.

Impulse = Force $\times$ Time

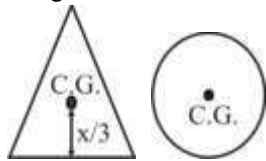
- It is a vector quantity and its SI Unit is N-s or kg- m/s

12. In a symmetrical and uniform object, where is the center of gravity located?

- (a) At the geometric center
(b) At one end of the object
(c) At the midpoint of the object
(d) At an arbitrary location

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Ans. (a) : Center of gravity—The point at which all the weight of an object may be considered to be concentrated.
 • In symmetrical and uniform object the center of gravity is located at geometric center.



13. Select the correct statement regarding the 1st and 2nd moment of area of circular lamina with radius 'R'.

- (a) 1st moment of area is always +ve and 2nd moment of area is always -ve.
- (b) 1st moment of area and 2nd moment of area are always +ve.
- (c) 1st moment of area is may be either -ve or +ve based on the chosen reference axes, but 2nd moment of area is always +ve.
- (d) 1st moment of area is always -ve and 2nd moment of area is always +ve.

SSC JE 11/10/2023 (Morning)

Ans. (c) : 1st and 2nd moment of area of a circular lamina with radius 'R' is indicating 1st moment of area is may be either -ve or +ve based on the reference axis but 2nd moment of area is always +ve.

14. What is the term for the force that opposes the relative motion or tendency of such motion of two surfaces in contact?

- (a) Friction
- (b) Tension
- (c) Gravity
- (d) Inertia

PSSSB JE (Civil) 21.01.2024

Ans. (a) : Friction—Friction always acts to oppose relative motion between two surfaces in contacts.

Gravity—Gravity is a force that pulls things downward.

Inertia—The tendency of an object to resist a change in its motion.

15. The maximum value of frictional force, which comes into play when a body just begins to slide over the surface of the other body, is known as:

- (a) coefficient of friction
- (b) angle of friction
- (c) normal reaction
- (d) limiting friction

Kerala PSC Sub Engg. 12/07/2023

Ans. (d) : Limiting Friction:-

The maximum value of frictional force, which comes into play, which a body just begins to slide over the surface of the other body, is known as limiting friction.

Coefficient of Friction:-

It is defined as the ratio of limiting friction to the normal reaction (R_N) between the two bodies. It is generally denoted by ' μ '.

Mathematically,

$$\text{Coefficient of Friction } (\mu) = \frac{F}{R_N}$$

16. Efficiency of the machine is given by

- (a) Velocity Ratio/Mechanical Advantage
- (b) Mechanical Advantage/Velocity Ratio
- (c) Mechanical Advantage/Machine friction
- (d) Velocity Ratio/Machine friction

BMC Tech. Asst. (Civil) 22/10/2023

Ans. (b) : Efficiency of machine :- The work done on the machine by plying the effort is called work input W_{input} similarly the work done by the machine on the load in called work output (W_{output})

$$\eta = \frac{\text{work output}}{\text{work input}}$$

$$= \frac{L \times d_L}{E \times d_E} = \frac{L/E}{d_L}$$

$$\text{so } \eta = \frac{\text{Mechanical advantage}}{\text{Velocity ratio}}$$

17. A machine is said to be reversible when the

- (a) load gets lowered on the application of the effort
- (b) load gets highered on the removal of the effort
- (c) load gets highered on the application of the effort
- (d) load gets lowered on the removal of the effort

GSSSB AAE (Civil) 17/12/2023

Ans. (d) : Reversible machine—It is said to be reversible when the load (W) gets lowered on the removal of the effort. In such a case, work is done by the machine in reverse direction.

Irreversible machine—It is said to be irreversible when the load (W) does not fall down on the removal of the effort. In such a case, work is not done in the reverse direction.

The machines having efficiency less than 50% are irreversible or self-locking, whereas, machines having efficiency greater than 50% are said to be reversible.

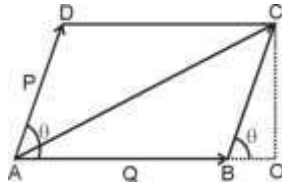
18. Which of the following statements is/are correct?

- A. The forces are represented by the directions only in the polygon law of forces.
- B. In the triangular law of forces, the resultant force is shown in the same order as the applied forces.
- C. In the parallelogram law of forces, the forces are acting simultaneously on a body.
- D. In the triangular law of forces, the resultant force is shown in the reverse order of the applied forces.

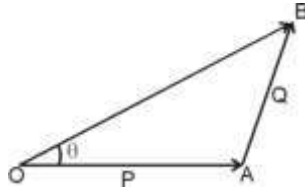
- (a) C and D
- (b) A and B
- (c) A and C
- (d) B and D

TSPSC AE 05/03/2023

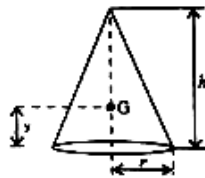
Ans. (a) : • In the parallelogram law of forces, the forces are acting simultaneously on a body.
• Forces are represented by both direction and magnitude in polygon law of forces.



• In the triangular law of forces, the resultant force is shown in the reverse order of the applied forces.



19. What will be the value of 'y', the distance of center of gravity, for the SOLID CONE given in the figure?



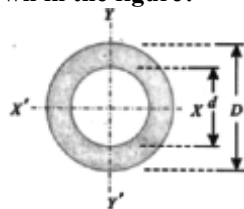
- (a) $\frac{r}{4}$ (b) $\frac{h}{4}$
(c) $\frac{h}{3}$ (d) $\frac{r}{2}$

DDA JE 01/04/2023 Shift-I

Ans. (b) :

- The centre of gravity of a cube is at a distance $\ell/2$ from every face.
- The centre of gravity of a cylinder is at a distance of $h/2$ from its base.
- The centre of gravity of right circular cone is at a distance of $h/4$ from its base, measured along the vertical axis. (where; h = height of cylinder)
- The centre of gravity of a segment of sphere of a heights h is at a distance $\frac{3(2r-h)^2}{4(3r-h)}$ from the centre of the sphere, measures along the height.

20. Which of the following expressions is correct to compute the moment of inertia (I_{yy}) of a hollow section shown in the figure?



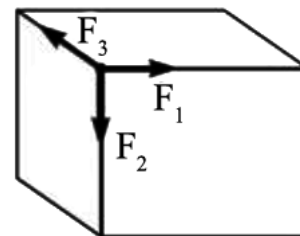
- (a) $\frac{\pi}{64}(D^4 - d^4)$
(b) $\frac{\pi}{8}(D^4 - d^4)$
(c) $\frac{\pi}{16}(D^4 - d^4)$
(d) $\frac{\pi}{32}(D^4 - d^4)$

AIIMS Rishikesh JE (Civil) 30/09/2023

Ans. (a) :

Lamina	I_{xx}	I_{yy}
Hollow Circular Section	$\frac{\pi}{64}(D^4 - d^4)$	$\frac{\pi}{64}(D^4 - d^4)$
Triangle	$\frac{bh^3}{36}$	$I_{yy} = \frac{hb_1^3}{12} + \frac{hb_2^3}{12}$
Circle	$\frac{\pi D^4}{64}$	$\frac{\pi D^4}{64}$
Rectangle	$\frac{bh^3}{12}$	$\frac{hb^3}{12}$
Ellipse	$\frac{\pi ab^3}{4}$	$\frac{\pi ba^3}{4}$

21. The system of force represented in the following figure is the _____

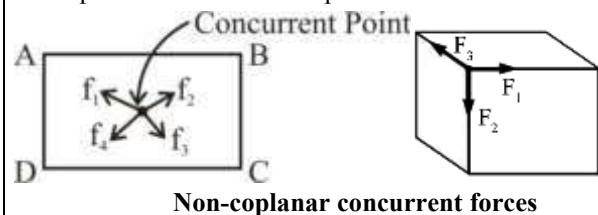


- (a) coplanar concurrent force system
(b) non-coplanar concurrent force system
(c) coplanar non-concurrent force system.
(d) non-coplanar non-concurrent force system

APPSC AE (Civil/Mech.) 15/05/2022

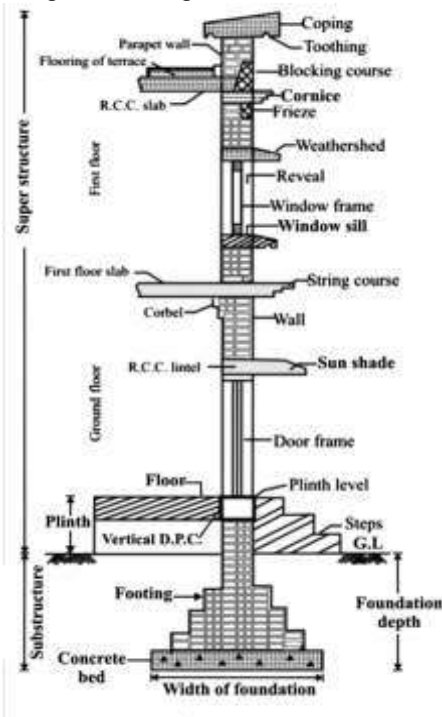
Ans. (b) : Non-coplanar concurrent force system-

Multiple forces lying in different plane and intersecting at one point are called non-coplanar concurrent force.



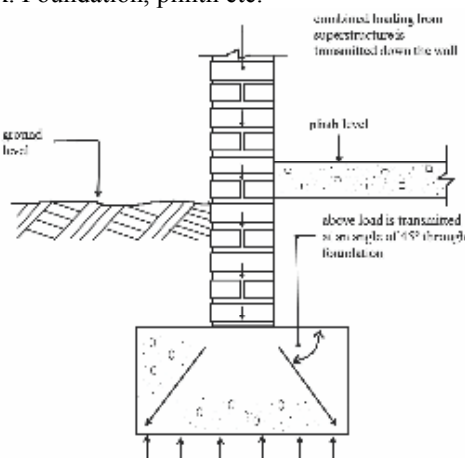
COMPONENTS OF BUILDING

- The building components are the structures that serve the purpose of load transfer, supporting, and protecting the building.



Sub Structure

- A substructure transfers the load from the various building components to the earth.
- It is the parts of building, constructed below the ground level (G.L.)
Ex. Foundation, plinth etc.



Substructure and its components

■ Foundation

- It is the lowest part of the building structure resting on soil below ground level. Its main function is to distribute the load evenly and safely to the ground.

■ Plinth

- The part of the structure between the surface of the surrounding subsoil and the surface of the raised floor of the building, immediately above the ground.
- The width of the plinth beam should be equal to the width of the foundation at the ground level.
- It acts as a barrier to the dampness and moisture reaching the superstructure.
- The plinth protects from water seepage in a framed structure.
- It protects the building from cracks at the time of settlement of the foundation.

Super Structure

- The portion above the ground floor level is known as super structure. It includes walls, columns, beam, floor, roofs, door and windows, lintel etc.

■ Damp Proof Course :

DPC is a barrier of impervious material built into wall or pier to prevent moisture from moving to building foundation. It is mainly laid on plinth beam at plinth level or floor level.

Thickness - 2.5 - 4 cm with cement concrete 1 : 1.5 : 3 and cement mortar 1 : 2 DPC provided over full width of plinth wall but not provided at the sill of door and verandah opening.

■ Walls

- A wall can be used for the transfer of load or for just partition purposes.
- Walls are of different types depending on their usage and location such as cavity walls, partition walls, retaining walls, compartment walls, dwarf walls, parapet walls, and curtain walls.

■ Classification of walls -

1. Load bearing walls -

The wall which is constructed to support superimposed load and their own loads.

- Such a wall is made in first class brick and rich mortar.

Ex. Solid wall with piers (pilasters), Veneered wall, Cavity wall, Solid wall.

2. Non-load bearing walls or Drop walls-

It takes only self load i.e. partition wall. It serves as screen for privacy.

- It can be removed without affecting the building structure.

- Generally thickness is 100-125 mm
Ex. Partition wall, Panel wall, Curtain wall, Free standing wall, Dwarf wall

3. Retaining walls -

A structure provided to the down side of the road to protect freshly cut/fill or old surface of a natural hill.

- It is used for support artificial cutting.

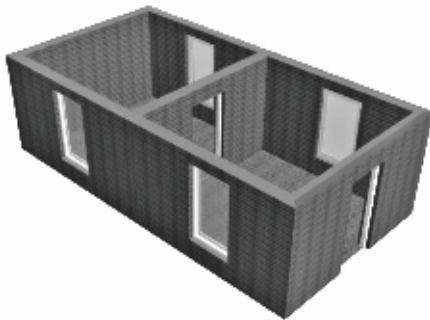
4. Partition walls-

It is a thin wall constructed to divide an enclosed space.

TYPE OF STRUCTURE

■ Load bearing structure :

- The structure in which a load of the roof is transferred through the walls to the foundation.
- The loadbearing structures are used for the construction of small buildings. Small structures like temples, small houses, rural buildings, and low-rise buildings are examples of load-bearing structures.
- Residential building up to ground + 2 floors can be built economically with such structure.
- The load-bearing structure has good sound insulation properties.



■ Framed structure :

- The building components like beams, columns, and slabs are integrated to form a framed structure.
- In the framed structure, the load is transferred through this frame to the foundation.
- The framed structure offers good stability and strength. These structures can easily withstand earthquake loads and wind loads.
- These structures can be used to construct multi-story buildings.
- These structures can absorb the shocks and vibrations in a better way as compared to loadbearing structures.



■ Composite Structures :

- The load-bearing and framed structures are combined to form the composite structures. The composite structures are used for long spans.

- The advantages of load-bearing structures and framed structures are coined in composite structures.
- The walls in the composite buildings act as load-bearing structures while the columns run through the structure as framed structures.
- Some examples of composite structures are long shed diaries, storage houses, workshops, etc.

■ National Building Code-

NBC is a document that provides guidelines for construction, maintenance and fire safety of the structure.

- NBC was first published in **1970**.
- Minimum life period of building is taken **50 years**.
- Most economical shape of building is **square shape**. It is most earthquake resistance shape.
- **IGBC** - Indian Green Building Council.

❖ Classification of Building in Civil Engineering-

Group	Building Classification	Use
A	Residential Building (Treats as light construction)	Sleeping, Living with or without cooking or dining
B	Educational Building	Education purpose.
C	Institutional Building	Medical or other treatment or care of persons suffering from physical or mental illness. Ex.- Nursing home, orphanage, jail, sanatoria, hospitals.
D	Assembly Building	Building where groups of people gather. Ex.- Temple, assembly halls, theatre
E	Business Building	Used for keeping records of business transactions, town halls, court house etc.
F	Mercantile Building	Used as housing shops, stores, showrooms to display and sales.
G	Industrial Building	Assembling or processing all types of material is to be carried out.
H	Storage building	Storage purpose or sheltering of goods, vehicles, grains.
J	Hazardous building (Notational colour → Black)	For storage, handling and manufacturing of explosive materials.

Questions Asked in Previous Years

1. A metal fastener which connects wythes of masonry to each other or to other materials is known as _____.
 (a) Bond (b) Wall tie
 (c) Column (d) Pier

GSSSB Planning Asst. 30/03/2024

Ans. (b) : Wall tie— A wall tie is a mechanical metal fastener that connects wythes of masonry to each other or the other materials, also referred to as an anchor.

2. A panel wall is an _____ in a framed building.
 (a) Internal non-load bearing wall
 (b) External load-bearing wall
 (c) Internal load-bearing wall
 (d) External non-load bearing wall

UKPSC JE (Civil) 24/12/2023 Paper-I

Ans. (d) : Panel wall—Panel wall is the external non-load bearing wall, commonly related to framed structures.

Non-load bearing wall—Non-load bearing wall carry their own load only. They generally serve as divide walls or partition walls.

Load bearing wall—Load bearing wall are designed to carry super-imposed loads transferred through roofs in addition to their own self weight.

3. Which of the following offers a sense of security and protection?
 (a) Boundary wall (b) Area wall
 (c) Edge wall (d) Perimeter wall

MP Vyapam Sub Engg. 06/11/2022 Shift-II

Ans. (a) : Boundary wall— Boundary wall means any wall, fence, or enclosing structure erected on or directly next to a cadastral property boundary, and any other structure, including security devices, such as spikes, barbed wire, razor wire, or electric fences, affixed to or on top of a boundary wall.

4. Minimum gap between openings in wall should be
 (a) 1 brick (b) 2 bricks
 (c) 3 bricks (d) 2.5 bricks

PSSSB JE (Civil) 20.01.2024

Ans. (b) : The minimum gap between openings in wall should be 18 inches or 2 bricks.

5. What is the minimum recommended wall thickness for load bearing walls?
 (a) 100 mm (b) 50 mm
 (c) 300 mm (d) None of the above

HSSC JE 18.02.2024

Ans. (a) : According to IS 456 : 2000-

- Minimum thickness of load bearing RCC wall should be 100 mm.
- If the story height is equal to length of RCC wall, the percentage increase in strength is 10.

6. If the soil is dry, DPC for ground floor consists of the layer of
 (a) metal (b) coarse sand
 (c) fine sand (d) concrete

PSPC JE 06/03/2022

Ans. (b) : If the soil is dry, DPC for ground floor consist of the layer of coarse sand. Coarse sand layer of about 75-100 mm thickness is provided over the entire area under the floor.

7. Which of the following is NOT the property of material, which is used for damp proofing course?
 (a) The material should be perfectly pervious
 (b) The material should be flexible so that it can accommodate the structural movement without any fracture
 (c) The material should be such that leak-proof jointing is possible
 (d) The material should be durable and should have the same life as that of the building

MH PWD CEA 28/12/2023 Shift-I

Ans. (a) : Damp proofing—Dampness in building refers to the access and penetration of moisture into the building through the walls, floor, roof etc. Provision of damp proof course prevents the entry of moisture in the building.

Requirements for materials for damp-proofing

The following are the requirements of ideal materials for damp proofing—

- They should be impervious
- They should be durable with life span as long as that of the building
- They should be capable of bearing the load that may be imposed on them.
- They should be dimensionally stable.
- They should be flexible enough to accommodate the structural movements without undergoing any fracture.
- They should be inexpensive.

8. As per National Building Code, what will be the maximum permissible built-up area for a plot area for 200 m² to 500 m²?
 (a) 33.33% of the plot area
 (b) 50% of the plot area
 (c) 40% of the plot area
 (d) None of the above

UKPSC AE 16.08.2023 Paper-2

Ans. (b) :	
Area of the plot	Maximum permissible built-up area
Less than 200 m ²	60% with two-storeyed structure
200-500 m ²	50% of the site
500-1,000 m ²	40% of the site
More than 1000 m ²	33.33% of site

9. Identify the correct statement with respect to different components of a building.

- (a) Lintel beams are built between sub structure and super structure of a building, so that load is distributed uniformly.
- (b) Partition walls should be designed to carry the roof loads.
- (c) Thermal insulation efficiency of cavity walls is better than of solid wall for the given thickness.
- (d) Stretcher bond is considered to be stronger than English bond for the given thickness.

Odisha Lift Irr. JE 21/06/2023

Ans. (c) : Cavity wall– Cavity walls are constructed for heat insulation sound insulation and damp prevention, it is economical as the cost of such a wall is only 80% of the solid wall of the same thickness.

- To prevent dampness in the cavity walls a horizontal DPC layer is provided in these walls about 15 cm below the ground level and cavity is taken down only 10 cm below the DPC below this level.

10. Which element of a building divides superstructure and substructure?

- (a) Strap beam
- (b) Lintel beam
- (c) Plinth beam
- (d) Landing beam

UPPCL JE (Civil) 22/06/2022 Shift-II

Ans. (c) : Plinth beam of a building divides superstructure and substructure.

- A plinth beam is provided at plinth level and refers to a horizontal structure element that interconnects columns thereby preventing buckling of columns.

Strap beam:- help to distributes weight of either heavily distributable column or eccentrically loaded column footings to adjacent footings

Lintel Beam:- Built on top of openings such as portals, doors, windows etc

Landing Beam:- Beam provided between stairs changing direction to support the landing between to flight stairs.

11. In ordinary residential and public buildings, the damp proofing course is generally provided at

- (a) Ground level
- (b) Plinth level
- (c) Sill level
- (d) Lintel level

UKPSC AE (Civil) 2022 Paper-II

Ans. (b) : In ordinary residential and public buildings, the damp proofing course is generally provided at plinth level.

- DPC is prevent the entry of damp or moisture in the building the damp proof course is provided at various levels of the entry of dampness into the building
- Thickness DPC for boundary wall is 25 mm
- Thickness DPC for building is 40-50 mm

12. Which of the following is not a component of sub-structure?

- (a) Girders
- (b) Abutments
- (c) Piers
- (d) Wing walls

JKSSB JE 29/10/2021 Shift-I

Ans. (a) : Sub-structure– A bridge substructure consists of the follow components which transfer the bridge load forces to the foundation.

- (i) Abutment
- (ii) Piers
- (iii) Pier caps
- (iv) Wing walls

- Super-structure components

- (i) Girder (ii) Bearings (iii) Trusses (iv) Decks (v) Barriers (vi) Arches (vii) Spandrel

13. Which of the following type of buildings fall under group A as per the building classification by NBC?

- (a) Assembly buildings
- (b) Institutional buildings
- (c) Residential buildings
- (d) Educational buildings

SSB SI PIONEER (Civil) 22.01.2024

Ans. (c) : As per National building code of India (2016).

Group A : (Residential buildings)– Ex. Lodging or rooming houses, darmitaries, hotels etc.

Group B : (Educational buildings)– Ex. School, college etc.

Group C : (Institutional buildings)– Ex. Hospital, custodial institutions.

Group D : (Assembly buildings)– Ex. Theatres, Motion picture house, Auditoria, museums etc.

Group E : (Business buildings)– Ex. Banks, offices of architects, doctor, engineer, post office, T.V. station, air traffic control tower.

Group F: (mercantile building) – Ex. Shop, store etc.

Group G : (Industrial building) – Ex. Laboratory, dry clinic plant, power plant etc.

Group H : (Storage buildings)– Ex. Ware houses, cold storage, transit sheds etc.

Group J : (Hazardous buildings)– Ex. Artificial flower, synthetic lether, explosive etc.

14. One of the main objectives of providing foundation is to provide uniform of the structures.

- (a) Settlement
- (b) Pressure
- (c) Load transmission
- (d) Both (a) and (b)

ISRO URSC Draughtsman 18/04/2024

Ans. (a) : One of the main objectives of providing foundation is to provide uniform settlement of the structures.

15. The lowest part of the structure which transmit the load to the soil is known as

- (a) Superstructure
- (b) Plinth
- (c) Foundation
- (d) Basement

JKSSB Draftman 24.09.2023

Ans. (c) The lowest part of the structure which transmit the load to the soil is known as foundation.

• Plinth is divides super structure and substructure. The part which is above the plinth level is called superstructure.

Basement :- Floor of a building which is partly or completely below the ground.

16. The component of a building below the ground is called :

- (a) framed structure (b) hybrid structure
(c) super-structure (d) sub-structure

UKPSC Draftsman 05/11/2023

Ans. (d) : Sub-structure- It is the lower portion of the buildings, usually located below the ground level, which transmits the loads of the super-structure to the supporting soil.

17. The lowest part of the super structure between the ground and the floor is called :

- (a) D.P.C. (b) Lintel
(c) Plinth (d) Beam

UKPSC Draftsman 05/11/2023

Ans. (c) : A part of the super-structure, located between the ground level and the floor level is known as plinth.

18. Which of the following is used as escape element in building for fire safety?

- (a) Lobby (b) Strong room
(c) Floor (d) Outer wall

Assam PWD JE 13/08/2023

Ans. (a) : Lobby is used as escape element in building for fire safety.

19. As per Part 4 of the National Building Code of India (2016), which of the following types of buildings are classified as Group-B buildings?

- (a) Storage buildings (b) Assembly buildings
(c) Educational buildings (d) Business buildings

DSSSB JE TIER-2 27.09.2023

Ans. (c) As per Part 4 of the National Building Code of India (2016),

Group A– Residential building
Group B– Educational building
Group C– Institutional building
Group D– Assembly building
Group E– Business building
Group F– Mercantile building
Group G– Industrial building
Group H– Storage building
Group J– Hazardous building

20. Under which category of building construction do air traffic control towers come?

- (a) Storage building (b) Hazardous building
(c) Institutional building (d) Business building

MH PWD JE 15/12/2023 Shift-II

Ans. (d) : As per National building code of India (2016).

Group A : (Residential buildings)– Ex. Lodging or rooming houses, darmitaries, hotels etc.

Group B : (Educational buildings)– Ex. School, college etc.

Group C : (Institutional buildings)– Ex. Hospital, custodial institutions.

Group D : (Assembly buildings)– Ex. Theatres, Motion picture house, Auditoria, museums etc.

Group E : (Business buildings)– Ex. Banks, offices of architects, doctor, engineer, post office, T.V. station, air traffic control tower.

Group F : (mercantile building) – Ex. Shop, store etc.

Group G : (Industrial building) – Ex. Laboratory, dry clinic plant, power plant etc.

Group H : (Storage buildings)– Ex. Ware houses, cold storage, transit sheds etc.

Group J : (Hazardous buildings)– Ex. Artificial flower, synthetic leather, explosive etc.

21. As per NBC-2016, constructed buildings have been divided into ____ groups.

- (a) 4 (b) 2
(c) 3 (d) 9

MH PWD JE 15/12/2023 Shift-III

Ans. (d) : See the above explanation.

22. As per National Building Code of India (1970), which of the following is group C building?

- (a) Educational building
(b) Institutional building
(c) Residential building
(d) Assembly building

MH WRD CEA 29/12/2023 Shift-II

Ans. (b) : See the above explanation.

23. The construction above plinth level called:

- (a) Super structure (b) Wall
(c) Above structure (d) 1 & 2

Andaman PWD Architectural Asst. 19/02/2023

Ans. (a) : Super structure- In building construction, construction above plinth level is called as super structure.

Sub structure- Construction below the plinth level is known as sub structure.

• Level where the substructure and super structure of building meet is called plinth level.

24. Which of the following building components plays the biggest role in the stability of a structure?

- (a) Plinth (b) Foundation
(c) Super-structure (d) Columns

DSSSB AE (Mains) 22.06.2024 Shift-II

Ans. (b) : Foundation-The dictator of stability.

The foundation is the lowest part of the building structure.

It provided a stable base on which the entire structure rests.

The foundation transfer the load from the building to the ground and ensures that any movements of the earth do not affect the stability of the building.

STONES

- Rock is a mineral mass of more or less uniform composition.
- It may consist of a single mineral (monomineralic) or of several minerals (polymineralic)
- Monomineralic rocks are quartz, sand pure gypsum and magnesite, and polymineralic ones are granite, basalt and porphyries.
- **Rock forming minerals -**
Quartz, Mica, Gypsum, Dolomite, Amphibole, Calcite, Feldspar etc.

- **Properties of Minerals-**

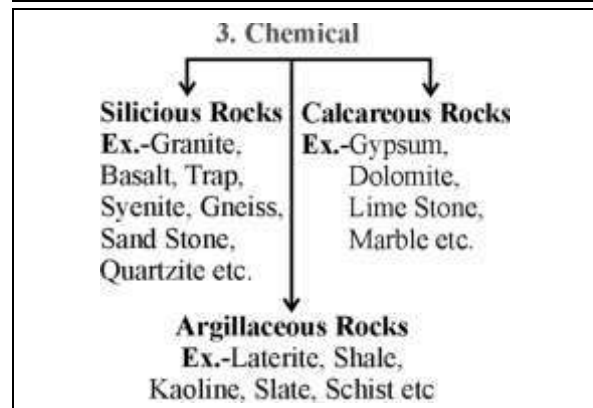
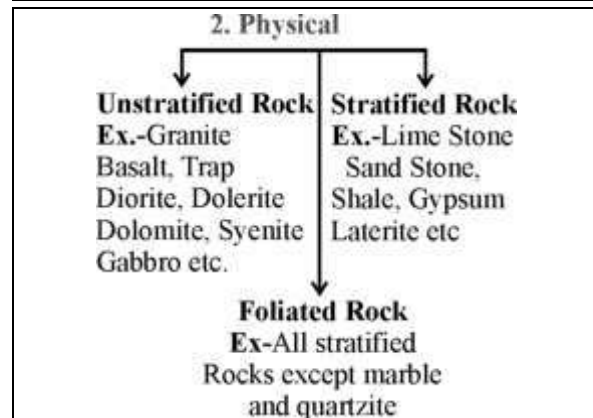
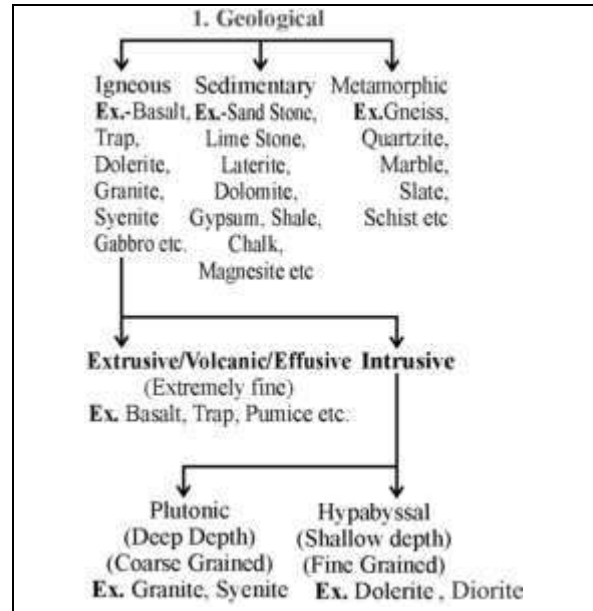
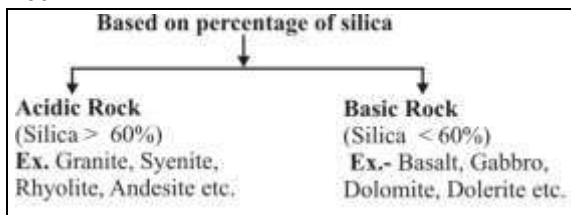
Cleavage	Measurement of the capability of some minerals to split along certain planes parallel to the crystal faces
Streak	Colour of the mineral in powder form
Luster	Shine on the surface due to reflection of light of a mineral
Texture	It is defined as shape, arrangement, distribution and coarseness of grains of a mineral.

- **Hardness of stone based on Moh's scale-**

Talc	}	1	Scratched
Gypsum		2	by the finger nail
Calcite	}	3	Scratched
Fluorite		4	by
Apatite		5	knife
Feldspar	}	6	Scarcely scratched
Quartz		7	by knife
Topaz	}	8	Not scratched
Corundum		9	by
Diamond		10	knife

- **Classification of Rocks-**

On the basis of Percentage of silica available in rock-





■ Compressive strength of different types of stones-

Stone	Compressive strength (in MPa)
Trap	350-380
Gneiss	206-370
Basalt	150-185
Slate	75-207
Dolerite	90-150
Syenite	90-150
Granite	75-127
Lime stone	54
Sand stone	64

■ Use of various types of stone-

Name of Rock	Use
Granite	Railway ballast, Roofing, Abutment, Pier and Sea walls
Marble	Ornamental work
Lime Stone	Manufacture of cement
Slate	Flooring, Roofing
Quartzite	Retaining wall
Basalt	Marine work, Rubble masonry
Kankar	Manufacture of Hydraulic lime

■ Tools Used in Quarrying of Stone-

Jumper	To make hole
Scraping spoon	For Cleaning hole
Dipper	For making deep hole
Priming Needle	To make space for fuse
Tamping Rod	For tamping of explosive Length- 600 mm Dia (φ)- 16 mm
Crow bar	To removed the wedge
Wedge	For split the rock slab

■ Methods of Quarrying

Method	Suitability	Example
Wedging	Costly, Soft and Stratified rock.	Sand stone, Lime stone, Laterite, Marble and Slate etc.
Heating	Most suitable for quarrying of small thing and regular block of stone from rock.	Granite, Gneiss etc.
Digging	To get stone at a small scale.	Serpentine, Gypsum, Aterite.
Channeling	Obtaining stone in the form of block.	
Blasting	To obtain stone at a large scale.	

■ Steps for Blasting-

Boring→ Cleaning→ Charging→ Tamping→ Firing

■ Quantity of Explosive-

$$A = \frac{L^2}{0.008}$$

A = Quantity of gun powder

L = Length of line of least resistance (m)

■ Types of Stones Finishing-

Boasted finishing	For making non-continuous parallel marks on the surface of stone. It is done by a tools called booster.
Furrowed finishing	Sides are sunk up to 20 mm width and the middle portion is projected by 15 mm.
Polished finish	Provided for marbles, granite which are mostly used for floor tiles.
Reticulated finish	A margin of 20 mm wide is marked on the sides of surface and irregular sinking type finish is made in the middle area.
Tooled finish	It is a classic finish which consists parallel continuous marks.
Scrabbling finish	Rough surface finish achieved after removing irregular projections on the stone surface by the scrubbling hammer.
Vermiculated finish	Sinking in this type of finish is more curved and like worm eaten appearance.

Note-

- Time required for perfect seasoning of stone is 6 to 12 month.

■ Specific Gravity of Various Types of Stone-

Name of Stone	Specific gravity
Sand Stone	2.65 - 2.95
Marble	2.7 - 2.85
Granite	2.65 - 2.79
Basalt	2.6 - 3
Slate	2.72 - 2.89
Laterite	2 - 2.2
Lime Stone	2 - 2.75
Gniess	2.5 - 2.7

■ Various types of test and purpose for stone-

Type of Test	Determine for
Abrasion Test (By Dorry Testing machine)	wearing resistance
Attrition Test (By Deval Testing Machine)	Hardness, Toughness and rate of wearing resistance
Crushing Strength Test (By C.T.M) (IS : 1121-1974)	Compressive strength
Smith's Test	Soluble minerals/ Muddy matter

Brard's Test	Frost resistance
Acid Test	Weather resistance
Crystallization Test (IS : 1126-1974)	Durability
Hardness Test (Moh's Scale)	Hardness
Impact Test (By Page Impact Machine)	Toughness
Water Absorption Test (IS 1124-1974)	% Voids (≥5% for good stone)

Note-

☛ **Chronological order of Hydraulic conductivity**

Vesicular basalt > Fractured metamorphic rock > Lime stone > Sand stone.

- ☛ Black marble is obtained from Jaipur.
- ☛ Hydrolysis is a type of chemical weathering under which granite is convert into clay.

■ **Stone used in various work-**

Hard stone	Used in Rubble masonry • Cross cut saw is used for cutting.
Heavy weight stone	Used in Dam, retaining wall and harbor.
Light weight stone	In Arch masonry.

Note-

- ☛ Calcium hydroxide is used to protect stones from sulphate attack in Industries.

Composition of sand stone	Quartz, Lime and Silica.
Composition of granite	Quartz, Feldspar, Mica.

BRICKS

■ **Size of various types of bricks-**

Brick	Usual size	Nominal size
Conventional/ Traditional/ user size	$9" \times 4\frac{3}{8}" \times 2\frac{3}{4}"$ (23×11.2×7.0) cm	$9" \times 4\frac{1}{2}" \times 3"$ (23×11.4×7.6) cm
Standard/ Modular/ Normal size	(19×9×9) cm	(20×10×10) cm

■ **Ingredients of Good Brick Earth-**

Ingredients	% in brick
Silica (SiO ₂)	50 - 60
Alumina (Al ₂ O ₃)	20 - 30
Lime (CaO)	< 5
Iron Oxide (Fe ₂ O ₃)	5 - 6
Magnesia (MgO)	<1
Alkalies	<1

■ **Functions of Various Brick Ingredients-**

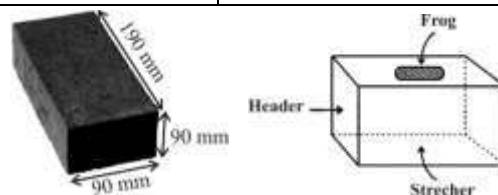
Ingredients	Function
Silica	Imparts Strength Retain shape Excess-Brittle (Due to loss of cohesion)

Alumina	Impart plasticity Excess -Cracks developed, corner deformed
Lime	Reduce the shrinkage on drying Excess - Brick over burnt and shape changed
Iron Oxide	Red colour, Used as flux Gives strength and hardness Excess - Provide dark blue or blackish colour
Magnesia	Yellow colour and its prevent to shrinkage, Reduce warping Excess -Give yellowish colour

Note -

- ☛ Steel moulded bricks are good compared to wooden moulded bricks.
- ☛ Steel moulded bricks are used in facing work.
- ☛ Mould are made by steel or timber of Shisham.

Frog	10 cm × 4 cm × 1 or 2 cm
Stock Board (To make frog)	21 cm × 10 cm × 6 cm
Pallet Board (To dry the brick)	30 cm × 12 cm × 1 cm



Standard brick

■ **Sequence for the Preparation of Brick Earth-**

Unsoiling → Digging → Weathering →
Blending → Tempering/Kneeding → moulding
→ drying → burning

■ **Burning Zone of Bricks-**

Burning Temperature- 900 - 1200°C		
Dehydration Zone 400-650°C	Oxidation Zone 650-900°C	Vitrification Zone 900-1100°C

■ **Efficiency of Kiln-**

Types of kiln	1 st Class Brick outcome	Remark
Pazawah	50-60%	—
Allahabad kiln	60-70%	Intermittent
Bull's Trench kiln	70-80%	Semicontinuous
Hoffman's kiln	80-90%	Continuous

■ **Class of Brick on the Basis of Strength**
IS : 10719557-1970

Class	Comp. Strength
Grade AA	≥ 140 kg/cm ²
Grade A	≥ 105 kg/cm ²
Grade B	≥ 70 kg/cm ²
Grade C	≥ 35 kg/cm ²

Note-

- As per IS 1077 : 1992, cl. 7.2, after immersion in cold water for 24 hrs, water absorption shall not be more than 20% by weight up to class 12.5 and 15% for higher classes.

■ **Efflorescence Test- According to IS 3495 (part-III) : 1992**

White patches	Alkalies
Up to 10%	Slight
10 - 50%	Moderate
>50%	Severe
Presence in large amount	Serious

■ **Special Forms of brick-**

Figure	Brick Name	Figure	Brick Name
	Rounded end		Cant
	Double cant		Compass
	Bull nosed		Perforated
	Hollow		Coping
	Queen closer		King closer
	3/4 Brick		Bat

□ **SPECIAL TYPES OF BRICKS-**

1. **Refractory brick/Fire resistance brick-**

These brick are capable to resist very high temperature up to 1500°C without melting or softening.

- Lime quantity kept less so that brick burnt at high temperature of 1700 - 1800°C.
- The minimum average compressive strength- 32.5 MPa.
- Water absorption- 4 - 10%

Colour- Whitish yellow or light brown.

Use- Furnace lining, hollow tiles etc.

○ **Refractory bricks are following three types-**

A. **Acid refractory brick-**

Ingredient: 95 - 97% silica + 1 - 2% lime

Use: Where acidic slag are formed.

B. **Basic refractory brick-**

These are use where basic slag are made. These are two types-

a. **Magnesia refractory brick-**

Ingredient- 70% magnesium oxide (MgO) + 30% silica and alumina

b. **Dolomite refractory brick-**

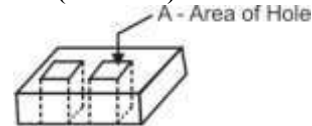
In these brick is carbonate of calcium and magnesium [CaMg(CO₃)₂] are used as raw material

Use : In shaft and rotary kilns, which are use for production of lime and cement.

C. **Neutral refractory brick-**

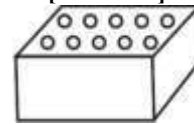
Ingredient of these brick are bauxite, silica and iron oxide. It is use where acidic or basic slag are made.

2. **Hollow brick (IS : 3952)-**



- Maximum hollow ≥ 50% of total plan area.
- It is use for making sound proof and heat resistance wall.

3. **Perforated Brick [IS : 2222]-**



- Total hollow area ≥ 30 - 40% of total plan area.
- Use-** Covering wall sound proof and heat insulating wall construction.

Compressive strength	≥ 7N / mm ²
Water absorption	≥ 15%
Efflorescence	≥ 10%
Warpage	≥ 3 %

4. **Over-burnt brick-**

In over burnt brick a soft molten mass is produced and the brick loose their shape.

5. **Under burnt brick-**

When bricks are not burnt to cause complete vitrification, the clay is not softened because of insufficient heat and the pores are not closed. These brick have higher degree of water absorption and less compressive strength.

■ **General Data about bricks-**

Types of bricks	Water absorption (%)	Compressive Strength (Kg/cm ²)	Use
1 st Class	≤ 20	>105	Facing work R.B.Slab
2 nd Class	≤ 22	>70	Hidden Structure
3 rd Class	< 25	>35	Temporary brick masonry
Perforated Bricks (IS 2222)	15	70	Partition Wall

Hollow Bricks (IS 3952)	20	35	For making heat proof, sound proof, damp proof walls
Paving Bricks (IS 3583)	<5	400	Road pavement
Soling Bricks (IS 5779)	< 20	50	Soling of road
Refractory Bricks (IS 6902)	4 -10	350	Kiln lining, furnace boiler combustion
Engineering Brick Class-A	4 -5	>125	D.P.C
Class-B	7	75	Multistorey building
Sundry bricks	-	15-25 ≈ 21	-

FILES

The clay product which thickness is less than 40mm is known as tiles.

- Burning of tiles is same as brick burning but some times tiles or clay products are burnt in two times-
- Ist is at 600 - 700°C is called biscuiting and IInd is at 900 - 1100°C, after dipping the tiles/clay product in the solution of desired colour.

❑ SPECIAL TYPES OF CLAY PRODUCT-

○ Stoneware-

It is made from refractory clay mixed with crushed pottery, stone and sand, burnt at high temperature and cooled slowly. Stoneware consists of about 75% silica and 25% alumina. Iron oxide is added to give colour

Ex.—Domestic sewer pipe, wash basin, water closet, drains pipe and fittings.

○ Earthenware-

These are made by burning ordinary clay at low temperature and cooling slowly. Glazed earthenware becomes resistant to weathering action.

Ex.- Faience

○ Majolica-

It is Italian earthenware coated with opaque white enamel, ornamented with metallic colour.

- Manufactured from low heat clays to which up to 20% calcium carbonate added in the form of chalk.

Use- Doorways, window casing and facing tiles.

○ Fire Clay-

These are pure hydrated silicates of alumina and contain a large proportion of silica (55-75%), alumina (20-35%), Iron oxide (2-5%) with about 1% of lime, magnesia and alkalis.

- It is capable of resisting very high temperatures up to 1700°C, without melting or softening and resist spalling.

Use- For manufacturing fire bricks used in furnace lining, hollow tiles and crucibles.

○ Terracotta-

Clay is mixed with powdered glasses, pottery and sand ground to fine powder and pugged several times till it gets uniform and soft for moulding.

- Terracotta is refractory clay product and is used in ornamental parts of building.
- The clay used should have sufficient iron oxide and alkaline matters.
- It is cheap and impervious.
- Muffle furnace are use for burning of terracotta product.

○ Porcelain-

A high grade ceramic ware having white colour, zero water absorption and glazed surface.

- Porcelain is fine earthenware which is white, thin and semi-transparent.
- It is used for manufacturing sanitary wares containers and crucibles, reactor chambers and electric insulators.

○ Glazing-

Glazing is a process of providing a glassy or impervious layer on the surface of clay product or ceramics.

- The glazing layer is fused to a ceramics body by burning at a high temperature.
- Thickness of glazing is 0.1 to 0.2 mm.

MORTARS

- It is a paste (Capable of setting and hardening) obtained by adding water to mixture of fine aggregates such as sand and binding material, e.g., clay, gypsum, lime or cement or their combinations.

■ Classification :

On the basis of bulk density :

Type of mortar	Bulk density (kg/m ³)
Heavy weight	> 1500
Light weight	< 1500

On the basis of binding material :

- **Cement Mortar**— Prepared from portland cement, sand and water.
- **Lime Mortar**— Mixture of air hardening lime, sand and water.
- **Mud Mortar**— Prepared from clay nodules, it is used in temporary construction work.
- **Gypsum mortars** : They are prepared from gypsum or anhydride binding materials.

Types of construction	Type of mortar
Pointing work	Cement mortar 1 : 1
Damp proof course (DPC)	Cement mortar 1 : 2
Concrete pavement	Cement mortar 1 : 2
Masonry in super structure	Cement mortar 1 : 3
Masonry in foundation	Cement mortar 1 : 6
Plastering	Cement mortar 1 : 4

■ Introduction

Lime is a binding material found in the form of lime stone. It is not found in free state in the atmosphere.

- Lime is obtained from the calcinations of lime stone.

❖ Sources of Lime-

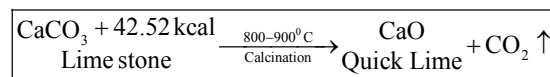
Type of Stone	Type of lime
Lime Stone (CaCO_3)	Pure Lime
Kankar	Hydraulic Lime
Dolomite (MgCO_3)	Magnesia Lime
Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)	Sweet Lime
Shell, Chalk	Pure Lime

❖ Lime and its chemical formula-

Name of Lime	Chemical Formula
Lime Stone	Calcium Carbonate [CaCO_3]
Lime, Quick lime, Lump lime, White lime, Rich lime, Pure lime	Calcium oxide [CaO]
Slaked lime, Fat lime	Calcium Hydroxide [Ca(OH)_2]
Plaster of Paris (P.O.P.)	Calcium Sulphate [$\text{CaSO}_4 \cdot 1/2 \text{H}_2\text{O}$]
Gypsum	Calcium Sulphate [$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$]

○ Calcination-

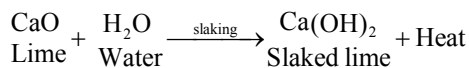
The process under which lime stone is burned at 800°C to 900°C to removed CO_2 & moisture is called calcination.



○ Slaking of Lime-

In this process quick lime reacted with water and formed Ca(OH)_2 .

- Volume increases 2 to 2.5 times of its initial volume.



- Slaking is an exothermic reaction.

Type of lime	Slaking time
Lump lime, Quick lime, Rich lime, Pure lime, Fat lime, White lime	2 to 3 hrs.
Hydraulic lime, Poor lime, Lean lime	12 to 48 hrs.

○ Hardening or setting of lime-

It depend on the types of lime and its hardening condition. It is three types-

- Carbonate Hardening
- Hydrate hardening
- Hydrosilicate hardening

Carbonate hardening-

In this process slaked lime reacts with CO_2 and set & hard. $\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O} + \text{Heat}$

■ Various types of lime-

1. Pure lime/Fat lime/White lime/Rich lime-

It slakes rapidly and its volume increase by 2-2.5 times than its original volume.

- These lime contain 95 to 97% calcium carbonate (CaCO_3) and quantity of impurity does not increase more than 2 to 3%.

- It is manufactured by burning of marble, white chalk, sea shell and coral.

Use-Plastering and white washing.

2. Lump lime-

It is obtain in the form of lump after calcination.

3. Quick lime/Caustic lime-

It is obtained immediate after calcination is called Quick lime.

4. Slaked lime-

The lime whose hydration is completed is called slaked lime.

5. Magnesia lime-

It is manufacture by calcination of dolomite. It contain 20 to 35% magnesia.

- Colour - Reddish

○ Types of lime on the basis of Impurities-

1. Pure lime- Impurities < 5%

2. Impure lime- Impurities > 5%

Impure lime is following two types-

(i) Lean lime or Poor lime/Impure lime-

It consists 80% CaO , less than 5% MgO and clay impurities more than 7% in the form of silica, alumina and iron oxide.

- Setting and hardening process is very slow.

- It's expansion is less than that of fat lime.

(ii) Hydraulic Lime-

It is capable to setting under water and in damp situation.

Impurity range- 5 to 30%.

- setting time under water- 7 to 30 days.

❖ Hydraulic lime is classified into further three categories-

Item description	Feebly Hydraulic lime	Moderate Hydraulic lime	Eminently Hydraulic Lime
% Impurities	05 to 10%	11 to 20%	21 to 30%
Slacking action	Few minutes	1 or 2 hours	1 day or more
Setting action	3 week or more	1 week or more	1 days or more
Hydraulicity	Feebly	Moderate	Eminently
Use	Used for ordinary masonry work	For superior type of masonry work	Use in very damp places

❖ Classification of Lime as per BIS : 712-1984-

Class of lime	Example	Use
Class A	Eminently Hydraulic lime	Hydraulic structure
Class B	Semi Hydraulic lime	Masonry and in lime concrete
Class C	Pure lime/Fat lime	Plaster work
Class D	Magnesium lime/Dolomite lime	White washing and finishing
Class E	Kankar lime	Masonry mortar
Class F	Siliceous dolomite lime	-

■ Test of lime-

1. Visual Inspection Test-

Class of lime	Colour
Class A	Dirty white
Class B	Light dirty white
Class C	White

- Lumps of lime indicates quick lime or unburnt lime.

2. HCl Test/Acid Test-

This test is perform to find out impurities and amount of calcium carbonate.

- A teaspoon of powdered lime is taken in the test tube and 10 ml of 50% dilute hydrochloric acid (HCl) is added to it, and heat for few minute.
- If bubble is formed during heating it indicate calcinations of lime is not done perfectly.

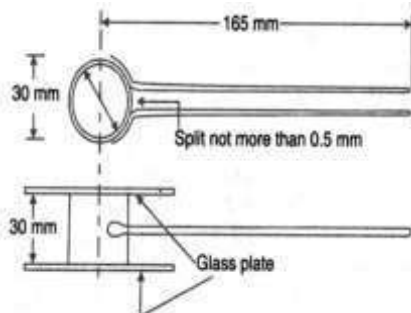
3. Ball Test-

Balls (40 mm size) of stiff lime paste are made and left for 6 hours. After six hours, the balls are immersed in a water basin. If expansion and disintegration of balls is observed, the lime is of type C. Little expansion and numerous crack indicate it to be class B lime. Class A lime will have no adverse effect.

4. Soundness Test [IS : 6932 (Part-IX)]-

Aim-To find out the quantity of free lime, unsoundness and disintegration property of lime.

- This test is conduct with the help of Le-chatelier apparatus.



- External diameter of cylinder of Le-chatelier apparatus = 30 mm
- The expansion of indicator should not be more than 10mm.

5. Compressive Strength Test [IS : 6932 (Part -II)]-

12 cube of 50mm sides are prepared from standard lime sand mortar (1:3)

- 6 Cube are tested after 14 day's and remaining 6 cube are tested after 28 day's with the help of compression testing machine.
- Rate of loading- 150 N/min

📖 Note-

- ☛ Carbide lime is a by-Product of manufacturing of acetylene.
- ☛ Barium plaster is used as final coat for surface of X-Ray room.
- ☛ Potash- lime glass is also known as Bohemian glass.

■ Unit weight of lime-

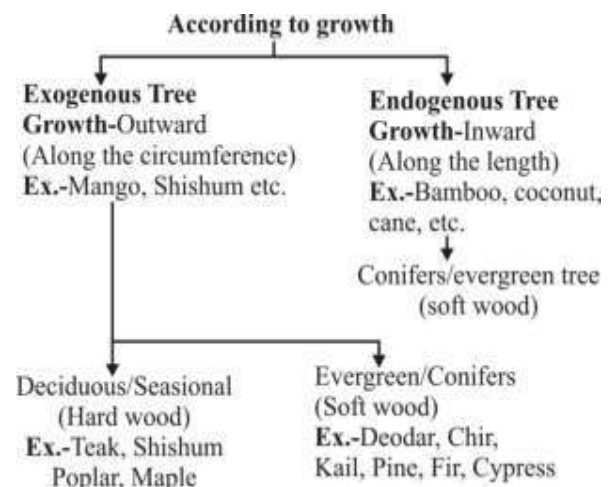
Type of lime	Unit weight (kg/m ³)
Unslaked lime	1050
Slaked lime	640
Hardened lime	800

- Lime putty is the plastic paste of lime and water.

Class of lime	Modulus of rupture (kg/cm ²)
Class A (Hydraulic lime)	≥ 10.5
Class B (Semi hydraulic lime)	≥ 7

TIMBER

■ Timber classification on the Basis of Growth-



○ Conifers Tree-

These trees having pointed needle like leaves. Most Conifer tree are evergreen tree but not all of them.

(Ex.- Larch tree (larix Laricina) or Tamarack)

■ On the Basis of Modulus of Elasticity (E)-

Group	E (kN/mm ²) in bending
A	> 12.5
B	9.8 – 12.5
C	5.6 – 9.8

■ Availability-

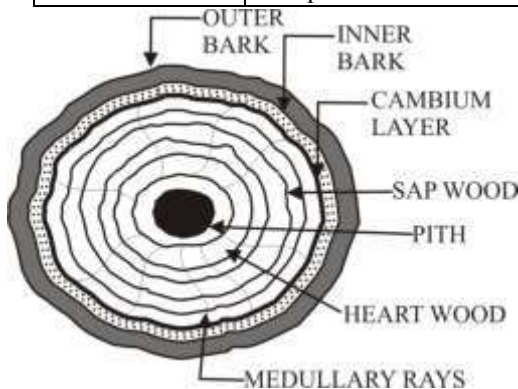
Grades	Quantity in m ³ per year
X	≥ 1415
Y	355 - 1415
Z	< 355

■ Durability-

Durability	Avg. life in months
High	≥ 120
Moderate	60 - 120
Low	< 60

■ Structure of timber :

Medulla (Pith)	The innermost part or core of the stem of a tree
Heart wood	Death portion of the tree
Sap wood	Outer layers of a log of wood
Cambium	To growth wood cells
Bark	Protect the wood against mechanical damage
Transverse septa (Medullary rays)	The vascular tissue which Encloses the pith
Annual rings	A cellular tissue and woody fibre arranged in distinct concentric circle
Log	Trunk of tree obtained after the removal of branches.
Lumber	It is a log pieces of timber sawn into pieces of desired shape.



■ Seasoning of Timber (IS : 1141)-

Purpose of Seasoning-

1. Reduce the weight of timber.
2. Reduce the shrinkage and warping after placement in structure.
3. Increase strength, durability and workability.
4. Make it suitable for painting.
5. Reduce its tendency to split and decay.

• Method of Seasoning and its property-

Method	Property
(A). Natural or Air Seasoning- (6 month to 1 Year)	It take long time but best quality of seasoned wood are obtain. • Easy and most economical method. • Reduce moisture up to 12-15%
(B). Artificial Seasoning-	
1. Water Seasoning (2 - 4 weeks)	It is quick process but elastic property and strength are reduced.
2. Boiling (3 - 4 Hour)	This process is very quick but expensive.
3. Kiln Seasoning (3 - 5 days)	Most effective and economical method.
• K.D- Kiln dried	• Loss in strength < 10%

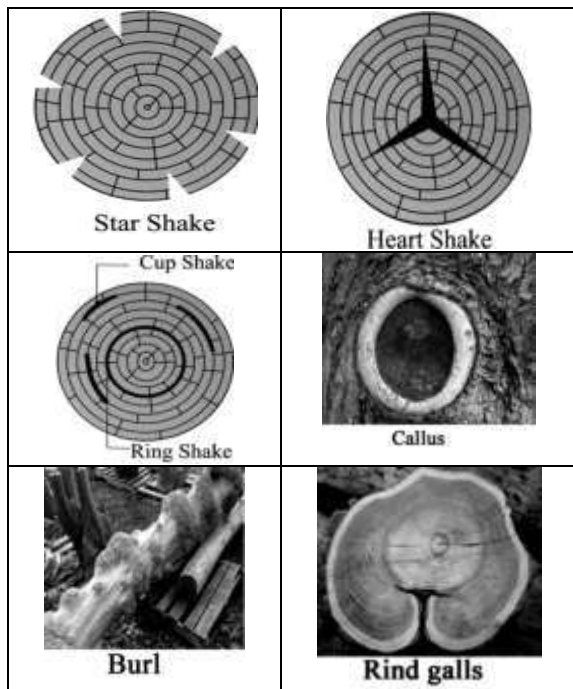
• A.D - Air dried	• Used for rapid seasoning on large scale. • Kiln seasoning causes case hardening.
4. Charring or Scorching	• It is used for lower part of wood pole which is below the ground level.
5. Mc. Neil's Process (15 - 60 days)	• Best but most expensive method.
6. Electric Seasoning	• Timber losses their strength and may split. • Most expensive method.

• Strength of timber at 12% Moisture Content-

Shear strength	6.5 -14.5 N/mm ²
Bending strength	10.2 -18.2 N/mm ²
Compressive strength	33 -77.5 N/mm ²
Tensile strength	80-190 N/mm ²

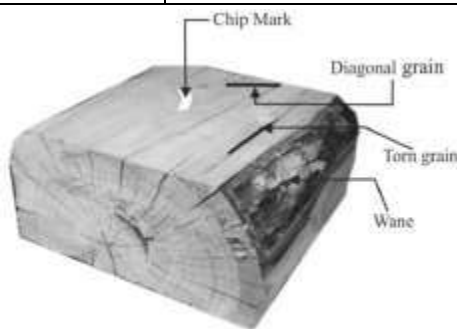
■ Defects of Timber-

Checks	Longitudinal cracks which is normal to the annual rings
Shakes	Longitudinal separation b/w the Annual rings.
Star shake	Wide at outside and diminish inside
Heart shake	Wide at center and diminish out side
Cup shake	Caused due to rupture of tissue in circular direction. It is developed due to non uniform growth
Ring shake	When cup shake cover the entire ring.
Radial shake	When timber is exposed to sun for seasoning after being felled down
Knots	These are the base of branches which are broken or cut-off from the trees.
Rind Galls	Abnormal growth or curved swellings on the body of tree.
Foxiness	It is a sign of decay appearing in the form of yellow or red tinge. Cause-Over maturity lack of ventilation.
Burl	It is a deformed growth occurs when the tree receives shock or injury in its young age.
Callus	It is the soft tissue or skin which cover the wound of a tree.
Druxiness	White spots are formed on the top surface of wood.
Twisted fiber	It is caused by wind turning the trunk of young tree in one direction. • Reaction wood is the wood with twisted fiber.
Upsets	In this case wood fibers damaged by compression or crushing.
Rupture	It is due to injury or impact.



■ Defect Due to Conversion of Timber–

Defect	Description
Chip Mark	A mark or sign placed by planer on finished surface of timber.
Wane	It is the original rounded surface on the manufactured part of timber.
Torn Grain	Small depression occurs on the finished surface (along the fiber of timber) due to falling of tool.
Diagonal Grain	It is formed because of improper timber sawing indicate by diagonal mark on the straight-grained surface of the timber.



■ Defect due to seasoning-

Warp	Due to unequal shrinkage the curved deformation formed along the length of board.
Bow	Curve along the face of board caused by the wood on one face shrinking more than face.

Cup	This is the hollowing of the board throughout its length on its bark side face
Twist	In this defect the end of timber is rotate in opposite direction.

■ Preservation of Timer (IS: 401)-

It is done with the helps of various types of preservative to increase life, durability of timber.

1. **Tarring-**

Process of heating the coal tar to make it in workable condition is called tarring.

2. **Charring-** It is a old method of preservation of timber. This method is not suitable for exterior wood works.

3. **Oil Paint-** It is suitable for well seasoned wood and generally applied 2-3 coats.

4. **Creosote Oil-**

It is derived from wood or coal tar and best antiseptic material.

➤ It is applied at 50°C and pressure of 0.7 - 1.0 N/mm².

5. **Solignum Treatment-** This treatment well suitable for preserving timber from white ants.

6. **AsCu Treatment-**

It is developed at forest research institute Dehradun.

7. **Worms and Insects treatment-**

8. **Dipping-** In this method timber is dipped directly in the preservative solution. The solution penetrates the timber better than the case of brushing or spraying.

9. **Fire resistance of timber-**

(i) **Able's Process-** It is used to make wood Fire resistance.

➤ Chloride, Borex, Boric Acid, Sodium arsenate and Ammonium sulphate is used in Able's Process of Preservation of timber.

(ii) **Bethel Process-** It is used when max. absorption of the preservative is desired.

(iii) **Boucherie Process-** It is used to treatment of green wood.

○ **Empty cell process-**

It is also known as pressure process. It is aimed at a maximum penetration of the preservative with a minimum net retention.

➤ The Lawry process and Rueping process are commonly used.

○ **Diffusion process-**

It is the method of treatment of timber (poles and planks) and other plant material like in green condition.

■ Properties of a good timber-

Properties	Value
Density	540 kg/m ³
Specific gravity	1.54
Moisture content	10-12%
Shrinkage	0.1- 0.3% Along fibers
Swelling	0.1- 0.8% Along length
Sound	2-17 time more than air
Conductivity	

■ Use of Various Type of Timber-

Guava	Scientific instruments
Babool	Agricultural instruments
Mulberry	Sports Goods
Jackfruit	Musical instruments
Benteak	Boat
Teak	Plywood
Sal, Deodar	Railway sleepers, Timber

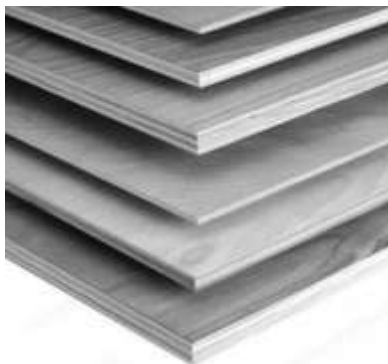
■ VENEERS (IS : 14315)



It is the thin strip of timber which thickness is about 0.4 mm to 0.6 mm. It should not be exceed 1 mm in any case.

- It is also known as Ply and made by good quality timber like Teak, Sal, Deodar etc.
- Walnut is most suitable wood for this purpose.

■ PLYWOOD



Plywood is a material manufacture from thin layer or 'Plies' of wood veneer that are glued together with adjacent layer having their wood grain rotate upto 90^0 to one another.

- Plywood are glued under pressure of 130 - 140 MPa and from an odd number of layers (≥ 3 layers) of veneers. Each layers are perpendicular to each other.

○ Advantage of Plywood-

- Strength of plywood is equal in all direction.
- Impact load resistance capacity is more.
- It is made of odd layers of ply.
- Tendency to shrink, swell and twisting is reduced.
- It can be curved into desired shape.

○ Parts of plywood and its other name-

- Outer most veneer sheet - **Faces**
- Interior ply (grain parallel to face) - **Core/Centre**
- Interior ply (grain perpendicular to face) - **Cross band.**

■ Fiber boards-

It is a type of engineered wood product that is made out of wood fibers.

○ Types of fiber board-

1. Particle board/Low density fiber board (LDF)
2. Medium density fiber board(MDF) ($<400 \text{ kg/m}^3$)
3. High density fiber board (HDF)

Note:- Hard fiber board can be used as wall slab, door board, floor, furniture and other decorations.

○ Hard board -

Hard board is a tough smooth panel made with wood fibers compressed under high pressure and heat.

MISCELLANEOUS MATERIALS

■ Introduction-

Glass is an amorphous substance having homogeneous texture and mixture of metallic silicates.

■ Constituent of glass their function-

Constituent	Function
Silica/Sand	It is the major constituent of glass.
Lime	It makes the glass fluid and suitable for blowing, drawing, rolling, pressing or spinning.
Soda	Impart durability and toughness. Acts as an accelerator for the fusion of glass.
Potash	It renders glass infusible and makes fire resistance.
Lead oxide	Imparts colour, brightness and shine.

■ Classification of Glass Based on Composition-

Glass	Composition
Common glass	Silicate of Na, Ca and Fe
Soda lime glass	Silica, lime and soda
Lead glass or flint glass	Silica, lead and potash
Boro-silicate glass	Silica borax, lime and feldspar

■ Various manufacturing Process of Glass-

Process	Used for
Blowing	Glass bottle and Jar
Drawing	Tube, Rod, window glass
Rolling	Glass sheet
Pressing	Open pot
Casting	Lens, mirror
Spinning	Heat, sound and electric insulator glass.

■ Colouring Pigment-

It is mixed to impart colour in the glass.

Colour	Pigment
Blue	Cobalt oxide, cupric oxide
Red	Selenium oxide, Iron
White	Antimony oxide, tin
Yellow	Lead with antimony
Ruby Red	Gold chloride
Green	Chromium oxide

■ Commercial Forms of glass-

Type of Glass	Remark
Pyrex glass	It is fire resistance and use for making laboratory apparatus and insulator.
Optical Glass	- It contain phosphorus, lead silicate and cerium oxide. - It is absorb UV ray and use for making lenses.
Opal glass or milk glass	It is used where high thermal shock resistance & chemical durability is desired.
Ground glass	Used for bedroom, toilets and for making black board.
Obscured glass or Patterned glass	It is used in doors and window of bedroom and bathroom.
Bullet Proof or Laminated glass	It produced by placing vinyl plastic and glass in several alternate layers and pressing them with outer layer of glass Used in banks, Jewelry stores and display window.
Sheet glass	It is used for glazing door, window and partition. made by blowing, available with in 2 - 6 mm thickness.
Plate Glass	It is used for all engineering purpose and is superior than sheet glass.

■ Forming and Shaping-

- Molten glass can be fabricated to desired shape by one of the following method-
 1. Blowing,
 2. Flat drawing

PLASTICS

- Plastics are made from resin with or without fillers, plasticisers and pigments.

■ Types of plastics :

• Thermo plastic :

- It is softens on heating and hardens on cooling.
- They can be remoulded, for use as many times as required.
- These are formed by addition polymerisation and have long chain molecular structure.
- They can be remoulded, for use, as many times as required.

- **Examples** are material resins— rosin, kopal, amber, shellac; cellulose derivatives— cellulose acetate, cellulose nitrate, nitrocellulose or celluloid, cellulose acetate-butyrate; polythenic or vinyl resin— polyethylene, polyvinyl chloride, polyvinyl acetate, vinyl chloride = vinyl acetate, poly vinylidene chloride, polystyrene, polymethyl methacrylate or lucite or plexiglass and polytetrafluoroethylene; polyamides Nylon 6:6, Nylon 6 and Nylon 11.

• Thermosetting plastic :

- It cannot be reused.
- They are hard, strong and more brittle.
- The important thermosetting resins are phenolic resins or phenoplasts (bakelite), amino resins, polyester resins, epoxy resins and silicon resins.
- The principal uses are in electrical equipment, plugs, sockets, switches, ash trays, handles etc.

FIBRES

- Fibres are a flexible, hair like strand whose length is much more than its width or thickness.
- The purpose of adding fibre is to control cracking due to plastic shrinkage and drying shrinkage.
- When added to concrete, fibres reduce permeability of concrete and hence reduce bleeding. Further, some of the fibres in concrete are added to improve resistance to impact and abrasion.
- The concrete with fibres is called fibres reinforced concrete (FRC).

■ Types of Fibres

- **Natural Fibres** – These are naturally occurring vegetable fibres. Some examples of natural fibres are jute, bamboo, sisal, flex, coir, banana etc.
- **Synthetic Fibres** – Artificially manufactures fibres are referred as synthetic fibres. These include steel fibres, glass fibres, carbon fibres, polymers i.e. plastic fibres.

• Jute Fibres

- Jute is a naturally occurring fibrous material which is traditionally used to make sacking bags and as a backing material in carpets.
- Jute fibres are added in concrete mainly to improve its resistance to shrinkage.
- Jute fibres have a good bonding with concrete.

• Glass Fibres

- The glass fibres are available in the form of strands which can be cut into desired lengths and used as reinforcement in concrete.
- The glass fibres reinforced concrete (GRC) is lightweight and has very good resistance to aggressive environment like alkali attack, acid attack etc.

• Plastic Fibres

- Plastic fibres are typically synthetic fibres which are engineered for concrete to withstand long term alkaline environment.
- Plastic fibres are manufactured polymer based materials such as polypropylene, nylon or polyethene.

- Plastic fibres are added during the mixing operation of concrete.
- Plastic fibres in concrete include control of plastic shrinkage during fresh or green stage of concrete.

ALUMINIUM STEEL

- The principal constituents of bauxite ($\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$) which yield aluminium on a commercial scale are hydrated oxides of aluminium and iron with some silica.
- Aluminium is silver white in colour with brittle metallic lustre on freshly broken surface.
- Aluminium is harder than tin.
- Tensile strength of aluminium is 117.2 N/mm^2 in the cast form and 241.3 N/mm^2 when drawn into wires.
- It is most suitable for making door and window frames, railings of shops and corrugated sheets for roofing system.

GALVANIZED IRON

- Galvanized iron is the same as standard iron, the only difference is that it features a layer of zinc.
- The added layer of zinc helps to protect the iron from rust and corrosion.
- Without it, the iron will be exposed to moisture and oxygen from its surrounding environment.
- Corrugated galvanized iron sheets are used for roof covering.
- The GI sheets are generally 0.9 m wide. These are manufactured in the length of 1.8 m, 2.2 m, 2.5 m, 2.8 m, 3.0 m, and 3.2 m.

BITUMEN

- Bitumen is a petroleum product obtained by the fractional distillation of crude oil.
- It is viscous liquid, black or brown in colour.
- It is soluble in carbon di-sulphide and carbon tetra chloride but insoluble in water.
- The bituminous materials are mostly employed for the construction of flexible pavement.
- Specific gravity of Pure bitumen 0.97 - 1.02.
- It oxidizes slowly and chemically inert.
- Bitumen is more resistant to water than tar.

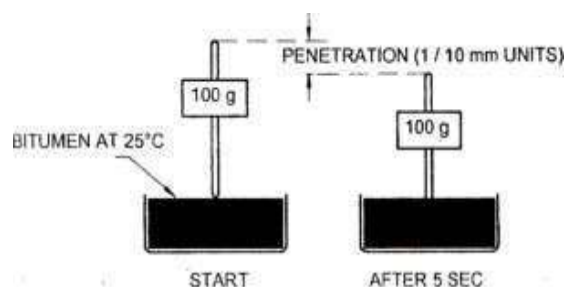
■ Tests on Bitumen

1. Penetration Test [IS : 1203 - 1978]–

Apparatus- Penetrometer.

Object- To determine hardness or softness of bitumen

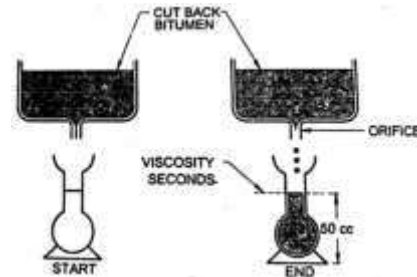
- Common grades are 30/40, 60/70 and 80/100.



2. Viscosity Test [IS : 1206 : 1978]

It is the measure of resistance to flow. It is suitable to test tars and cutbacks.

Apparatus- Orifice type viscometers.



3. Ductility Test [IS : 1208 – 1978]

Apparatus- Standard briquette.

To measure the adhesive property of bitumen and its ability to stretch.

C/S area of briquette $10 \text{ mm} \times 10 \text{ mm}$ (1 cm^2)

Rate of pull- 50 mm/min.

Temperature - 27°C .

Minimum ductility- 50- 75cm

4. Softening Point Test [IS : 1205–1978]

Apparatus- "Ring and Ball".

Dia. of steel ball- 10 mm

Softening point- $35^\circ - 70^\circ\text{C}$.

5. Flash and Fire Point Tests [IS : 1209 – 1978]

Object- To determine flash and fire point of bitumen

Apparatus- Pensky Marten's closed cup

- Fire point is always > flash point.

- Minimum specified flash point for pavement = 175°C

7. Specific gravity test [IS : 1202 – 1978]

Apparatus- Pycnometer

Specific gravity for-

(i). Bitumen- 0.97 - 1.02

(ii). Tar- 1.10-1.25

(iii). Natural asphalt- 0.92- 1.02

■ Cutback Bitumen-

It is obtained by reducing the viscosity of bitumen by diluents or by fluxing asphaltic bitumen in presence of some suitable liquid distillates of coal tar or petroleum.

- It is prepared by using naphtha or kerosene oil.

Use- Road construction and soil stabilization, cold region.

Cutback Bitumen are of three types–

(a) Rapid Curing (RC) Cutback-

Recommended for surface dressing and patch work.

Penetration value- 80 - 120.

It is flux with Petroleum, Naphtha or gasoline.

(b) Medium Curing (MC) Cutback-

Recommended for premix with less quantity of fine aggregates.

Bitumen is flux with kerosene and light diesel oil.

(c) Slow Curing (SC) Cutback-

It is obtained by blending bitumen with high boiling point gas, oil or by controlling the rate of flow and temperature of crude during the first cycle of refining.

Note :

- Cutback bitumen used for premix with appreciable Quantity of fine aggregates.
- RC-2 is more thick than RC-1 but RC-2, MC-2 & SC-2 have same viscosity.
- Each group of cutbacks is subdivided into six categories in the increasing order of viscosity.

■ **Bitumen Emulsion -**

- It is liquid product in which a substantial amount of bitumen is suspended in finely divided condition in an aqueous medium and stabilized by means of one or more suitable materials.
- Emulsion is the two phase system consisting of two immiscible liquid. Bitumen/Tar content in it- 40 - 60% (remains is water)
- Emulsion is always applied in cold state.

Types of Bitumen Emulsion -

- Slow setting - Use for fine aggregate mixes
- Medium setting - Used for premixing with coarse aggregate
- Rapid setting - Used for surface dressing.

■ **Blown bitumen or oxidized bitumen-**

- It is obtained by passing air under pressure at a high temperature through the bitumen.
- It can be used as roofing and damp-proofing felts, in the manufacture of pipe asphalts and joint fillers.
- It has a lower penetration grade and more softening point in comparison to pure bitumen.

■ **Plastic bitumen-**

- It consists of bitumen, thinner and a suitable inert filler (40 to 45%).
- It is used for filling cracks in masonry structures for stopping leakage.

POLY-VINYL CHLORIDE (PVC)

- PVC is an economical construction material which has very good insulating properties, good water resistance and good fire resistance.
- PVC sheets are used to make electrical panels and boards in buildings. It is a light weight material and is easy to use and assemble.
- PVC pipes are used as water and waste water carrying pipes.
- PVC sheets are used as flooring, roofing and wall panelling to give decorative look to the structure.

CHLORINATED POLYVINYL CHLORIDE

- CPVC is a thermoplastic produced by chlorinated of polyvinyl chloride (PVC) resin.
- CPVC is significantly more flexible than PVC, and can also withstand higher temperatures.
- Uses include hot and cold water delivery pipes and industrial liquid handling.

POLYPROPYLENE FIBRES (PPF)

- A polypropylene fibre has good compressive and tensile strength.
- These are used in reinforced concrete as a partial replacement to steel to take up tensile stresses.

Questions Asked in Previous Years

1. **Polyvinyl chloride (PVC) is a**

- (a) thermosetting material
- (b) thermoplastic material
- (c) elasto-plastic material
- (d) rigid plastic material

GPSC AE (Civil) 18/09/2022

Ans. (b) Polyvinyl chloride (PVC)–

- It is a plastic that gets deformed easily when heated and can be molded again into other forms.
- It is used to make pipes, containers, various types of toys etc.
- It is a thermoplastic material.

2. **Bitumen felt is used for**

- (a) Water proofing (b) Damp proofing
- (c) Both (a) and (b) (d) None of these

JSSC JE (Civil) 03/07/2022

Ans. (c) : Roofing felt or bitumen felt– is a roll material prepared by impregnating roof cardboard with soft bitumen.

- Subsequently coating it on one or both sides with high-melting bitumen and finally facing it with finally ground mineral powder, mica or coloured mineral granules.
- Bitumen felt used for water roofing damp proofing.

3. **Polyethylene and polyvinyl chloride resins are used in various parts of building areas for:**

- (a) structural strength
- (b) structural ductility
- (c) water proofing
- (d) termite proofing

SSC JE Civil 14/11/2022 Shift-I

Ans. (c) : Polyethylene and polyvinyl chloride resin are used in various parts of building areas for water proofing.

- Polyvinyl chloride resins are totally rust-proof, rot-proof, termic-proof, and water proof.

4. **Which of the following is a requirement for thermal insulation in materials?**

- (a) High temperature resistance
- (b) Low density
- (c) High permeability
- (d) Low thermal conductivity

SSC JE (Pre) 06/06/2024 Shift-I

Ans. (d) : Thermal resistance of a material is the property which resists the flow of heat in a material.

- For a material to be a good thermal insulator, it must have low thermal conductivity.

5. **Which of the following materials possesses a specific gravity value in the range of 0.97 to 1.02?**

- (a) Pure bitumen
- (b) Asbestos
- (c) Ordinary Portland cement
- (d) Lime

DDA JE Civil 28/03/2023 Shift-III

Ans. (a) : Specific gravity test on bitumen– A knowledge of the correct specific gravity of bituminous materials have mainly two application convert the specified bitumen content by weight of volume basis.

- When the binder is measured by volume in necessary to know the coefficient of expansion or specific gravity value is useful to identify the source of a bituminous binder.
- Pure bitumen has specific gravity in the range from 0.97 to 1.02.

6. Which type of thermo-resins helps make plastics as clear as glass and possess excellent electrical properties?

- (a) Styrene (b) Cellulose
(c) Alkyd (d) Cumarone- indene

ITBP OVERSEER 27/09/2023

Ans. (b) : Thermoplastic or thermoresins–These plastics soften on heating and harden on cooling. The process of softening and hardening can be repeated any number of times, provided the temperature is not so high as to cause chemical decomposition.

- Major thermoplastic is PVC, polyethylenes, cellulose, acrylic, styrene etc.
- Where, cellulose base conductive materials have excellent electrical and thermal conductivity. It is also stable, strong, wear resistant, transparent.
- The films of cellulose exhibit excellent optical properties with glass.

Thermosetting plastics–These plastics undergo chemical changes at temperatures 127°–177°C and set into permanent shape under pressure. Reheating will not soften them.

Example– Phenol, formaldehyde, melamine formaldehyde.

7. Which of the following is NOT a type of polymer?

- (a) Fibres (b) Brass
(c) Plastics (d) Elastomers

GAIL JA (Tech) 13.05.2023

Ans. (b) : Polymer– High polymer, also known as macromolecular, are large molecules of colloidal dimensions having high weight.

Example– Resins, plastic, rubbers, elastomers

Note– Brass is classified as a metal.

8. Which of the following is a thermosetting plastic?

- (a) Polycarbonate (b) Bakelite
(c) Polytetrafluorethylene (d) Polyvinyl chloride

CRPF Assistant Commandant 2023

Ans. (b) : Thermoplastic– These are the type of polymers which becomes soft upon heating and becomes hard on cooling. Such plastic can undergo infinite cycles of heating and cooling provided the temperature is not so high to cause any chemical composition.

Example– Polystyrene, nylon, Teflon etc.

Thermosetting plastic– These are the plastic which set after application of heat and pressure and then do not change their form on further application of heat and pressure. These plastic originally pass through the thermoplastic phase.

Example– Bakelite, E-poxy resin, Melamine, resin etc.

9. The pipe material 'UPVC' stands for _____.

- (a) Unplasticized polyvinylchloride
(b) Ultrastrong polyvinyl chloride
(c) Unplasticized polyvanadium chloride
(d) Ultrastrong polyvanadium chloride

AIIMS Rishikesh AE (Civil) 01/10/2023

Ans. (a) : UPVC–Unplasticized polyvinylchloride.

- It is a type of piping that is made from PVC plastic.

10. Where is lead glass commonly used in building construction?

- (a) Plumbing and piping
(b) Facades and windows
(c) False ceiling
(d) Flooring works

SSC JE (Pre) 06/06/2024 Shift-I

Ans. (b) : In the case of lead glass, lead oxide (PbO) replaces the calcium oxide. However, with the exception of glass for protection against x-rays, this type of glass has no significance for the building industry.

- It is used in building construction as a Facades and windows.

11. Which of the following is NOT an engineering property of glass?

- (a) Recycling property (b) Value
(c) Transparency (d) Strength

PGCIL DT 08/02/2024

Ans (b) : Engineering property of glass–

- (a) Strength (b) Transparency
(c) Workability (d) Transmittance
(e) Recycle property.

12. Which is the acidic refractory material that is used for preparing coke oven and lining for glass furnaces?

- (a) Dolomite (b) Silica
(c) Fire-clay (d) Quartzite

ITBP OVERSEER 27/09/2023

Ans. (b) : • Acid refractory bricks consist of silica bricks (95-97% silica and 1-2% lime) and ganister bricks (ganister - a hard coloured sand stone containing 10% and 2% of lime), used in lining furnaces having siliceous and acidic slag, steel industry and coke oven.

- The softening temperature ranges from 1700°C to 1800°C.
- These cannot be used for lining of furnaces which have to be cooled and reheated frequently.

13. Glass used in windows to prevent heat loss:

- (a) Colored glass (b) Frosted glass
(c) Processed glass (d) Insulating glass

PGCIL DT 05.12.2023

Ans. (d) Insulated glass application– Insulating glass is traditionally used at office buildings, hospitals, hotels, houses and those buildings where large amount of heating or cooling is required. That place where humidity and temperature needs to be controlled insulated glass is best suited for them.

- 14. Which property of borosilicate glass makes it suitable for thermal shock resistance ?**
- Low density
 - High transparency
 - Low thermal expansion coefficient.
 - High refractive index

SSC JE (Pre) 07/06/2024 Shift-I

Ans. (c) : Borosilicate glass– Borosilicate glass is a form of glass that contains silica and boron trioxide as its major ingredients.

- Borosilicate glasses have much lower thermal expansion coefficients than most common glass making them very resistant to thermal shocks.
- Such glass is less thermally stresses and sustain temperature difference of up to 165°C without cracking. Reagent bottles and flasks, as well as digits, electronics and cooking are all made from it.

- 15. Fiberglass materials have a usable temperature up to**
- 105°C
 - 473°C
 - 45°C
 - 200°C

MH PWD JE 16/12/2023 Shift-I

Ans. (d) : Fiberglass– Fiberglass materials have a low service temperature which is below 200°C. This is despite the fact that they usually have high strength. These materials also have a great impact resistance and are extremely flexible. Fiberglass is composed of glass fibers bonded with a thermosetting resin. It is resistant to bacteria or fungus attack.

- 16. The glass which is used for glazing of windows, door and for making ordinary glassware.**
- Soda-lime glass
 - Bonemian glass
 - Pyrex glass
 - Common glass
 - Answer not known

TNPSC AE (Civil) 27/05/2023

Ans. (a) : Soda-lime glass- It is also known as soda ash glass or soft glass. it is obtained by fusing a mixture of silica, lime and soda. The quality of this glass can be improved by adding alumina magnesium oxide and the glass is then called crown glass. This is most type of glass used in doors, windows and for making glassware such as bottles.

- 17. Percentage content of silica in window glass, is**
- 85 to 90
 - 45 to 55
 - 55 to 60
 - 70 to 75

JSSC JE (Civil) 03/07/2022

Ans. (d) : The composition of soda-lime glass is normally 60-75% of silica, 12-18% soda and 5-12% lime. • A low percentage of other materials can be added for specific properties such as colouring. • Percentage content of silica in window glass is 70 to 75%.

- 18. Seasoning of timber is**

- a process of removing sap
- creosoting
- painting with sodium silicate
- coating with tar

PSSSB JE (Civil) 21.01.2024

Ans. (a) : Seasoning of timber (IS : 1141)– It is the process of reducing the moisture content of timber in order to prevent the timber.

It is use for–

- Reduce its weight and increase strength and durability
- Make timber burn readily as a fuel
- Make it suitable for paining
- Reduce its tendency to split and decay and reduce shrinkage and warping.

- 19. In which type of seasoning is timber immersed in a solution of suitable salt, and then taken out and seasoned in ordinary way?**

- Water seasoning
- Chemical seasoning
- Kiln seasoning
- Boiling

SSC JE (Pre) 07/06/2024 Shift-I

Ans. (b) : Chemical or salt seasoning–An aqueous solution of certain chemicals have lower vapor pressure than that of pure water. If the outer layers of timber are treated with such chemicals the vapor pressure will reduce and a vapor pressure gradient is setup. In chemical seasoning timber immersed in a solution of suitable salt and then taken out and seasoned in ordinary way.

- 20. In plywood, three or more veneers in odd numbers are placed one above the other with the direction of grains of successive layers at _____ to each other.**

- 60°
- 45°
- 90°
- 30°

SSC JE (Pre) 07/06/2024 Shift-I

Ans. (c) : Plywood–A wood panel glued under pressure on odd number (three or more) of layer of veneers are placed one above the other with the direction of grains of successive layers at perpendicular to each other is known as plywood.

- 21. _____ determines the thickness of plywood board.**

- pile width
- pile length
- pile area
- number of pile layers

SSC JE (Pre) 05/06/2024 Shift-I

Ans. (d) : Plywood–A wood panel glued under pressure from an odd number (usually 3 to 13) of layers of veneers is known as plywood.

As per IS: 303-1989, thickness of plywood

- 3 ply → 3, 4, 5, 6 mm
- 5 ply → 5, 6, 8, 9 mm
- 7 ply → 9, 12, 15, 16 mm
- 9 ply → 12, 15, 16, 19 mm
- 11 ply → 19, 22, 25 mm
- more than 11 ply → as per order.

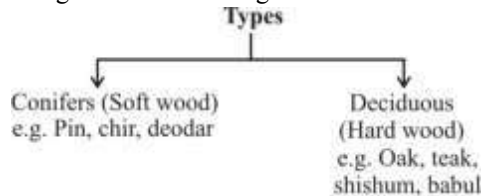
22. Which types of trees grow inwards and fibrous mass is seen in their longitudinal sections?
 (a) Deciduous (b) Endogenous trees
 (c) Exogenous trees (d) Conifers

SSC JE (Pre) 06/06/2024 Shift-I

Ans. (b) : Endogenous trees—These are the types of trees which grows in bulk in inward direction and fibrous mass can be seen across their longitudinal section.

Example—Bamboo, cane, palm etc.

Exogenous tree—These grow outward, for all engineering work we use exogenous tree.



23. How many methods are employed for the seasoning of Timber?
 (a) Three (b) Two
 (c) Four (d) Five

PGCIL DT 08/02/2024

Ans. (b) : Seasoning of timber:- The newly cut trees have water in large quantity in sap and minimum in this inner part of wood.

- We remove sap of the wood, then do seasoning for drying the wood and making for structural use
- By drying the timber we make its strength high more elastic and durable.
- A well seasoned timber has 12% moisture content in it.
 - Natural seasoning
 - Artificial seasoning

24. How are trees classified based on mode of growth?
 (a) Grade and elasticity
 (b) Perpendicular and parallel
 (c) Endogeneous and exogeneous
 (d) Small and large

HSSC JE 18.02.2024

Ans. (c) : Classification of trees— Trees are classified as endogenous and exogenous according to the mode of growth.

Endogenous Trees— Trees grow inwards e.g. palm, bamboo etc.

Exogenous trees— Trees grow outwards and are used for making structural elements. They are further subdivided as conifers and deciduous.

25. Select the **INCORRECT** objective of seasoning of timber.
 (a) Reduce the shrinkage and warping after placement in structure
 (b) Increase strength, durability and workability
 (c) Reduce its tendency to split and decay
 (d) Increase its weight

Odisha JE Lect. 28/01/2024 Paper-I

Ans. (d) :

Some of the objects of seasoning wood are follows—

- Reduce the shrinkage and warping after placement in structure.
- Increase strength, durability and workability.
- Reduce its weight.
- Reduce its tendency to split and decay.

26. In the context of structure of timber, the function of _____ is to grow wood cells on the inside and smaller best cells on the outside.
 (a) sap wood (b) bark
 (c) medullary rays (d) cambium

SJVNL Field Engg. 22/01/2024

Ans. (d) : Cambium—The second layer is the cambium, a thin tissue where tree growth takes place. Cambium cells are constantly dividing. Producing food transporting phloem cells closer to the bark of the free and xylem or wood cells towards the core of the tree.

27. Which group of timber are most commonly available in quantity 1415 m³ or more per year according to IS: 399-1963?
 (a) Z (b) Y
 (c) X (d) Q

DDA JE 17/10/2023 (Shift-III)

Ans. (c) :

Classification of timber based on availability—

X : Most common grade – 1415 m³ (1000 tonnes) and more per year

Y : Common grade – 355 m³ (250 tonnes) to 1415 m³ (1000 tonnes) per year

Z : Less common grade – Below 355 m³ per year.

Based on durability

Durability **Average life**

High ≥ 120

Moderate $60 \leq \text{life} \leq 120$

Low < 60

Basis of seasoning characteristics—

1. High refractory: Class A

2. Medium refractory: Class B

3. Non refractory: Class C

28. A very thin sheet of wood which is cut from the round logs with 0.5 to 5 mm thickness is called:
 (a) veneer (b) chipboard
 (c) fibre wood (d) blockboard

Assam PWD JE 13/08/2023

Ans. (a) : Veneers (IS 14315)— The primary process in the manufacture of wood based products is veneering which produces thin sheets of wood known as veneers.

- The thickness of veneers varies from 0.4 to 0.6 mm. In no case it should exceed 1 mm.

29. Star shake, a type of defect in timber arises due to _____.
 (a) growth of layers of sapwood over Wounds
 (b) severe frost and fierce heat of sun
 (c) wind causing young tree to turn in one direction
 (d) greater evaporation of sap at the end grains of log

DSSSB JE (Tier-I) 29/06/2022 Shift-I

Ans. (b) : Star shake– It is radial splits or cracks wide at circumference and diminishing towards the centre of the tree. This defect may arise from severe frost and fierce heat of sun. Star shakes appear as the wood dries below the fibre saturation point. It is a senous fault leading to separated by when sawn.

30. During the construction of particle board in the extrusion pressing process, what is the orientation of the wood particles with respect to the plane of board?

- (a) 45° (b) 30°
(c) 90° (d) 0°

SSC JE Pre. 09/10/2023 (Morning)

Ans. (c) : Particle board/chip board (IS : 3129,12406, 3478)– They are manufactured from particles of wood or other ligno-cellulose materials which are agglomerated, formed and pressed together by the use of an organic binder together in the presence of heat, pressure or moisture.

• During the construction of particle board in the extrusion pressing process, it is the orientation 90° of the wood particles with respect to the plane of board. They are manufactured from small timber pieces and wood wastes. The latter is first converted into small chips.

31. A wood panel glued under pressure from an odd number of layers of veneers is known as

- (a) plywood (b) fibre board
(c) hard board (d) particle board

MH PWD CEA 28/12/2023 Shift-III

Ans. (a) : Plywood :

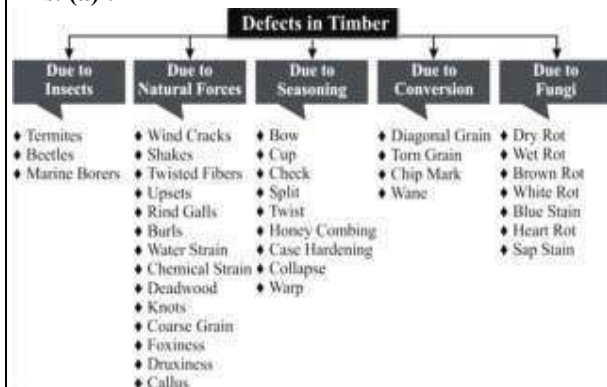
- A wood panel glued under pressure from an odd number (usually 3 to 13) of layers of veneers is known as plywood.
- Plywood may be classified upon direction of gains in the piles and on the type of adhesive used.
- Normally the alternate plies are oriented at 30° or 60° in star plywood.

32. Which of the following defects occur in the seasoning process of wood?

- (a) bow (b) brown rot
(c) sap stain (d) blue stain

AIIMS Rishikesh AE (Civil) 01/10/2023

Ans. (a) :



33. Timber is considered moderately heavy when the density varies from

- (a) 2.5 to 4.5 kN/m³ (b) 5.5 to 7.5 kN/m³
(c) 7.5 to 9.5 kN/m³ (d) None of these

UKPSC JE (Civil) 24/12/2023 Paper-I

Ans. (b) : Density of light to very light timber is less than 5.5 kN/m³ moderate timber has density between 5.5 to 7.5 kN/m³ and heavy to very heavy timber has density greater than 7.5 kN/m³.

34. The shrinkage of wood from green to over dry condition will be maximum in

- (a) Longitudinal direction
(b) Tangential direction
(c) Radial direction
(d) Wood exposed to moisture

UKPSC AE 16.08.2023 Paper-2

Ans. (b) : Shrinkage of wood– Shrinkage is the reduction in linear and volumetric dimensions in drying of wood.

- Linear shrinkage along the fibres lies between 0.1 to 0.3 percent, in radial direction between 3 to 6 percent and in the tangential direction between 7 to 12 percent.
- In general the radial shrinkage of wood is 60 percent of the tangential and the longitudinal shrinkage is negligible.

35. The density of wood used for construction in the ranges between

- (a) 1.2 to 1.3 g/cm³ (b) 1.5 to 1.6 g/cm³
(c) 2.3 to 2.6 g/cm³ (d) 2.6 to 2.9 g/cm³

ESE 19.02.2023 Paper-II

Ans. (b) : The density of wood used for construction in the ranges between 1.5 to 1.6 g/cm³.

36. As per IS : 303 and 10701, the thickness of 5 ply plywood boards for structural purpose are available in

- (a) 6 mm and 9 mm (b) 12 mm and 16 mm
(c) 16 mm and 19 mm (d) 10 mm and 15 mm

ESE 19.02.2023 Paper-II

Ans. (a) : Thickness of plywood boards (IS : 303 and 10701)–

Board	Thickness (mm)	
	General purpose	Structural purpose
3 Ply	3,4,5,6	4
5 Ply	5,6,8,9	6,9
7 Ply	9,12,15,16	12,16
9 Ply	12,15,16,19	16,19
11 Ply	19,22,25	19,25
above 11 ply	On order	

37. According to IS : 14315-1995, the maximum thickness of commercial veneers produced from wood is:

- (a) 12 mm (b) 6 mm
(c) 8 mm (d) 3 mm

Kerala PSC (PWD) Draftsman 15/06/2023

Ans. (b) : As per IS 14315 : 1995, clause 9.3

The maximum thickness of the veneer shall be 6 mm.

Veneers— A thin slices of wood that typically are glued on to core panels in order to produce flat panels.

- The thickness of veneers lies between 10–6 mm having same strength in all direction.
- These are commercial wood which are used to make plywood.

38. The innermost central portion or core of the tree is called as

- (a) Cambium layer (b) Medulla
(c) Annular rings (d) bark

ISRO URSC TA 18.04.2024

Ans. (b) : Structure of timber—

Bast—The barks inner layer called bast conveys the nutrients from the crown downwards and stores them.

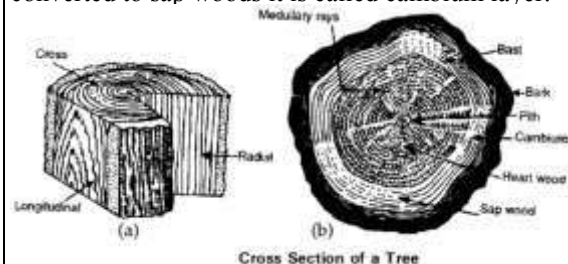
Pith—Inner most central portion or core of the tree is called the pith or medulla.

Sap wood— The outer annual rings, between heartwood and cambium layer is known as sapwood.

Heart wood— It consist of the inner annual rings round the pith.

Inner bark— It is the inner skin or layer covering the emulsion layer.

Cambium layer— The thin layer below bark not converted to sap woods it is called cambium layer.



39. The moisture content in a properly seasoned timbers will in the range of?

- (a) 5% to 10% (b) 8% to 10%
(c) 10% to 12% (d) 12% to 15%
(e) Answer not known

TNPSC AE (Civil) 27/05/2023

Ans. (c) : The process of drying the wood to moisture content approximately equal to the average humidity of surroundings where it is to be permanently fixed is called seasoning.

- The seasoning of timber is required to remove sap from the timber.
- The moisture content in a well seasoned timber is 10-12%.

40. Which of the following types of wood flooring is the softest wood?

- (a) Pine (b) Oak
(c) Maple (d) Pecan

Andaman PWD Architectural Asst. 19/02/2023

Ans. (a) Pine flooring—

- Pine wood flooring is the softest wood.
- Evergreen trees • Pins, space and firm
- Less costly • Almost light

Uses—Chips for laminated wood, flooring, roofing, shingles.

41. The shearing strength of wood along the fibres is:

- (a) 6.5 to 14.5 N/mm² (b) 10 to 30 N/mm²
(c) 2.5 to 3 N/mm² (d) 20 to 30 N/mm²

UPMRCL JE 02/01/2023

Ans. (a) Properties of timber—

- Tensile strength along the grains is 2-4 times stronger than compressive strength.
- The shearing strength of wood along the fibres is 6.5 to 14.5 N/mm².
- The shearing strength along the fibers. Resistance of wood to cutting across the fibers is 3 to 4 times greater than that along the fibers.

42. Timber can be made more fire resistant by

- (a) Dipping and stepping process
(b) Sir Abel's process
(c) Charring
(d) Hot and cold open tank treatment

KRIDL AE (Civil) 05/02/2023

Ans. (b) Fire resistance of timber—

Sir Abel's process— Surface of wood is painted by a weak solution of sodium silicate.

- Thereafter slaked lime solution of the consistency of a paste is applied followed by the application of concentrated solution of sodium silicate in two coats the second being applied after 6 hours of the first coat.

Composition of the solution is—

- Sodium silicate 56g
- Water 50 g
- Kaolin 75 g

43. Identify the endogenous tree type from among the following.

- (a) Palm (b) Pine
(c) Deodar (d) Oak

SJVNL Field Engg. 18/03/2023

Ans. (a) Endogenous tree—These tree grow more in length. Inwards and fibrous mass can be seen in the longitudinal section.

Example: Bamboo, cane, palm.

These trees have limited engineering applications.

Exogenous trees— Trees grow outward and these are used for making structural elements.

- They are further subdivided as conifers and deciduous. Ex-Deodar, chir, teak, shishum pine etc.

44. Along the grains, tensile strength of timber is the corresponding compressive strength

- (a) same (b) less than
(c) not comparable (d) more than

NBCC JE 09/05/2022

Ans. (d) : Tensile strength of timber along the grain (parallel to grain) is 2 to 4 times more than the compressive strength.

- It is an order of 80 to 190 N/mm². Further, across the grain (perpendicular the grain) tensile strength of timber is low.

45. Which of the following is not a types of seasoning of timber?

- (a) Air Seasoning (b) Soil Seasoning
(c) Electrical Seasoning (d) Water Seasoning

MP Vyapam Sub Engg. 06/11/2022 Shift-II

Ans. (b) : Air seasoning– The log of wood is sawn into planks of convenient sizes and stacked under a covered shed in cross wise direction in alternate layers so as to permit free circulation of air.

Water seasoning– The logs of wood are kept completely immersed in running stream of water, with their larger ends pointing upstream.

Electrical seasoning– The logs are placed in such a way that their two ends touch the electrodes.

- Current is passed through the setup, being a bad conductor, wood resists the flow of current, generating heat in the process, which results in its drying.

46. Tensile strength of timber parallel to the fibres is in the range of

- (a) 10–80 N/mm² (b) 80–190 N/mm²
(c) 190–250 N/mm² (d) 250–310 N/mm²

GPSC AE Class-2, N.W.R. 05/09/2021

Ans. (b) : Tensile strength of timber parallel to the fibre is in the range 80-190 N/mm².

The compressive strength is lower and is usually 30-77.5 Mpa (N/mm²).

- Shear strength 6-15 N/mm².
- Tensile strength along a direction parallel to the grains is found to have the greatest strength that can be developed under any kind stress.

47. _____ is a sign of decay appearing in the form of yellow or red tinge or discolouration of overmatured trees.

- (a) Foxiness (b) Twisted fibres
(c) End splits (d) Upsets

MH WCD JE 14.07.2024 Shift-II

Ans. (a) :

Knot	These are the base of branches which are broken or cut-off from the trees.
Rind galls	Abnormal growth or curved swellings on the body of tree.
Foxiness	It is a sign of decay appearing in the form of yellow or red tinge. Cause –Over maturity lack of ventilation.
Burl	Burl is the growth of tree in which the grain has grown in a regular projection or the timber body. • It formed when the tree receives shock or injury in its young age.
Callus	It is the soft tissue or skin which cover the wound of a tree.
Druxiness	White spots are formed on the top surface of wood.
Twisted fiber	It is caused by wind turning the trunk of young tree in one direction. • Reaction wood is the wood with twisted fiber.
Upsets	It is due to the crushing of fibers running transversely during the growth of the tree due to strong winds and unskilled felling consequently resulting in discontinuity of fibers.

48. As per IS 3129-1985, the permissible tolerance for the length of finished boards shall be _____.

- (a) ±6 mm (b) ±2 mm
(c) ±8 mm (d) ±4 mm

SSC JE (Pre) 07/06/2024 Shift-I

Ans. (c) : According to IS 3129-1985, the permissible tolerances on the nominal sizes of finished boards shall be as follows–

Dimension	Nominal size	Tolerance
Length	for all lengths	±8 mm
Width	for all widths	±8 mm
Thickness	above 25 mm	±1 mm
	upto and including 25 mm	±0.8 mm

49. Timber which are slow and difficult to season free from defects, are classified as based upon their behavior to cracking and splitting during normal air-seasoning practice.

- (a) Null refractory
(b) Moderate refractory
(c) High refractory
(d) Low refractory

SSC JE (Pre) 06/06/2024 Shift-III

Ans. (c) : Non-refractory timbers can be rapidly seasoned without any trouble. They can be seasoned even in the open air and sun. Examples are deodar, simul etc.

• Moderately refracting timbers have tendency to split and to crack during seasoning. They are therefore to be protected against rapid drying conditions.

• Highly refracting timbers are likely to be damaged severally during seasoning. They are difficult to season.

50. Which of the following indicates a preliminary stage of dead knot, where the fibres of knot are not firmly held in the surrounding wood?

- (a) Tight knot (b) Dead knot
(c) Loose knot (d) Round knot

SSC JE (Pre) 06/06/2024 Shift-III

Ans. (c) : Knots in Timber–These are the sections of the branches of the tree present on the surface of the wood which appears in the form of hard and dark pieces.

• Knots are the spots of weaknesses in timber when used to carry compression.

Pin knot–When the diameter is less than 12 mm.

Small knot– When the diameter is 12-20 mm.

Medium knot– When the diameter is 20-40 mm.

Large knot–When the diameter is more than 40 mm.

Tight knot–Tight knot are those which are joined securely to the adjacent wood.

Dead knot– The fibers of knot are properly interconnected with those of surrounding wood. Hence it can be easily separated out from for engineering purposes.

Loose knot– It indicates preliminary stage of dead knot.

The fibers of knot are not firmly held in the surrounding wood.

51. _____ are popularly known as white ants, though they are in no way related to ants.

- (a) Bacteria (b) Flies
(c) Termites (d) Viruses

SSC JE (Pre) 06/06/2024 Shift-III

Ans. (c) : White ants are really called termites.

Although, these insects are often called white ants they are nothing like ants when we dig a little deeper.

- White ants actually belong to the cockroach family.

52. To make timber more fire resistant than it is, the wood is first impregnated with a fire retarding chemical solution such as _____.

- (a) gasoline
(b) ammonium phosphate
(c) butane
(d) turpentine

SSC JE (Pre) 05/06/2024 Shift-I

Ans. (b) : Fire Resistance of timber– Fire proofing makes timber resistant to fire at high degree that it is difficult to ignite and support its own combustion. The fire resistance of wood can be enhanced either by impregnating it with chemicals like phosphates of ammonia, mixture of ammonium phosphate and ammonium sulphate etc. or by designing wood to provide slow burning construction.

53. Which property of timber makes it resistant to corrosion and rust?

- (a) High strength
(b) High moisture absorption
(c) Low density
(d) Non-metallic composition

SSC JE (Pre) 06/06/2024 Shift-I

Ans. (d) : Corrosion is a natural process that occurs when a material reacts with its environment such as air, water or other substances.

- Corrosion resistant materials are designed to resist this process, either via a protective layer on the surface or through a chemical composition that does not react with the environment.
- Timber is non-metallic composition those makes it resistant to corrosion and rust.

54. Which property of particle board makes it advantageous for use in ceiling panels?

- (a) Thermal insulation properties
(b) Sound insulation properties
(c) Lightweight
(d) Termite resistance

MPPGCL JE 01/06/2024

Ans. (b) : Particle board:- It is made out of small size timber and wood waste residue of all types like logs and tops of trees, edgings of saw mills, end cuts, stumpetc and other similar woody material.

→ Sound insulation of particle board makes it advantages for use in ceiling panels

55. Which of the following IS codes provides specifications on 'Plywood for concrete shuttering work - Specification [Wood and other lignocellulosic products]'?

- (a) IS 5440:2011 (b) IS 5450:2011
(c) IS 4990:2011 (d) IS 2330:2011

MPPGCL JE 01/06/2024

Ans. (c) : IS 4990 : 2011 → Ply wood for concrete shuttering work- specification (wood and other ligno cellulosic products)

IS 5440 : 2011 → optical flats

IS 2330 : 2011 → Metallic Materials - Tube flanging test

56. Which of the following types of wood is known for its high strength and resistance to decay, making it suitable for outdoor construction?

- (a) Cedar (b) Pine
(c) Oak (d) Mahogany

RITES AM 05/05/2024

Ans. (d) : Mahogany wood is a durable hardwood that is resistant to scratches, dents and other types of damages. It is also resistant to rot and decay, making it a popular choice for outdoor furniture and decking.

57. What is the primary purpose of a rip saw?

- (a) Making finer cuts
(b) Cutting along the grain
(c) Cutting panels for door shutters
(d) None of these

HSSC JE 18.02.2024

Ans. (b) : Rip saw–A rip saw is wood saw that is specially designed for making a rip cut, a cut made parallel to the direction of the wood grain.

Compass saw–A compass saw is a type of saw used for making curved cuts known as compasses, particularly in confined spaces where a larger saw would not fit.

Dovetail saw–A small backsaw used to cut dovetails, these saws will usually have a higher number of teeth per inch (around IS-20 T.P.I) with teeth sharpened in a rip tooth pattern and minimal set to leave a narrow kerfs this fine tooth pattern also works well in cross cutting operations.

Tenon saw–A mid sized backsaw, the saw derives its name from its used in the cutting of tenons for mortise and tenon joinery. Tenon saws are commonly available with rip-filed teeth for rip cutting and cross-cut for cutting across the grain.

58. What is the difference between soft wood and hard wood?

- (a) The colour of soft wood is light whereas the colour of hard wood is dark
(b) Soft wood is heavy and hard wood is light
(c) Soft wood is more fire-resistant than hard wood
(d) Soft wood has more strength in compression and shear compared to hard wood

HSSC JE 18.02.2024

Ans. (a) :	
Soft wood	Hard wood
In soft wood the fibers are less dense.	In case of hard wood the fibers are quite close and dense.
It is light weight and softer than hardwood.	It is heavy weight and harder than softwood.
It is light in colour	Normally these are dark colour woods.
It has poorer resistance to fire than hardwood and burn at a high rate	It has better resistance to fire softwood.
It has less strength and shear in compression hard wood	It has more strength and shear in compression hard wood

59. Which of the following additives is typically included in paint to increases itself life and stability but may raise environmental or health concerns if released into the environment?

- (a) Pigments
(b) Bio-accumulative agents
(c) Plasticizers
(d) Solvents

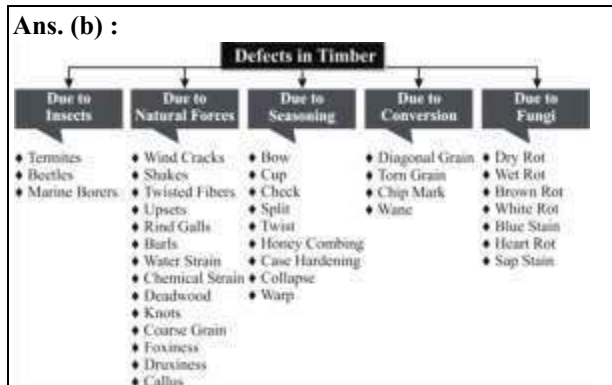
BHEL Supervisor Trainee (Civil) 21.01.2024

Ans. (b) : Bio-accumulative agents are used in paints to increases its life and stability but may raise environmental or health concerns if released into the environment.

60. Identify the defect in timber, which is NOT caused by seasoning of timber?

- (a) Checks (b) Rind gall
(c) Warpage (d) Splitting

SSC JE Mains 04.12.2023



61. Which of the following is NOT related with defects in timber?

- (a) Cup shake (b) Upset
(c) Rindgall (d) Bark

MH PWD CEA 28/12/2023 Shift-I

Ans. (d) : See the above explanation.

62. Which of the following defects is NOT caused by seasoning of timber?

- (a) Splitting (b) Dry rot
(c) Checks (d) Warpage

MH WCD JE 15.07.2024 Shift-III

Ans. (b) : See the above explanation.

63. Which of the following is manufactured from particles of wood or other ligno cellulose materials, which are agglomerated, formed and pressed together using an organic binder together in the presence of heat, pressure or moisture?

- (a) Block boards (b) Particle boards
(c) Plywood (d) Veneers

SSC JE Pre. 11/10/2023 (Morning)

Ans. (b) : Particle board/chip board (IS : 3129,12406, 3478)– They are manufactured from particles of wood or other ligno-cellulose materials which are agglomerated, formed and pressed together by the use of an organic binder together in the presence of heat, pressure or moisture. They are manufactured from small timber pieces and wood wastes. The latter is first converted into small chips.

64. Crushing of fibres running transversely during the growth of the tree due to strong winds is known as–

- (a) Upsets (b) End splits
(c) Twisted fibres (d) Rind galls

CHB Asst. Architect 05.02.2023

Ans. (a) : Upsets – Caused by the crushing of fibre running transversely during the growth of the tree due to strong winds and unskilled felling consequently resulting in discontinuity of fibres.

Twisted fibres – Caused by wind constantly turning the trunk of young tree in one direction.

Rindgall – It is peculiar curved swellings formed on the body of a tree. These are caused due to the growth of layers over the injuries left over after improper felling of trees.

Knot– Knots are bases of branches buried by cambial activity of the mother branch. The root of the branch is embedded in the stem, with the formation of annual rings at right angles to those of the stem. The knots interrupt the basic grain direction of the wood, resulting in a reduction of its strength.

65. Curved swellings found on the body of a tree are known as

- (a) Shakes (b) Knots
(c) Rind galls (d) Upsets

ISRO URSC Draughtsman 18/04/2024

Ans. (c) : See the above explanation.

66. The number of zones in India for classifying allowable moisture content for building timber as per the Indian Standard are -

- (a) Four (b) Six or five
(c) Three (d) Two or one

SSC JE Civil 14/11/2022 Shift-I

Ans. (a) : As per IS 287 : 1993

Zones– The country has been broadly divided into the following four zones on the basis of information collected by the forest research institutes on the seasonal changes in the moisture content of timber at 12 localities in India supplemented by published

meteorological data on the humidity variations in the country.	
Zone-I	Average annual relative humidity less than 40%.
Zone-II	Average annual relative humidity 40-50%.
Zone-III	Average annual relative humidity more than so and up to 67%.
Zone-IV	Average annual relative humidity more than 67%.

67. What is the maximum limit of water-soluble content (percentage by mass) present in fly ash, which could be used as an additive to brick earth?
- (a) 1.5% (b) 5%
(c) 15% (d) 0.1%

BHEL Exe. Trainee, 24.08.2023

Ans. (d) : Apparatus required for water absorption test—

The following apparatuses are required for the testing of water absorption of fly ash bricks.

- (i) A sensitive weighing balance capable of weighing within 0.1% of the total mass of the specimen.
(ii) Ventilated oven [$110^{\circ}\text{C} (\pm 5^{\circ}\text{C})$]
(iii) Water bath [$27^{\circ}\text{C} (\pm 12^{\circ}\text{C})$]
(iv) Damp cloths.

68. As per IS 712, which of the following is class A type lime?
- (a) Magnesium lime
(b) Fat lime
(c) Semi hydraulic lime
(d) Eminently hydraulic lime

ISRO URSC Draughtsman 18/04/2024

Ans. (d) : As per IS 712-1984— Cl— 3.1

Building lime—

Class A- Eminently hydraulic lime used for structures purposes.

Class B- Semi-hydraulic lime used for masonry mortars lime concrete and plaster undercoat.

Class C- Fat lime used for finishing coat in plastering, white washing, composite mortar etc.

Class D- Magnesium/dolomitic lime used for finishing coat in plastering, white washing.

Class E- Kankar lime used for masonry mortars.

Class F- Siliceous dolomitic lime used for undercoat and finishing coat of plaster.

69. Which of the following non-metallic materials are also known as thermo softening plastic?
- (a) Elastomers (b) Thermoplastics
(c) Thermoset materials (d) Minerals

SSB SI PIONEER (Civil) 22.01.2024

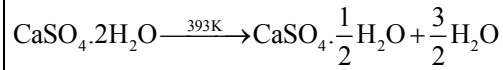
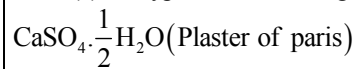
Ans. (b) : Thermoplastic materials are those which soften on the application of heat, with or without pressure and require cooling to be set to a shape.

- They can be heated and cooled any number of times, only they should not be heated above their decomposition temperatures.
- They are highly plastic and are easy for moulding or shaping.

70. Which is the product that is formed after the heating of gypsum at 393 K and evaporation of 75% of water content from it?
- (a) Cement (b) Geo-polymer
(c) Plaster of Paris (d) Calcined lime

UKPSC JE (Civil) 24/12/2023 Paper-I

Ans. (c) : Gypsum on heating at 393 K will produce



Most plasters theoretically approach which contains about 6.2% of water.

Properties—

- White in colour
- Setting time is 5 to 10 minutes
- Specific gravity is 2.57.

71. What is the chemical combination formula of Plaster of Paris?

- (a) $\text{CaCO}_3 \cdot 2\text{H}_2\text{O}$ (b) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
(c) $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$ (d) $\text{CaSO}_3 \cdot 2\text{H}_2\text{O}$

SSC JE (Pre) 07/06/2024 Shift-I

Ans. (c) : See the explanation of above question.

72. Unslaked lime is :

- (a) calcium carbonate (b) calcium oxide
(c) calcium hydroxide (d) calcium sulphate

UKPSC Draftsman 05/11/2023

Ans. (b) : Unslaked lime—

Unslaked lime or quick lime (CaO) pure lime. generally called quick, however, contains more or less magnesium oxide, which gives the product a brownish or grayish tinge. Quick lime obtained after the calcination of limestone. It is also called caustic lime. It is capable of slaking with water and has no affinity for carbonic acid. The specific gravity of pure lime is about 3.40.

73. Identify the INCORRECT statement with respect to a type of stone 'Kankar'.

- (a) Kankar is irregular in shape
(b) Kankar has a porous structure
(c) Kankar is a type of metamorphic rock
(d) Nodular Kankar is used to produce hydraulic lime

DDA JE Civil 28/03/2023 Shift-III

Ans. (c) : Kankar: A stone with irregular shape and porous structure that is used to produce hydraulic lime. Kankar is a sedimentary rock.

74. What is produced when water is added to quick lime?

- (a) Fat lime (b) Hydraulic lime
(c) Lime stone (d) Caustic lime

JSSC JE (General Engg.) 16/10/2023

Ans. (d) : Caustic lime is obtained by adding water in quick lime.

- It is capable of slaking with water and has no affinity for carbonic acid. The specific gravity of pure lime is about 3.4.

75. Which lime contains about 70% to 80% CaO and 20% to 30% clay?
 (a) Fat lime (b) Pure lime
 (c) Poor lime (d) Hydraulic lime

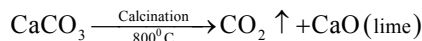
JSSC JE (General Engg.) 16/10/2023

Ans. (d) : Hydraulic lime—It is a product obtained by moderate burning (900°C-1100°C) of raw limestone which contains small proportions of clay (silica and alumina) 5-30 percent and iron oxide in chemical combination with the calcium oxide content (CaO + MgO 70-80% with MgO less than 5%). In slaking considerable care is required to provide just sufficient water and no excess, since an excess would cause the lime to harden.

76. Lime is obtained by burning limestone at a temperature of about:
 (a) 1000 °C (b) 800 °C
 (c) 1100 °C (d) 850 °C

UPPCL JE 21/02/2022 Shift-I

Ans. (b) : Calcination of lime— It refers to the heating of lime stone of redness in the presence of air. Lime is obtained by calcination of limestone. Moisture and CO₂ are removed from the limestone leaning behind lime.



77. Which of the following is NOT a property of Lime?
 (a) Flexible and easily workable
 (b) Poor plasticity
 (c) Solidify in less time and become hard
 (d) Highly resistant moisture

PGCIL DT 08/02/2024

Ans (b) : Property of lime—

- Lime possesses good plasticity and easy to work with.
- It stiffens easily and resistance to moisture.
- The excellent cementitious properties make it most suitable for masonry work.
- The shrinkage on drying is small because of its high water retentivity.

78. Which of the following is NOT a characteristic of poor lime?
 (a) Slaking requires more time and so it hydrates slowly.
 (b) It makes thin paste with water.
 (c) setting and hardening is fast.
 (d) The colour varies from yellow to grey.

UPRVNL JE (Civil) 23/12/2022

Ans. (c) : Poor lime— It is also known as lean lime or impure lime. As it contains more than 30% of clay, which makes lime to slaking slowly.

- It sets and hardens very-slowly compared to the other types of limes. It has very poor binding properties and can form a thin paste with water. It is colour varies from yellow to gray.
- It is used for inferior types of works because of its inferior quality.

79. Fat lime is pure lime that contains approximately calcium oxides :
 (a) 90% to 95% (b) 80% to 90%
 (c) 80% to 85% (d) 85% to 90%

UKPSC JE (Civil) 24/12/2023 Paper-I

Ans. (a) : Fat or pure lime—It is a pure lime that is made by burning a pure limestone rock like chalk, shell or coral.

- It contains approximately 90% to 95% of calcium oxides, fat lime absorbs carbon dioxide when it is exposed in air and gets transferred into calcium carbonate.

• **Fat lime has the following properties—**

1. It hardens very slowly
2. Fat lime has very high degree of plasticity
3. Fat lime slakes vigorously
4. Fat lime sets very slowly if exposed to air.

80. Which one of the following is NOT correct for characteristics of lime?

- (a) Lime possesses good plasticity and is easy to work with
- (b) It stiffens easily and is resistant to moisture
- (c) The excellent cementitious properties make it most suitable for masonry work
- (d) The shrinkage on drying is large because of its high water retentively

ESE 19.02.2023 Paper-II

Ans. (d) Characteristics of lime—

- (i) Lime has good plasticity and has high workability.
- (ii) It has good cementitious properties and is suitable for masonry works.
- (iii) If stiffens easily and has light resistant to moisture, because of its high water retentively. Shrinkage on drying is small compared to cement.

81. As per IS : 712 – 1984, the lime used for structural purposes (for making mortar and concrete for construction and foundation works) having an initial setting time of 2 hours (minimum) and final setting time of 48 hours (maximum) is :

- (a) Class D - Magnesium/Dolomitic lime
- (b) Class C - Fat lime
- (c) Class A - Eminently hydraulic lime
- (d) Class F - Silicious Dolomitic lime

JSSC JDLCCE JE 28/09/2023 (Civil)

Ans. (c) : As per IS 712-1984– Cl– 3.1

Building lime—

Class A— Eminently hydraulic lime is used for making mortar and concrete for construction and foundation works, i.e. for structural purposes.

Characteristics—

- (i) The colour is grey
- (ii) Calcium oxide and clay are 60-70 and 25 percent respectively.
- (iii) Sets and hardens reading under water with initial setting time 2 hour and final setting time 48 hours.
- (iv) Slakes with difficulty.

Class B- Semi-hydraulic lime used for masonry mortars lime concrete and plaster undercoat.

Class C- Fat lime used for finishing coat in plastering, white washing, composite mortar etc.

Class D- Magnesium/dolomitic lime used for finishing coat in plastering, white washing.

Class E- Kankar lime used for masonry mortars.

Class F- Siliceous dolomitic lime used for undercoat and finishing coat of plaster.

82. Which of the following lime is used in masonry work?

- (a) Hydraulic lime (b) Fat lime
(c) Quick lime (d) White lime

MH WCD JE 14.07.2024 Shift-III

Ans. (a) : Hydraulic lime is obtained by burning of kankar.

- Hydraulic lime has proportion of clay 5–30%.
- Hydraulic lime is used in lime concrete in masonry work.

83. When heated to 205 °C, pure gypsum loses its luster and its specific gravity is increased from _____ to _____ due to the loss of water of crystallization.

- (a) 2.3 ; 2.95 (b) 1.5 ; 2.95
(c) 2.3 ; 2.7 (d) 2.3 ; 3

UPPCL JE 21/02/2022 Shift-I

Ans. (a) : Gypsum– Gypsum is a non-hydraulic binder occurring naturally as a soft crystalline rock or sand. Pure gypsum is a white in colour and so soft that it can be scratched by a finger nail.

- When heated to 205°C pure gypsum loses its luster and its specific gravity is increased from 2.3 to 2.95 due to the loss of water of crystallization.

84. As per IS : 1077, how many whole bricks shall be selected at random from the sample for carrying out dimensions test?

- (a) 5 (b) 10
(c) 15 (d) 20

HSSC JE 18.02.2024

Ans. (d) : Dimension test (IS 1077)– 20 pieces out of selected pieces are taken and are laid flat.

The dimensions of bricks when tested shall be within the following limits per 20 bricks.

For modular size–

Length 3720 to 3880 mm (3800 ± 80 mm)

Width 1760 to 1840 mm (1800 ± 40 mm)

Height 1760 to 1840 mm (1800 ± 40 mm)

(For 90 mm high bricks)

760 to 840 mm (800 ± 40 mm)

(For 40 mm high bricks)

85. What type of bricks are known for their high compressive strength and resistance to fire?

- (a) Perforated bricks (b) Solid bricks
(c) Engineering bricks (d) Common bricks

JSSC JE (Civil Engg.) 04/10/2023

Ans. (c) : Engineering bricks are used where in construction where strength and resistance to water/fire and frost attack are important.

- Some common application examples are–Retaining walls, damp proof courses, manholes, sewers and general ground works.

86. Which one of the following statements is NOT correct?

- (a) Rustic Brick has mechanically textured finish, varying in pattern
(b) Arch Bricks are over-burnt also known as clinker bricks obtained from inner portion of the kiln
(c) Pale Bricks are over-burnt bricks obtained from outer portion of the kiln
(d) Body Bricks are well burnt bricks occupying central portion of the kiln

ESE Pre. (Civil) 19/02/2023

Ans. (c) Rustic brick– It has a mechanically textured finish which varies in the pattern.

Arch bricks– These are over burnt bricks obtained from the inner portion of the kiln.

Pale bricks– These are under burnt bricks obtained from outer portion of the kiln..

Body bricks– These are well-burnt bricks obtained from the central portion of the kiln.

87. Which of the following is an example of an igneous rock?

- (a) Phyllite (b) Marble
(c) Aplite (d) Dolomite

DSSSB AE (Mains) 30.06.2024 Shift-I

Ans. (c) : Igneous Rock:– It is also known as primary, unstratified rocks. Igneous Rocks are formed as a result of the solidification of molten mass lying below or above the earth's surface. If the magma solidifies below the earth's surface itself, the solid crystalline rock is termed or deep-seated plutonic rock. The examples are granite, Aplite, Syenite, diorite and gabbro.

88. Marble is formed after the metamorphosis of

- (a) Sand stone (b) granite
(c) Slate (d) Lime stone

DSSSB AE (Mains) 22.06.2024 Shift-II

Ans. (d)	
Rock	Rock after metamorphism
Granite	Gneiss
Basalt	Schist
Limestone/Marl	Marble
Mudstone / shale	Slate
Sandstone	Quartzite

89. Specific gravity of most of stones lie between_____.

- (a) 3.2-3.5 (b) 2.5-3
(c) 4.5-5.4 (d) 1.2-2.2

SSC JE (Pre) 06/06/2024 Shift-III

Ans. (b) : A good stone should not be porous, rain water, enter the pores which is generally acidic, chemical composition of stone limestone and weak sandstone are relatively less durable than a good sand stone, granite or gneiss.

- Specific gravity for most of the building stone lie between 2.5-3.0
- Crushing strength of good building stone should be more than 1000 kg/cm² or 100 MPa.
- Toughness index ≤ 13 .

90. Granite, which is mainly composed of quartz and feldspar particles, is obtained from :

- (a) Metamorphic Rocks (b) Igneous Rocks
(c) Segimentary Rocks (d) All of the above

Odisha Lect. (Civil) 28.01.2024 Paper I

Ans. (b) : Granite which is mainly composed of quartz and feldspar particles is obtained from igneous rocks. Igneous rock also known as primary unstratified rock are of volcanic origin and are formed as a result of solidification of molten mass lying or above the earth's surface.

91. A good building stone should not absorb water more than

- (a) 5% (b) 10%
(c) 15% (d) 20%

UKPSC JE (Civil) 24/12/2023 Paper-I

Ans. (a) Characteristics of good building stone are–

- Compressive strength $> 1000 \text{ kg/cm}^2$.
- High durability and co-efficient of hardness > 14 .
- Specific gravity > 2.7
- Toughness index > 13
- Water absorption $< 5\%$

92. Select the Indian standard code which provides guidelines for testing and determination of the compressive strength of natural building stones.

- (a) IS 1121 (Part 3) : 2013
(b) IS 1121 (Part 1) : 2013
(c) IS 1121 (Part 2) : 2013
(d) IS 1121 (Part 4) : 2013

DSSSB JE TIER-2 27.09.2023

Ans. (b) : IS : 1121 (Part-I) 2013 – Compressive strength of stone.

IS : 1121 (Part-II)– Transverse strength test stone.

IS : 1121 (Part-III) – Tensile strength of stone.

IS : 1121 (Part-IV) – Shear strength of stone.

IS : 1124 – Absorption test of stone.

IS : 1126 – Crystallisation test of stone

93. Formation of _____ type(s) of rocks involves biological activity in addition to complex mechanical or chemical processes.

- (a) sedimentary rocks (b) metamorphic rocks
(c) volcanic rocks (d) igneous rocks

SSC JE Pre. 11/10/2023 (Morning)

Ans. (a) Sedimentary rock– are also known as aqueous or stratified rocks. The properties of the sedimentary rocks very considerably depending upon the nature of the sediment and type of bond between the sediment and grains.

Ex- Sand stone, lime stone, shale, gravel, gypsum etc.

94. Among the following, the hardest mineral is :

- (a) Quartz (b) Mica
(c) Talc (d) Calcite

ISRO URSC TA 18.04.2024

Ans. (a) : Talc is a soft rock.

- The moh's scale of mineral hardness is based on scratch hardness comparison ranging from 1 to 10, a value of 10 being the hardest of minerals.
- The hardness talc, the softest of minerals, defines the value of 1 on the scale.

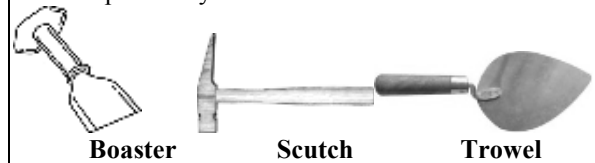
Type of rocks	Hardness on Moh's scale
Talc, easily scratched with the thumb-nail	1
Gypsum	2
Calcite	3
Fluorite	4
Apatite	5
Orthoclase	6
Quartz, not scratched steel	7
Topaz	8
Sapphire	9
Diamond (Hardest)	10

95. A broad - faced chisel used for dressing a stone to a comparatively smooth surface is called a

- (a) soft stone chisel (b) booster
(c) claw chisel (d) fillet chisel

SJVNL Field Engg. 18/03/2023

Ans. (b) A broad-faced chisel used for dressing a stone to a comparatively smooth surface is called a booster.



96. According to Moh's Hardness Scale, the Hardness value of Quartz is _____.

- (a) 7 (b) 5
(c) 2 (d) 10

JSSC JE (Civil) 31/10/2022

Ans. (a) Hardness number for different minerals based on Moh's scale are–

Mineral	Scale number
Talc	1
Gypsum	2
Calcite	3
Fluorite	4
Apatite	5
Feldspar	6
Quartz	7
Topaz	8
Corundum	9
Diamond	10

97. **Crushing strength of good building stone should be more than**

- (a) 50 N/sqmm (b) 100 N/sqmm
(c) 150 N/sqmm (d) 200 N/sqmm

MH WCD JE 14.07.2024 Shift-III

Ans. (b) : Crushing strength of stone is determine by compression test. This test occurs in compression machine. After immerse 24 hrs stone are obtained and then rate of loading 140 kg/cm²/minute is apply So, compressive strength are express in kg/cm²

Ultimate crushing strength of stone (kg/cm²) =

$\frac{\text{crushing weight}}{\text{weighted surface}}$

The crushing strength of stone is 100 N/mm².

98. **In which type of dressing of stone are about 1 cm vertical or horizontal grooves sunk with a chisel having its shape as a hollow semi-circle?**

- (a) Punched dressing
(b) Reticulated finish
(c) Close picked and fine tooling
(d) Boasted or droved finish

SSC JE (Pre) 06/06/2024 Shift-III

Ans. (a) : **Punched dressing**—In this method of dressing of stone, about 1 cm vertical or horizontal grooves are sunk with a chisel having its shaped as a hollow semi-circle. The sides of the rock are kept chamfered or sunk.

- **Close picked and fine tooling**—A punched stone is then further dressed so as to obtain a finer surface.

- **Boasted or drove finish**—It is a very common type dressing of stone in which the surface of the stone is covered with parallel marks that may run in any direction.

99. **In which type of the finish is the booster or chisel used to make non-continuous parallel marks on the stone surface? These marks may be horizontal, inclined, or vertical.**

- (a) Hammer dressed finish
(b) Dragged or combed finish
(c) Rubbed finish
(d) Furrowed finish dressing of stones

SSC JE (Pre) 06/06/2024 Shift-I

Ans. (b) : **Dragged or combed finish**—The dragged or combed finish is the booster or chisel used to make non-continuous parallel marks on the stone surface. This finish is used only in soft stones.

- These marks may be horizontal inclined or vertical.

- Boosted finish, dragged or combed finish, are same of the finishes which can be developed by using specific type of chisel in specific way.

Hammer dressed finish—The stone blocks are made roughly square or rectangular by means of Waller's hammer. The exposed face is roughly shaped by means of mash hammer.

Rubbed finish—This type of finish is obtained by rubbing a piece of stone on the level surface.

Furrowed finish—This type of finish is applied to the fillets or flat bands of cornices, string courses, doors and windows archita etc.

100. **Expanded perlite is used as an insulating material. It is a chemically inert substance composed basically of**

- (a) limestone and rock salt
(b) glass and calcium carbonate
(c) silica and aluminium
(d) asbestos and mica

PGCIL DT 08/02/2024

Ans (c) : Expand perlite— Perlite is a volcanic rock containing from 2 to 5% bonded water. It is a chemically inert substance composed basically of silica and aluminium, but some impurities, such as Na₂O, CaO, MgO and K₂O which are hygroscopic can absorb moisture easily.

101. **As per IS 3495 part-3 (1992), soluble salts, if present in bricks, will cause efflorescence on the surface of bricks. If the white deposits cover about 10% of the surface, the efflorescence is said to be**

- (a) nill (b) moderate
(c) slight (d) heavy

HSSC JE 18.02.2024

Ans. (c) : Efflorescence test of brick as per IS : 3495 Part-3— It is the whitish crystalline substance which appears on the surface due to presence of salt in brick.

Exposed area of brick	Conditions
10% exposed area of the brick is covered with a thin salt layer.	Slight
It is covering upto 50% of the exposed area of brick but unaccompanied by powdering or flaking of the brick surface	Moderate
There is a heavy deposit of salt which covers 50% or more than 50% of the exposed area of the brick surface but unaccompanied by powdering or flaking of the brick surface.	Heavy
There is a heavy deposit of salt accompanied by powdering and flaking of the exposed surface of the brick.	Serious

102. **Depending on the quality of burning, B class bricks are**

- (a) Under burnt (b) Over burnt
(c) Well burnt (d) Normal burnt

ISRO URSC Draughtsman 18/04/2024

Ans. (c) : Characteristic of B class brick (Second class) :

- A second class brick is well-burnt but slightly over burnt is acceptable.
- It has a rough surface.
- Its edges are neither straight nor well defined.
- It is not free from lumps and cracks.
- It does not have a uniform colour.
- It has fine, compact and uniform texture.

103. In case of absorption test on burnt clay building bricks as per IS 3495 (part 2);1992, bricks shall be soaked in cold water for a duration of _____

- (a) 16 hours (b) 9 hours
(c) 12 hours (d) 24 hours

SSC JE (Pre) 06/06/2024 Shift-III

Ans. (d) : Water absorption test of bricks as per IS 3495 (part 2) 1992, bricks shall be soaked in cold water for a duration of 24 hours at temperature $27 \pm 2^\circ\text{C}$.

- Five bricks are taken for test.
- They are allowed to dry in an oven at 110° to 115°C till they attain a constant weight which usually takes place in 48 hours.

104. As per IS 1077:1992, the size of standard modular burn clay building bricks is _____

- (a) $19\text{ cm} \times 18\text{ cm} \times 18\text{ cm}$
(b) $22\text{ cm} \times 15\text{ cm} \times 10\text{ cm}$
(c) $25\text{ cm} \times 19\text{ cm} \times 9\text{ cm}$
(d) $19\text{ cm} \times 9\text{ cm} \times 9\text{ cm}$

SSC JE (Pre) 06/06/2024 Shift-III

Ans. (d) : Size of various types of bricks–		
Brick classification	Usual size	Nominal size
Standard/modular/ normal size	$(19 \times 9 \times 9)\text{ cm}$	$(20 \times 10 \times 10)\text{ cm}$
Conventional/traditional/ user size	$9'' \times 4\frac{3}{8}'' \times 2\frac{3}{4}''$	$9'' \times 4\frac{1}{2}'' \times 3''$ $(23 \times 11.4 \times 7.6)\text{ cm}$

105. The temperature at which vitrification of low melting clay bricks occurs at a temperature of _____.

- (a) 300°C - 500°C (b) 900°C - 1100°C
(c) 600°C - 800°C (d) 1200°C - 1400°C

SSC JE (Pre) 06/06/2024 Shift-I

Ans. (b) : Vitrification–To convert the mass into glass like substance. The temperature ranges 900 - 1100°C for low melting clay and 1000 - 1250°C for high melting clay.

106. What is the maximum percentage of absorption allowed for bricks?

- (a) 90% (b) 75%
(c) 20% (d) None of these

HSSC JE 18.02.2024

Ans. (c) : 20% of its dry weight, water absorption of a burnt clay building brick up to class 12.5 as per IS 1077-1992, is immersed in cold water for a duration of 24 hour.

- Water absorption of IInd and IIIrd class brick, when immersed in cold water for duration of 24 hour are 22.5% and 25%.

107. As per IS code 1077 : 1992 the maximum Water Absorption of common burnt clay brick is not more than by weight for higher classes.

- (a) 20 percent (b) 15 percent
(c) 12.5 percent (d) 10 percent

DDA JE Civil 29/03/2023 Shift-I

Ans. (b) : Water absorption as per IS : 1077-1992 (Clause 7.2)– The bricks, when tested in accordance with the procedure laid down in IS : 3495 (Part-2) : 1992 after immersion in cold water for 24 hrs. water absorption shall not be more than 20% by weight upto class 12.5 and 15% by weight for higher classes.

108. According to IS Code provisions, minimum compressive strength of heavy-duty bricks required for masonry in heavy engineering works such as bridge structures and industrial foundations is

- (a) 40 N/mm^2
(b) 20 N/mm^2
(c) 10 N/mm^2
(d) 5 N/mm^2

MH Nagar Parishad JE (Civil) 24/11/2023

Ans. (a) : Heavy duty burnt clay brick (IS 2180)– The compressive strength of heavy duty brick should not be less than 40 N/mm^2 .

- Water absorption should not be more than 10% after 24 hours immersion in water for heavy burnt clay bricks.

Classification–

Class 400 → Compressive strength 40 - 45.0 N/mm^2

Class 450 → Compressive strength 45.0 N/mm^2

Efflorescence → Should be nil.

Bulk density → Should be less than 2500 kg/m^3 .

109. According to IS-1077 (Specification common burn clay building brick), what is the limiting percentage of water absorption for class 25 bricks?

- (a) 5% (b) 10%
(c) 15% (d) 7%

DDA JE Civil 01/04/2023 Shift-III

Ans. (c) : Water absorption as per IS : 1077-1992 (Clause 7.2)– The bricks, when tested in accordance with the procedure laid down in IS : 3495 (Part-2) : 1992 after immersion in cold water for 24 hrs. water absorption shall not be more than 20% by weight upto class 12.5 and 15% by weight for higher classes.

110. The compressive strength of a second class brick is

- (a) 10.5 N/mm^2 (b) 12 N/mm^2
(c) 7.0 N/mm^2 (d) 4.0 N/mm^2

MH PWD CEA 28/12/2023 Shift-I

Ans. (c) :

Class	Compressive strength
1st class brick	10.5 N/mm^2 or 105 kg/cm^2
2nd class brick	7 N/mm^2 or 70 kg/cm^2
3rd class brick	3.5 N/mm^2 or 35 kg/cm^2

111. The number of bricks required per cubic metre of brick masonry is _____.

- (a) 430 (b) 500
(c) 450 (d) 340

TNPSC AE (Civil) 27/05/2023

Ans. (b) :

Nominal size of brick = 20 cm × 10 cm × 10 cm

Per cubic meter required number of brick =

$$= \frac{1 \text{ m}^3}{0.20 \times 0.10 \times 0.10 (\text{m}^3)} = 500 \text{ m}^3$$

112. The clay used for brick making consists mainly of :

- (a) Silica and alumina
- (b) Silica and magnesia
- (c) Lime and alumina
- (d) Lime and magnesia

ISRO URSC TA 18.04.2024

Ans. (a) : The clay used for brick making consists mainly of silica and alumina mixed in such a proportion that clay becomes plastic when water is added to it.

The proportion of various ingredients are as–

- Silica 50 – 60%
- Alumina 20 – 30%
- Lime 2 – 5%
- Magnesia <1%
- Iron Oxide 3 – 5%

113. What should be the recommended size of frog provided in the standard brick?

- (a) 9 × 4 × 0.8 cm
- (b) 9 × 4 × 1 cm
- (c) 10 × 3 × 1 cm
- (d) 10 × 4 × 1 cm

ITBP OVERSEER 27/09/2023

Ans. (d) : The most important purpose of frog in a brick is to form keyed joint between brick and mortar and therefore the brick are laid with frogs on top. Frog is not provided in 4 cm high bricks and extruded brick.

- The size of frog should be 10 × 4 × 1 cm.

114. According to IS : 1077-1992, non-modular size of the bricks is ____.

- (a) 190×90×40 mm
- (b) 190×90×90 mm
- (c) 230×110×40 mm
- (d) 230×110×70 mm

UP MRC AM (Civil) 02.01.2023

Ans. (d) : The size of non-modular brick size is 230 × 110 × 70 mm.

- Additionally, for obtaining proper bond arrangement and modular dimension for the brick work with the non-modular sizes.

115. Which of the following ingredients of bricks enables the brick to retain its shape and imparts durability, prevents shrinkage and warping?

- (a) Silica
- (b) Alumina
- (c) Lime
- (d) Magneisa

MH PWD CEA 28/12/2023 Shift-I

Ans. (a) Silica– It enables the brick to retain its shape and imparts durability, prevents shrinkage and warping.

Alumina– Absorbs water and renders the clay plastic.

Lime– Normally constitutes less than 10% clay.

Magnesia– Rarely exceeding 1%, affects the colour and make the brick, yellow, in burning.

116. The minimum average compressive strength of common burnt clay bricks shall not less than ____.

- (a) 3.50 kg/mm²
- (b) 3.50 N/mm²
- (c) 10.00 N/mm²
- (d) 7.50 N/mm²

ISRO Technical Assistant Civil 20-09-2023

Ans. (b) : As per IS 1077-1992 Cl 4.1, the common burnt clay bricks shall be classified on the basis of average compressive strength.

Class designation	N/mm ²	Average compressive strength not less than (kgf/cm ²)
35	35	350
30	30	300
25	25	250
20	20	200
17.5	17.5	175
15	15	150
12.5	12.5	125
10	10	100
7.5	7.5	75
5	5	50
3.5	3.5	35

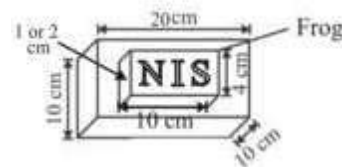
117. The purpose of providing frog in clay bricks is to :

- (a) form a reinforced cement column
- (b) form a key for holding the mortar
- (c) drain out the moisture or water
- (d) circulate air in the brick wall

DDA JE 01/04/2023 Shift-II

Ans. (b) : The purpose of providing frog is to form a key for holding the mortar and therefore, the brick are laid with frogs on top. Frog is not provided in 4.6 m high bricks and extruded bricks.

- The size of frog should be 10 × 4 × 1 cm.



118. Efflorescence is the ill effect of

- (a) dampness
- (b) growth of vegetation
- (c) action of weathering agents
- (d) chemical action of mortar on masonry

PPSC JE 06/03/2022

Ans. (a) : As efflorescence is a sign of excessive moisture attach on structure, so not addressing the problem can lead to some unpleasant surprise like structural damage or mold formation.

- Efflorescence results from moisture.
- Sometimes salt, inside the structure react within the other structural materials and can damage gradually.
- Efflorescence is the ill effect of dampness.

119. Second class bricks are recommended for

- Hidden masonry work
- Reinforced brick work
- Flooring brick work
- Pointing

MHADA JE 01/02/2022, Shift-II

Ans. (a) Second class brick, are supposed to have the same requirements as the first class ones except that.

- Small cracks and distortions are permitted.
- A little higher water absorption of about 22.5% of dry weight is allowed.
- The crushing strength should not be less than 7 N/mm².

Used– Second class bricks are recommended for all important or unimportant hidden masonry work and centering of reinforced brick and reinforced cement concrete (RCC) structures.

120. Which type of material is mainly used in making insulating tubes, switch blocks and lamps sockets?

- Earthenware
- Terracotta
- Porcelain
- Polished terra cotta

UPSSSC JE 16/04/2022

Ans. (c) : Porcelain– A high grade ceramic were having white colour zero water absorption and glazed surface which can be safe or hard consists of finely dispersed clay, kaolin, quartz and felspar, backed at high temperature and covered with coloured or transparent glass.

121. The dimension of modular bricks when tested in accordance with IS : 1077 – 1992, the maximum tolerance in length of brick is limited per 20 bricks as :

- ± 10 mm
- ± 40 mm
- ± 60 mm
- ± 80 mm

GPSC DEE (GWSSB) 04.07.2021

Ans. (d) : As per IS 1077-1992 Cl. 6.2 For modular size bricks (limits for 20 bricks)		
	Dimension (mm)	Tolerance (mm)
Length (L)	3800 mm	± 80 mm
Width	1800 mm	± 40 mm
Height	1800 mm	± 40 mm For 90 mm high bricks

122. Which component enhances the refractory properties of bricks and makes them resistant to high temperatures?

- Alumina
- Silica
- Iron oxide
- Clay

MPPGCL JE 01/06/2024

Ans. (a) : These are made from fire-clay using the same process as an ordinary

- They are yellowish or light brown coloured brick
- It is made up of materials which have high melting points and have properties which make them suitable to act as heat resisting barriers between high and low temperature zones.
- Alumina enhances the refractory properties of bricks and makes them resistant to high temperatures.
- Water absorption varies from 4–10% and this compressive strength lies b/w 15–20 N/mm²
- It is generally used for the lining blast furnaces ovens, kiln, Boilers and chimneys

123. Mortar usually used in masonry work is

- 1 : 1
- 1 : 2
- 1 : 6
- 1 : 10

SSB SI PIONEER (Civil) 22.01.2024

Ans. (c) : Mortar usually used in masonry work is 1 : 6.

- For external wall masonry = 1 : 4
- For internal wall masonry = 1 : 6
- For ceiling wall masonry = 1 : 3
- For grouting = 1 : 1
- For pointing = 1 : 2

124. What type of mortar can be used in unimportant buildings made of bricks?

- Cement mortar
- Lime mortar
- Mud mortar
- Epxy mortar

HSSC JE 18.02.2024

Ans. (c) : Mud mortar– They are the cheapest type of mortar prepared with locally available ingredients and are used for masonry works, surfacing floors and plastering wall surfaces in low cost houses.

125. Which of the following is an application of ferrous metals in construction?

- Reinforcing bars used for concrete structures
- Window frames made up of aluminium
- PVC pipes used for plumbing
- Roofing tiles

MPPGCL JE 01/06/2024

Ans. (a) : Ferrous metals such as steel are widely used in construction for building structures, bridges and roads due to their high strength and durability Reinforced concrete, which uses steel rebar is a common construction material.

JOB LAYOUT

- Job layout can be defined as a drawing of the proposed construction site which shows different locations such as entry point, exit point, equipment, and material stores, temporary facility, site office, and place where workers will stay.
- Job layout helps us to plan the construction site in such a way that different construction resources like tools, machinery, materials, manpower, etc. can be arranged easily and optimal uses of construction space can be achieved.

■ Following are the main purpose of job layout :

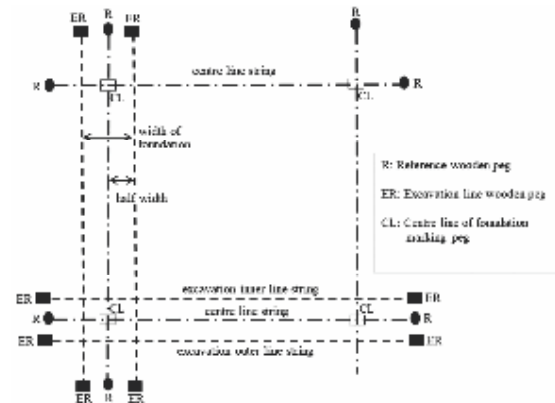
- It helps in reducing the completion time for the construction.
- It provides easy movement of equipment from one point to another.
- It helps in reducing wastage and deterioration of the material.
- It saves time by delivering and making a uniform flow of material at the site.
- It provides more safety to the worker at the site.
- The output from manpower and equipment can be increased using the job layout.

■ Factors Affecting Job Layout

- (1) **Type of project :** The construction layout varies according to the project and its functioning.
- (2) **Method of construction :** The construction at the site may require a pre-cast structure or cast-in-situ or both.
- (3) **Availability of resources :** Various resources such as manpower, machinery, material, etc. are required at the construction site.
- (4) **Temporary road :** Roads are important to transfer material and equipment from one place to another place inside the construction site.
- (5) **Miscellaneous facilities :** The necessary provision for facilities such as electricity, water supply, material storage yard, and telephone connection should be there in the site job layout.

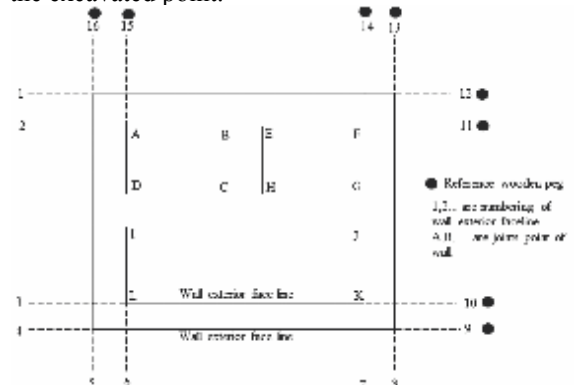
● Centre Line Method of Job Layout

- The Centre line method is generally used for load-bearing structures that have a wall foundation of a similar cross-section.
- In this method, the center line length of all the layout structures is measured which have similar cross sections and the same type of foundation.



● Face Line Method of Job Layout

- In the face line method, the marking by lime sand powder is done on the wall exterior and interior surface.
- The marked line is extended by 2 meters away from the excavated point.



EARTHWORK

- The process of the excavation and deposition of excavated material is known as earthwork.
- The earthwork includes the excavation, loading, transportation, deposition, compaction, and improvement of the soil. After the clearance of the site, the earthwork begins.
- Earthwork can be defined as engineering work that involves moving the soil or processing the soil from the earth's surface.
- In this process, the soil moves from one part to other parts and help in achieving the desired shape required for construction purpose.
- Earthworks mainly required heavy machinery equipment for the excavation of soil and backfill.
- Heavy machinery is generally used due to the involvement of large quantities of the material which has to be moved.

■ Excavation for Foundation

- Excavation can be defined as a process that helps in transferring subsoil, rock, or any other material using machinery and tools.
- It includes trenching, tunneling, earthworks, and wall shafts.
- One of the common practices using excavation is building construction.
- Excavation is primarily used in foundation for digging, trenching, and site development.

The following points are considered while doing excavation work :

- If the soil does not permit the vertical sides of the trench, support should be provided.
- The shoring can be done for the unstable sides of the trench.
- The excavated material should be placed at least 1 m away from the place of the excavation.
- The bottom of the trench should be perfectly leveled.
- The bed of the foundation should be rammed before pouring concrete for better stability.
- The soft soils or the rocks should be removed and the bed of the trench should be leveled and filled with stabilized soil.
- The wires should be placed around excavation work so that no person or any stray animal from the outside area falls inside the excavated region.
- Underground water pipelines, gas pipelines, communication cables, etc. should be protected while digging a trench.

■ Earthwork for Embankment

- Earthwork is the engineering work using machinery and tools for moving or processing subsoil and underground rocks.
- The subsoil may be transported from one location to another or formed into any shape that is required for the construction.
- Earthwork generally involves cutting and filling and machine excavation at the site.

FOUNDATION

- Foundation is the lowermost part of the structure which transfers the load of the superstructure and other loads to the ground.
- A foundation may be defined as a solid base on which the structure rests. Foundation remains in direct contact with the ground to transfer the dead load and superimposed load.
- The foundation plays a major role in the stability and strength of the structure.

■ Functions of Foundation

- A foundation provides a hard and level surface that is suitable for the construction of a superstructure over it.
- The foundation distributes the load from the structure to a larger area which helps in reducing the load intensity. We know that pressure is the ratio of force to area.

- If the area is larger the pressure reduces. The foundation acts on the same principle. The load of the structure is distributed by the foundation and transferred to the ground.
- The larger the area of the foundation, the lesser will be the load intensity and the safer will be the structure.
- The load is distributed uniformly by the foundation. If the load is distributed non-uniformly or unevenly, there can be differential settlements in the base.
- The differential settlements can cause cracks in the building components. In extreme cases, even failure of building components can occur.
- There is a significant impact of winds and earthquakes on the buildings. The wind and earthquake loads have a tendency to overturn the building due to their horizontal impact.
- The foundation binds the superstructure and provides lateral stability to the structure.

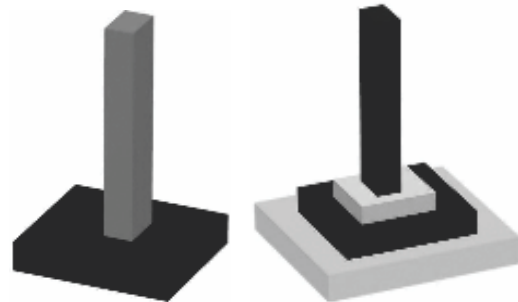
SHALLOW FOUNDATION

■ Classification of shallow foundation :

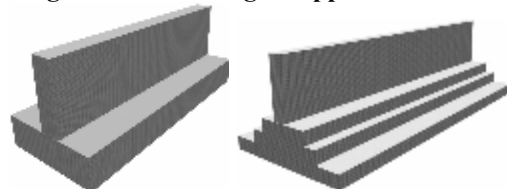
● Spread footings :

- The spread footings are the footings that distribute the load to the earth by spreading the load over a larger area.

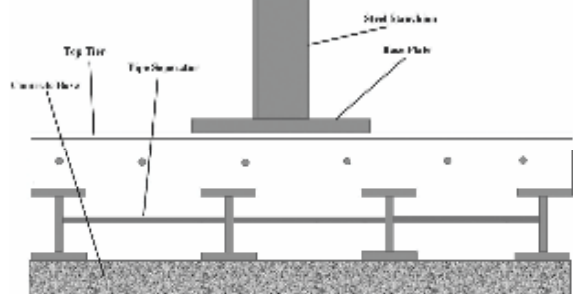
Types of spread footing :



Single column footing Stepped column footing



Strip wall footing Stepped wall footing

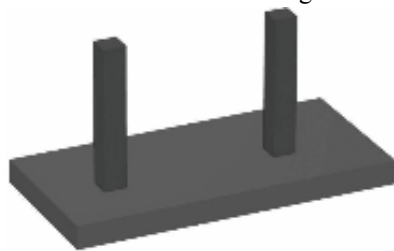


Grillage footing

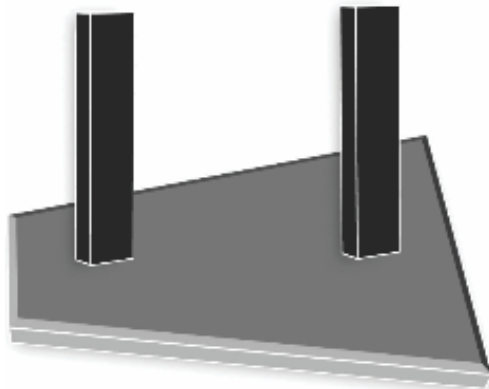
● Combined footings :

- If the columns are constructed near to each other, it is not possible to provide the individual footings.

- So, a combined footing for two or more columns is provided.
- The combined footings are more economical as compared to the individual footing for each column.



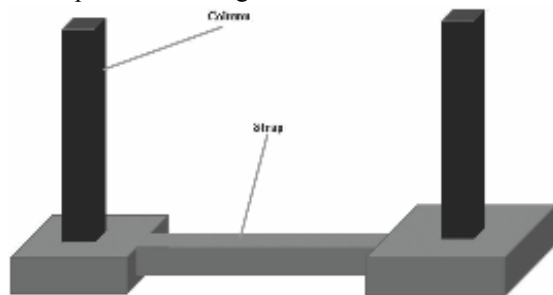
Combined rectangular footing



Combined trapezoidal footing

● **Strap footings :**

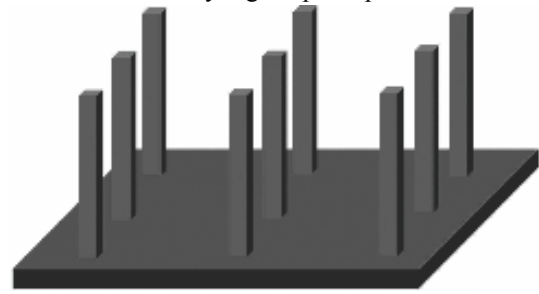
- Strap footing is a special type of combined footing.
- The combined footing can only be used if the columns are not much far from each other.
- If the columns have a larger distance between them, the trapezoidal footings become narrow.



● **Raft foundations :**

- The raft foundation is also known as the mat foundation. The raft foundation is provided throughout the base of the superstructure as a mat.
- It is a continuous slab that supports a number of columns. The mat foundation transfers the load of all the components of the building to the earth.
- The raft foundation also reduces the differential settlements.
- The raft foundation is suitable for the regions where the bearing capacity of the soil is low or the soil is subject to movement.

- Sometimes structures like commercial buildings, water tanks, silos, storage tanks, etc. have very high loading. So, a mat foundation can be used when the structure faces very high superimposed loads.



Columns



Raft

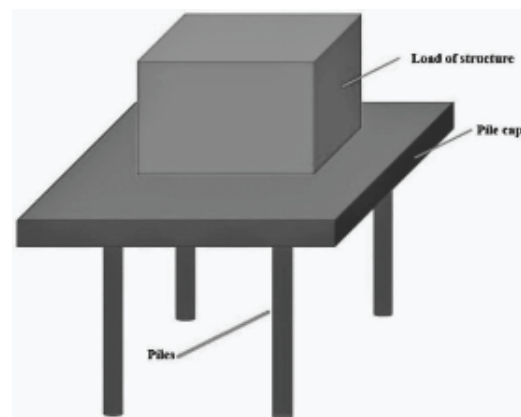
DEEP FOUNDATION

- If the hard stratum lies deep below the ground, a deep foundation can be provided. A deep foundation is the type of foundation that has more depth than its width.

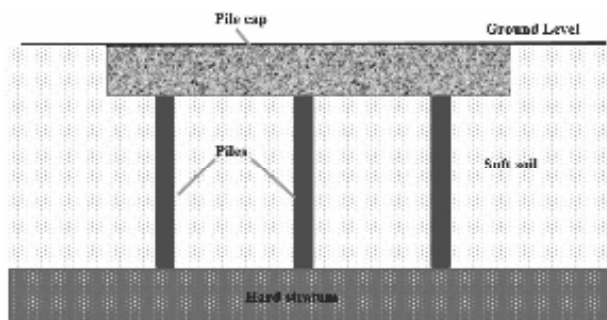
■ **Types of deep foundation**

● **Pile foundation**

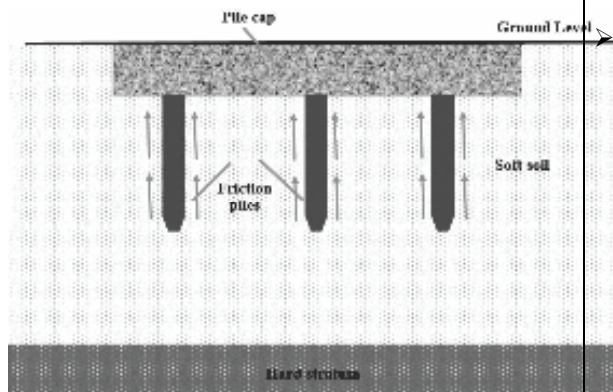
- A pile may be defined as a slender long column made of timber, concrete, steel, or composite material that is used to transfer the load of the structure through its bottom or friction action or by a combination of both.
- The diameter of the piles is generally equal to or less than 0.6 m.



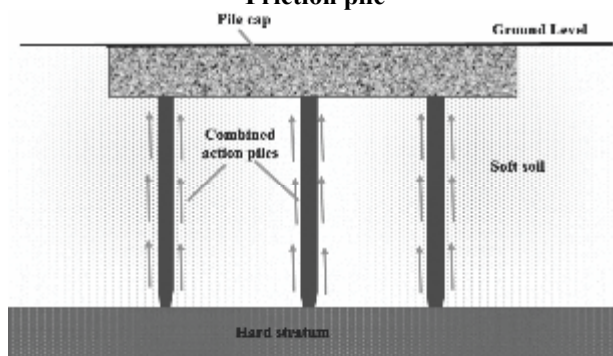
Pile foundation



Mechanism of end bearing pile



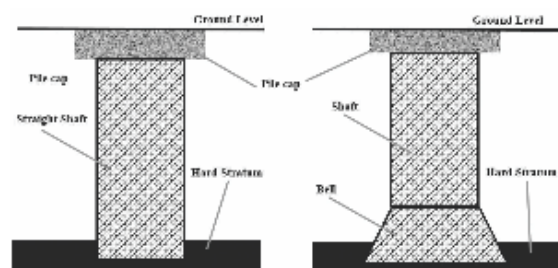
Friction pile



Combined action piles

● Pier foundation

- A pier is a drilled cylindrical column with a large diameter.
- If the diameter of the cylindrical structure is less than or equal to 0.6 m, it is known as drilled pile.
- If the diameter of the bored pile is more than 0.6 m, it is called a pier.
- The load can be transferred by the bottom end or skin friction or by the combined action.
- A pier can be provided as a straight shaft or a bell can be provided at the bottom.
- If the hard stratum lies within 5 m below the ground level, a straight concrete pier can be used for the transfer of the superimposed load.
- If the hard stratum is deeper than 5 m, the bottom of the pier can be enlarged in the form of a bell.
- The angle of the bell portion is kept around 60°.

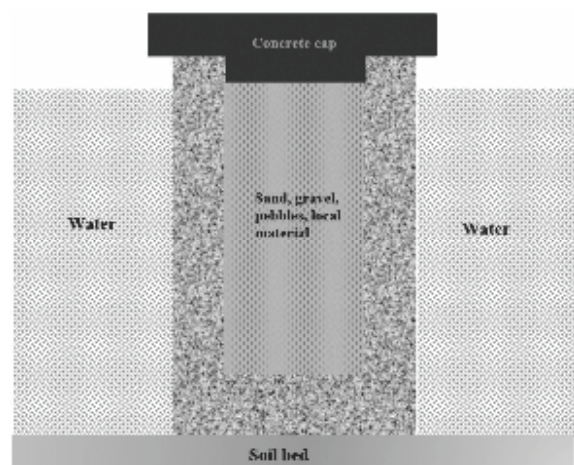


Straight shaft

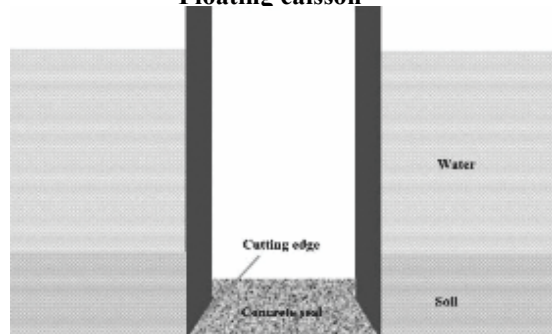
Bell shape

● Well foundation or Caissons

- Caissons are box or cylindrical type structures that are hollow in nature.
- The caissons are fabricated on the ground and penetrated at the waterbed.
- The caissons are used to support the bridges in the water bodies.



Floating caisson

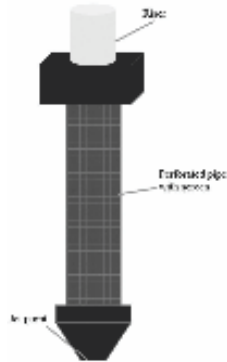


Open caisson

DEWATERING

- Drainage is the process of removal of the water from the soil. The drainage can be classified into two types which are surface drainage and sub-surface drainage.
- The runoff water that moves on the ground is diverged in any other direction to save the site from the flow of water. This type of drainage is known as surface drainage.
- If the water which is held in the pores of the soil is removed, this process is known as sub-surface drainage or dewatering.
- The dewatering also improves the properties of the soil.

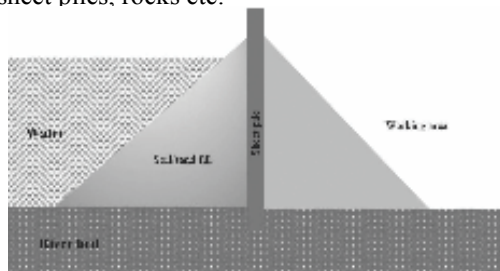
- If the water is removed only at the time of construction and the water level is maintained again, then it is called temporary dewatering.
- If the water is removed permanently and the water level is varied, it is called permanent dewatering.



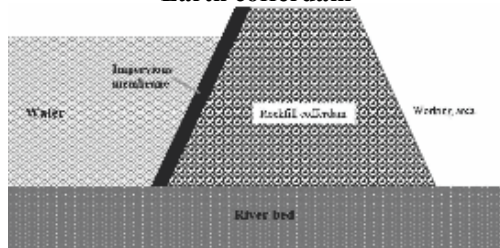
Well point

COFFER DAM

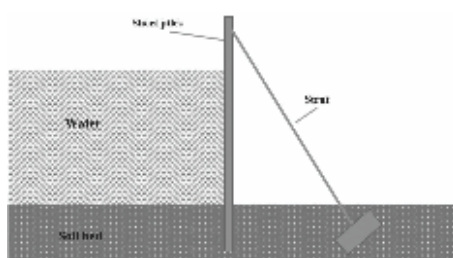
- The coffer dams are an arrangement of enclosing the working area so that water can't enter and the construction work can be performed.
- The coffer dams are made temporarily and facilitates the construction of bridges, piers or dams.
- When the work is to be carried out in an open water, the coffer dams are used.
- When water table is high, coffer dams can be used on the ground construction too.
- The cofferdams should be stable against the water currents.
- The coffer dams can be constructed from the earth, sheet piles, rocks etc.



Earth cofferdam



Rockfill cofferdam



Sheet pile cofferdam

BEARING CAPACITY

- The supporting power of a soil or rock is referred to as its bearing capacity.

○ Gross pressure intensity (q)-

It is the total pressure at the base of footing due to weight of structure, self weight of footing and weight of earth fill.

○ Net pressure intensity-

$$q_{net} = q_g - \bar{\sigma} \quad q_g = \text{Gross pressure}$$

■ Various types of bearing capacity of soil-

1. Ultimate bearing capacity (q_u)-

It is the maximum gross pressure that soil can support before it fails in shear.

$$q_u = CN_c + \gamma D_f$$

2. Net ultimate bearing capacity (q_{nu})-

It is the minimum net pressure causing shear failure of soil.

$$q_{nu} = q_u - \bar{\sigma} \quad \text{Where, } \bar{\sigma} = \gamma D_f$$

3. Net safe bearing capacity (q_{ns})-

$$q_{ns} = \frac{q_{nu}}{\text{FOS}} = \frac{q_u - \gamma D_f}{\text{FOS}}$$

4. Gross safe bearing capacity (q_s)-

Max. pressure which soil can carry safely without risk of shear failure

$$q_s = q_{ns} + \gamma D_f = \frac{q_{nu}}{\text{FOS}} + \gamma D_f$$

$\bar{\sigma}$ or γD_f = Overburden pressure.

○ Factor of Safety-

$$\text{FOS} = \frac{\text{Ultimate net bearing capacity}}{\text{Allowable net bearing capacity}}$$

$$\text{Safe bearing capacity} = \frac{\text{Ultimate bearing capacity}}{\text{Factor of safety}}$$

5. Net Allowable bearing pressure/capacity (q_{na})-

It is the maximum net intensity of loading that can be imposed on the soil with no possibility of shear failure or the possibility of excessive settlement.

$$q_{na} = \frac{q_u}{\text{F.O.S}}$$

- It can be used for the design of foundations.

$$(i) \quad q_{na} = q_{ns}, \quad \text{If } q_{np} > q_{ns}$$

$$(ii) \quad q_{na} = q_{np}, \quad \text{If } q_{ns} > q_{np}$$

q_{np} = Net safe settlement pressure.

Decreasing order of bearing capacities-

$$q_u > q_{nu} > q_s > q_{ns}$$

Load carrying capacity of footing-

$$\text{Strip} < \text{Circular} < \text{Square footing}$$