

Fibers:

- Fiber or fibers is a class of Materials which are having continuous filaments or having discrete elongated pieces similar to the length of thread.
- There are mainly 3 types of fibers which are commonly used as a construction material.
 - Steel fiber
 - Carbon fiber
 - Glass fiber

Steel fiber:

- Steel fibers are made from the cold drawn steel wire with low content of carbon or stainless steel wire.
- They are manufactured in various types such as hooked steel fibers, undulated or flat steel fibers according to the need required in the construction project.
- These fibers are used in the construction for concrete reinforcement.
- Steel fiber reinforced concrete is less expensive than hand tied re-bar. Shape dimensions and length of the fiber are more important because it increases the tensile strength of the concrete.

Properties :

- It increases the tensile strength of concrete.
- It is more tough and hard.
- It avoids corrosion and rust stains.
- They are more elastic in nature.
- Steel fibers are available with standards as ASTM 820/96, ASTM 1116/95 and DIN 1045.
- It has a tensile strength of 1100 N/mm^2 .
- They are available in the shapes like flat, hooked and undulated.

Applications/uses :

- Steel fibers are highly used in tunnel lining work.
- It is mostly used in the construction of airport runways and highway pavements.
- Most commonly used in precast concrete so as to increase the length strength.
- They are used in shotcrete.
- Used in the construction of parking.
- It is used in anti-seismic buildings.

Carbon fibers :

- carbon fiber is a consisting of extremely thin fibers about 0.005 mm to 0.010 mm in diameter and Mostly composed of carbon atoms.
- Carbon fiber is alternately called graphite fiber.
- The Carbon atoms are bonded together in Microscopic crystals which are more or less aligned parallel to the long axis of the fiber. Their crystal alignment makes sizes of fiber stronger.
- It can be combined plastic resin and wound or moulded to form composite materials like carbon fiber reinforced plastic to provide a high strength to wt. ratio of the materials.

Properties :

- It has a high tensile strength, low wt. and low thermal expansion.
- They are rigid materials which are resistant to stretching and compression.
- It is chemically inert or unreactive materials.
- They are resistant to corrosion.
- Fibers contained about 85% carbon has excellent flexural strength.

Applications / uses :

- Carbon fiber is mostly used to reinforce Composite Material.
- Reinforced carbon-carbon (R.C.C) consists of carbon fiber-reinforced graphite and is used structurally in high temp. applications.
- It increases the tensile as well as compressive strength of concrete.
- Due to high tensile strength, low wt. and low thermal expansion it makes the carbon fiber very popular in aerospace, military and Motorsports along with other competition sports.
- Carbon fiber is extensively used in the bicycle industry, especially for high-performance racing bikes.
- It is also used in some tennis rackets.

Glass fibers :

- It is also called as fiber glass. Glass fiber is the material made from extremely fine fibers of glass.
- It was invented in 1938 by Russell Games Slayter.
- The fresh and thin fibers are stronger because the thinner fibers are more ductile.

Properties:

- It has high ratio of Surface area to Weight.
- They have good thermal insulation.
- It has a good tensile strength but has no strength against compression.
- Compressive strength is weak but can be increased by reinforcing it with plastic.
- When the glass fiber is reinforced with plastic, then reinforced material can resist both compressive and tensile forces as well.
- It is resistant to chemical attack. However, if its surface area is increased, then it makes them more susceptible to chemical attack.
- They are corrosion resistant.

Applications/uses:

- Corrugated fiber glass panels are widely used for outdoor canopy or greenhouse construction.
- It is used as a reinforcing agent for many polymer products like FRP and GFRP which uses tubes, pipes for drinking water and 'sewers, office plant containers and flat roof systems etc.

- It is reinforced With plastic Material So as to increase tensile strength.
- Uses of regular fiber glass are mats, insulation, reinforcement sound absorption heat resistance fabrics, Corrosion resistant fabrics and high strength fabrics.
- The reinforced glass fiber With polymer and plastic is commonly used in fire Water System, cooling Water systems, drinking Water systems, Sewage system gas system etc.

Plastics :

- plastic is an Organic material prepared out of resin.
- plastic may be defined as a Natural or Synthetic Organic Material Which are having the property of being Plastic at some stage of their Manufacture When they can be moulded to required Size and Shape.
- The typical uses of plastics in building are listed below :
 1. Corrugated and plain sheets for roofing.
 2. For making jointless Flooring.
 3. Flooring tiles.
 4. over head Water tanks
 5. Bath and Sink Units.
 6. Cisterns and floats.

7. Decorative laminates and Mouldings.
 8. Window and door frames and Shutters from bathroom doors.
 9. Lighting fixtures.
 10. Electrical conduits.
 11. Electrical insulators.
 12. Pipes in carry cold water.
- Preliminary there two types of plastics
 - Thermoplastic
 - Thermosetting Plastic

Thermoplastic :

- In this Variety, the linkage between the molecules is very loose.
- This property helps for reuse of waste plastic.
- Bitumen, cellulose and Shellac are the examples of this Variety of Plastics.

Thermosetting Plastics :

- Thermosetting Plastics are made up from long chains of molecules that are cross-linked.
- They have a very rigid structure.
- Once heated, thermosetting plastics can be moulded, shaped and pressed into shapes.
- The scrap of such plastic is not reusable.
- Bakelite is an example of such plastic.

Types of plastics :

PVC :

- PVC is poly vinyl chloride.
- PVC are tough and exceptionally resistant to chemical attack.
- PVC require protection from ultraviolet exposure if installed outdoors and start softening when subjected to high temp.
- PVC pipes are made by an Extrusion Process and fittings, Flanges, and Valves are Manufactured by injection molding method.
- PVC has many applications in industries and it's also used in home water piping.

RPVC :

- RPVC means Rigid Poly Vinyl chloride.
- PVC comes in two basic forms: flexible and rigid (RPVC), RPVC is used in construction (especially pipes), Packaging (especially bottles), and credit cards, just to list a few examples.
- These are strong & durable.
- These are flexible, light-wt. & hence easy to transport.
- These require easy installation & low maintenance.

- These are high electrical & chemical resistance.
- These are termite proof & UV resistant.
- These are manufactured conforming to IS 4985: 2000 standards.
- These are resistant to moisture, abrasion & wearing.
- RPVC applications include salt water handling, portable water supply schemes in urban areas, Acid & slurry transportation, Disposal of chemical effluent & waste etc.

HDPE :

- HDPE plastic better known as High density Polyethylene is a polyethylene thermoplastic created from petroleum. Also known as alkathene or polythene when used for pipes.
- HDPE is commonly used to produce items like plastic bottles and cutting boards.
- HDPE is made when intense heat is applied to petroleum. Also known as cracking, this process creates ethylene gas. At this stage of production, the gas molecules will then attach forming polymers which in turn, produce Polyethylene.
- HDPE is commonly used to create containers like milk and water jugs.

→ HDPE is also very flexible and strong.

→ HDPE is resistant to corrosion and light-weight, making it an ideal option when compared to other types of plastic.

→ It is easy to recycle.

→ It also as lined material with carbon steel pipe.

FRP :

→ Fiber Reinforced polymer (FRP) composite is defined as polymer that is reinforced with fiber. fiber may be carbon, glass etc.

→ FRP Composites are anisotropic. Therefore their properties are directional, meaning that the best mechanical properties are in the direction of the fiber placement.

→ These materials have a high ratio of strength to density, exceptional corrosion resistance and convenient electrical, magnetic and thermal properties.

→ The primary function of fiber reinforcement is to carry the load along the length of the fiber and to provide strength and stiffness in one direction.

→ fiber + Polymer matrix = FRP

→ Used in pretressed concrete, underwater piping and structural parts of offshore platform platform, as internal reinf-

reinforcement for concrete structures, for strengthening of various structures constructed from concrete, masonry, timber, and even steel, for seismic retrofitting etc.

GRP:

- Glass-reinforced plastic (GRP) is a composite material consisting of plastic reinforced with fine glass fibers. These fibers may be arranged randomly, flattened as a sheet, or woven to make a fabric-like material.
- A plastic resin is then overlaid onto the glass fibers to create combined uniform material. This resin may include epoxy, Vinyl ester, Polyester, polyurethane or Polypropylene.
- The glass fibers in GRP are cheaper, more flexible, and lighter than their carbon counterpart, making it an ideal reinforcing agent for many polymer products.
- Additionally, glass fibers are also non-magnetic, corrosion-resistant, resistant to electromagnetic radiation, and chemically inert under specific circumstances. These properties make GRP materials an ideal material for structures and components, such as: Aircraft, boats, automobiles, water tanks, roofing, oil and gas lift systems etc.

Artificial timbers:

- The timber which is converted in a factory by some mechanical processes is termed as "Artificial timber" or 'Industrial timber'.
- Such timber possesses desired shape, appearance, strength and durability, following are some varieties of artificial timber.

- 1) Plywood
- 2) Veneer
- 3) Fiberboard
- 4) Block board
- 5) Particle board
- 6) Flush door

The use of artificial timber is justified over natural timber following reasons.

- 1) Available in large sizes of which least jointing required.
- 2) More stable to atmospheric changes as compared to timber.
- 3) Surfaces are plan and no jack-planing or machining needed.
- 4) Pasting of veneers or laminates is easier and more durable.
- 5) Stronger than the solid wood as it has same strength in all direction.

- 6) The thinner Sheets are Flexible.
- 7) Storing, Stacking and transporting is easier.

Acoustic Materials:

→ When the sound intensity is more, then it gives the great trouble or nuisance to the particular area like auditorium, cinema hall. Hence it is very important to make that area or room to be sound proof by using a suitable material called as inside sound 'Acoustic Material.'

→ acoustic treatment is provided so as to control the outside sound of the various building until such that sound will be audible without any nuisance or disturbance.

Types Of Acoustic Materials:

- 1) Acoustic Plaster
- 2) Acoustic tiles
- 3) Perforated plywood
- 4) Fibrous Plaster
- 5) straw board
- 6) Pulp board
- 7) compressed fiber board
- 8) Hair felt
- 9) cork board slabs
- 10) foam glass
- 11) Asbestos cement boards
- 12) Thermocool
- 13) foam plastic
- 14) chip board
- 15) Gasket cork sheet.

Properties Of Acoustic Materials :

- Sound energy is captured and absorbed.
- It has a low reflection and absorption of sound.
- Higher density improves the sound absorption efficiency at lower frequencies.
- It controls the sound and noise levels from machinery and other sources for environmental amelioration and regulatory compliance.
- Acoustic material reduces the energy of sound waves as they pass through.
- It suppresses echoes, reverberation, resonance and reflection.

Uses Of acoustic Materials :

Acoustic material plays a vital role in the various areas of building construction. In studio, class room, reading hall, cinema theatre etc.

Artificial Sand :

It is obtained as a by-product while crushing stones to get coarse chips.

Wall cladding :

It refers to external layer of building which provides aesthetic affect along with

protects the building structure from weathering phenomena like rainfall. It may be of stone cladding, Vinyl cladding or aluminium cladding etc.

Micro - Silica :

- Micro silica also known as silica fume or condensed silica fume is a Mineral admixture composed of very fine solid glassy spheres of silicon dioxide.
- It is usually found as a by-product in the industrial manufacture of ferrosilicon and metallic silicon in high-temp. electric arc furnances.
- These are used to improve strength and durability of concrete.

Ch-3 Earthquake Resistant Construction

Configuration: Can be defined as: building Size & Shape, the size & location of structural elements & the nature, size & location of nonstructural elements that may effect structural performance. The latter include such elements as heavy non structural walls, staircases, exterior wall panels & heavy equipment items.

→ If the configuration is good the seismic design will be simple & economical & good performance is more likely to be assured. If the configuration is bad seismic design will be expensive & good performance will be less than certain.

→ Seismic codes distinguish between regular & irregular configurations, & it is the latter that may have a detrimental influence on the effectiveness & cost of seismic engg. & on building seismic performance itself.

Lateral Load Resisting Structure:

A lateral load resisting structure (LLRS) uses systems like moment frames, shear walls or braced frames to safely transfer horizontal forces from floors to the foundation, preventing collapse through continuous load paths, rigidity, & ductility.

With common elements being Concrete cores, Steel bracing or rigid frame connections.

Key lateral load Resisting Systems:

Moment - Resisting Frames: Rigid connections betⁿ beams & columns allow the frame to resist bending, transferring loads via flexural action.

Shear Walls: Solid Vertical elements acting as giant cantilevers, resisting loads primarily in shear, often forming cores in buildings.

→ Braced frames: Diagonal members added to frames, carrying forces as axial tension compression, significantly increasing stiffness.

Tube systems: Closely spaced perimeter columns & beams forming a strong outer "tube" often combined with a central core.

Dual systems: Combinations, such as Moment frames with shear walls, for redundancy & enhanced performance.

Load path & Design concepts:

Continuous path: Loads must travel uninterrupted from the point of application through the structure to the foundation.

Diaphragms: floors & roofs act as horizontal diaphragms, distributing lateral forces to Vertical Resisting elements.

Stiffness & Rigidity: Systems are designed for lateral stiffness to control sway and resist forces effectively. Often calculated based on relative rigidities.

Ductility: Especially for earthquakes, elements are designed to deform without collapsing, absorbing energy.

Structural Regularity: Avoiding soft stories and irregularities is crucial for predictable performance.

Physical & structure:

Size & shape: floor area, number of floors, overall dimensions, plan layout.

Materials: Exterior Walls (Masonry, Wood, SIPs), roof (material, construction) Windows, & insulation.

Age: Influences materials, construction quality and energy efficiency.

Performance & Systems :

Energy Efficiency: Insulation levels, air leakage, HVAC Systems, renewable energy integration.

Indoor Environment: Air quality, lighting, acoustics.

Durability & Maintainability: How long the building lasts and how easily it's kept up.

Context & Usage :

Location: Urban, Suburban, rural setting; neighboring land uses.

Occupancy: Number of occupants, Usage Patterns (residential, commercial, academic)

Architectural Style: Aesthetic Qualities.

Effect of Structural Irregularities :

Structural irregularities in earthquake-resistant construction can significantly affect the performance of a building during seismic events. The irregularities can lead to uneven distribution of forces, increased vulnerability to lateral loads, and potential failure of structural elements. The main effect include:

1) Increased stress Concentration:

Irregularities can cause certain areas of the structure to experience higher stress levels, leading to potential failure.

2) Torsional Response: Buildings with irregular shapes may experience torsional movements during an earthquake, which can exacerbate damage.

3) Pounding Effects: Adjacent buildings with different heights or stiffness can collide during an earthquake, causing additional damage.

4) Reduced Ductility: Irregular structures may not perform well under lateral loads, reducing their ability to absorb energy and deform without collapsing.

5) Non - Uniform Drift:

Structural irregularities can lead to non-uniform lateral displacements, which can compromise the integrity of connections and joints.

6) Increased risk of collapse: Overall, structural irregularities can increase the risk of collapse during an earthquake, making it crucial to address these issues in the design phase.

Vertical Irregularity: Vertical irregularity in building design refers to sudden changes in a structure's mass, stiffness, strength or geometry along its height, creating discontinuities that compromise seismic performance by disrupting the smooth path for lateral forces (like wind or earthquakes) to the foundation, potentially causing stress concentration and damage, especially in "soft stories" setbacks. Common types include mass irregularity (heavy floor), stiffness irregularity (soft story) Vertical ~~irreg~~ geometric irregularity (setbacks/offsets), and in-plane discontinuity (offset shear walls).

Types OF Vertical Irregularities:

Mass Irregularity: A story's weight is significantly more (e.g., $> 150\%$) than an adjacent story, creating uneven load distribution.

Stiffness Irregularity (Soft story):

A story's lateral stiffness is significantly less (e.g., $< 70\%$) than stories above or below, causing excessive deformation and damage.

Vertical Geometric Irregularity: Abrupt changes in horizontal dimensions, like setbacks, where a storey is much wider or narrower than the one above or below (e.g., $>130\%$ difference).

In-Plane Discontinuity: An offset in vertical lateral force-resisting elements (like shear walls or frames) in diffⁿ stories, bending the load path.

Plan Configuration Problem:

A "plan configuration problem" usually refers to challenges in structural/seismic design, where irregular building shapes (L, U, T, or with re-entrant corners, large openings, or sudden stiffness changes) create stress concentrations and torsional twisting, leading to potential failure during earthquakes, unlike simple rectangular plans that distribute forces evenly. It can also refer to issues in software architecture, concerning complex software organization or even urban planning (e.g., inefficient layout).

In Structural Engineering (Most Common Context) :

The Problem : Asymmetric or complex building plans (like L-shapes, T-shapes) cause the center of mass (COM) and center of rigidity (COR) to shift, inducing harmful twisting (torsion) during seismic events.

Consequences : Excessive stress, overstressing of members, and potential collapse, especially at re-entrant corners.

Solutions : Prefer simple, symmetrical shapes (rectangular, square).

Building Corner Reinforcement :

Building corner reinforcement adds steel bars (rebar) and sometimes mesh or stirrups at structural corners in concrete or masonry to resist twisting (torsional) forces, prevent cracking from uplift or bending, and improve overall strength and seismic resistance, especially in two-way slabs and beam-column joints. It involves placing extra bars in top/bottom or diagonally, essential for resisting "opening moments" that try to pull corners apart, creating a robust connection for durability.

Why it's needed :-

Controls torsion: In two-way slabs, loads cause corners to lift and twist (torsional moments) leading to cracks; reinforcement resists this.

Resists "opening moments": External forces or uneven loads can create moments that try to open the corner, pulling faces apart.

Enhances Strength: provides added support where beams and columns meet, crucial for earthquake resistance and preventing collapse.

Increases Durability: Prevents chipping and cracking at vulnerable points, improving structural integrity over time.

* Lintel Band: A lintel band (also known as a continuous horizontal reinforced concrete member that runs through all the walls of a building at the lintel level (above doors and windows)).

Core Purpose & Functions:

Structural Support: It functions as a beam to support the weight of the masonry above openings like doors and windows.

Seismic Resistance: In earthquake-prone areas, it ties all walls together to create a "box action", ensuring the building acts as a single unit and preventing walls from collapsing outward.

Load Distribution: It distributes both vertical and lateral (wind/seismic) loads evenly across the building's supports.

Crack Prevention: It reduces stress concentrations at the corners of openings, which are typical points where diagonal cracks begin.

Typical Specifications:

Width: Usually equal to the thickness of the supporting wall (e.g., 230 mm or 115 mm).

Depth: Commonly ranges from 75 mm to 150 mm depending on the span and local building codes.

Sill Band Note: A "sill band note" in construction refers to specifying a horizontal reinforced concrete (RCC) beam at the window sill level in building plans, acting as a structural tie to bond walls, distribute loads, and significantly boost seismic resistance, preventing cracks and collapse around opening by tying masonry to frame elements.

Key Characteristics & Purpose :

Reinforcement : Contains longitudinal steel bars (e.g., 8-10 mm) and stirrups (e.g., 6 mm @ 150 mm c/c) within concrete, tied to vertical bars.

Location : Horizontal band at the window sill level (around 900 mm high).

Function :

The Walls together : Create a single, cohesive structural unit.

Load Transfer : Distributes loads evenly especially around openings.

Crack Control : Prevents cracking and failure around windows/doors.

Seismic Resistance : Essential for earthquake safety, tying masonry to RC frame.

Plinth band : A plinth band is a crucial horizontal reinforced concrete beam built at the base of walls. Just above the foundation, to tie columns together, uniformly distribute wall loads, prevent cracks from uneven soil settlement, resist lateral forces like earthquakes, and provide a level base for masonry also acting as a moisture barrier.

Roof Band (Structural): A concrete ring beam (RCC band) at roof level in masonry buildings, providing stability or a mental band for roof fixing.

Gable Band: A gable band in building construction is a critical horizontal reinforced concrete (RC) or timber beam placed at the top of a gable (triangular) wall, especially for pitched roofs, acting as a structural tie to connect roof elements (rafters/ridge beam) to the gable wall, ensuring the roof and wall act as a unified box, which significantly enhances earthquake resistance and stability by preventing walls from spreading or collapsing under stress.

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ch-6 CONSTRUCTION AND MOVING EQUIPMENTS

Draglines:

- Draglines are based on the universal power unit basic crane rigging to which is attached a drag bucket.
- The machine is primarily designed for bulk excavation in loose soils up to 3m below its own track level by swinging the bucket out to the excavation position and hauling or dragging it back towards the power unit.
- Dragline machines can also be fitted with a grab clamshell bucket for excavating in very soils.

TRACTORS:

- A tractor is a engineering vehicle specifically designed to deliver a high tractive effort at slow speeds, for the purpose of handling a trailer machinery used in agriculture or construction.
- The durability and engine power of tractor made then very suitable for engineering tasks.
- Tractors can be fitted with engineering tools such as dozer blades, buckets, hoes,ippers, etc.
- The most common attachments for the front of a tractor are dozer blades.

- When attached to engineering tools, the tractor is called an engineering vehicle.
- Tractor converts engine power to traction power used for pulling and pushing.
- A tractor is a multi-purpose machine. Light models can be used for agricultural or haulage works. Heavy crawler units are used for large scale earth moving works.
- Typical project applications of tractors are land clearing, ripping and towing other construction equipment.
- Types of tractors are (i) Wheeled tractors
(ii) Crawler tractors

Bulldozer: A bulldozer or dozer (also called a crawler) is a large tractor equipped with a metal blade at the front for pushing material (soil, sand, snow, rubble, or rock) during construction work.

- It travels most commonly on continuous tracks, though specialized models riding on large off-road tires are also produced.
- Its most popular accessory is a ripper, a large hook-like device mounted singly or in multiples in the rear to loosen dense materials.
- Bulldozers are used heavily in large & small scale construction, road building, mining & quarrying, on farms, in heavy industry factories, & in military applications in both peace & wartime.

→ The Word "bulldozer" refers only to a motorized unit fitted with a blade designed for pushing.

→ The Word is Sometimes used inaccurately for other heavy equipment such as the generally similar front end loader designed for carrying material rather than pushing it.

→ The Word is Sometimes used

→ The term originally referred only to the blade attachment but is now commonly applied to any crawler tractor with a front-mounted blade.

Power Shovel:

→ A power shovel, also known as a motor shovel, stripping shovel, front shovel, mining shovel or rope shovel, is a bucket-equipped machine usually powered by steam, diesel fuel, gasoline or electricity & used for digging & loading earth or fragmented rock & for mineral extraction.

→ Power shovels are type of rope/cable excavator, where the digging arm is controlled & powered by winches & steel ropes, rather than hydraulics like in the modern hydraulics excavators.

→ Basic parts of a power shovel include the track system, cabin, cables, rack, stick,

boom foot pin, Saddle block, boom point & bucket.

→ The size of bucket varies from 0.73 to 53 cubic meters.

→ Power shovels are used principally for excavation & removal of over burden in open-cut mining operations; they may also be used for the loading of minerals, such as coal. They are the classic equivalent of excavators & operate in a similar fashion.

→ Other uses of the power shovel include:

1. Close range work
2. Digging Very hard Materials
3. Removing large boulders.
4. Excavating materials & loading trucks
5. Various other types of jobs such as digging in gravel banks, in clay pits, cuts in support of work, road-side berms etc.

* What is a Smooth Wheel roller?

→ Static rollers, also known as smooth wheel rollers, exert pressure on the surface without employing vibrations.

→ Smooth wheel rollers are useful for finishing operations after the compaction of fills & for compacting the granular base course of the highway.

Pneumatic Tyred roller (PTR):

A pneumatic tyred roller is heavy construction equipment that uses multiple rubber tires instead of steel drums to compact soil & asphalt.

owning cost: owning costs are the Fixed, Upfront & long term expenses of having an asset (like purchase price, depreciation, taxes, insurance, financing) While operating costs are Variable expenses of using it (like fuel, labour, Maintenance, repairs).

* owning cost (fixed/capital costs):

These are costs related to acquisition & holding the asset.

Initial Purchase: price, taxes, delivery, assembly.

financing: Interest paid on loans.

Depreciation: Loss in Value over time.

Insurance & taxes: Annual Premiums & Property taxes.

Storage: costs to store the equipment.

→ Operating costs are the ongoing, day to day expenses business incurs to maintain, operates & administrative its core activities, excluding interest, taxes & capital investments.

* Key components of operating costs:

fixed operating cost: Expenses that do not change with production Volume, such as rents, insurance & Salaries.

Variable Operating costs: costs that fluctuate based on Production levels or activity, such as raw materials, Shipping & Sales commissions.

Common Examples: Rent, utilities (electricity, water), Pay roll / salaries, Marketing / advertising, raw materials, office Supplies & Maintenance / repairs.

ch-7 Soil Reinforcing Techniques

Introduction: Soil reinforcement is a ground improvement technique using materials like synthetic fibers, grids, or strips (geosynthetic) to enhance soils strength, stiffness, & load-bearing capacity, creating composite materials for stable slopes, retaining walls, foundations & pavements where natural soil is weak or prone to deformation.

Necessity Of Soil Reinforcing :-

Improved Load-bearing Capacity: Reinforced soil supports heavier loads (e.g. in foundations) compared to unreinforced, weak soil.

Slope Stabilization: It provides tensile strength to soil slopes, preventing landslides, erosion & failure in hilly or steep areas.

Retaining Structure support: It is crucial for constructing steep or near-vertical retaining walls, especially for road embankments, bridge abutments, & land reclamation.

Foundation Support: It reduces structural settlement & increases stability for structures built on poor-quality, loose soil.

Cost-Effective Infrastructure: ^{Soil} reinforcement allows for faster construction times and reduces the need for expensive, traditional concrete structures.

Versatility in Application: It is used in various projects, including roads, railways and industrial sites to increase soil tensile strength and resistance to shear.

Embankment Strengthening: Embankment strengthening involves enhancing slope stability, preventing erosion, and reducing settlement, often using methods like geotextiles, geogrids, berms and vegetation.

Key Strengthening Techniques:

Geosynthetics (Geotextiles / Geogrids):

High-strength materials placed at the base ($200-1000 \text{ kN/m}$) provide resistance against slip failure and increase load-bearing capacity by interlocking with soil particles.

Drainage system: Wick drains (1-3 m spacing) accelerate consolidation in soft soils, reducing long-term settlement.

Slope Stabilization: Reshaping banks (reprofiling) accelerate consolidation in soft soils, reducing to a more gradual slope, installing rock rolls (riprap), and using Wooden Piles to Prevent Sliding.

Engineered fill and reinforcement:

Using expanded polystyrene (EPS) blocks or specialized mattress section to build.

* What is the Slope Cutting method?

→ The slope cutting involves cutting slopes up to 4.5 meters high. The works will be done in phases, establishing erosion control measures first. For slopes under 4 meters, the cutting will be done in 1.5m layers until the proposed grade is reached, then turfed.

* How to Stabilize a slope?

→ i) Installing drains: The amount of water in the soil can have a serious impact on the stability of a slope.

ii) Terracing: Also known as cutting benches, this process involves cutting a series of step-like terraces into the slope.

iii) Building retaining Walls: These can take many forms, but the principle is the same.

* What is a Wire mesh used for?

Wire mesh is a Versatile material Used for reinforcement, filtration, Protection, and decoration in construction (concrete, fencing), agriculture (animal pens, crop Protection), industrial setting (machine guards, Shelving), and homes (security Screens, Oven racks, strainers).

Use Of Wire Mesh:

Construction & Architecture:

concrete Reinforcement: Prevents cracks and adds strength to slabs and Walls (Welded Wire mesh).

Security: Security fencing, Window guard and grilles.

Aesthetics: facades, Partitions, and decorative elements in buildings.

Flooring: Bare grating for industrial Walkways, mezzaines and decks.

Industrial & Manufacturing:

Filtration: filtering impurities in Water, chemicals and air.

Conveyor Systems: Reinforcing belts for material transport.

Support: Support networks in aerospace and machinery.

CHAPTER-2 PREFABRICATION

* Prefabrication:- Prefabrication is a construction method where building components, such as walls, panels or modules, are manufactured in a controlled factory setting & then transported to the site for final assembly.

* Necessity of Prefabrication:-

- Prefabrication is used to effect economy in cost.
- Components manufactured under controlled conditions.
- The speed of construction is increased since no curing period is necessary.
- Prefabrication helps in the use of locally available materials with required characteristics like light-weight, easy workability, thermal insulation, non-combustibility, etc.

* Use of Prefabrication:-

- Components produced: walls, floors, roof trusses, staircases, complete room modules, & structural steel/concrete frames.
- Common Applications: Apartment blocks, housing developments, office buildings, warehouses, factories, & detached homes.

* Classification of Prefabrication:-

- 1) Small prefabrication
- 2) Medium prefabrication
- 3) Large prefabrication
- 4) Open system of prefabrication
- 5) Closed system of prefabrication
- 6) Partial prefabrication
- 7) Total prefabrication

1) Small Prefabrication :

- For eg:- brick is a small unit precast & used in buildings. This is called as small prefabrication. That the degree of precast element is very low.

2) Medium Prefabrication :

- Suppose the roofing systems & horizontal member are provided with precast elements.
- These constructions are known as medium prefabricated construction. Here the degree of precast elements are moderate.

3) Large Prefabrication :

- In large prefabrication most of the members like wall panels, roofing/flooring systems, beams & columns are prefabricated.
- Here degree of precast elements are high.
- One of the main factors which affect the factory prefabrication is transport.
- The width of road & mode of transport vehicles are the factors which factor the prefabrications which is to be done off site (or) factory.
- Small elements the conveyance is easier with normal type of lorry.
- on site prefabrication is preferred for following reasons:
 - Factory situated at a long distance from

delay due to removal eliminated completely in this method of construction suitable for any type of building provided lifting & erection equipments are available.

7) Total Prefabrication:

→ very high speed can be achieved by using this method of construction.

→ The choice of these two methods depend on the situations when the factory produced elements are transported & erected site we call it off-site prefabrication.

→ If this method is to be adopted then we have a very good transportation of the products to site.

→ If the elements are cast near the building site & erected, the transportation of elements can be eliminated, but we have consider the space availability for establish such facilities though it is temporary.

→ The choice of the method of construction also depends on the following;

1. Type of equipment available for erection & transport.

2. Type of structural scheme (linear elements & panel).

3. Type of connections between elements.

4. Special equipment devised for special method construction.

* Advantages of Prefabrication

- Self-supporting ready-made components are used, so the need for formwork, shuttering & scaffolding is greatly reduced.
- Construction time is reduced.
- Speed up construction because of curing is not necessary.
- Improve the quality as the components can be manufactured under control condition.
- Use locally available materials with required characteristics.
- Minimize of wastage.
- Onsite construction is minimized.
- Requirement of skilled labors such as mason, carpenters, bar benders etc., can be reduced.
- It save manpower.
- Shrinkage of the units which largely eliminated.
- Less expansion joints are needed.
- More accurate & better workmanship.
- Cross section of member can be reduced by use of high strength concrete.

* Disadvantages of Prefabrication

- Careful handling of prefabricated components such as concrete panels or steel & glass panels is required.
- Attention has to be paid to the strength & corrosion-resistance of the joining of prefabricated sections to avoid failure of the

the Construction Site.

→ vehicle have to cross a congested traffic.

→ Heavy weighed elements to transport.

4) Open system of Prefabrication :-

→ In the total prefabrication systems, the space frames are casted as a single unit & erected at the site.

→ The wall fitting & other fixing are done on site.

5) Closed system of Prefabrication :-

→ In this system the whole things are casted with fixings & erected on their position.

6) Partial prefabrication :-

→ In this method of construction the building elements (mostly horizontal) required are precast & then erected.

→ Since the casting of horizontal elements (roof/floor) often take there time due to erection of formwork the completion of the building is delayed & hence this method is restore

→ use of double tees, cored slabs, slabs etc., as some of the horizontal elements.

→ This method is efficient when the elements are readily available when the building reached the roof level.

→ The delay caused due to erection of formwork

Joint.

- Similarly, leaks can form at joints in prefabricated components.
- Transportation costs may be higher for voluminous prefabricated sections than for the materials of which they are made, which can often be packed more compactly.
- Height restrictions under bridges.
- Road transport maximum widths.
- Additional cost of temporary bracing for transportation and/or lifting or permanent framing to support prefabricated assemblies.
- Large prefabricated sections require heavy-duty cranes & precision measurement & handling to place in position.
- Greater erection equipments are needed.

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