Chapter - 1

Introduction to Construction Technology

Structure:

A combination of members connected together in such a way to severe a use is called structure.

Types of structures:

1. Rigid frame
2. Truss

Structural members:

→ Those members that are interconnected in such way so as to constitute structure is called structural members.

→ Example → beams, columns, strut, slab, cables.

Parts of building:

1. Sub-structure / foundation :—

→ It is the lower position of the building.

→ Located below the ground level.

→ Direct contain with the ground to which the load transmitted.

2. Super structure :—

→ It is part of structure which is above ground level.

→ Upper position of the building.

Components of building:

1. Foundation
2. Masonry units a) wall b) columns
3. Floor structures
4. Roof structures
5. Doors, windows
6. Stairs
7. Building finishes

Functional requirement:

1. Comfort and convenience
2. Dimensional stability
3. Durability
4. Strength and stability
5. Fire protection
6. Termite control
7. Heat thermal insulation
8. Light and ventilation
9. Economy
10. Moisture and damp prevention

Chapter -2

Fundamentals of Construction Technology

Introduction:

→ Construction is the process of constructing a building or infrastructure.

→ CT means the study of the methods and equipments used to build structure based totally on manual efforts.

Construction activities:

→ General construction work:-
Starting from sub structures to reinforced concrete and structural steel super structures, highways, bridges, airports, soils, dams, etc.

→ Specialized construction work:-
Mechanical and electrical erection work, sanitary and plumbing work, roofing work and other similar work of specialized nature.

→ Auxilliary construction work:-
It means to be temporary in nature.

Construction process:

→ The nature of the construction activities involved, the place where construction work is to be carried out and time available for construction work.

→ Construction process varies worldwide. Construction is a very labour intensive process.

→ Degree of mechanization depends on the nature of construction work.

→ It can be simple as well as complicated.

Construction workers:

a) Unskilled :—
A worker endowed with only muscle power falls under unskilled category.

b) Semi skilled :—
A smart unskilled worker, who acquires skill after a long tenure at construction sites, falls under semiskilled category.

c) Skilled :—
A deserving semi skilled worker may be promoted to skilled category.

Construction estimation:

→ Technology involved in the construction and installation activities.
→ Availability of the required materials and construction equipment for planned output.
→ Critical milestones in the construction schedule.
→ Man power requirement for efficient implementation.
→ It takes a lot to transform a design on paper into a functioning facility or an infrastructure or a utility or an industry.

Requirements of construction estimate:

1. Drawing
2. Specification
3. Rates

Construction schedule:

→ A series of tasks and activities in a project are to be completed with defined and limited resources.

→ Each activity has an early date and early finish date.

→ A realistic construction schedule which is agreed upon by the owner and the executing agency should be the yardstick for progress measurement.

Productivity and mechanized construction:

→ The productivity of any construction equipment is a term that indicates how many unit of output the equipment produces in an hour depending on the job conditions and management as well as the operator's skill, persistence and coordination with other construction forces.

→ Productivity refers to the ratio of output versus input.

Quality:

→ Quality should be most important consideration in all construction activities.

→ Reliability, durability and safety of construction work depend mostly on quality.

→ Different authors have defined quality on different ways.

→ Quality means predictable degree of uniformly and reliability.

Safety:

→ Risk is an inherent part of all construction activities.

→ Risk is likely to affect safety, health and environment.

→ Safety depends on human attitude.

→ Construction activities expose both men and material to risks
→ Modern concept of safety relies more on involving construction workers directly in safety efforts apart from their adhering to prescriptive approach
→ Training is a mode of learning that changes behaviour and attitude.
→ Executing agencies would follow the lead taken by the owners on safety.
→ If construction workers identify hazardous situation ahead and take necessary corrective action, probability of accidents at construction sites would be drastically reduced.

Chapter - 3

Preparation work and Implementation

Site layout:

1. Site location:-

→ how to reach from the nearest town/city, airport, railhead, harbour.
→ distance involved and cost of travel.
→ availability of public transport.
→ load and dimension restriction on road bridges.
→ economic mode of transportation of materials and equipment

2. Accomodation:-

→ availability of hotels/guest houses/restaurants/residential accomodation and expenses involved to avail such facilities.

3. Services:-

→ Availability of facilities like banks, post office, telephone services, water supply, power supply, market, school/colleges, hospitals/nursing homes/medical facilities, clubs, fire station, petrol stations, police station, security provider.

4. Manpower:-

→ availability of local unskilled, semi-skilled and skilled workers.

5. Materials:-

→ availability of raw materials, finished products and spare parts locally.

Infrastructure development:

→ Boundary wall along the project boundary with lockable gates for security.
→ Arrangement for office and residential accomodations.
→ Electrical power for all participating agencies.
→ Potable and construction water.
→ Project roads with necessary temporary linking roads.
→ Drainage facilities to avert water logging at site.
→ Yard illumination.
→ Warehouse, cement sheds, open storage yard.
→ Workshop, garage and parking facilities.
→ Testing laboratories facilities.
→ Medical facilities including a standby ambulance.
→ Fire fighting facilities including parking a fire-tender at the site.
→ Communication facilities - postal, courier, electronic internet, etc.
→ Diesel and petrol filling station.
→ Security at the site.

Communication methods:

→ The basic purpose of construction work is to execute a job at a reasonable cost within the scheduled time frame with assured quality.
→ In evolving construction methods, the following should be kept in view.

• Quality of construction is to be assured - quality assurance creates a bright working environ-

ment conducive for the best of human efforts.
• Project implementation is to be completed within the scheduled time — timely execution is cost effective.
→ Quality can be totally assured even where large outputs on continuous basis are planned if quality remains inherent in the construction methods.
→ Quality apart, modern construction equipment and machineries come in all sizes — micro mini to mega size with the production matching the sizes.

Construction materials:

1. Cement concrete :—
→ Concrete is a mixture of binding material like cement, water, fine aggregate (sand), coarse aggregate and admixture and proportion to achieve concrete of desired properties of fresh state harden state.

2. Steel structure :—
→ Produced in the form of plates, sections and shapes.
→ High tensile both are used to connect structural steel members.
→ For manufacture wagons and containers for the road way the rivets are still used.

3. Metal products :—
→ Castiron and ductile iron pipes and fittings are extensibely used in plumbing drainage work.

→ Aluminium and aluminium alloys are used in buildings in various forms.

4. Timber :—

→ Timber is mostly used for temporary work.

5. Masonry works :—

→ Multistoried residential or industrial buildings are built of RCC or steel structures.

6. Soils :—

→ If the construction site is located in a low lying area, then the site has to be developed by transporting large volumes of soils from outside.

Deployment of construction equipment :

→ Bulldozers, scapers, shovels, backhoes, draglines, trenchers, dredgers, boring machines, dump trucks, etc are used in earthwork after careful selections.

→ Pumps are extensively used for dewatering purposed.

→ Mixers and batching plants are used for concrete production, truck mixers, dumpers, pumps, cranes and conveyance are used for transporting and placing concrete.

→ Some of the commonly used construction equipment and machineries are dump trucks, tractor trailers, hoists, derricks, cranes, etc.

→ Cranes can be of various types and they are used extensively.

Prefabrication in construction:

→ Prefabrication in construction allows parallel execution of different activities whereby execution time could be significantly reduced.

→ In building construction, steel super structures are designed over reinforced cement concrete (RCC) foundations.

→ Cast-in-situ reinforced concrete foundation and sub-structure are constructed at or below the GL, while fabrication of steel structures is carried out at the shops.

→ Instead of structural steel super structures, RCC super structures may also be prefabricated at the shops.

→ Trasportation, handling and erection of steel structures are relatively less problematic.

→ Fabrication detailing is done, keeping possible transportation problems in mind.

→ Capacity of transports would determine the dimensions and weight of fabricated steel to be transported.

→ Fabricated members could easily be spliced at the site.

→ Riveting is used for fabrications of wagons, etc, for the railways, but not for splicing joining anymore.

False work and temporary works:

→ It may be defined as temporary structure that is intended to support a permanent structure while it is not self-supporting.

→ It is also a temporary work and doesn't form part of the permanent feature of any project, expect where the cost of removal would be prohibitive.

→ Scaffolding is temporarily assembled timber or steel tube platforms or working areas.

→ Scaffolding can be assembled independent of permanent structures or if necessary can be tied to the permanent structures also.

→ Cofferdams are very important for offshore construction.

→ Executing/construction agencies are responsible for design of falsework and temporary work.

→ Before we using this material check its quality and condition for used in false work and temporary works.

→ In the checking time we take attention upon where the temporary vertical member is laterally joined.

Chapter - 4

Earthwork

Introduction:

→ It is created through the moving / processing of parts of the earth's surface involving quantities of soil.

→ It is earth moving.

→ It involves excavation and filling.

Classification of soil:

1. Coarse grained (non - cohesive): —

→ It is composed of rock fragments.

→ Boulders are over 200mm in size.

→ Particle size of ~~xxxxx~~ cobbles lie between 60-200mm.

→ Grain size of gravel lie between 2-60mm.

→ Grain size of sand lie between 0.06 - 2mm.

2. Fine grained (cohesive): —

→ It is composed of fine particles each of which contain only one mineral.

→ It is not rounded, but are more angular and flaky shape.

→ Grain size of silt lies between 0.002 - 0.06mm.

→ Grain size of clay particles is less than 0.002 mm.

3. Top soil or organic matter: —

→ Soil at the top is a mixture of mineral matter, organic matter, air and water.

Project site development:

→ If existing ground is marshy, it may be necessary that the entire site top soil be replaced with appropriate soil. If any site is partly marshy, replacement may be made with available soil from other areas of the site, if found suitable for the purpose.

→ If there are any water logged areas, water should be pumped out beyond the site boundary or drained out by digging narrow ditches.

→ Site should be cleared of loose stones or boulders, if any lying on project implement areas.

→ If project site is uneven in levels, the site is to be levelled manually or by deploying construction equipment depending upon the quantum of work involved.

Setting out:

→ It is done w.r.t. reference baseline by the use of a theodolite and steel or fibre glass tapes.

→ Permanent grid pillars are solidly built outside the project layout area by means of closed traverse survey.

→ MSL is the datum for elevation. Elevation, so, indicate relative height w.r.t. MSL.

→ A contour map of a project site is prepared on the basis of the BM established at the site.

→ Centre lines of excavation pits/trenches need to be marked at the ground level by driving pegs along the excavation lines.

Mechanized excavation:

1. Confined excavation:—

→ It is related to excavation carried out for construction of individual foundation and trenches.

→ Outline of the foundation are marked with wooden pegs or lime powder before construction equipment are deployed.

2. Sloped excavation:—

→ It is involved in case of a deeper excavation.

→ It is to be carried out upto a level where from confined excavation could be done.

3. Bulk excavation:—

→ It can be carried out where quantum of excavation involved is voluminous.

→ Big versatile construction equipment can be deployed in such cases.

4. Excavation in rock:—

→ Construction equipment is it deployed is possible if the rock is weak.

→ In open areas, weak rock like siltstone or mud stone can be excavated with common earth moving equipment.

5. Embankment formation :-

→ Embankment formation by earth filling is not just dumping earth, as slope the embankment is an important factor there

Groundwater control :

1. Temporary exclusion :-

a) Sump pumping →

→ It is a temporary solution where excavation is carried out to a level the water table or where water gets into the excavated pit.

b) Sheet piling →

→ It is very common for water exclusion as well as earth retaining properties during and after excavation for the temporary and permanent solution.

c) Cofferdams →

→ It is a water tight dam that is built for temporary exclusion of soil and water so that construction both off shore and on shore can be carried out in the dry below the G/W.

d) Deep bored wells →

→ It is effective in excavation depths in excess of 6m right upto 100m or more.

e) Well point system →

→ It is installed at relatively close spacing, usually in the range of 500mm to 2.5m

-to adequately dewater fine grained or stratified soils.

f) Horizontal drains:→

→ is an alternate to the vertical well points or borewells, horizontal system of dewatering may be used.

2. Permanent exclusion :—

a) Drainage / sand drain →

→ Easy and inexpensive way of watering.

→ Water exclusion from soil is used on both sides of road and under embankment.

b) Sheet piling →

→ It is used to form permanent retaining wall for river bank strengthening.

→ These sections have inter locking joint to form a water seal.

c) Diaphragm walls →

→ It is a cast-in-situ reinforced concrete wall.

→ It is constructed in panels to allow concrete to set and have thermal movement before the next panel is cast in the same way.

d) Contiguous piling →

→ It is reinforced concrete piled, wall having similarity in concept to reinforced concrete diaphragm wall but relatively more simple, quick and inexpensive.

e) Slurry trench cut-off walls →

→ It is an inexpensive method of excluding groundwater.

f) Thin grouted membrane →

→ In it the execution method involves driving of structural steel sections, sheet pile sections or rectangular hollow sections into the ground down to the required depth.

g) Pressure grouting →

→ The principle of it is to inject a substance to fill the voids in soil or the fissures in rock by pumping the fluid down a small diameter tube placed in a drill hole.

h) Caissons →

→ It is like a reinforced concrete cofferdam with in which excavation is carried out by dredging.

Chapter-5

Piling

Introduction:

→ Transfer both vertical load to the underlying hard soil strata to resist heavy uplift and horizontal forces.

→ It is necessary to carry out detailed soil investigation to better understand the existing soil quality and decide whether piling is necessary or not.

Classification of piles:

1. Load bearing pile :—

→ A pile must not be bearing on cohesive soil mass because such soil is compressible in nature and is likely to consolidate over a period of time resulting in settlement.

2. Friction pile :—

→ In case of it, the piles transfer most of their loads to the underlying soil mass through skin friction.

Pile driving methods:

1. Impact pile driving :—

→ It is done with hammer which imparts dynamic energy by the impact of a falling ram.

→ Types of hammers are

- impact hammer
- drop hammer

- single-acting hammer
- double-acting hammer
- hydraulic impact hammer

2. Pile rig:—

→ It is used on ground comprising a leader mounted on a crane base.

→ This driving method depend on

- pile and hammer weight
- ground conditions
- pile length
- manoeuvrability

3. Driving a vibratory device attached to the pile top, generally in soils with less cohesion:—

→ This method is not noisy and vibration is also not excessive.

→ In this, the piles used are

- vibratory pile drivers
- hydraulic pile drivers

4. Jacking the pile against reaction:—

→ This method is applicable for short stiff piles.

Load test and quality control:

→ Quality of piles driven determines whether any pile foundation would measure upto the design requirements or not.

→ The integrity of the pile and its capability as a structural unit to carry the applied load.

→ The load bearing and deformation characteristics of both the soil and pile.

Load test :—

→ It is generally accepted that a load test is the most reliable means of checking the designer's estimate of safe working load and determining the actual load bearing capacity of a pile.

→ If pile is driven by dynamic means, its driving history is recorded and then the load testing is done.

Chapter - 6

Concrete and Concreting

Introduction:

→ It is a construction material.

→ It is produced by mixing properly the proportioned quantity of cement, sand, aggregate and water.

Important properties of concrete:

1. **Workability :—**

→ It is defined as the property of concrete which determines the amount of useful internal works necessary to produce feel compaction.

Factors affecting workability →

→ water content.

→ shape, size, surface tension, porosity, absorption grading of aggregates.

→ air entraining agents.

→ temperature.

Methods of determining the workability →

a) **Slump test**

→ The test is carried out with a mould called slump cone, whose top diameter is 10cm, bottom diameter is 20cm and height is 30cm.

b) **Compaction factor test**

→ In this test, the workability may be defined as the amount of applied work required to compact the concrete to maximum density.

c) **Vee bee test**

→ It carries out the relative effort measurement to change the mass of the concrete from a definite shape to the other.

2. No segregation :—

→ It may be defined as the breaking of cohesion in a mass of concrete during transportation.

→ If the quantity of water in the mix is more, the large size aggregates tends to separate thus causing segregation.

3. Harden concrete :—

a) Strength →

→ It is defined as the resistance of a harden concrete to rupture under different loadings.

b) Compressive strength →

→ Durability of concrete improves with this.

→ Bond strength of concrete improves with this.

c) Flexural strength →

→ It estimate the load at which concrete member may crack.

d) Tensile strength →

i) direct method

→ It suffers from a no. of difficulties related to holding the specimen properly in the testing machine without introducing stress concentration and to the application of uniaxial tensile load.

ii) indirect method

→ It is developed to determine the tensile strength.

4. Durability :—

→ It is defined as the period of time upto which concrete is harden state withstands.

→ This property is mainly affected by water cement ratio.

13 Use of admixtures:

→ To increase plasticity of concrete without increasing the water content.
→ To reduce bleeding and segregation.
→ To retard or accelerate the setting time.
→ To accelerate the development of strength at early ages.
→ To reduce the rate of heat evolution.
→ To increase the durability of concrete to specific exposure condition.

Form work:

→ A form is a mould which ensures that the dimensions of the structure or element to be constructed confirm to the drawings within specified tolerances.
→ Cost of it goes up due to the following reasons: —

- design work is carried out without taking the sizes of available forms into consideration.
- possible reuse of forms is overlooked by not making concrete members of similar sizes.

→ Proper design of forms provide: —

- strength
- rigidity
- tightness
- good alignment
- reasonable economy
- desired texture on exposed concrete surface
- ease of handling
- ease of stripping

→ The basic material used for it is timber and plywood over the years.

Shotcrete (sprayed concrete):

→ It is continuously spraying concrete at high speed onto a backup surface or substrate using purpose made process equipment so powerfully that a fully compacted self supporting concrete structure is formed instantaneously without sagging or sloughing.

→ Depending on the setting acceleration, it can be applied to any elevation including on vertical or inclined face or even overhead.

→ There are two basic process for shotcrete application are • dry process and
• wet process.

→ It has advantages in many application process because of its method of placing.

→ Use of it is limited in specific types of construction work.

Light weight and heavy weight concrete:

Light weight concrete:—

→ It can be produced with a dry density.

→ It is produced principally for ⟶
• reducing the dead load of a structure.
• lowering the cost of foundation.
• adding fire-resisting capability, insulation, etc.

→ The principal technique of producing these are ⟶

• excluding fine constituents of the normal aggregates, thus creating air-filled voids.
• including bubbles of gas in a cement paste to form a cellular structure containing 30-50 voids.
• replacing natural aggregates as a whole or partly with available these of low density containing a large proportion of voids.

→ Structural members made with it have reduced self weight as a result of which structural members would have thinner sections, costing less.
→ It can therefore be concluded it would be advantageous for precast construction work because of the following →
• larger units can be produced compared to normal weight concrete without causing any problem in transporting, handling and lifting.
• because of largers units, no. of joints would be fewer.
• larger unit and fewer joints can expedite the construction work.

Heavy weight concrete :—

→ It is produced with both heavy weight coarse and fine aggregates are used in the construction of nuclear reactors and other structures.
→ It increases the weight as well as density of concrete.
→ It accounts for a small section of concrete type production within the construction industry.

mainly within the nuclear industries.
→ Production of it for shielding is not as simple as for normal weight concrete.
→ These are used selectively where strength of 28MPa or more is required.
→ It is useful to be used as counter weight or simply to enhance dead weight to reduce bulk volume of normal concrete.
→ It is required in ship's ballast and encasement of underwater/submarine pipelines for air, gas or even liquid.

Ready-mixed concrete:
→ The most significant advantage of it is that it is produced under controlled conditions unlike at most construction sites except for large sites where developing the required controlled condition is possible.
→ They are mainly of two types.
• concrete mixed in a central plant and then transported to the site for placing.
• concrete ingredients are batched in a central plant but are mixed in truck mixer either in transit or immediately before placing.

High performance concrete:
→ It is a product developed to satisfy effectively the performance requirements for the desired application and is essentially a modification of ordinary concrete.

→ It has a wide range of prospective applications.
→ It has been considered suitable for use in high rise buildings, high dams, pre stressed bridges, airport pavement, off shore structures, structure exposed to severe exposure condition, etc.

Self compacting concrete:

→ It is a high performance composite that flows under its own weight over a long distance without segregation and use of vibrators.
→ Since the introduction of it in practical use is difficult, sites relating to access and congested reinforcements, therefore it has been developed further utilizing various materials.
→ The supply cost of it could be from 10-50% higher than that of conventional concrete of the similar grade.

Extreme weather concreting:

→ Good quality concrete is produced around the world including some regions where the climates are typified by prolonged periods of extreme, hot or cold.
→ The specifications and guidelines furnish the details and methods of combating the extreme weather conditions for building concrete elements and structures.

1. Hot weather concreting:—

→ Both production and placing of concrete can be affected by high temperature.

2. Cooling measures :—

$$T = \frac{0.22(T_a W_a + T_c W_c) + T_w W_w}{0.22(W_a + W_c) + W_w}$$

T = temperature in °C of freshly mixed concrete
W = mass of ingredient per unit volume of concrete
'a', 'c', 'w' = aggregate, cement, water

3. Cold weather concreting :—

→ It is produced by incorporation of frost bound materials.
→ Cooling of mix.

Pre-stressed concrete:

→ A concrete member in which internal stresses of such magnitude and distribution are introduced so that the stresses resulting from given imposed loads are counteracted to a certain desired degree.
→ It requires both high strength concrete and high tensile steel called tendon.

1. Pre-tensioning :—

→ High tensile steel tendons are tensioned between fixed abutments before the concrete is poured round them.

2. Post-tensioning :—

→ The concrete is poured 1st leaving ducts containing the high tensile steel tendons.

Under watering concrete:

→ It is a special operation that may have to be carried out in remote and difficult areas in unusual environment.
→ Placing it, is to use specially made water light box or skip instead of the tremie.
→ Operation is to be continued without interruption.
→ The quality of concrete should be rich.

Curing of concrete:

→ The process of creation of an environment during a relative short period immediately after the placing and compaction of concrete favourable on setting and the hydration of concrete is called curing.

Curing conditions:—

→ Adequate moisture within concrete to ensure sufficient water for continuing hydration process.
→ Warm temperature to help the chemical reaction.

Curing period:—

→ To develop design, it has to be cured upto 28 days.

Method of curing:—

→ Ponding of water over the concrete surface after it has set.
→ Covering the concrete with wet straw or damp earth.
→ Covering the concrete with wet burlap.
→ Sprinkling of water.

Chapter-7

Roof and Roofing

Introduction:

→ Roof is constructed on top of building to protect it from heat, rain, wind, solar radiation and other environmental agents.

→ Roofing protects the roof from damage and deterioration.

Cast-in-situ reinforced concrete roofs:

→ It is of 2 types.

• permanent forms • temporary forms

→ Permanent forms are of 2 types:

a) Structurally participating :—

→ It is designed to provide the temporary support for the plastic concrete and loads caused due to the construction activities ultimately becoming part of the permanent roof slab contributing to its strength.

b) Structurally non-participating :—

→ It is designed solely to support the plastic concrete and loads caused due to the construction activities.

Pre-cast reinforced concrete roofs:

→ Pre-cast roof element is designed as a single span beam in bending.

→ Roofing is built of the following material:

• grading underbed
• insulation
• water proofing

→ The joints of the erected precast roof slabs are checked and sealed with mortar before the underbed is laid.

Roofs covered with sheets:

→ Suitable materials for covering roofs are →
- hot dip galvanized corrugated sheets.
- aluminium profiled sheets.

→ The functional requirements of roof covering are →
- strength and stability.
- resistance to weather.
- durability and freedom from maintenance.
- safe access during maintenance.
- resistance to passage of heat.
- resistance to passage of sound.
- security.
- aesthetics.
- fire safety.

→ Roof sheets should be of low self-weight to be cost effective.

Water proofing over roofs:

→ Water may penetrate the roof concrete via inter connected voids within the cement paste or at the paste aggregate interface.

→ Water proofing of roof is carried out using membrane.

→ The membrane should be of one of the following types →

- 2 piles of hessian/polyster base felt and three mopping of bitumen.
- 3 piles of hessian base felt and four mopping of bitumen.
- 4 piles of fibre base felt and five mopping of bitumen.

Chapter-8

Finishing work

Introduction:

→ It is executed for protection against environmental deterioration as well as for architectural attractive sheds.

→ It consists of the following processes.

a) Plastering
b) Pointing
c) Facing
d) Glazing
e) Flooring
f) Painting

Plastering:

→ Plastered surface are hard, resistant, rigid, provided a monolithic surface even at corners.

→ It is a thin plastic covering of different compositions applied using trowel to generally on walls and ceilings, is a protective coating on structures, buildings and other installations and has architectural, decorative and protective function.

→ It should be properly applied so as to avoid cracking when movements due to drying, shrinkage, or thermal changes are restrained.

→ It is classified into ordinary, decorative and special based on the kind of surfaces to be plastered.

Pointing:

→ It is used to denote finishing of mortar joints of either stone masonry or brick masonry.

→ The joints are raked out to a depth of about

down and then these spaces are filled up by suitable mortar in the desired shape.

Facing:

→ It is used to describe materials used as a non structural, thin, decorative, external finish such as natural stone facings applied to brick or concrete backing to enhance architectural beauty.

→ It may be external or internal.

→ Facing work is carried out with both natural and artificial made products.

Glazing:

→ Windows, doors, skylights, shop windows and other light transmitting enclosures are glazed with the glasses.

Flooring:

→ It is floor covering that would meet the maximum standards at reasonable cost.

→ The function of it are →

• appearance • high resistance • hygiene

→ The ground floor of a residential building consists of hardcore, damp-proof membrane and concrete slab.

Painting:

→ Paint is a fluid material which when spread on a surface dries up and hardens to form a continuous, adhering and cohesive film.

→ Painting in buildings and structures is a finishing operation intended for protection and decoration purposes.

→ The term paint covers a wide range of paints, wood paints, varnishes and oil for internal and external uses.

→ It provide protective surface to materials like timber, steel, etc.

→ It also provide visually attractive finish to the material.

Construction joints and electrification:

Needs:-

→ They prevent cracking of concrete.

Construction joints material issued:-

→ The concrete has hardened, then the concrete is hacked or chiselled and watered.

Electrification:-

→ It is needed to achieve different levels of illumination in building to ensure effiient of electricity including safety from fire and shock.

Types of fittings:-

a) Indoor fittings b) Outdoor fittings

Laying procedure:-

→ Make a sand bed or fine riddle soil bed as per the ~~power~~ cable ~~bracket~~ / ~~to~~ ~~be~~ measurement given in the buildings.

→ Lay the cable in the middle of trench.
→ Provide sand bed on top of the cable.
→ Lay the protective tile just above sand bed.
→ Back fill the excavated soil leaving 300mm from the G/L.
→ Lay the cable warning tape and again back fill the remainings portion of the trench upto G/L.

Plumbing :-

→ These services include services like water supply, drainage and sanitation and gas supply required for buildings.

Chapter-10

Building Items

Plastering:

→ The process of covering rough walls and uneven surfaces in the construction of houses and other structures with a plastic material called plaster.

→ Removes the unevenness of the surfaces and sometimes this is used to develop for decorative effects.

Purpose of plastering:

→ To provide an even, smooth, regular, clean and finished surface and sometimes to improve appearance also.

→ To preserve and protect the surface from atmospheric influences by acting as a protective coating.

→ To conceal the defective workmanship.

→ To cover up the use of interior quality and porous materials and joints formed in masonry work.

→ The basic purpose of internal plastering is to protect the surfaces against dust and vermin nuisance.

Types of plastering:

1. Lime plastering
2. Cement plastering
3. Mud plastering

Construction procedure:

1. Lime plastering :—

→ The process of covering the surface by lime plaster in various proportions depending upon the nature of work and no. of coats to be applied.

→ These proportions of lime and sand are generally adopted for either external work or internal work and adequate quantity of cement is added with the lime plaster to increase its strength particularly for external work.

→ Step I

Particulars	First coat	2nd coat	3rd coat
1. Name of coat	Rendering coat	Floating coat	Finishing coat
2. Thickness	12mm	6 - 9mm	3mm
i) When lime plaster is applied in one coat	1 lime : $1\frac{1}{2}$ river sand	—	—
ii) When lime plaster is applied in two coat	-do-	2 lime : 1 white sand	—
iii) When lime plaster is applied in three coat	-do-	1 lime : 1 sand	4 lime : 1 fine white sand

→ Step II

For the application of plaster, ground work is required

→ Step III

Plaster is applied in one, two or three coats.

2. Cement plastering :—

→ It is an ideal coating for external rendering.

→ It is specially suited for damp conditions such as bathrooms, reservoir banks, floors, copings etc where non-absorbent surfaces are desired.

→ It is usually applied in a single coat. But in certain cases when thickness of plaster is more than 15mm or it is desired to have finer finish, then plaster is applied in two coats.

→First coat or rough coat, usually average thickness of the first coat of plaster is 12mm on brick masonry and 23mm on rubble masonry.
→Second coat or fine coat, before applying it, the first coat is left to set but not to dry and is roughened to form proper key with the 2nd coat.

3. Mud plastering :-
→It is the cheapest type of plastering generally employed in the construction of village houses, temporary sheds, and structures of temporary importance
→Besides being cheap, it provides insulation against heat and keeps the house cool for comfortable living.
→It is also carried out for two coats.

Advantages of plastering:
→To improve the appearance of the structure as a whole and give smooth surface.
→To protect the exposed surfaces from the effect of atmospheric actions.
→To rectify the defective workmanship.

Disadvantages of plastering:
1. Blistering of plastered surface :-
→The small patches swell out beyond the plane of the plastered surface and this defect is particularly seen in case of plastered surface inside the building.
2. Cracks :-
→These are formed on the plastered surface and may be hair cracks which are easily seen.

3. Efflorescence :—

→ The soluble salts are present in plaster mucking material as well as building materials such as bricks, sand, cement, etc. Even water used in the construction work may contain soluble salts

→ When newly constructed wall dries out, soluble salts are brought to the surface and they appear in the form of a whitish crystalline substance such a growth is referred to as the efflorescence and it seriously affects the adhesion of paint with wall surface

4. Flaking :—

→ The formation of a very small loose mass on the plastered surface is known as flaking.

5. Pealing :—

→ The plaster from some portion of the surface wong off and a patch is formed, its called as a pealing.

6. Popping :—

→ Popping defect consists of formation of conical holes known as popes, in the plastered surface due to presence of a particle substance which expands on being set.

Pointing :

→ Its the art of finishing the mortar joints are exposed brick/stone masonry with suitable cement line mortar in order to protect the joints from weather effects and also to improve the appearance of building structure.

→It being cheap be adopted in places of low rainfall
→Finishing of mortar joints.

Purpose of pointing:
→To improve the appearance of the structure as a whole and give smooth surface.
→To protect the exposed surfaces from the effects of atmospheric actions.
→To recieving the defective workmanship

Type of pointing:
1. Flat/flash pointing
2. Cut/weathered/struck pointing
3. Raised pointing
4. Keyed/grooved/rubbed pointing
5. V-grooved pointing
6. Truck pointing
7. Beaded pointing

Construction of pointing:

1. Flat or flash pointing:—
→In the type, the raked joints are filled up by mortar and finished off flush with the face of the wall. The edges are neatly trimmed with a trowel and the straight edge.

2. Cut or weathered or struck pointing:—
→In this type, the face of the pointing, instead of keeping vertical is kept sloping outward. To achieve this, the mortar is first filled up into the cracked joint and then top horizontal joints are pressed

inside by an amount of 3-6mm with a special pointing tool.

3. Recessed pointing :-

→ In this type, the face of the pointing is kept vertical and is pressed inside the plane of the wall by means of a suitable tool.

4. Key or grooved or rubbed pointing :-

→ In this type, the craked joints whether vertical or horizontal are first filled up flush with the face of wall and then a semi-circular notch is formed by a tool known as 'pointer' or 'nails'. The pointing is known as rubbed pointing as semi-circular notch is formed by rubbing the middle of joints.

5. Tuck pointing :-

→ In this type, the mortar is first pressed in the cracked joints and is finished flush with the face of the wall. It is a neat and attractive appearance but the fillet part is durable. Hence, it is adopted for old work.

6. V-grooved pointing :-

→ There are two types of v-grooved pointing. One is formed by projecting the V-shape of the pointing face outside the wall surface and the other by pressing the V-shape inside.

7. Beaded pointing :-

→ In this type, the cracked joints are first filled up with mortar and finished flush with the face of

the wall and then head is formed by a steel or iron rod with a concave edge in the middle of joint.

Advantages of pointing:

→ Gives a smooth flush to the mortar in two joints.
→ Preventing the formation of voids in the surface which would be susceptible to weather damage.
→ Encouraging rainwater runoff instead of it pooling in the joint.

Disadvantages of pointing:

→ Excessive moisture in the bricks.
→ Laying the bricks in the rain.
→ Very low temperatures when laying.
→ Very high temperatures when laying.

Chapter-11

Damp Proof Course

Introduction:

→ Dampness is the presence of hygroscopic organisational moisture.

→ It gives rise to unhygienic conditions, apart from reduction in strength of structural components of the building.

Causes of dampness:

1. Moisture rising up the walls from ground.
2. Rain travel from wall top.
3. Rain beating against external wall.
4. Condensation: —

→ Due to this of atmospheric moisture, water is deposited on the walls, floors and ceilings. This moisture may cause dampness.

5. Other causes: —

→ Poor drainage at the building site.
→ Imperfect orientation of walls.
→ Imperfect roof slope
→ Defective construction.

Excess of dampness:

→ It gives rise to breeding of mosquitoes and creates unhealthy living conditions.
→ Travel of moisture through walls and ceiling may cause unslightly patches.
→ The wall decoration is damaged, which is very difficult and costly in repairing.

→ Continuous presence of moisture in the walls may cause efflorescence resulting in disintegration of bricks, stones, tiles, etc and consequently reduction in strength.
→ The flooring gets loose ended because of reduction in the adhesion when moisture enters through the floor.
→ Electrical fittings get deteriorated giving rise to change of short circuiting.
→ On damp floors one can't use floor covering.
→ Dampness promotes and accelerates growth of termites.
→ Moisture causes rusting and corrosion of metal fittings attached to walls, floors and ceilings.
→ Moisture brand may cause softening of plaster, specially lime plaster.

Anti-treatment measures and treatment:

Reasons measures:—

→ It is necessary to prevent water leakage in the buildings so as to provide healthy and happy environment.
→ It will also avoid damages to household articles, costly painting and short circuiting of electrical wiring.

Method of preventing dampness:

1. Membrane damp-proofing:—

→ D.P.C. is introduced between the source of dampness and the part of building adjacent to it.

→D.P.C. consists of flexible materials such as bitumen, mastic asphalt, plastic sheets, cement concrete, etc

2. Integrall damp-proofing :—

→It consists of adding certain water proofing compounds of materials to the concrete mix, so that it becomes impermeable.

3. Surface treatment :—

→It consists of application of layer of water repellent substances or compounds on these surfaces through which moisture enters.

→It is effective only when the moisture is superficial and is not under pressure.

4. Cavity wall construction :—

→This is an effective method of damp prevention, in which the wall of a building is shielded by an outer skin wall, leaving a cavity between the two.

5. Gunniting :—

→It consists of depositing under pressure, an impervious layer of rich cement mortar over the exposed surfaces of water proofing or over pipes, cisterns, etc for resisting the water pressure.

6. Pressure grouting :—

→It is effective in checking the seepage of raised ground water through foundations and sub-

structures of a building

It consists of forcing cement grout, under pressure, into cracks, voids, etc present in the structural components of the building or in the ground. Thus the structural components and the foundations which are liable to moisture penetration are consolidated and are thus made water-penetration resistant.

Chapter - 12

Building Maintenance and Safety Measures

Introduction :***

→ Building maintenance and proper management of buildings avoid deterioration and keep them safe.
→ Provide a pleasant and confortable living environment and their life.

Purpose :

→ Problems that building owner usually encounter in the maintenance and safety properties.
→ Maintenance and safety are 2 closely related issues.
→ Safety is not only to costomers but also to the environment.

Importance:

→ To maintain the value of building.
→ To ensure optimum use of building.
→ To create and maintain a suitable appearance.
→ To enhance the safety of users.

Need:

→ Statutory requirement.
→ Safety of public health, etc.
→ The need to maintain public.

Method:

1. Day-to-day repair :-

→ The purpose of it is to ensure satisfactory continuous functioning of various service in the building.

2. Annual repair :-

→ These works are planned on year to year bases.

3. Special repair :—
→ It is necessary to prevent the structure and service from deterioration and restore it to its original conditions to the extent possible

4. Additions and alterations :—
→ The works of addition and alterations are carried out in building to suit the special requirement of occupants for functional efficiency.

5. Preventive maintenance :—
→ It is carried out to avoid breakdown of machinery and occurrence of maintenance problems in buildings and services.

Causes and types of buildings :

Causes of defects in buildings :—
→ Building maintenance case.
→ Defective roof construction.
→ Defective cladding.
→ Poorly fitted and maintained doors and windows.
→ Faulty central heating equipment.
→ Defective drainage and sanitation.
→ Inadequate ventilation.
→ Faults in wall cavities.
→ Inadequate damaged of a DPC.
→ Poor design in construction.
→ Defective roof coverings.
→ Faulty rain water goods.
→ Damaged water services.
→ Cold bridging.
→ Damaged water mains

→ Poorly water proofed basements.
→ Rising of groundwater.
→ Soil erosion.
→ Wall tie failure.
→ Poorly executed structural alterations.
→ Poor quality of building materials.
→ Failure of arches and lintels.
→ Corrosion of steel reinforcement.
→ Structural failure.
→ Inadequate foundations.
→ Thermal movement.
→ Shrinkage of plasters and cements.

Types of defaults in buildings:—
→ Design deficiencies.
→ Material deficiencies.
→ Construction deficiencies.
→ Sub-surface deficiencies.

Safety in buildings:

Safety:—
→ It is a handly procedure.
→ It aims at reducing the accidents.

Causes of accidents:—
→ During execution of work.
→ Carelessness of workers.
→ Defects in equipments.
→ Improper planning.

Types of accidents and classifications of accidents:

1. According to severity of injury :—

a) Major accident

b) Minor accident

c) Accidental hazard

2. According to nature of injury :—

a) Death

b) Temporary disablement

c) Partial disablement

3. According to the cause of accident :—

a) Equipment fault

b) Construction site faults.

c) Trench collapse

d) Crane failure

Preparation of report on maintenance :

1. Name and address of construction.

2. Description of repair and renovation works required

3. Scope of services.

4. Professional fee.

5. Validity of the proposal.

6. Termination of service

7. Probability and anti-collusion clauses.

8. Insurance.

9. Delivery proposal.

Execution procedure of any type of building maintenance work:

1. Policy of maintenance.

2. Deciding and preparing maintenance programmes.

3. Obtaining funds for them.
4. Getting work done.
5. Controlling progress of work.
6. Budget expenditure.

Important law:

1. Fire safety :-

→ It is the most important.

→ License and registration is most important to ensure that fire safety.

Precautions:

1. Not exceedings the maximum occupancy within any part of the building.
2. Maintaining proper fire exists.
3. Placing and maintaining two correct type of fire extinguishers in easily available place.
4. Compliance with electrical codes to prevent over heating and ignition from electrical faults.
5. Prohibiting flammable materials in certain areas of facility.
6. Maintaining fire alarm system for detection and warning of fire.
7. Obtaining and maintaining a complete inventory of fire stop.
8. Ensuring that spray fire proofing remains undamaged.
9. Maintaining a high level of training and user of the building avoids obvious mistake.

Post accident procedure :

1. Seek immidiate medical attention for your injuries.
2. Make sure to document for medical visits, doctors name, any treatment you have recieved before and medication you are prescribed
3. Report your injury to supervisor as soon as possible.
4. Make sure to record the name and position of the person you report and the date you inform them.
5. Take down any contact information of a witness to your accident.
6. Take pictures of your injuries, the location where the accident has occurred and the equipment or tool involved in it.
7. Try to preserve as much widen as possible if you can hold on the tools equipment involved in your injury.