BHADRAK ENGINEERING SCHOOL & TECHNOLOGY
(BEST), ASURALI, BHADRAK

ADVANCE CONSTRUCTION TECHNIQUES AND EQUIPMENT (Th-03)

(As per the 2020-21 syllabus of the SCTE&VT, Bhubaneswar, Odisha)

Sixth Semester

Civil Engg.

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TOPIC WISE DISTRIBUTION OF PERIODS AND MARKS

Sl. No	Chapter	Topics	Periods as per Syllabus	Expected mark chapter wise
1.	**CHAPTER– 1**	**Advanced construction materials**	**10**	**25**
2	**CHAPTER– 2**	**Prefabrication**	**08**	**10**
3	**CHAPTER–3**	**Earthquake Resistant Construction**	**08**	**20**
4	**CHAPTER– 4**	**Retrofitting structures**	**08**	**15**
5	**CHAPTER– 5**	**Building Services**	**08**	**10**
6	**CHAPTER– 6**	**Construction & earth moving equipment**	**10**	**10**
7	**CHAPTER– 7**	**Soil reinforcement techniques**	**08**	**10**
	TOTAL		**60**	**100**

CHAPTER NO -01

ADVANCED CONSTRUCTION MATERIALS

Learning objective

1.1 Fibers and Plastics-
Types of fibers- Steel, Carbon, glass fibers, Use of fibers as construction material, properties of Fibers.

Types of plastics- PVC, RPVC, HDPE, FRP, GRP etc. Colored plastic sheets. Use of plastic as construction material.

1.2 Artificial Timbers – Properties and uses of artificial timber. Types of artificial timber available in market, strength of artificial timber.
1.3 Miscellaneous materials – Properties and uses of acoustics materials, wall claddings, plaster boards, micro-silica, artificial sand, bonding agents, adhesives etc.

1.1 FIBERS AND PLASTICS-

TYPES OF FIBERS- STEEL, CARBON, GLASS FIBERS, USE OF FIBERS AS CONSTRUCTION MATERIAL, PROPERTIES OF FIBERS.

TYPES OF PLASTICS- PVC, RPVC, HDPE, FRP, GRP ETC. COLORED PLASTIC SHEETS. USE OF PLASTIC AS CONSTRUCTION MATERIAL.

Fibers and plastic:-

The presence of micro-cracks at the mortar aggregate interface is responsible for the inherent weakness of plain concrete . The weakness can be removed by inclusion of fibers inthe mix.

The plastic is one of the recent engg. material which has appeared in the market all over the world. Some varieties of of naturally occurring thermo-plastic here known to Romass Who extracted & used these plastic for various purposes.

A) TYPES OF FIBERS :-

B) Steel fibres :-

The use of steel fibre in concrete can improve its many properties. The benefits of usingsteel fibres in concrete are as follows :-

-Steel fibres are generally distributed throughout a given cross-section where reinforcing bars or wires are placed only where required.

-Steel fibres are relatively short & closely spaced as compared with continuous reinforcing bars of wires.

-It is generally not possible to achieve thew same area of reinforcement to area of concreteusing steel fibres as compared to using a network of reinforcing bars of wires.

-Steel fibres are typically added to concrete in low volume dosages (less than 1%) &reducing plastic shrinkage cracking.

Steel fibres typically do not significantly alter free shrinkage of concrete , however at high enough dosages they can increase the resistance to cracking & decrease crack width.

Advantages of steel fibers reinforced concrete :-

-SFRC distributes localized stresses.

-Reduction in maintenance & repair cost.

-Provides tough & durable surfaces.

-Reduces surface permeability ,dusting& wear.

-Cost saving.

-Increase tensile strength & toughness.

-Resistance to impact .

-Resistance to freezing.

Carbon fibres :-

-Carbon fibres are a new breed of high strength materials & it is light weight fibre used inadvanced composites.

-It is usually combined with other materials to form a composite.

-Carbon fibre is composed of carbon atoms bonded together to form a long chain. The fibres are extremely stiff, strong & are used in many process to create excellent building material.

-High stiffness & strength carbon fibre materials are also available through specialized heat treatment process with much higher values.

-The two most common uses for carbon fibre are in applications where high strength toweight & high stiffness to weight are desirable.

Glass firers :-

-A glass fibre reinforced plastic similar to carbon fiber, but high much lower strength &stiffness but also much lower cost.

-glass fibre concretes are mainly used in exterior building faced panel & as Architectural pre-cast concrete.

Advantages :-

-It has been tested in the laboratory & also in the actual installations & can be anticipated tosurvive as long as pre-cast concrete.

-Glass fibre function better due to the absence of steel reinforcement that may corrode.

-Relatively light weight compared to the traditional store, if installation is first &comparatively simple.

-It can be made into any shape.

-The weight being 75% to 90% less compared to solid concrete. Due to light weight, it decreases the load applied on the structure.

-It is less weak to weather effects.

Uses of fibres as construction material :-

-Improve freeze thaw resistance.

-Improve impact resistance & abrasion resistance.

Increase resistance to plastic shrinkage during

curing.

-Improve structural strength.

-Reduce steel reinforcement requirement.

-Improve ductility.

-Reduce crack width & control the crack width tightly , thus improving durability.

Properties of fibres :-

-The mechanical properties of the fibre dominated by the contribution of the fibre to the composite.

The four main factors that govern the fibre contributions are :-

a) The basic mechanical properties of the fibre.

b) The surface interaction of fibre & resin.

c) The amount of fibre in the composite.

d) The orientation of the fibres in the composite.

The basic mechanical properties of the most commonly used fibres are :-

-The surface interaction of fiber & resin is controlled by the degree of bonding that exists between the two, this is heavily influenced by the treatment given to the fiber surfaces &description of the different surface treatment.

-The amount of fiber in the composite largely governed by the manufacturing process used.However reinforcing fabrics with closely packed fibers will give higher fiber volume fractions.

-Fiber diameter is an important factor here with the more expensive smaller diameter fiberproviding higher fiber surface area.

-As a general rule, the stiffness & strength of a laminate will increase in proportion to the amount of fiber present.

-Finally reinforcing fibers are designed to be loaded along their length & not across theirwidth. This feature of composites can be used to good advantages in design along the orientation of the main load path.

Types of plastic :-

PVC (polyvinyl chloride) /RPVC (Rigid polyvinyl chloride) :-

-It is known as polyvinyl chloride. PVC is used of replacing traditional building materials,such as wood, metal, concrete.

-It is the most important polymer for the construction section or building construction.

-It is used in drinking water &waste water pipe, flooring wall covering, cable & many otherapplications.

-It provide a modern alternate to tradition materials such as wood, metal, rubbed & glass,

these products are often lighter & less expensive.

FRP/GRP (Fiber reinforcement plastic / glass reinforced plastic) :-

-The fiber glass reinforced plastic or FRP is formed by using two materials in conjuction witheach other to form a composite material of all together different properties.

-It is also sometimes reffered to as the glass fiber reinforced plastic or GRP.

-In FRP or GRP, the glass fiber provides stiffness &strength while resin provides a matrics totransfer load to the fiber.

-The FRP offers a combination of properties not easily found in the traditional material & ithas come as a boon especially for the building & construction industry.

HDPE (High density polyvinyl or polyethylene) :-

High density polyvinyl or polythylene is a polythylene thermoplastic made from petroleum. It is sometimes called alkathene or polythene, when used for pipes with a highstrength to density ratio.

Advantages of RPVC or PVC :-

-It is strong & light weight.

-Easy to install.

-It is durable.

-Cost effective.

-Shape material.

-Fire resistance.

-Good insulation.
-Versatile.

Uses of plastic as construction materials :-

Plastics are strong, lightweight & they are easy to transport.

-They are durable, knock & scratch resistant with excellent weather ability.

-Plastics are easy to install.

-Plastics offer limitless possibilities in design achieved by extension, bending, moulding etc.

-They can be given any range & colors by adding pigments.

-The plastics are low conductors of heat& thus are used as insulation materials in greenbuilding concept.

-Plastics are manufactured in different forms such as moulding pipes, sheets etc.

-At present plastic find use in building mainly in thin covering, panels, sheets, pipes etc.

-Skill-full use of plastics will expand the fullness & life of conventional building materials &help them to function more efficiently & economically.

-A wide range of applications of plastics in buildings are given below :-

(a) Uses of plastics in faced panel exterior covering, carpentary etc.

(b) Uses of plastics interior covering, floors, walls, ceilings, doors, partitions etc.

(c) Uses of plastics in roof covering, tightness, domes & lighting elements.

(d) Uses of plastics in sanitary equipment & piping.

1.2 ARTIFICIAL TIMBERS – PROPERTIES AND USES OF ARTIFICIAL TIMBER. TYPES OF ARTIFICIAL TIMBER AVAILABLE IN MARKET, STRENGTH OF ARTIFICIAL TIMBER.

Artficial timber :-

Timber for construction is one of the main forest products used around the world. it is used in buildings both large & small, here we considered timber for the construction of building of six or more storey & the bio-chemistry & chemistry of the wood modification that couldenable much larger building.

Supporting structure :-

-In timber construction each building shape can be constructed economically when the supporting structure is developed in the section, where the structure of the inner space as well as the direction of load transmission & main secondary support system have to be considered in the design.
-Further reduction of materials needed in timber construction can be achieved by usingcompressed frameworks with the advantage of simple contact correctors.

Doors & windows :-

There are large varieties of doors & window used in market such as battened & legged door,frame & panelled door & flush door.

Properties of artificial timber :-

- -Moisture content.

- -Temp. Effect.
- -Strong & light weight.
- -Safe.
- -Easy to install.
- -Cost effective.
- -Durable.
- -Comfortable.
- -Flexible.

Use of artificial timber :-

It is used in construction in various purposes such as:-

a) Load bearing material.
b) Building shape.
c) Building maintenance.
d) Supporting structure.
e) Door & window.

a) Load bearing material :-

Timber as load bearing material has only a chance if the conception of the construction can show a availability which is not only functional technical or architectural but which can also justify its economy.

-It is essential to define clearly the quality criteria of the timber construction & to aim at reading easily the force & load fluctuation & reducing the material through load & detailplanification with functional adaptation to technique & construction.

b) Building shape :-

The 1st planification criteria of a timber construction is its shape many design possibilities given by the easy manipulation & the low dead load timber especially for houses, halls & roof shapes are well known, the links between building shape construction support energy requirement & cost of maintenance are simple, but do not go without planification.

c) Building maintenance :-

-Timber constructions being superficially in terms of material quality & use of material & badly executed, leads to an image of high maintenance costs concerning timber construction.

-Made of historical construction, planification of new timber construction must not lead

history oriented building or roof shapes.

d)Supporting structure :-

-In timber construction, each building shape can be constructed economically when the supporting structure is developed in the section, where the structure of the inner space as well as the direction of load transmission & main secondary support system have to be considered in the design.

-further reduction of the material needed in timber construction can be achieved by using compressed frameworks, with the advantages of simple contact correctors.

e) Doors & windows :-

There are large varities of doors & windows use in market such as battened door, framed &panelled door & flush door etc..

Types of artificial timber available in the market:-

The timber which is converted in a factory by some mechanical process is termed as artificial timber or industrial timber & such timber possess desired shape appearance strength & durability.

-Following are the some type of artificial timber :-

i) Plywood

ii)Block board

iii)Particle board

iv)Fiber board

v)Veneer/Plies

i)Plywood

-Plywood have thickness like 3mm , 6mm, 8mm, 10mm, 12mm, 15mm, 19mm, 25mm etc..

-Piles are pasted to each other with alternate layer having cross grains.

-plywood is used for packing also an addition to these uses.

-plywood has almost the same bending stiffness in both axes.

-Plywood is about 10% cost then block board of the same thickness and availability.

ii)**Block Board**:-Block boards have thickness like 16mm,19mm and 25mm.

-Block board is used as structural member and for panels.

-fix of screws nails on the edge of the block board easily done.

-Block board has poor bending stiffness across the width of the sheet.

-Block board is about 10% cheaper then plywood of the same thickness and availability.

v)Plies /veneer :-

-It is a board prepared from thin layer of timber called plies.

Strength of artificial timber :-

-Best quality timbers have the highest strength (strength means capable to bear load).

-Anisotropic material like timber has different structure at different portion. So the strengthof timber is different at different points.

-Grain structure determines the strength of the timber. Some types of strength are :-

i) Compressive strength : 500kg/cm2 to 700kg/cm2 load is enough to test timber strength.

ii) Tensile strength : when timber is enough strong to the tensile force ,it perpendicular forceis made then timber is weaker. 500-2000kg/cm2 is the range of tensile strength load.

iii) Transverse strength : enough bending strength indicates good quality timber.

1.3 MISCELLANEOUS MATERIALS – PROPERTIES AND USES OF ACOUSTICS MATERIALS, WALL CLADDINGS, PLASTER BOARDS, MICRO-SILICA, ARTIFICIAL SAND, BONDING AGENTS, ADHESIVES ETC.

Miscellaneous material :-

Properties & uses of acoustics material :-

When we choose the material that will make the structure of a building. We are making decisions that will affect the nature of sound within the building. Many times that an acoustical designer has been called into fix the acoustics after the building has been completed.

-First we take a look at some commonly used building materials & there acoustic properties& then well examined the ways. These material can be used for sound isolation & acoustic treatment.

Uses :-

-It is used in concrete stone &other masonry material.

-It is also used in wood & wood products.

-It is used in steel.

-Dry wall & plaster.

-Glass & other transparent material.

-Insulating material (fiber glass ,foam).

-Plastic & rubber.

Wall cladding :-

-Wall cladding is a type of decorative covering intended to make a wall look like. It is made of a different material.

-In most cases its design to be permanent & it may provide benefits like insulation & water proofing.

Plaster board :-

-Plaster board is basically an inner layer of gypsum sandwiched between two outer layer of lining paper & various additives in the gypsum layer & varying the wet & strength of the lining paper, will give the finished board different properties.

-Plaster board is good for cutting down noise transmission, particularly sound.

-Most common plaster boards come with the option of either tapered as edge or squareedge.

-Tapered edge boards are ideal for either jointing , while square edge is generally used for textured finished.

-Joint cracking on plaster board ceiling is almost in variably caused by warping of the joints.

The wood dried out.

Micro silica :-

Micro silica or silica fume is a finer particle than cement.

-It is used in high strength concrete M50 & above.

-The purposes is to fill the small voids which cement can not fill, it is produced by mechanical processing of rice-husk.

Artificial sand :-

-Artificial sand making machine is to dig rocks & river pebbles from river through the impact crushed is processed in to sand for construction use.

-Artificial sand particles surface roughness more angular, combining aggregate, cement, aggregates between the high mechanical bite force source.

Bonding agents :-

-Bonding agents is two component, 100% solids, moisture, medium viscosity, high strength, multi-purpose liquid epoxy adhesive.

-Use bond freshly mixed concrete to hardened concrete. Fill voids & crack in concrete masonry.

-Use as a binder in epoxy mortar.

-It can be used as an anchoring adhesive.

Adhesives:-

-Construction adhesive refers to a board range of similar products used to bond common material used in the construction.

The basic characteristics of these products are :-

-Availability in squeeze tubes.

-Water or solvent based.

-Can fill gaps & imperfectius in material.

-Tend to remain flexible after drying.

-Water proof or water resistant.

-Usually dry or water resistant.

There are two ways of construction adhesive.

i)Beads , ii)Full coverage.

POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER

Q-1 Define wall cladding ?[2018-s]

Ans :- Wall cladding is a type of decorative covering intended to make a wall look like. It ismade of a different materials. Some of the most common examples can also be an artistic element in interior decorating.

Q-2 Name two acoustic material.[2018-s]

Ans :-Acoustic fibre glass is a popular choice of sound absorbent material for DIY installation. It is rigid, weighs little & you can cut it into the appropriate shape or size with everyday tools.

Q-3 What is carbon fibre ?[2018-w]

Ans :-Carbon fibre is a new breed of high strength materials & it is light weight fibre used in advanced composites.

-It is usually combined with other materials to form a composite.

Q-4 Define artificial timber.[2018-w]

Ans :-An artificial timber is a construction material. It donates wood which is suitable for building or carpentry & for various engineering & other purposes.

Q-5 Define workability of concrete.

Ans:-Workability is the case with which a concrete can be mixed, placed & compacted so that a dense concrete is obtained. The workable mix should not show any segregation on bleeding of concrete.

Q-6 What do u mean by curing of concrete ?

Ans :-Curing is the process of preventing the less of moisture from the concrete while maintaining a satisfactory temp. require. The curing should also prevent the developmentof high temp. gradients within the concrete.

Q-7 What do u mean by target strength in concrete mix-design ?

Ans :-A concrete mix is designed for target strength (σ_t) given by the following expression.

σ_t=σ_{ck} +kσ

Where, σ_{ck} = Characteristic strength.

K= Statistical constant.

σ = Standard deviation to measure the precision of production of concrete.

POSSIBLE LONG TYPE QUESTIONS

1) Describe briefly how plastics are being used in construction of structures ?[2018-s,2016-s]

2) Write short note on : i) Wall cladding.

ii) Micro-silica.

iii) Artificial sand.

iv) Acoustic material.[2019-s]

3) Describe the various types of plastics used as construction material.[2018-s]

4) Write down the uses of fibres as construction material.[2018-s]

5) Describe the various types of cladding used in construction.[2018-s]

6) Describe the properties & uses of artificial timber.[2018-s]

7) Write the properties of carbon fibre.[2018-w]

8) List down the advantages & dis-advantages of carbon fibre.[2018-w]

9) Write down the uses of plastic as construction material.[2018-w]

10) Explain the properties & uses of artificial timber.[2018-w]

11) What are the durability requirement of concrete as per IS-456 ?[2019-s]

12) What are different methods for measuring workability &explain any one method?[2019-s]

13) Write short note on : i) RPVC

ii)PVC

CHAPTER NO-2

PRE-FABRICATION

Learning objective

2.1 Introduction, necessity and scope of prefabrication of buildings, history of prefabrication, current uses of prefabrication , types of prefabricated systems, classification of prefabrication, advantages and disadvantages of prefabrication,

2.2 The theory and process of prefabrication, design principle of prefabricated systems, types of prefabricated elements, modular coordination

2.3 Indian standard recommendation for modular planning

2.1 INTRODUCTION, NECESSITY AND SCOPE OF PREFABRICATION OF BUILDINGS, HISTORY OF PREFABRICATION, CURRENT USES OF PREFABRICATION , TYPES OF PREFABRICATED SYSTEMS, CLASSIFICATION OF PREFABRICATION, ADVANTAGES AND DISADVANTAGES OF PREFABRICATION

Prefabrication is the practice of ascending components of a structure in a factory or other manufacturing site transporting complete assemblies or sub-assemblies to the construction site where the structure is to be located.

Necessity & scope of prefabrication of building :-

A house building illustrates, the process of prefabrication the conventional method of building is to transport bricks, timber, cement, sand, steel & construction aggregates etc..to the site & to construct the house on site from these material.

-In prefabricated construction only the foundations are constructed, in this way, while sections of wall, floors & roof are prefabricated in a factory transported to the site.

-Prefabrication is used in the manufacture of ships, aircraft & all kinds of vehicles &machines.

History of prefabrication :-

-Prefabrication has been used since ancient times, for example it is claimed that the world's

oldest known engineer road way, the sweet track construction in England. Prefabricated timber section brought to the site rather than assembled on site.

-In srilanka used prefabricated building technology to erect giant structure, which datesback as far as 2000yr, where some sections were prepared separately & then fitted together.

In 19th century Australia a large number of prefabricated houses were from the united kingdom.

-The method has widely used in the construction of prefabricated housing in the 20th century, such as united kingdom to replace houses during world war-2 . assembly section in factories saved time on site & reduced cost. However the quality was left in use for longer than its designed life.

In London in 1851 was a highly visible example of Iron & glassprefabrication construction.

Current uses of prefabrication :-

-The most widely used form of prefabrication in building & civil engg. Is the use of prefabricated concrete & steel section in structures where a particular part or form isrepeated many times.

-It can be difficult to construct the form work required to mould concrete components on site & delivering wet concrete to the site.

-Pouring concrete section in a factory brings the advantages of being able to re-use moulds& the concrete can be mixed on the spot without having to be transported.

-Prefabricating steel section reduces on site cutting & welding costs as well as the associated hazards.

-Prefabrication techniques are used in the construction of apartment blocks & housing development with repeated housing units.

-The availability of prefabricated housing units had increased to the point that they may not be distinguish from traditionally built units to those that line in them .

-The technique is also used in office blocks & factory building. Prefabricated steel & glasssections are large buildings.

-Radio towers for mobile phone & other services often consists of multiple prefabricated section.

-Prefabrication has become widely used in the assembly of air crafts &space crafts with components.

Types of prefabricated system :-

-These are two main types of prefabrication namely volumetric (often referred to as modular) & panellised, both of these types of construction can be achieved in timber, steel & concrete & can also be mixed with-in the same scheme.

-Steel systems for housing are usually light gauge galvanised steel.

-Timber system can be relatively traditional in that the construction mirrors what might be produced on site using components such as timber studs & sheathing.

-It can make use of timber beams which give longer span with a relatively light weight beam. A third option is structural insulated panel system, which use fewer studs in part on the bond between rigid insulation core & outer sheathing material for strength.

-One factor that differentiates all fabricated timber system from what might be termed traditional timber frame is the amount of work under taken in the factory.

Classification of prefabrication :-

-Classification of prefabrication member according to their statical function:-

i) floors & beam

ii) columns & load bearing walls

iii) prefabricated stains

iv) large pipes

v) foundations

classification of prefabricated member according to their materials & strength characteristics :-

i) reinforced concrete

ii) pre-stressed concrete

iii) mixed-structural element

iv) special concrete element

Advantages of prefabrication :-

-High capacity enabling the realization of important projects.

-Factory made products.

-Shorter construction time-less than half of conventional cost in site construction.

-Opportunities for good architecture.

-Healthy buildings.

-Reduced energy.

-Cost effective solution.

-Safety in construction.

-Increase in the availability of construction.

-Reduction of construction waste.

Dis-advantages of prefabrication :-

-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 efficiently.

-Large prefabricated section repair heavy duty cranes & precision measurement & handling to place in position.

2.2 THE THEORY AND PROCESS OF PREFABRICATION, DESIGN PRINCIPLE OF PREFABRICATED SYSTEMS, TYPES OF PREFABRICATED ELEMENTS, MODULAR COORDINATION

The theory & process of prefabrication :-

An example from house building illustrates the process of prefabrication. The conventional method of building a house to transport bricks, timber, cement, sand, steel & construction aggregate, etc.. to the site & to construct the house on site from these materials.

-In prefabricated construction, only the foundations are constructed in this way, while section of walls, floors & roofs are prefabricated in a factory, transported to the site, lifted into place by crane & bolted together.

-Prefabrication is used in the manufacture of ships, aircraft & all kind of vehicles & machines where sections previously assembled at the final point of manufacture are assembled elsewhere instead, before being delivered for final assembly.

-The theory behind the method is that time & cost is saved if similar construction takes can be grouped, & assembly line techniques can be employed in prefabrication at allocation where skilled labour is available, while congest at the assembly site, which wastes time, can be reduced.

-The method finds application particularly where the structure is composed of repeating units or forms, or where multiple copies of the same basic structure are being constructed.

-Prefabrication avoid the needs of transport so many skilled workers to the constructionsite, & other restricting condition such as lack of power, lack of water, or a hazardous environment are avoided.

Design principle of prefabricated system :-

-Design for prefabrication, preassembly & modular construction.

-Simplify & standardize connections details.

-Simplify & separate building system.

-Consider worker safety.

-Minimize building components & materials
-Select fittings, fasteners, adhesive & sealants that allow for quicker assembly & facilitate the removal of reusable material.

-Reduce building complexity.

-Design for reusable material.

-Design for flexibility

&adaptability.

Types of prefabricated elements :-Precast beam :-

There are two main categories of beams :

i) Internal beams : where floor loading is approximately symmetrical.

ii) External beams : where floor loading is predominantly non-symmetrical.

Precast columns :-

For structures of five storeys or less, each column will normally be continuous to the full height of the building. For structures greater than five storeys two or more columns are spliced together. The main types of precast columns are :

i) Edge columns : symmetrical in one direction.

ii) Internal columns : symmetrical in all directions.

iii) Corner columns : not symmetrical at all.

Precast floor slabs :-

The main types of slabs are used in the precast frames are :

i) Hollow cored slab

ii) Dual tee slab

Precast walls :-

Precast concrete walls serve two functions :

-Stability.

-As walls or boxes surrounding staircases & lift

shafts.Walls may be classified as infill or cantilever :

-Infill walls rely on contiguous composite action with the beam & column frame.
-Cantilever walls or boxes act as deep beams to which the frame is attached.

Precast staircases :-

Three options are available for precast staircases :

-A single precast unit containing all the flights & landings.

-Separate precast flights & landings.

-Parts of the flights & landings are made in one piece.

Modular co-ordination :-

-Modular co-ordination is a concept of coordination of dimension & space in which buildings & components are dimensioned & positioned in terms of basic unit or module.

-The basic module is known as 1m which is equivalent to 100mm.

-It is internationally accepted by the international standard organisation & many other countries including Malaysia.

2.3 INDIAN STANDARD RECOMMENDATION FOR MODULAR PLANNING

This Indian standard was adopted by the Indian standards institution on27th February 1987, after the draft finalized by the modular co-ordination sectional committee had been approved by the civil engineering division council.

-This standard was1st published in 1975. This revision has been prepared incorporating the advancement made in the modular planning & design since more than a decade.

-In the preparation of this standard, considerable assistance has been rendered by the National buildings organisation, NewDelhi.

This standard is applicable to the construction of all types of buildings, materials & construction techniques & in accordance with the principles of modular coordination.

POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER:

Q-1 Define pre-fabrication .[2018-s]

Ans :- Pre-fabrication is the practice of ascending components of a structure in a factory or other manufacturing site & transporting complete assemblies or sub- assemblies to the construction site where the structure is to be located.

POSSIBLE LONG TYPE QUESTIONS:

Q-1 Classify pre-fabrication & describe .[2016-s]

Q-2 Write the advantages & dis-advantages of pre-fabrication.[2016-s]

Q-3 Write down the materials used in pre-fabrication system.[2018-w]

Q-4 Write the necessity of pre-fabrication.[2018-w]

CHAPTER NO -3

EARTHQUAKE RESISTANT CONSTRUCTION

Learning objective

3.1 Building Configuration
3.2 Lateral Load resisting structures
3.3 Building characteristics
3.4 Effect of structural irregularities-vertical irregularities, plan configuration problems.
3.5 Safety consideration during additional construction and alteration of existing Buildings.
3.6 Additional strengthening measures in masonry building-corner reinforcement, lintel band, sill band, plinth band, roof band, gable band etc.

Introduction :-

Earthquake resistant structure are designed & constructed to withstand various types of hazards earthquake exposures at the site of their particular location.

-According to building coats, earthquake resistant structure are intended to withstand the largest earthquake of a certain probability that likely to occur at their location.

-This means that loss of life should be minimized by preventing collapse of building forrepair earthquake while the loss of functionality should be limited for frequent once.

3.1 BUILDING CONFIGURATION :-

-Shape & surrounding of any building plays a very important role in governing the energy consumption in any building. Such factors may cause heat loss, when heat gain is required.

-For any given enclosed building volume, there are more ways in which actual dimensions of highly length & breadth can very result in different surface areas.

-Thus two buildings both have the same materials, may have different surface areas & hence different rate of heat loss & heat gain.

3.2 LATERAL LOAD RESISTING STRUCTURE :-

-The first step in architectural planning of a building is to select the lateral load resisting system.

-The load resisting system must be of closed, so that it is able to transfer all the forces acting either vertically or horizontally to the ground.

-BIS (bureau of Indian standard) has approved three major types of lateral force resisting system in the code-IS-1893(part-1). These consist of moment resisting building frame system, bearing wall system, dual system.

-The systems are further sub-divided into different types depending upon construction material use & different framing system & response reduction factor.

-Response reduction factor 'r' is basically an indicator of the performance of the structure in earthquake.

-A low value of R=1.5 indicate an extremely earthquake building & a high volume of R=5 indicates an earthquake resistant type building like special moment resistance reinforced concrete frame or shear wall buildings.

Moment resisting frame :-

-In building frame system, the members, columns, beams & joints of frame are resisting the earthquake forces primarily by flexure.

Bearing wall system :-

This system supports all or most of the gravity loads as well as lateral loads.

-In general, a bearing wall system has a comparability low value for response factor.

-It has a poor in elastic response capacity.

Dual system :-

This system consists of shear wall & moment resisting frame such that,

-The two system are designed to resist the total design force in proportion to their lateral stiffness considering the interaction of the dual system at all floor level.

3.3 BUILDING CHARACTERISTICS :-

-The seismic forces exerted on a building are not externally developed force like wind instead of they are the response of cycling motion at the base of a building causing acceleration & hence inertial forces.

-The response is therefore essentially dynamic in nature:-The dynamic properties of the structure such as natures period damping & mode shape plays crucial role in determining response of the building.

-Beside other characteristics of the building system, also affect the seismic response such as ductility, building foundation, response of non-structural elements etc..

Mode shape & fundamental period :-

The elastic properties & mass of building causes to developed a vibrators motion when they are subjected to dynamic action.

-The vibration of a building like wise consist of a fundamental mode of vibration & the additional contribution of various mode, which vibrate at higher frequency.

-In low rise building, the seismic response depends primarily on the fundamental mode of vibration accordingly the period of vibration of this mode expresses in second.

Building frequency ground period :-

-Inertial forces generated in the building depends upon the frequencies of the ground onwhich the building is standing & the building natural frequency.
When this are near or equal to one another, the building response reaches a peak level, in some circumstances.

Damping :-

-The degree of structural amplification of the ground motion at the base of the building is limited by structural damping. Therefore damping is ability of the structural system to dissipate the energy of the earthquake ground shaking. Since the building response is inversely properly to damping.

-The more damping a building poses the sooner it will stop vibrating which is highly desirable for the standpoint of earthquake performance. There is no numeric method available for determining the damping.

-Today some of the more advance technique of earthquake resistant design construction employee added damping device like shock observer to increase artificially the damping of a building & so improve its earthquake performance.

Ductility :-

Ductility is defined as the capacity of the building materials, systems or structures to observe energy by deforming in the inelastic range.

-The safety of the building from collapse is in the basics of energy which must be impartedto the structure in order to make it fail.

-Therefore ductility of a structure in fact is one of the most important factor affecting its earthquake performance.

Seismic weight :-

-Seismic forces are proportional to the building weight along the height of the building. When height increases the weight also, weight reduction can be obtained by using lighter materials.

Fibers staticity or redundancy (statically indeterminant) :-

-In general fiber static structure have advantages because if primary system falls, the lateral force can be re-distributed to secondary element or system prevent progressive failure.

-Moreover fiber staticity of the structure causes the formation of plastic hinges that can observe considerable energy without de-priving the structure of its stability. Therefore the redundancy of fiber static structure is highly desirable characteristic for earthquake resistant design.

Non-structural element :-

The non-structural damage problem is particularly difficult to deal because the non-structural component that are subjected to seismic forces are not normally within the design scope of the structural engineer.

-Whose responsibilities is provide the seismic safety of the building. In addition, non-structural components are often added after the initial building design.

-In general non-structural damage is caused in two ways. The component maybe directly affected by ground motion transmitted by the main structure of the building & be subjectedto acceleration & consequent inertial forces in similar way to the building structure.

Foundation soil :-

-The knowledge of foundation soil is essential to correct earthquake resistant design.

-In cases a soil behaving well under static loads will pose serious problem under seismic loads.

-Problem related to foundation soil can be classified two groups.

-Influence of sub-soil on the characteristic of seismic movement. Land slights & loose of soilresistance.

-Problem caused by load transmitted to the soil by foundations & the setting of the foundation under static & seismic loads.

-This problem generally arises in loose unsaturated granular soils which may be compactedas a result of earthquake.

Foundation :-

-The foundation of the building is subjected to earthquake stresses. The following major recommendation on structural design must be born in mind.

-Foundation should preferably be designed as considered in order to avoid relative horizontal displacement.

-In case of isolated footing, they should be join to each other by means of foundation, beam or ties. These ties should be designed such that it will bear tension & compression forces.

-It s recommended that part of building foundations, which results on soils of different type to different depths should be designed as separate units.

3.4 EFFECT OF STRUCTURAL IRREGULARITIES- VERTICAL IRREGULARITIES, PLAN CONFIGURATION PROBLEMS.

Effect of structural irregularities :-

A building that slacks symmetry & has discontinuity in geometry, mass or load resisting element is called irregular in structure.
-These irregularities may causes by interruption of force flow & stress concentration.

-A symmetrical arrangement of mass & stiffness of element may cause a large torsional force.

-These irregularities categorized in two types,

i) Vertical irregularity

ii) Horizontal irregularity

i) Vertical irregularities :-

-Vertical irregularities referring to sudden change of strength, stiffness geometry & mass results in irregular distribution of forces & determination over the height of building.

Vertical discontinuity or load path :-

One of the major contributor to structural damage in structures during strong earthquake is the discontinuity or irregularities in the load path or load transfer.

Irregularity in strength & stiffness :-

-A weak storey is defined as one in which the storage lateral strain is less than 80% of that in the storey above.

-The essential characteristics of a weak or soft storey consist of a discontinuity of strength & stiffness, which occurs at that second storey connection.

Mass irregularity :-

Mass irregularities are considered to exit where the effective mass of any store is more than 200% of the effective mass of an adjacent store.

Vertical geometry irregularities :-

A vertical set back is a geometric irregularities in a vertical plane.

-It is considered when the horizontal dimension of the lateral force resisting system in any storey is more than 150% of that in an adjacent storey.

-The general solution of a set back problem is the total seismic separation in plane through separation section so that portion of the building are free to vibrate independently.

Plane configuration problem :-

-Plane irregularities which refer to a symmetrical plane shape i.e. “L”, “U”, “F”, etc or this continuities in the horizontal resisting element such as cut-out, large opening, re-entrantcorner, resulting in torsion diaphragm deformation & stress concentration.

Torsion irregularities :-

-Torsion irregularities shall be considered when floor diaphragm are rigid in their own plane in relation to the vertical structural element that resist the lateral forces.

-The lateral force resisting element should be a well balanced system i.e. not subjected to significant torsion.

-Significant torsion will be taken as the construction where the distance between the storage centre of gravity & storage centre of mass is greater than 20% of the width of thestructure in their major plan dimension.

-Torsion or excessive lateral deflection is generated in a symmetrical buildings or eccentric & a symmetrical layout of the bracing system that may result in permanent shape or even partial collapse.

Re-entrant corner :-

-The entrant, lack of continuity of inside corner is the common characteristic of the overall building configuration that in plan assume the shape of an L, T, H or combination of these shape occurs due to lack of tensile capacity & force concentration.

-According to IS-1893(part-1):2002 plan configuration of a structure & its lateral force resisting system contain re-entrant corners, where both projection of the structure beyondthe re-entrant corner are greater than 15% of its plan dimension in a given direction.

-There-entrant corner of the buildings are subjected to two types of problem :-

i) The 1st is that they tend to produce variations of rigidity.

ii) The 2nd problem is the torsion.

Non-parallel system :-

-The vertical load resisting elements are not parallel or symmetrical about the major axis of the lateral force resisting system.

-These situation are upon faced by architects.

-This condition results in a high probability of torsion forces under a ground motion, because the centre of mass & resistance does not coincide.

Diaphragm dis-continuity :-

-The diaphragm is a horizontal resistance element that transfer forces between vertical resistance element.
-The diaphragm discontinuity may occur with variations in stiffness including those having cut-outs or open areas greater than 50% of the gross enclosed diaphragm area or change in effective diaphragm effective stiffness of more than 50% from one storey to the next.

3.5 SAFETY CONSIDERATION DURING ADDITIONAL CONSTRUCTION & ALTERNATION OF EXISTING BUILDING :-

In sufficient precaution with respect to safety of works are not taken, there are chances of serious accident involving having loss of man & materials.

- Some of the safety.
- Suitable packing piece must be provided at the required points.
- The chains should be dropped gradually from a height procedure should never beoverloaded.
- The legs brother chain should be open out to search as angle so as endangered the stabilityof the work.
- The levels of panel points on the false work should be maintained as per the desired chamber for truss to avoid strain.
- The lifting devices & mechanisms should be maintained in perfect running order so as toavoid there sudden failure without notice.

-The lifting should be carried out smoothly without sudden shocks.

3.6 ADDITIONAL STRENGTHENING MEASURES IN MASONRY BUILDING-CORNER REINFORCEMENT :-

The earthquake force shall be calculated for the full dead plus the percentage of imposedload.

-The properties of imposed load indicates above for calculating the lateral design forces for earthquake are applicable to average conditions.

-Lateral design force for earthquakes shall not be calculated on construction of impact effects forms the imposed loads.

-When the lateral load resisting elements are oriented along horizontal direction, the structure shall be designed for the effects due to full design earthquake load in the horizontal direction at time.

-When the lateral load resisting elements are not oriented along the horizontal directions, the structure shall be designed earthquake load in one horizontal direction plus 30% of designed earthquake load in the other direction.
-When effects due to the vertical earthquake loads are to be considered the design vertical force shall be calculated.

-From through given above shall be considered as appropriate.

Different types of band :-Lintel band :-

-During earthquake shaking, the lintel band undergoes bending & pulling actions. To resist these actions, the construction of lintel band requires special attention.

-Bands can be made of wood or of reinforced concrete , the RC bands are the best.

-The straight lengths of the band must be properly connected at the wall corners. This will allow the band to support walls loaded in there weak direction by walls loaded in their weak direction.

-Small lengths of wood spacers (in wooden bands) or steel links are used to make the straight lengths of wood runners or steel bars act together.

Sill band :-

Sill band do two work, 1st it is a tie beam between two column & 2nd it is transferred wallload above it to connecting columns. It also avoid unequal settlement of foundation.

Plinth band :-

Plinth band is just to take care of lateral load transfer mechanism from earthquake point of view, it also keep in uniform distribution of one load to foundation.

Roof band :-

A roof band is a load bearing member of a roof at roof level.

-Sometimes roof band is not required because the roof slab of load bearing wall masonryalso plays the role of a band.

-Roof beams are generally provided in the building with flat timber or G.I. sheet roof.

-In building with flat reinforced concrete or reinforced brick, roof, the roof band is not required because the roof slab itself plays the role of a band.

-However, in buildings with flat timber or G.I. sheet roof, a roof band needs to be provided.

- In buildings with pitched or sloped roof, the roof band is very important.

Gable band :-

This is the common type of sloping, which slopes is two directions. The two slopes met at ridge, at the end face, vertical triangles is formed.

POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER:

Q-1What do u mean by earthquake resistance structures ?[2015-s]

Ans :-Earthquake resistance structures are designed & constructed to withstand various types of hazardous earthquake exposures at the sites of their particular location.

Q-2 What do u mean by vertical irregularity ?

Ans :- Vertical irregularities refers to sudden change of strength, stiffness, geometry & mass results in irregular distribution of forces and/or deformation over the height of building.

Q-3 What is design basis earthquake (DBE) ?

Ans :- It is the earthquake which can reasonably be expected to occur at least once duringthe design life of the structure.

Q-4 What do u mean by shear wall ?[2012-s,2014-s]

Ans :-A wall that is primarily designed to resist lateral forces in its own place.

Q-5 What do u mean by lateral loads on the building ?[2012-s]

Ans :- Lateral loads on the building means the seismic horizontal load.

Q-6 What do u mean by gable band ?[2014-s]

Ans :- This is the common type of sloping, which slopes in two directions. The two slopesmeet at ridges, at the end face, vertical triangle if formed.

POSSIBLE LONG TYPE QUESTIONS

1) **Discuss the building characteristics in earthquake resistant construction.[2014-s]**

2) **Describe the structural irregularities in building.[2014-s,2017-s]**
3) **What are the safety considerations to be followed during additional construction &alteration of existing building ?[2013-s]**
4) **Explain building configuration briefly ?[2014-s]**
5) **What are the different bands used in additional strengthening measures in masonrybuildings ?[2014-s]**

CHAPTER NO:-4

RETROFITTING OF STRUCTURES

Learning objective

4.1 Seismic retrofitting of reinforced concrete buildings :
4.2 Sources of weakness in RC frame building
4.3 Classification of retrofitting techniques and their uses

Definition :- The seismic retrofitting is the modification of existing structure to make themmore resistance to seismic activity, ground motion or soil failure due to earthquake.

Retrofitting :-

Retrofitting of buildings is generally more economical as compared to demolition & re-construction even in the case of severe structural damage.

4.1 SEISMIC RETROFITTING OF REINFORCED CONCRETE BUILDINGS :-

-The seismic retrofitting of reinforced concrete buildings not designed to withstand seismic action considered.

-After briefly introducing how seismic action is described for design purposes, method for assessing the seismic vulnerability of existing buildings are presented.

-The traditional methods of seismic retrofitting are reviewed & their weak points are identified.

-Modern methods & philosophies of seismic retrofitting, including base isolation & energy dissipation devices are reviewed.

-The presentation is illustrated by case studies of actual buildings where traditional & innovative retrofitting methods have been applied.

-Seismic vulnerably is not an absolute concept but is strongly related to the event being considered.

-All seismic codes specify the seismic action by means of one or more design spectra.

-The elastic design spectrum depends on the vibration periods of the structure & on the available damping.

4.2 SOURCES OF WEAKNESS IN RCC FRAME BUILDING :-

i) Discontinuous load path/interrupted load path/irregular load path.

ii) Lack of deformation compatibility of structural member.

iii) Quality of workmanship & poor quality of materials.

Structural damage due to discontinuous load path :-

- -Every structure must have two load resisting system.
- -Vertical load resisting system for transferring the vertical load to the ground.
- -Horizontal load resisting system for transferring the horizontal load to the vertical load system.
- -It is imperative that the seismic forces should be properly collected by the horizontal framing system & properly transferred into vertical lateral load resisting system.
- -Any discontinuity, in this load path or load transfer make us one of the major contributionsto structural damage during strong earthquake. & should be well connect
- -Therefore all the structural & non-structural elements must have sufficient strength & ductility & should be well connected to the structural system so that the load path must becomplete & sufficiently strong.
- -Seismic forces should be properly collected by the horizontal framing system & properlytransferred into vertical lateral resisting system.
- -Discontinuity /irregularity in this load path or load transfer may cause structural damageduring strong earthquakes.
- **Structural damage due to lack of**

  deformation :-Main problem:-
- -Limited amount of ductility & the inability to redistribute load in order to safely with standthe deformations imposed upon in response to seismic loads.

Quality of workmanship & material :-

Faulty construction practices :-

-Lack of amount & detailing of reinforcement as per requirement of code.

-The end of lateral reinforcement is not bent by 135 degree.

Lack of quality control :-

-Of design material strength as specified.

-Falling of concrete by the corrosion of embedded reinforcing bars, porous concrete, age of concrete, proper maintenance etc.

Goals & objectives of retrofit :-

Retrofit strategy refers option of increasing the strain, stiffness & durability of the elements or the building as a whole.

-The different objective of retrofitting are :-

b) Increasing the ductility & enhancing the energy dissipation capacity.

c) Giving unity to the structure.

d) Eliminating sources of weakness through that produce concentration of stresses

e) Enhancement of redundancy in the number of lateral load resisting element.

f) The retrofit scheme should be cost effective.

g) Each retrofit strategy should consistently achieve the performance objectives.

4.3 CLASSIFICATION OF RETROFITS :- COLUMN STRENGTHENING :-

Column strengthening techniques includes the following :

a) Concrete jacketing
b) Steel jacketing
c) Fibre reinforced polymer sheet warping

a) Concrete jacketing :-

This method increases both strength & durability of the column but the composite deformation of the existing & new concrete requires adequate dowelling to existing column also the additional longitudinal bar need to be anchored to the foundation & should be continuous through the slab. Frequently these consideration are ignored.

b) Steel jacketing :-

Steel jacketing refers to increased the column with steel plate & filling the gap with non-shrink grout. It is a very effective method but it may be costly & its fire resistance has to be addressed.

c) FRP steel warping :-

The use of FRP sheet is becoming popular in India. FRP sheets are thin, light & flexible enough to be inserted behind services ducts, Thus facilitating installation in retrofitting of a

column, there is no significant increase in the size. The main drawbacks of FRP are high cost brittle behaviour & fire resistance.

Beam strengthening :-Addition of concrete :

There are some disadvantages in this traditional retrofit strategy. First addition of concrete increases the size & weight of the beam, second the new concrete required proper bonding to the existing concrete. Third the effects of drying shrinkage must be considered and as is induces tensile stresses in the new concrete. Instead of regular concrete, fibre reinforced concrete can be used for retrofit.

Steel plating :-

Gluing mild steel plates to beam is upon used to improve the beam flexural and shear performances. The addition of steel plate is simple & rapid to apply, doesn't reduce the storey clear height significantly & can be applied which the structure is in use.

F.R.P. warping :-

Like steel plates at F.R.P. laminates are attached to beams to increase their flexural & shear capacity. The amount F.R.P. attached to the soffit should be limited to retain the ductile flexural failure more.

Use of F.R.P. Bars :-

-F.R.P. bars can be attached to the web of a beam for shear strengthening . FRP bars can be used as tendons for external pre-stressing.

Beam to column joint strengthening :-

The different method of strengthening are follows :-

1)Concrete jacketing :-

The joint can be strengthen by placing ties through drilled holes in the beam but theplacement of such tie is difficult.

2)Concrete fillet :-

The use of concrete fillet at the joint to shift the potential hinge region away from the column face to the end of the fillet.

3)Steel jacketing :-

-Steel jacketing helps in transferring moments & ductility through confinement of the concrete.

-Steel plating is simpler as compare to steel jacketing where plates in the form of jackets are attached to soffit of beam & sides of the column.

Wall strengthening :-

A concrete shear wall can be strengthened by adding new concrete with adequate boundary elements for the composite action dowel need to be provided between the existing new concrete.

FRP or steel sheets, external pre-stressing or reinforced grouted can be employed for strengthening unreinforced masonry works.

4) Foundation strengthening :-

Foundation strengthening is done by strengthening the footing as well as the soil.

POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER:

Q-1 Differentiate between retrofitting & rehabilitation of building?[2012-s,2018-s]

Ans :-Retrofitting of building is generally more economical as compared to demotion & reconstruction above in the case of saver structure damage. Therefore seismic retrofitting of building structure is one of the most important aspect for migration seismic hazards as special in earthquake from countries.

Q-2 What is the seismic weight?

Ans :-It is the total dead load plus approximate amount of specified imposed load .

Q-3 What are the sources of weakness of RC frame buildings?

Ans :-Following are the main sources of weakness of reinforced concrete frame building:

-Discontinuous load path or irregular load path.

-Lack of deformation, compatibility of structural member.

-Quantity of workmanship & poor quality of material.

Q-4 What is retrofitting of structure?[2015-s,2019-s]

Ans :-Retrofitting of structure is generally more economical as compared to demolition & re-construction even in the case of sever structural damage.

Q-5 Define seismic retrofitting?[2016-s]

Ans :-Seismic retrofitting is the modification of existing structure to make them more resistance to seismic activity, ground motion or soil failure due to earthquake.

POSSIBLE LONG TYPE QUESTIONS

Q-1 Write the sources of weakness in RC frame building? 2)Classify the retrofitting techniques & their uses ?[2015-s]

Q-2 What are the different system to resist lateral loads in structures?[2018-w]

Q-3 Describe briefly the structural irregularities.[2019-s]

CHAPTER NO :-5

BIULDING SERVICES

Learning objective

5.1 Cold Water Distribution in high rise building, lay out of installation
5.2 Hot water supply – General principles for central plants-layout
5.3 Sanitation –soil and waste water installation in high rise buildings
5.4 Electrical services – i) requirements in high rise buildings ii) Layout of wiring - types of wiring iii) Fuses and their types iv)Earthing and their uses
5.5 Lighting – Requirement of lighting, Measurement of light intensity
5.6 Ventilation - Methods of ventilation (Natural and artificial Systems of ventilation) problems on ventilation
5.7 Mechanical Services- Lifts, Escalator, Elevators – types and uses.

5.1 COLD WATER DISTRIBUTION IN HIGH RISE BUILDING, LAY OUT OF INSTALLATION :-

-Water is heavy liquid, so the pumping system simply has to be capable of making heavy lifts to get the water to the top floor of a high rise building under enough pressure for the plumbing fire sprinkler & air-conditioning system to work properly.

-When u consider that pushing the water upon foot required 0.43pounds of pressure, a 500feet of tall building would required 215pound pressure, which is higher than the rated strength of most pipes.

-This is why pump must be installed at intervals to lift the water, or high pressure pipe systems & high pressure pump must be used with pressure reducing valves located at the supply to each floor.

-Another issue is the waste water drainage system. Water falling 500feet creates a lot of force drain line have to special vents to relief the pressure, the waste water flows through the pipes.

The major components of coldwater distribution :-

1)Sump-tank & roof-tank :-

To transfer water from sump-tank to roof-tank.

2)Up-feed pump :-

To provide water storage for coldwater system.

3) Pneumatic booster pump :-

To boost up-water pressure for the top floor.

4) Pressure reducing valve :-

To serve to reduce water to acceptable level for lower floors as the water pressure may be excessive due to gaining of static pressure.

Cold water supply distribution in by three types :-

*By normal water pressure.

*By over-head feed system.

* By air pressure system.

By normal water pressure :-

-The normal water pressure from the public water main is normally inadequate to serve buildings.

-The alternative solution is either by the over-head feed system or by the air pressure distribution system.

By over-head feed system :-

Water is pumped into a large tank on top of the building & is distributed to the fixtures by means of gravity.

Advantage :

-Water is not affected by peak load hour.

-Not affected by power interruptions.

-Time needed to replace parts will not affect the regular supply of water.

Dis-advantage :

-Water is subjected to contamination.

-High maintenance cost.

-Occupies valuable.

-Requires stronger foundation & other structure to carry additional load of tank & water.

Air pressure system :-

-When pressure supplied by city water supply is not strong enough.

-Compressed air is used to raise & push water into the system.

Advantages :

-With compact pumping unit.

-Sanitary due to air tight water chamber.

-Oxygen in the compressed air serves as purifying agent.

-Economical.(smaller pipe diameter)

-Less initial construction & maintenance cost.

-Adaptable air pressure.
Air pressure serves zone of about 10floor intervals.

Dis-advantages :-

-Water supply is affected by loss of pressure inside the tank in case of power interruption.

Operating principle of an air pressure water distribution system :-

An elastic or compressible & water is inelastic or non-compressible.
Thus, when air compressed into a closed compartment under atmospheric pressure to the extent of one half its volume content, the pressure will increase up to 15pounds per square inch. This pressure inside the tank is capable of elevating water up to 10.50meters high.

5.2 HOT WATER SUPPLY –GENERAL PRINCIPLES FOR CENTRAL PLANTS-LAYOUT :

-HOT WATER PRODUCTION :

To produce hot water there are several principles :

1) Hot water production in the apartments:

i) With individual heater, a gas fired boiler or electric heater.

Ii)A heat exchanger connected to a central heating system or district heating.

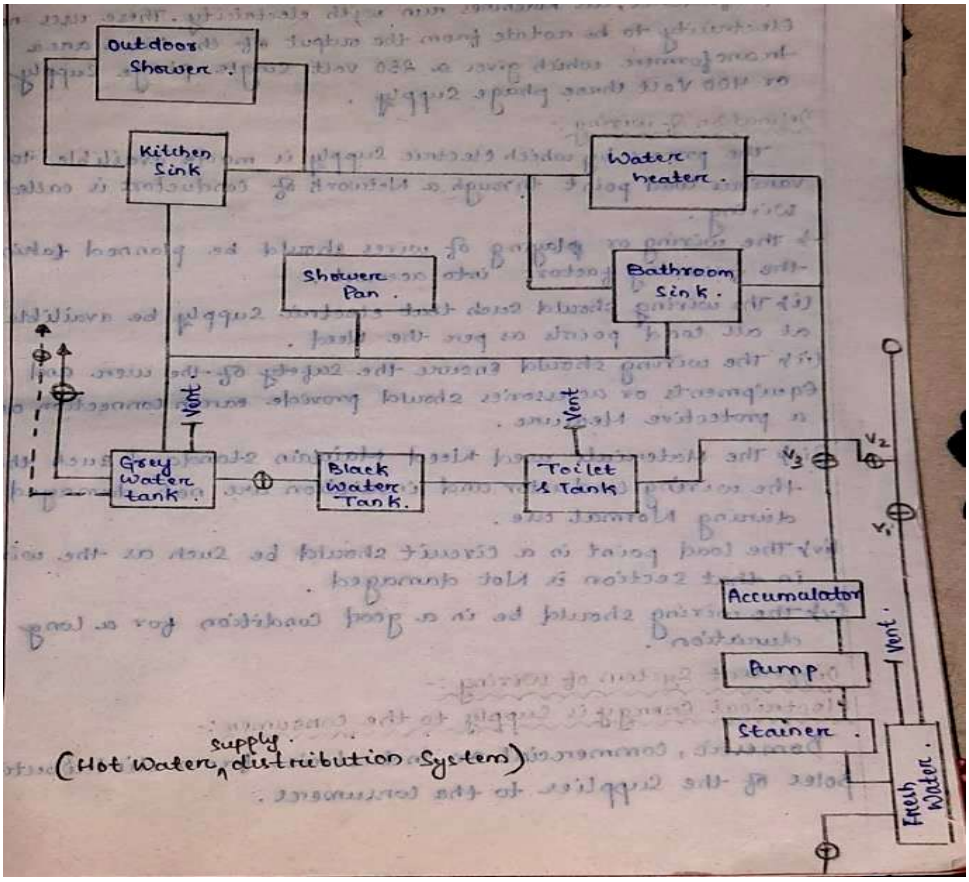
2)Central hot water production with circulation system.

Hot water production per apartment ::-

-There is hot water production with individual gas fired boilers, electrical heaters or heat

pumps in combination with exhaust air.

-In case of a gas boiler account must be taken for the requirements for the flue gas discharge . For hot water storage tanks keep in mind the extra weight of the storage tank in each apartment.



Individual heat exchangers :

Large city's such as amsterdan & Rotterdam have a district heating distribution system operated by a private utility company.

-This district heating distribution system supplies the heat for the heating in the apartment using an heat exchanger, to produce hot drinking water there are double-wall heat exchangers to guaranty the water quality, both heat exchangers can be combined to one device.

-The big advantages of this system is the simple layout of the water supply system & the individual metering. The water heaters are located close to the fixtures ,so there is a minimum in heat losses in the hot drinking water system.

-A disadvantage is that by maintaining a permanent high temp. of the district heating mainsa heat loss occurs in the shaft which warms the cold water pipes in the same shaft. One of the

regulations is to keep the cold water temp. lower as 25degree centigrade, so it is recommended to separate the cold water distribution in cold pipe shafts.

Central hot water production :-

If a central hot water production is used, the hot water is distributed from the central hotwater tank to the apartments with a hot water pipe & a hot water circulation pipe.

The general principles as follows are applicable :-

-Avoiding installing the circulation pipe in the apartments, use only supply pipes for the users .

-The maximum pressure in the distribution system is 600kpa.

-The user pressure for each apartment has a minimum of 200kpa.

-The maximum pressure for the hot water storage tank is 1000kpa.

-Each pressure zone needs a separate hot water system. Its not possible to locate the hot water storage tanks in the basement because of the high static pressure. This hot water concept provides space on the floors near the apartment.

-In a high rise building where the water distribution system is zoned vertically to maintain pressures with in the maximum criteria established , it is imperative that certain precautions be observed in the design of the hot & circulation water system.

-Each zone must be considered as a complete system with no inter connection with anyother zone.

-Each zone must have its own water heater, distribution piping, circulation hot water piping & circulation pumps.

-It is always desirable to locate the heater at the top of the system.

-The pressure on the heater & circulation pump are subjected to are much less than at thebase of the system.

5.3 SANITATION –SOIL & WASTE WATER INSTALLATION IN HIGH RISE BUILDINGS :-

TYPE OF HOUSE-HOLD WASTE WATER :-

Grey water :- All other house hold waste water from the bathroom showers, kitchen sinks & clothes wash areas & other taps water .

Grey water treatment :-

-Grey water for irrigation & domestic grey water system decontaminated grey water is used for irrigation.

-A domestic grey water treatment system diminishes bacteria, chemical pollutants & solids.

The treatment processes includes :-

* Filtering

* Settlement of solids

*Flotation & separation of lighter solids.
*An aerobic digestion.

* Chemical or UV disinfection.

FOUR SYSTEM, DEPENDING ON THE NO. OF PIPES USED :-

*One pipe system.

*Two pipe system.

* Partially ventilated single stack system.

*Single stack system.

PARTIALLY VENTILATED ONE PIPE SYSTEM :-

-In this system, single soil cum waste pipe used .

- It differs from one pipe system as the traps of soil fittings.

SINGLE STACK SYSTEM :-

-It contains soil cum waste pipe also act as a vent pipe.

-Very economical.

ONE PIPE SYSTEM :-

One set of pipe is used main soil waste pipe & main vent pipe. All components are connected to single waste pipe & SWP connected to the building drain.

TWO PIPE SYSTEM :-

-Two set of pipe is used soil pipe with vent pipe & waste pipe with vent pipe.

-All the content of WC are discharged into soil pipe.

-Waste pipe contains the waste water of sinks, wash basin etc.

-Both pipes are provided with separate vent pipe.

5.4 ELECTRICAL SERVICES – I) REQUIREMENTS IN HIGH RISE BUILDINGS II) LAYOUT OF WIRING - TYPES OF WIRING III) FUSES AND THEIR TYPES IV)EARTHING AND THEIR USES

Requirement of high rise building :-Electrical services :-

Electricity is used at home for different purposes such as lighting, moving of fan,

Operating refrigerator, washing machine & grinder etc.

-In factories, all machines run with electricity. These uses need electricity to be rotate from the output of the local area transformer which gives a 230volt singe phase supply or 400volt three phase supply.

Definition of wiring :-

The process by which electric supply is made available to various load point through network of conductors is called wiring.

-The wiring or laying of wires should be planned taking the following factors into accounts.

*The wiring should such that electric supply be available at all load points as per the need.

*The wiring should ensure the safety of the user & equipments or accessories should provide earth connection as a protective measure.

* The materials used need maintain standard such that the wiring conductor & insulation are not damaged during normal use.

* The load point in a circuit should be such as the wiring in that section is not damaged.

* The wiring should be in a good condition for a long duration.

Different system of wiring :-

Electric energy is supply to the consumer :-

-Domestic, commercial or industrial from distribution poles of the supplier to the consumers.

-Energy meter by the help of thick insulated wire called service conductor.

-From the energy meter, it goes to main switch & then to the main distribution poles. Then it goes to sub-distribution board. This sub-distribution board controls the circuit connection to

limited no. Of load points. so, these points are connected from the sub-distribution board.

Different methods of wiring are used under different condition. The selection of an individual system of wiring depends upon many factor given below :-

i) Initial cost

ii) Durability

iii) Mechanical protection.

iv) Fire safety

v) Appearance

vi) Accessibility.

Taking the above factor into account any of the following type of wiring are used .

Types of wiring system :-Cleat wiring system:-

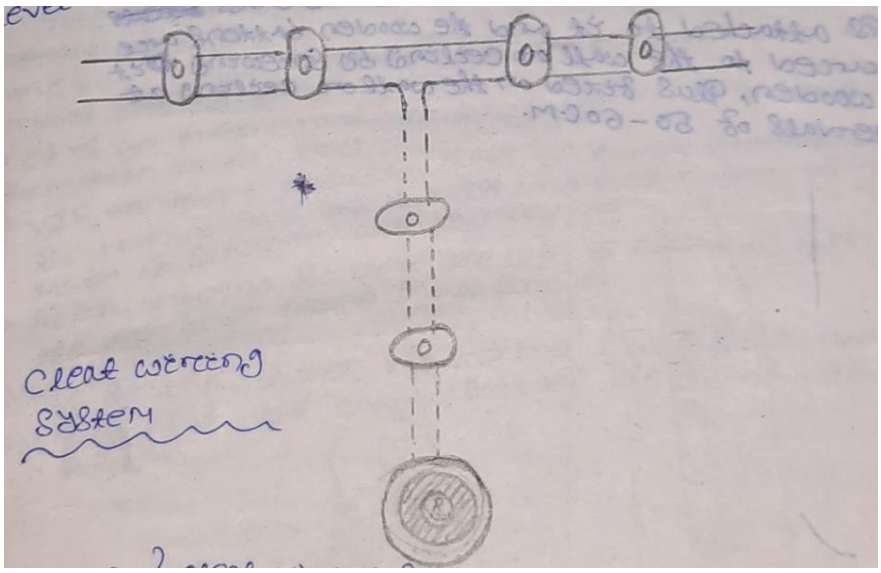
-This is the cheapest method of wiring ,which is not used practically for permanent wiring.

-It is uses for temporary purposes such as marriages , puja or for a limited period in indoor wiring.

-Single core VIR (vulcanized India rubber)or PVC (Polyvinyl chloride) are used in this system.

-The cables are run in groove of the glazed porcelain cleats which are fastened in woodened plugs, mounted on walls or wooden or bamboo poles.

-The wiring runs at height less than 1.5mtr. above the ground level. Each cleat should be at least 60cm. apart.



Merits of cleat wiring system :-

Following are the merits of cleat wiring system :

-This system is cheap & needs little skill.

-The wiring can be maintain easily & use again with very little waste of material.

-It is easy to locate fault.

De-merits :-
-It should not be used on a damp walls or ceiling etc.

-Dust collected over the wire.

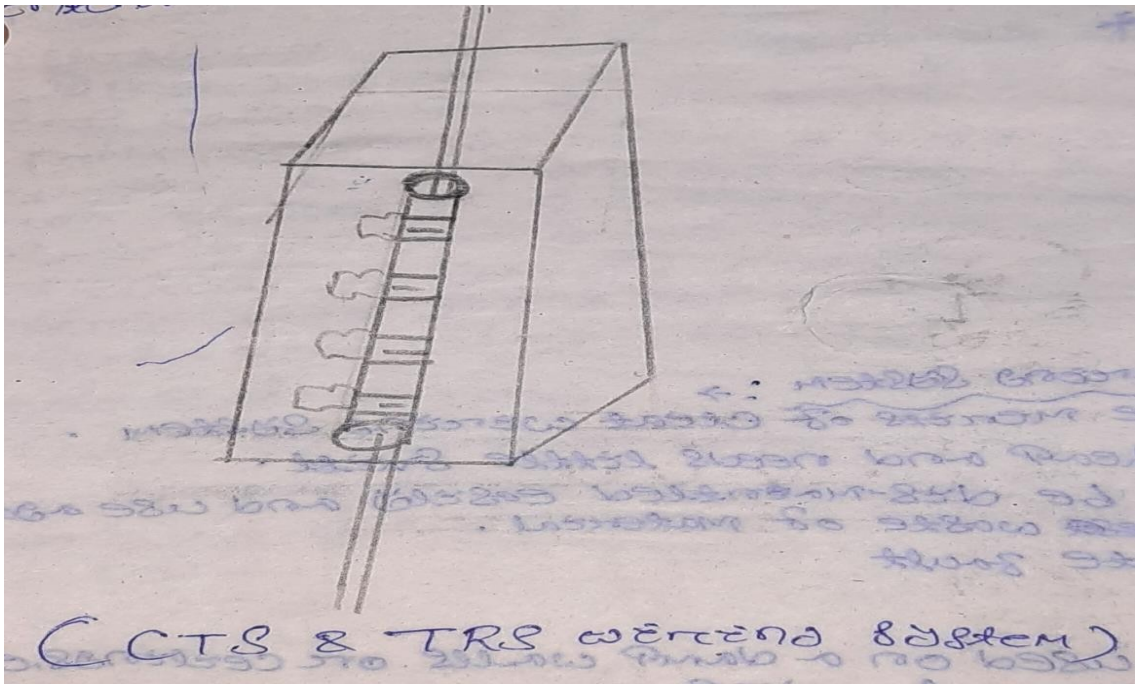
-There is no protection from mechanical injury, fire, gas or water leakage.

-Due to the above factor, the life span of such wiring is about 5years.

CTS & TRS Wiring system :- CTS (cable tyre sheath) TRS (tough rubber sheath)

-CTS means " cable tyre sheath" & TRS means "tough rubber sheath". In this system single core or three core, TRS cable with a circular oval shaped are used for low voltage installation. The TRS cables are fixed on well varnished, well seasoned, perfectly straight teak wood battens of about 1cm. thick the width of the batten depends on number & size of the cables to be carried by it.

-The cable is fixed to the batten by brass clips attached to it & the wooden battens are secured to the wall or ceiling by screwing it to wooden, plus fixed on the wall or ceiling at intervals of 50-60cm.



Merits :-

-In this wiring system installation is easy & quick, semi skilled worker can do the installation.

-Installation is not costly.

-The appearance is good & working is satisfactory.

-It is durable.

-The system provides good protection to the cables use against limited exposure todampness & adverse environmental hazardous.

De-merits :-

Prolonged exposure to dampness, elid &alkali fumes, etc will damage the insulation of the system.

Wooden casing & capping wiring system:-

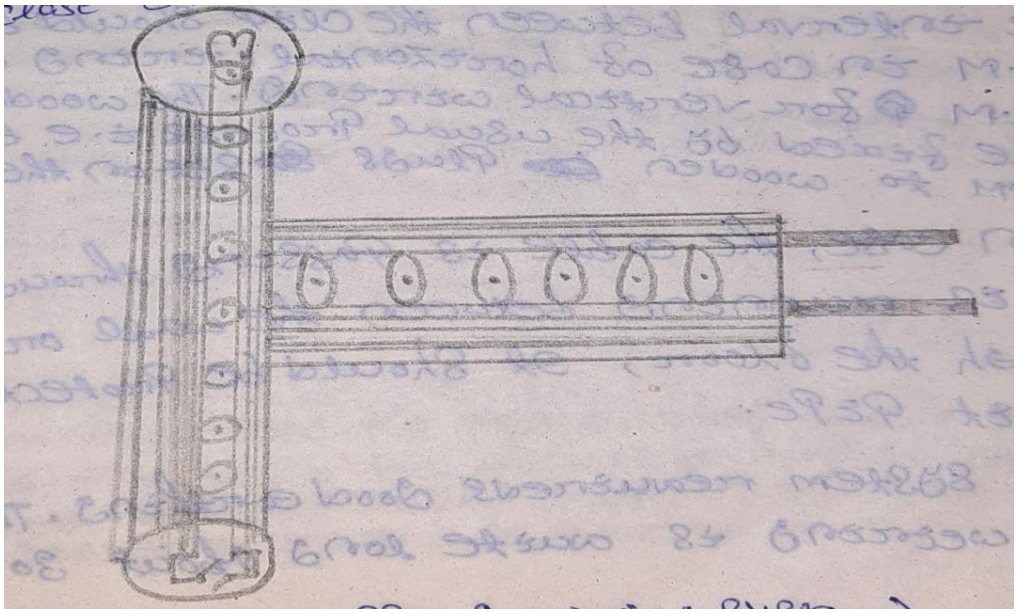
-This type of wiring is suitable for low voltage domestic installation, it was the most common type of wiring for more than half a century. Now it is giving way to conduit wiring pipe.

-It is an improvement over batten wiring as it provides protection to the wires.

-VIR or plastic insulated cables in two or triple are the run inside long rectangular casing made of seasoned, well polished teak wood .

-After drawing the wire, the case is closed by capping the open side using small screws.

-The spacing between the fixing screw should not be too long but close enough to keep the casing rigidly in position.



Merits :-

-There is sufficient mechanical & environmental protection to the wires or cables used.

-It is easy to install & wire again.

-It is easy to inspect by opening the capping.

De-merits :-

-It is expensive compared to batten wiring. It requires more labour cost & better workman.

-It take more time for installation.

-The fire risk is high as more volume of wood are used.

-It performance is affected under damp condition.

Lead sheathed wiring :-

-This type of wiring is suitable for low voltage installation. It may be used in damp places but unsuitable in location where acid & alkali fumes might be present.

-In this system, single core, twin core or three core, VIR cables covered with lead sheath are used ,because of lead cover , the cables can be used in places exposed to the sun & rain.

The lead sheath cables are fixed to the wooden battens fixed on the walls ceilings by means of joints clips or link clips. The interval between the clip should be nearly 10cm. In case of horizontal wiring & about 15cm. for vertical wiring. The wooden battens are fixed by the usual process i.e. by screwing them to wooden plugs set on the wall.

-In case, cable is passing through a wall or is running between the wall or passing through the floor, it should be protected by conduit pipe.

-The system requires good earthing. The life of such wiring is quite long about 30years.

Merits:-

-This type of wiring gives sufficient mechanical protection to the cable.

-Safe against fire hazardous .

-Protected from dampness.

-It can be exposed to sun & rain.

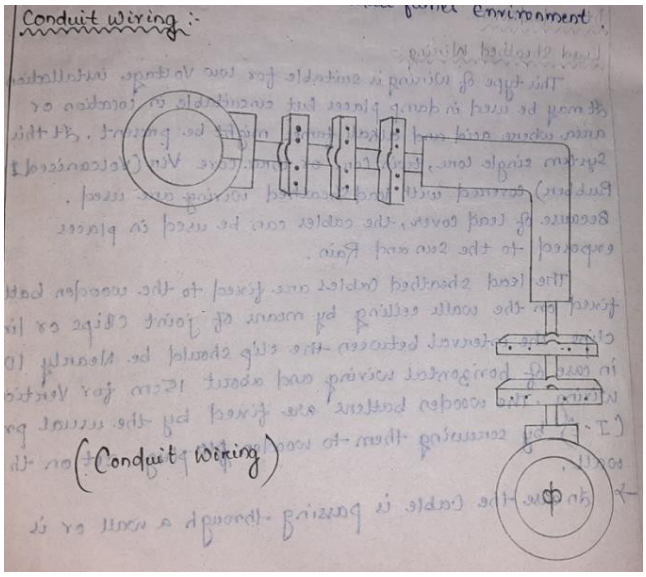
De-merits :-

-It is relatively expensive due to the cost of lead sheath.

-Yield workmanship & proper supervision is necessary otherwise the durability of insulation may be affected .

-It is not suitable in acid or alkali fume environment.

Conduit wiring :-



-In this system VIR wires or PVC cables are carried through steel or iron or PVC pipes calledconduit pipes. This gives good protection to the wire from mechanical damage.

-This system is suitable for low & medium voltage installation in both small & big building. There are two types of conduit wiring.

i) surface conduit wiring.

ii) concealed conduit wiring

i)surface conduit wiring :

-In this system of wiring the steel or iron conduit pipes are first cut with hacksaw for the appropriate length & are threaded with die set at the ends, ”T”-junction boxes, etc are fitted according to the need of the wiring scheme.

-The pipes are fixed on the walls on wooden battens.

-Then the cables are run through the conduit pipe by means of steel wire is known as fish wire.

-Conduit pipes are available in various sizes varying from 12mm to75mm dia.

-The size of the conduit pipe to be selected depends on the number & size of cables to run through it. The PVC conduit pipes don’t required threading.

ii) concealed conduit wiring :

-Small channels are formed in the world when the building is under-construction are buried in them by plastering the wall. Similarly the conduit pipes are said in the ceiling at the time of casting the roof.

-Conduit accessories like switch boards. Junction boxes are fitted at appropriate places during installation. Thus conduit pipes remain in conclude in the wall & ceiling.

Merits :-

Following are the merits of conduit wiring

-The wiring presents a neat & attractive appearance.

-It gives good protection against fire due to short circuit, mechanical damage of the insulation & moisture.

-Its durability is high. This wiring may last about 30-40years.

De-merits :

-The initial installation cost is high.

-High skilled technician is necessary.

-Location & replacement of defective wiring is difficult.

-The system requires good & continuous earthing & therefore the system is earthed at the entry of the supply cable.

Fuse :-

A fuse is a short piece of metal inserted in the circuit which melts when excessive current flows through it & thus break the circuit.

High rupturing capacity (HRC) cartridge fuse:-

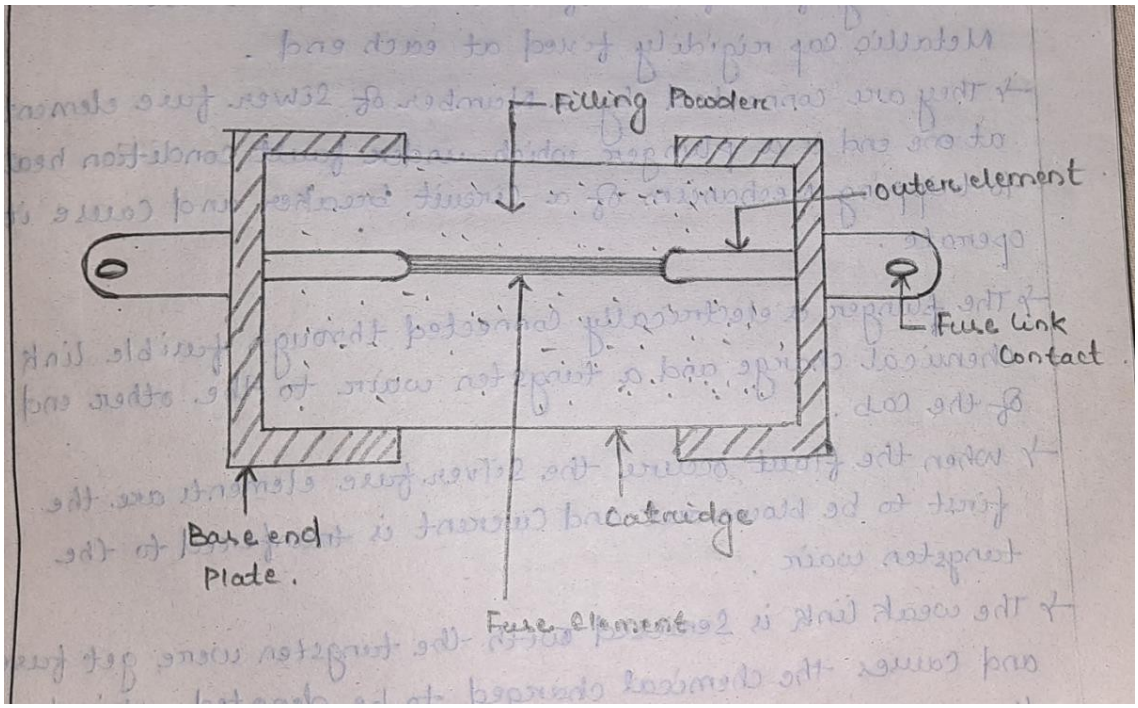
-The primary objection low & uncertain breaking capacity on semi-enclose re-wireable fuses is over come in "HRC "cartridge fuse as shown the different parts of a typical HRCcartridge fuse .

-It consist of a heat resisting ceramic body having metal end caps to which is welded silver current carrying element.

-The space within the body surrounding the element is completely packed with a filling powder.

-The filling material may be chalk, plaster of paris or marble dust & it acts as cooling medium.

-Therefore it carries the normal current without overheating when a fault occurs, the current increases & the fuse element melts before the fault current reaches its first peak, the heat produce in the process varies the melted silver elements.



Advantages :-

-They are capable of carrying high as well as low faults.

-They have high speed of operation.

-They require low maintenance.

-They are cheaper than other circuit interruption devices of equal breaking capacity.

-They permit consistence performance.

Dis-advantages :-

-They have to be replaced after each operation.

-Heat produced by the arc may affect the associate switches.

High rupturing capacity (HRC) with tripping device :-

-Sometimes HRC cartridge fuse is provided with a tripping device .when the fuse blows out under fault conditions, the tripping device causes the circuit breaker to operate.

-The body of the fuse is of ceramic material with a metallic cap rigidly fixed at each end.

-These are connected by a number of silver fuse element. At one end is a plunger which under fault conditions heats to tripping mechanism of a circuit breaker & cause it to operate.

-The plunger is electrically connected through a fusible link chemical charge & a tungsten wire to the other end of the cap.

-When the fault occur, the silver fuse element are the first to be blown out & then current is transfer to the tungsten wire.

-The weak link is series with the tungsten wire gets fused & causes the chemical charge tobe denoted, this forces. The plunger out words to operate the circuit breaker.

Advantages :-

-In case of single phase for in a three phase system, the plunger operates the tripping mechanism of circuit breaker to open all the three phases & thus event single phasing.

-The effects of whole short circuit current didn't be considered in the choice of current breaker. This permits the use of a relatively expensive circuit breaker.

High voltage fuse :-

The low voltage fuses have low normal current rating & breaking capacity. Therefore they can't be successfully used on modern high voltage circuit. Intensive research by the manufactures & supply engineer has lead to the development of high voltage fuses.

Type of high voltage fuses :-

i)cartridge fuse

ii) liquid type fuseiii)metal clad fuse

i)Cartridge fuse :-

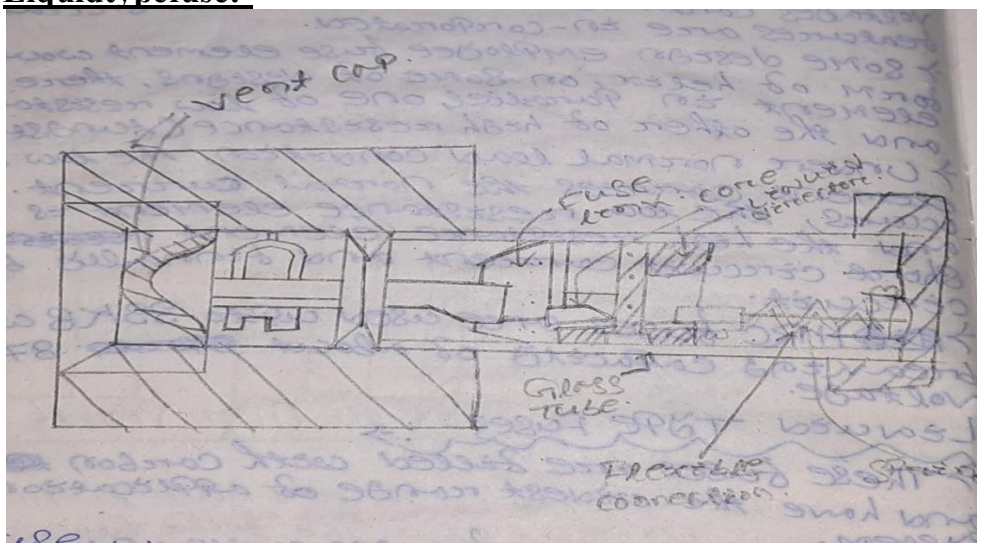
-This is similar in general construction to the low voltages cartridge type accept that special design features are in-corporate.

-Some design employee fuse element wound in the form of helix on some of designs, there are two fuse element parallel, one of low resistance (silver wire) & the other of high resistance (tungsten wire).

-Under normal load condition, the low resistance element carries the normal current, when fault occurs, the low resistance element is blown out & the high resistance element reduces the short circuit current & finally breaks the circuit.

-HRC fuses are used up to 33kb without breaking capacity of about 8700A atthat voltage.

ii) **Liquidtypefuse:-**



-These fuses are filled with carbon tetrachloride &have the widest range of application tohigh voltage system.

-They may be used for circuits up to range of about 100A rated current on systems up to 132KB & may have breaking capacity of the order of 6100A.

-It consist of a glass tube filled with carbon tetrachloride solution & sealed at both ends with brass cap.

-The fuse wire is sealed at one end of the tube & the other end of the wire is hold by a strong phosphor bronze spiral spring fixed at the other end of the glass tube. When the current exceeds the permissible limit, the fuse wire is blown out.

iii) **Metal clad fuse:-**

Metal clad oil immersed fuse having developed with the object of providing a substituted for the oil circuit breaker. Such fuses can be used for very high voltage circuit & operate most satisfactory under short circuit condition approaching their rated capacities.

Earthing :-

Earthing means providing a metallic connection of the users body to the general mass of the earth which is considered to be at zero potential.

-This ensures safety of the human life from any electrical shock resulting from leakage or live line coming in contact with the neutral accidentally or metal plates of any equipment or device coming in contact with the live wire.

-The earthing is done by connecting the earth terminal of socket outlet (connected to neutral) or non-current carrying part of electrical apparatus such as metallic frame work,

metallic covering of cables, etc.

Necessity of earthing :-

Earthing is provide for the following purposes :-

-To ensure that no current carrying conductor rises to a potential higher than its designated value with respect to general mass of the earth i.e., the line voltage maintain at a constant value.

-To prevent electrical shock to the human beings.

-To prevent risk of fire due to leakage current through unwanted path.

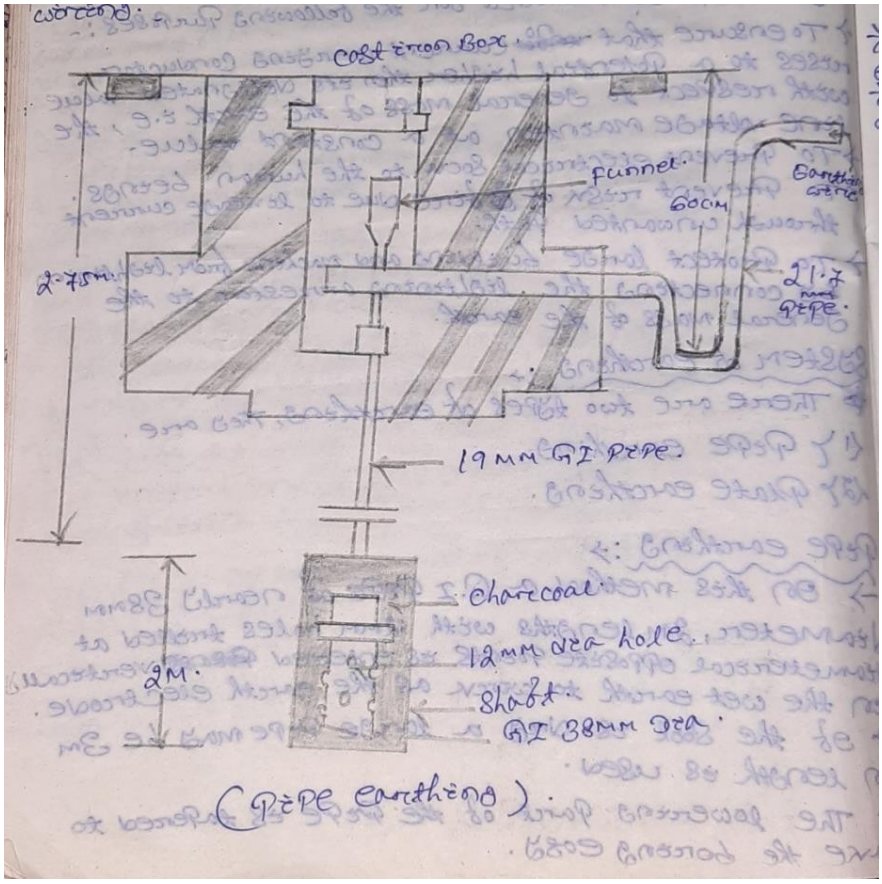
-To protect large building & machine from lighting by connecting the lighting arrestor to the general mass of the earth.

System of earthing :-

There are two types of earthing, they are :

i) Pipe earting
ii) Plate earthing

i) pipe earthing:-



-In this method, a G.I. pipe of nearly 38mm diameter, 2m length with 12mm holes trilled at diametrical opposite points is entered vertically in the wet earth to work as the earth electrode .

-If the soil is dry a large pipe may be 3m in length is used.

-The lowering part of the pipe is tapered to make the boring easy.

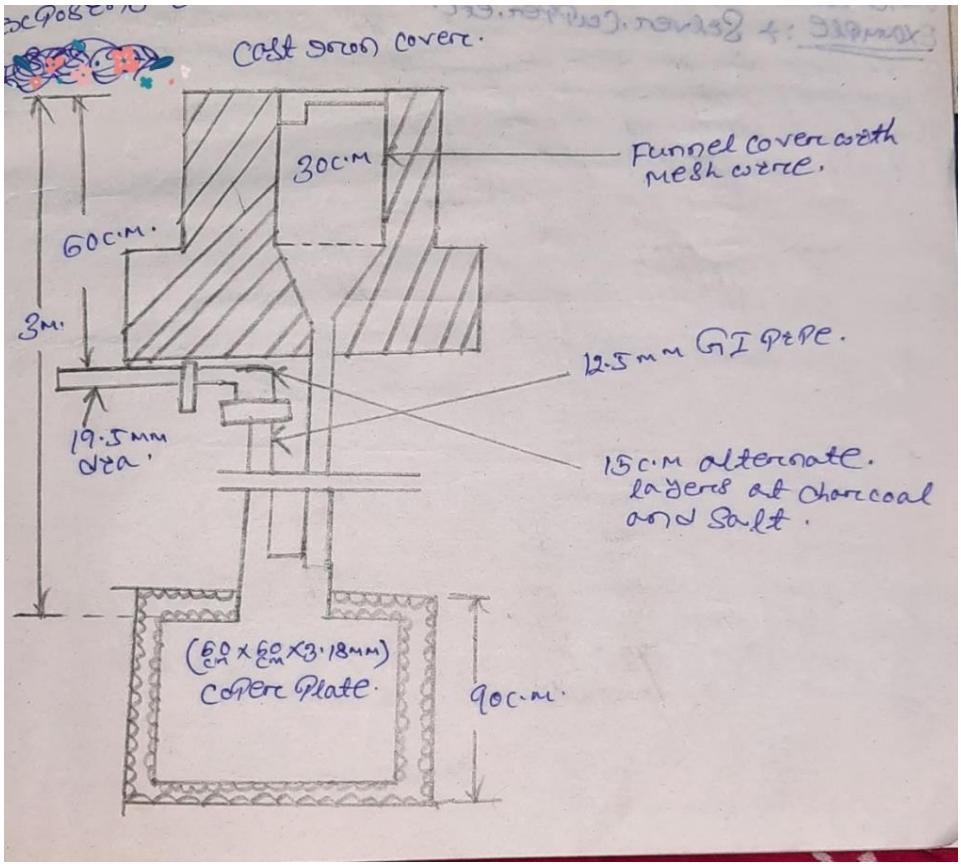
-A second narrow G.I. pipe of about 19mm diameter is fixed over the wider pipe through a reducing socket.

-A funnel with wire mesh is fixed at the top of the narrow pipe. During summer, water may be poured in the funnel to keep the soil wet & maintain the earth connection in good condition.

-Alternate layer of salt & charcoal are filled in the hole around the earth electrode. Salt attracts moisture from the surrounding & charcoal retains moisture near the earth electrode.

-A thick G.I. wire is screwed tightly to the narrow pipe & the other end is connected to the body of the main switch which is also linked to the earth wire running around wiring.

Plate earthing :-



-In this system of earthing, an earthing pit is made in the ground. A G.I. or copper plate is connected to the earth continuity conductors with nuts & bolts.

-The size of the plate for capper is (60*60*3.18)mm & for G.I. it is (60*60*6.35)mm.

-After placing the plate at the bottom of the pit, it is covered with nearly 15cm thick alternate layers of salts & charcoal.

-Then the bolted earth wire are drawn through G.I. pipe of diameter 12.7mm to the body of the main switch. Funnels may be added to pour water in the earthing pit.

-In principle the funnels are provided for ideal earthing.

-In practical wiring, the earthing is done is open space exposing it to rain to keep the place wet.

Uses :-

Generally pipe earthing are used for domestic small commercial building, small workshops & establishment using single phase supply.

-Plate earthing are used for large buildings, big workshops, sub-stations & industry using three phase supply.

5.5 LIGHTING

–REQUIREMENT OF LIGHTING, MEASUREMENT OF LIGHT INTENSITY :

In order that construction work can continue effectively and safely in periods of insufficient natural light, it is important that a site is fitted with suitable artificial lighting. Lighting can be used internally for general movement and working on the site itself, externally for illuminating entry, storage and circulation areas, and can also be an effective form of deterrent for trespassers.

There are a wide range of lamps available, from simple tungsten filament lamps to tungsten halogenand discharge lamps. Site lighting is generally run off mains electricity at a voltage of 230 V, rather than through the use of generators. Sometimes it can be necessary to reduce the voltage to 110 V.

Lighting plan

For an appropriate lighting plan to be drawn up, the types of activity that will be likely to require lighting need to be specified. These activities can then be given an illumination target (with the unit being lux). Lamps are often given a measurement in lumens (lm), which is the total quantity of visiblelight emitted. One lux is one lumen per square metre.

Examples of recommended minimum target values for building activities

include:

External lighting:

Circulation: 10 lx
Materials handling: 10
lxInternal lighting:

Circulation: 5 lx Working areas: 15 lxConcreting: 50 lx
Carpentry and joinery: 100 lx
Bricklaying and plastering: 100
lxPainting and decorating: 200 lx
Site offices: 200 lx
Drawing board positions: 300 lx

While manufacturers will often specify the best arrangement for lamps according to required use, it iscommon practice to plan for at least twice the recommended target values. This is because lamps in use can be subject to deterioration, dirt or other conditions that reduce their performance.

It is possible to calculate the required lumens for a particular need with the following

equation: Total lumens required = area to be illuminated (m2) x target value (lx) / Utilisation

factor Where the utilisation factor is 0.23.

Once the lamp type has been chosen, the required number can be calculated with the following equation:

No. of lamps required = total lumens required / lumen output of

lampSite arrangement

Lighting can be arranged on site in a static formation, where lamps are fixed to support poles, masts or items of plant such as scaffolding and tower cranes, or, it can be arranged locally, as and where work is progressing, by the use of moveable supports or being hand-held with trailing leads.

Walkways are often illuminated by bulkhead lamps on standard mains voltage. Bulkhead lamps have a die-cast aluminium alloy body together with a vandal-resistant translucent polycarbonate diffuser.

To illuminate general working areas, festoon (overhead) lighting can be suspended from grids at regular spacings. These are usually tungsten filament bulbs, and both cable and lampholders must be appropriately weather-resistant.

The arrangement must be such that visual intrusion and light spillage are kept to a minimum, particularly in close proximity to residential properties and busy roads where it may cause nuisance or distraction. Where necessary, lighting should be provided to site boundaries to ensure the safety of

passing pedestrians.

5.6 VENTILATION – METHODS OF VENTILATION (NATURAL AND ARTIFICIAL SYSTEMS OF VENTILATION) PROBLEMS ON VENTILATION

VENTILATION :-

-In various industrial enterprises hazards or potentially hazards condition exists.

Which can affect the health & safety of people working there.

-Fumes & vapours are given off from storage tank, processing tank & other type of processing equipment.

-Dust are given up from grinders, pulverisers, hammers & many other types of equipment.

-Paint, sprayer produced mixed which can get in to the working space if uncontrolled. But heavy industries have large number of situation in which maintenance of a clean working environment is essential.

Definition of ventilation :-

The process of removing used & also for ventilated air by fresh air from building is calledventilation in building. This can be done by natural method or artificial method.

Objectives of ventilation :-

Following are the various objects of ventilation :

-To remove the used air from the building.

-To supply oxygen or fresh air for human on the building.

--To remove the excessive moisture.

-To cool the body of human & remove the excessive heat.

-To prevent the suffocation of the elder.

Method of ventilation :-

The system of ventilation is broadly classified as follows:

- Natural ventilation
- Artificial ventilation

Natural ventilation :-

It is the air movement within a work area due to natural wind, temp. difference between the exterior & interior of a building or other factors, where mechanical air movement is notused.
-For ordinary building, natural forces are used for the removal of polluted air & enter the fresh air, in the building through ventilation inlet & outlet respectively.

i)Artificial ventilation :-

The artificial ventilation system can be broadly divided into three times.

i)vacume system

ii) plenum system

iii) air-conditioning system

i)Vaccum system :-

Vaccum system is one in which used of air is thrown out to the outside atmosphere by means of suitable exhaust fan install near the top ventilator, this exhaustion of the warmer air from the roof causes lower pressure inside the roof. There by permitting inward leakage of new fresh atmospheric air through the doors, windows, etc. Various types of fan are used for this purpose.

-This system is simple & cheaper but contains a number of demerits such as there is no control on the quality of the incoming air.

-This system is largely used for kitchen, public halls, industrial plants, etc.

ii) Plenum system :-

-The plenum system involve forcing or pumping in fresh air & causing the ventilated to be exhaust fan placed at the outlets.

-Provision of a cooler at a window with or without an exhaust fan & ventilator provides an example of such a plenum system of ventilation.

-In larger building such a plenum system may consist of distributing the incoming forced airat different points in the building through a system of grills.

iii) Air-conditioning system :-

-The atmosphere in the modern cities contains highly polluted smoke, fumes, germs & bacteria, etc. In such environments, natural ventilation or even ordinary mechanical ventilation for bringing the outside polluted air into the building will not serve us any useful purpose. In such conditions it is necessary to completely control the temp. & quality of outside air, before it is admitted into the room.

-The air-conditioning may be defined as the process of controlling the temp., humidity & distribution of air in a building with simultaneous removing the dirt, bacteria & toxic matter from the air.

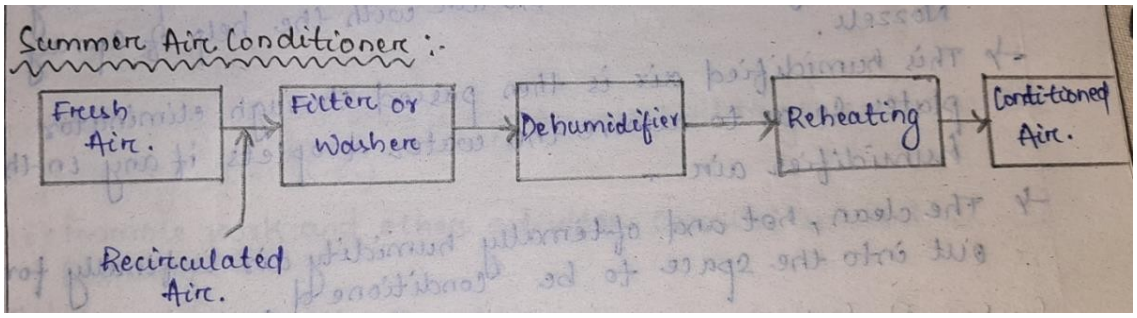
Air-conditioning thus provides a comfortable & whole some ventilation in the building.

Again air-condition system is divided into two parts:-

a) Summer air-conditioner

b) Winter air-conditioner

a) Summer air-conditioner :-

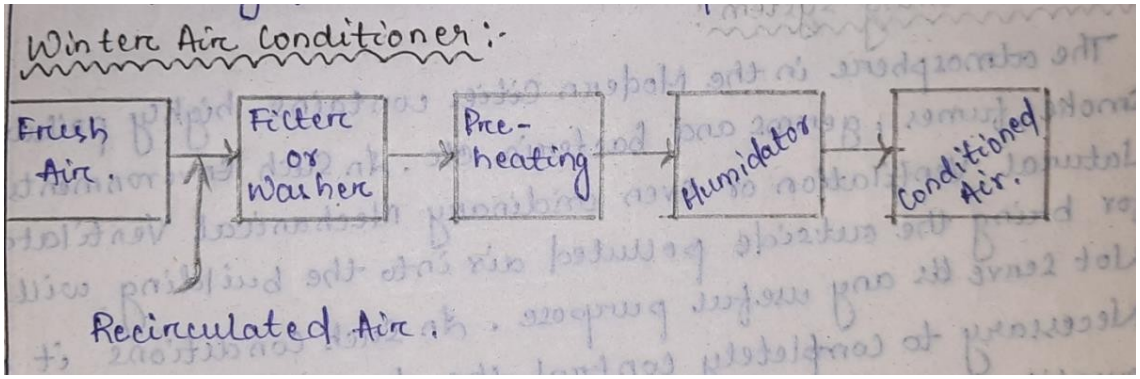


-In summer season, the external atmospheric temp. is high & the hot air has to be cold before it can be distributed in the building

-During the process of cooling, however the humidity of this air increases because at low temp. with the same amount of moisture, the relative humidity increases. Hence after cooling is becomes necessary to reduce the humidity of this air by trying it through a de-humidifier.

-A de-humidifier is in the form of a substance like ammonia, calcium chloride, etc or the air is cold & dried air is then finally forced out into the spaced to be condition.

b) Winter air-conditioner :-



-In winter season the external atmospheric temp. is low & this cold atmospheric air has to be heated up before, it can be distributed in the conditioned room.

-During this process of pre-heating ,however the humidity of air reduces because at high

temp. with the same amount of moisture, the relative humidity decreases. Hence after heating it become necessary to increase the humidity of this air by carrying it through a humidifier where air may be mixed with the water vapour by throwing water over the air with the help of spray nozzles.

-This humidifier air is then passed through eliminator plate so as to remove the water drop plates, if any in the humidifier air.

-The clean, hot & optimally humid air is finally out in to the space to be condition.

System of industrial ventilation :-

-In various industrial enterprises & potentially hazard condition exist which can effect the health & safety of people working there.

-Fumes & vapours are given off from storage tank, processing tank & other types of processing equipment.

-Pollution control however required that the pollutant may not be exerted out doors, these two opposing requirement can both be meet by installing pollution control device prier to exerting the ventilation stream, thus industrial pollution control made ventilation often go ahead even through engineering invented in both circumstances. There are two types of system

-In dilution ventilation contaminants release in to the work space are mixed with air flowing through the room either natural or mechanical induced air.

-In focal exhaust system the contaminants are captures at the sources before they accept into the work space. In focal exhaust system the contaminants are remove rather than just dilute then, it is more difficult to design rather than dilution ventilation system.

5.7 MECHANICAL SERVICES-
LIFTS, ESCALATOR, ELEVATORS – TYPES AND USES.

Mechanical services :

Excavator:-

-A excavator is the oldest type of machine which removes earth.

-It performs its work of moving the earth while the main unit is stationary.

-The little effort is required to move the dead weight of the earth in a vertical plane.

-The lateral motion is the horizontal plane & the effort required is primarily limited to acceleration & de-acceleration of the bucket in the plane.

-The range of an excavator is limited to reach of the boom, carrying the dead weight.

-The excavator may be mounted on crawlers, wheels or trucks & they may be provided with bucket of suitable sizes & capacity. The excavator in commonly used are of following five types :-

1) Back trench hoe excavator.

2) Clamshell excavator.

3) Dragline excavator.

4) Shovel excavator.

5) Skimmer excavator.

1) Back trench hoe excavator :-

This type of excavator is used to digging the foundation trenches below operating level.

-It can also be used for the excavation of smaller areas such as footing & trenches.

-The material caught is suitably discharged. The boom of the hoe is not inter-changeable with the other attachment.

-The hoe is an instrument for scrapping or digging & loosing the earth.

2) Clam shell excavator :-

-This type of excavator is used for digging below at or above the operating level in a vertical ways.

-The material remove is suitable dumped.

-The material to be handled should be relative loose or short up to medium hard.

-The clam shell excavator are widely used the handling of material & for working in limitedspace.

3) Dragline excavator :-

-This type of excavator are used for digging at on or below the operating level, it is useful under the following condition.

-The bottom conditions are wet.

-The dragging is to done well below the ground level.

-The grooving to be exactly is soft or medium hard.

4) Shovel excavator :-

-This type of excavator carries shovel at its lower end. This shovel is provided with sharp utility edge, this type of excavator used to dig out or involve the operating level.

-It can handled, loose rock & the material cut, in the shovel may be satisfied disposed offSkimmer excavator :-

-This type of excavator carries the skimmer at its lower end, it is used for surface excavation & levelling & it got the surface of the earth to depth of about 200mm-300mm.

-The skimmer excavator can also be used for laying loose the excavator material.

-These are powered stairs.

-They are used when it is necessary to move large number of people from floor to floor.

-These stairs have continuous operation without the need of operators. They have large capacity with low power consumption. The excavator are in the forms of an inclined bridge spanning between floors.

-They are generally operated at a speed of 30 or 40 meter/minute. Slope of stair is standardised at 30degree.

-Excavator is a power driven, inclined continuous stair way used for rising & loweringpassengers.

Compacting equipment :-

1) Rolling

2) Kneading

3) Vibration

1) ROLLING :-

In this process heavy weights in the form of rollers are used to place the soil particlestogether.

2) Kneading :-

In this process kneading of soil while at the same time applying pressure is allowed.

3) Vibration :-

In this process of soil particles are such can together in a compact mass.

4) Ramming :-

In this process soil particles are forced to move closer together by pounding action.

Elevator /Lift :-

Elevator /Lift are used in building having more than four storeys. They are used for providing vertical transportation of passengers.
-They can be either electric traction elevator or hydraulic elevator.

-Electric traction elevator are used in tall building & hydraulic elevators are used for low rise passengers, which rise up to about soil stores.

-Some importance terms generally used in elevators are define below :-

Annumciator :-

This is the load carrying element of an elevator including car platform, car frame enclose & car door or gate.

Car door electric contact :-

This is an electrical device for preventing normal operation of the driving machine unless the car door or gate is closed.

Car frame :-

This is the supporting frame to which the car platform guide shows, car safety hoisting rope or the plunger of a hydraulic elevator are attached.

Control :-

This is the system of governing the starting, stopping, direction of motion acceleration or speed & retardation of the car.

Emergency stock switch:-

This a car located device that when operated manually causes the car to be stock by this connecting electric power from the driving machine motor.

Machine :-

This is a power unit for rising & lowering an elevator car.

Signal operation :-

This starts & stocks a car automatically as loadings are reached in response to actuation to buttons in cars or a landing irrespective of direction of car travel or sequence in which buttons are actuated but the car can be started only by the button or starting switch in a car.

Solid waste :-

The term solid waste includes all those solid & semi-solid materials that are discarded by a

community.

-The solid waste generated through domestic & commercial activities is classified as municipal solid waste & is also called to refuse. The solid waste is generated by industries is known as industrial solid waste.

POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER:

Q-1 Define wiring?

Ans : The process by which the electric supply is made available to various load point through a networks of conductors is called wiring.

Q-2 What are the merits of cleat wiring ?

Ans : i)This system is cheap

ii) This wiring can be dismatled easily & used again with very little waste of material.

iii) It is easy to locate.

Q-3 What are the necessity of earthing ?

Ans : Earthing is provided for the following purposes.

i) To ensure that no current carrying conductor rises to a potential higher than its designed value.
ii) To prevent electrical shock to the human beings.
iii) To prevent risk of fire due to leakage current through unwanted path.

Q-4 What are the different types of earthing?

Ans :

1)Pipe earthing

2) Plate earthing

Q-5 Define fuse.[2018-w]

Ans : A fuse is a short piece of metal inserted in the circuit which melts when excessive current flows through it & this break the circuit.

Q-6 What is the unit of measurement of intensity of light ?[2014-s,2019-s]

Ans : The unit of measurement of intensity of light is 1 “lux”.

i.e, 1 “lux”= 1 lumen/m^2

Q-7 Define ventilation.[2015-s,2019-s]

Ans : The process of removing used & also for ventilated air by fresh air from building is called ventilation in building.

Q-8 What are the objectives of ventilation?

Ans : 1) To remove the used air from the building.

2) To supply oxygen for human on the building.

3) To remove the excessive moisture.

4) To prevent the suffocation of the elders.

Q-9 What is air conditioning ?

Ans : The air conditioning may be defined as the process of controlling the temp., humidity distribution of air in a building with simultaneous removing the dirt, bacteria & toxic matter from the air.

POSSIBLE LONG TYPE QUESTIONS

1. Describe the hot water supply for a building with a neat sketch ?[2016-s]

2. Write the methods ventilation & system of ventilation, Describe briefly[.2016-s,2017-s,2018-w]

3. What are the point to be considered for selection of wiring.[2016-s]

4. Briefly describe the layout of ventilation.[2014-s]

5. Describe the methods of distributing cold water in high rise building.[2018-w]

6. What do u mean by operating cost ?[2018-w]

7. Write short notes on :

i) Earthing

ii) Owning cost

8. Explain the method of ventilation in a building.[2016-s,2017-s,2018-s]

9. State general principles for central plants layout for hot water supply.[2019-s]

10. What do u mean by earthing? Describe different types of earthing.[2014-s]

11. Describe the different methods of ventilation.[2014-s]

CHAPTER NO:-6

CONSTRUCTION & EARTH MOVING EQUIPMENT

Learning objective

6.1 Planning and selection of construction equipments
6.2 Study on earth moving equipments like drag line, tractor, bulldozer, Power shovel
6.3 Study and uses of compacting equipments like tamping rollers, Smooth wheel rollers, Pneumatic tired rollers and vibrating compactors
6.4 Owning and operating cost – problems

6.1 PLANNING & SELECTION OF CONSTRUCTION EQUIPMENT :-

The type of equipment to be used in a building project depends up on the scope of work.

-The equipment to be used can be either standard type equipment which can be used for a no. of site action or can be a special type which meets the requirement of the particular project.

-The operation cost of equipments includes both the cost of owning & equipment & its working expenses.

Planning of equipment:-

Planning for equipment operation means best utilisation of machines for satisfactorily & efficient working of the project.

-In order to achieve this, it is necessary that the working of different group of machinesshould be arranged & co-ordinated that a continuous working stream is formed.

Selection of equipment :-

The selection, management & maintenance of construction equipment is particularly important when consider in the contest of earth moving & excavation plan.

-The selection of particular equipment is the complex exercise because of the wide variety of choice available for all classes of plant. Final choice is usually based upon experience.

Familiarity with a particular manufacturers machine availability or personal performance.

-The final selection depends upon following factors :-

a) Availability of equipment

b) Utility of equipment

c) Production cost of equipment

d) Availability of spare parts

e) Availability of skilled operator

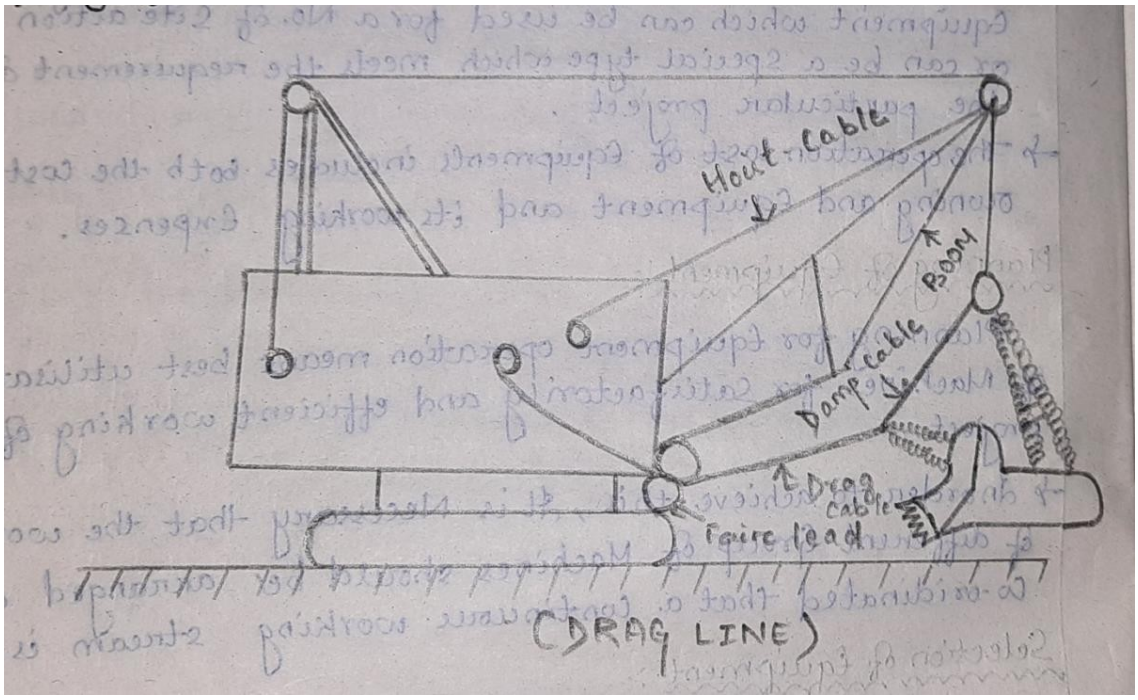
f) Useful life of equipment

g) Durability of project

6.2 STUDY ON EARTH MOVING EQUIPMENTS LIKE DRAG LINE, TRACTOR, BULLDOZER, POWER SHOVEL

Study on earth moving equipment :-

Drag line :-



Drag line is one type of excavator which is used at or below the operating level.

-Dragline components consist of a drag bucket & fairly assembly wire, ropes are used for the boom suspension, drag, bucket hoist & dump lines.

-The fairly lead guide the drag cable into the drum when the bucket is being loaded.

-The hoist line that operates over the boom point is used to raise & lower the bucket.

-Dry cable is used to pull the bucket through the material.

Operation of drag line :-

-Swinging the empty bucket to the digging position while at the same time slaking off the drag lines & the hoist lines starts the excavating cycle.

-There are separate drum on the crank until for each of these cable so that they can be co-ordinated into a smooth operation.

-Digging is accomplished by pulling the bucket towards the machine while regulating the digging depth by means of the tension maintained in the hoist line.

-When the bucket is filled, the operator takes in on the hoist line while playing out the dragline. Then the cycle is repeated.

Tractor :-

Important equipment for earth movement.

--It converts engine energy in to tractive energy.

-Tractors are usually worked by diesel engines having horse power ranging from 2HP to 200HP.

-The track type moves on an endless chain. They are:-

a) Slower in speed than wheel type

b) Generally they have a speed of about 12km/h.

c) They are used for uneven & rough ground.

d) Wheel tractor move on pneumatic tyres & have a speed of about 50km/h.

e) Thy operate best on smooth roads.

Bull-dozer :-

Same as in chapter :-5

Power shovel :-

It is used to excavate earth of all class except rock & load it in to wagons.

Operation of power shovel :-

The operation of a power shovel involves the following steps.

-First of all the power shovel is moved towards the required position with the reach of the earth phase to be excavated.

-The dipper is then lowered to the floor of the pit with teeth pointing in to the face.

-Now a crowding face is applied to the dipper stick & at the same, tension is applied to the

hoisting line to pull the dipper up the face of the pit.

-The hole revolving unit with front attachment is revolved to dump the excavated material in to the trucks & wagons.

6.3 STUDY & USES OF COMPACTION EQUIPMENT:-

These rollers have either two or three roles in line behind each other.

-The rollers are exactly hollow steel drum which can be fitted with water or damp sands to obtain the deserved pressure.

-These rollers are most suitable for compacting gravels, sands & such materials where a crossing action is needed.

-In general the compacted thickness varies from about 15cm for sub-grade.

Pneumatic rollers, sometimes called pneumatic tyred rollers, are a type of large, ride-on roller with several rows of rubber tires on the front or rear end. The rubber tires provide an 80% coverage area and uniform pressure throughout the width of the tires.

They are typically used for pavements and can help smooth out and polish a project, but are also great for cold-laid bituminous or cold mixed pavements and layers of loose soil.

4. Sheepsfoot

Sheepsfoot rollers, otherwise known as padfoot or tamping rollers, are rollers with many rectangular-shaped lugs, or "feet." They're great for compacting soil and silty clay in road construction work.

The sheepsfoot drum's weight can be increased by ballasting it with water, damp sand, or mounting steel sections onto it, providing a more efficient compacting job.

Likewise, any projects with wet clay or other fine-grained soils at great depths should use this type of roller. You can finish off areas compacted by sheepsfoot rollers by going over them with a pneumatic roller.

Smooth Wheeled or Static Rollers

There are generally two types of smooth wheeled rollers: single and double drum roller. They are also known as static rollers.

Double Drum or Tandem

The tandem, or double drum roller, has one steel drum in the front and one in the back. As the two drums move, this moves the roller. The efficiency of the tandem roller comes from the two drums — entire sections of a highway can be flattened and paved quickly and efficiently.

These rollers are great for flat or gradual surfaces like asphalt, but because they have very little traction, they're not recommended for anything specialized.

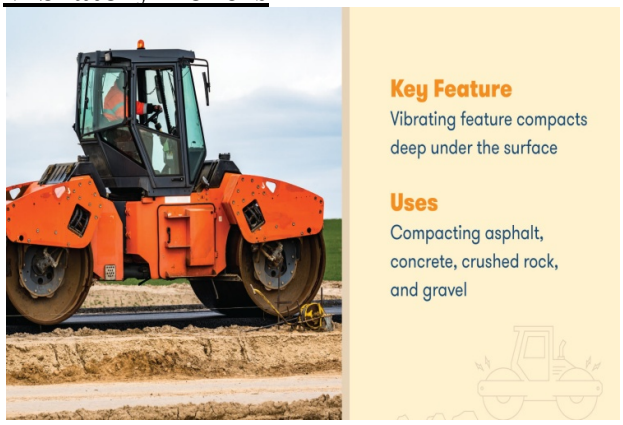
Single Drum or Three-wheeled

Three-wheeled or single drum rollers are some of the most common pieces of heavy-duty machinery. When people think of road rollers, they typically picture a three-wheeled roller. They typically have a steel drum in the front and two special wheels in the back that can prevent most flat tires from happening.

Single drum rollers can work in tighter spaces and more specialized projects due to their smaller size. They're great for creating foundations for buildings and paving highways or sidewalks, but because of the extra weight in the front, they won't roll over some surfaces.

One thing to note is that single-drum can also refer to other rollers, such as the padfoot or smooth roller. Understanding that aspect can help differentiate exactly what you need.

Vibratory Rollers



Vibratory rollers are almost identical to smooth wheel rollers (including the single and double drum) except for one major difference: they come with a specialized vibrating component. As the roller compacts and flattens the surface, it will vibrate.
Since soil, asphalt, and concrete have natural empty spaces, they can cause a building to warp and sink, causing damage to the structure. Using a vibratory roller on your construction project can help keep the building's structural integrity. Other types of soil that vibratory rollers are great at compacting are crushed rock or gravel.

6.4 OWNING & OPERATING COST :-

Ownership cost :-

Ownership cost is the cumulative result of those cash flows an owner experiences whetheror not the machine is productively employed in a job.

-The most significant cash flows affecting ownership cost are :-

i) Purchase expenses

ii) Salvaged value

iii) Tax saving

iv) Major repair & over hauls

v) Property tax

vi) Insurance

vii) Storage miscellaneous

i) Purchase expenses :-

The case out flow, the firm experience in occurring ownership of a machine is the purchaseexpense.

-It the total delivered cost including amounts for all option shipping & tax less the cost of

tired if the machine as rubber tyres.

ii) Salvaged value :-

Salvaged value is the cash flow a farm receive if a machine still has value at the time of its disposal.

-This revenue will occur at future data, used equipment prices are difficult to predict.

iii) Tax saving :-

The tax saving from depreciation are the phenomenon of the tax system in the united states.

-Under the tax laws of united state the depreciating a machine lose in value will as lesser the net cost machine ownership.

Straight line method of tax depreciation :-

The annual amount of depreciation (DN) for any year (N) is a constant value & thus the book value (BV_M). Decreases at a uniform rate over useful life of the machine the equation are:-

Depreciation rate, $R_n=1/N$

Where, N= Number of year

Annual depreciation amount D_n= unadjusted basis *R_n

= unadjusted basis/N

Book value in year n= BV_m= unadjusted basis-(n*D_n)

Problem no :-1

A tractor which adjusted basis Rs 3,50,000 & assume it has an estimated useful life of 5years. Determine the depreciation & book value for each of the 5year using the straight line method.

Ans : Given data :

Number of year, N= 5year

Unadjusted basis = Rs3,50,000

Depreciation rate =R_n =1 ÷ N =1 ÷ 5 =0.2

Annual depreciation amount, D_n = unadjusted basis×R_n

=350000×0.2

=70000

Book value in year, BV_M = unadjusted basis –(n ×D_n)

$=350000 –(0\times 70000)$

$=350000$

BV_m = unadjusted basis $–(n \times D_n)$

$=350000 – (1 \times 70000)$

$= 2,80,000$

BV_m = unadjusted basis $–(n \times D_n)$

$=350000 – (2 \times 70000)$

$= 2,10,000$

BV_m = unadjusted basis $–(n \times D_n)$

$=350000 – (3 \times 70000)$

$= 1,40,000$

BV_m = unadjusted basis $–(n \times D_n)$

$=350000 – (4 \times 70000)$

$= 70,000$

BV_m = unadjusted basis $–(n \times D_n)$

$=350000 – (5 \times 70000)$

$= 0$

A five year class machine is purchased for 1,25,000. It is sold in the 3rd year after purchases for Rs 91,000. What are the depreciation amount & what is book value of machine when it is sold. There will be income tax, if so on what amount.

Ans :

For five year depreciation rate, $R_n = 1 \div N = 1 \div 5 = 0.2$

Annual depreciation =Rs $1,25000 \times 0.2 = 25000$

For 3year depreciation rate, $R_n = 1 \div N = 1 \div 3 = 0.33$

Annual depreciation rate, $R_n = 125000 \times 0.33 = 41250$

Total annual depreciation = 25000+ 41250 =66,250

Total tax amount = 91000 – total annual depreciation

= 91000 -66250 =24750.

Measure repairs & over hauls :-

Measure repairs & over hauls are included under ownership cost because they result in an extension of a machines service life.

-They can be considered as investment in a new machine because a machine commonlyworks on many different projects considering major repair as an ownership cost, these expenses to all jobs.

-These cause should be added to the basis of the machine & depreciated.

Property taxes :-

In this context taxes refer to those equipment ownership taxes that charged & government subdivision.

-They are commonly used as a percentage rate applied against the book value of the machine.

-Depending upon location property taxes can range up to about 4.5% in many location. There will be no property tax on equipment over the service life the machine. They will decrease in magnitude as the book value decreases.

Insurance :-

Insurance as considered here, includes the cost to cover fire, theft & damage to the equipment.

-Annual rate can range from 1 to 3%. This cost can be actual premium payment to insurance companies or it can represent allocation to a self insurance fund maintained bythe equipment owner.

Storage & miscellaneous :-

Between job or during bad weather a company will require storage facilities for its equipments.
-The cost maintaining storage place a facility should prorated to those machines that requires such harbourage. The rate may range from nothing to perhaps 5%.

Operating cost :-

Operating cost is the sum of those expenses an owner experiences by working a machine on a project. Typical expenses includes:-

i) Fuel

ii) Lubricants (lube oil, filter, greases)

iii) Repair

iv) Tyres

v) Replacement of high wear items

Fuel :-

Fuel expenses is best determined by measurement on the job. Good service record tells the how many gallons of fuel a machine consumes over that period of the time & under what job condition.

Hourly fuel consumption can be calculated directly, when company record are not available manufactures consumption data can be used to construct fuel estimate.

Lubricants :-

The cost of lubricants, filters & greases will be depend on the maintenance practice of the company & the condition. In either case hourly cost arrive at by the operating hour between changes & consumption centre.

Repairs:-

Repairs are refer to here mean normal maintenance type repair.

-These are the repairs expenses include on the job site where the machines is operated & would include the cost of parts & labours.

Tyres :-

Tyres for wheel type equipment are a measure operating cost because they have a short lifein relation to the iron of a machine.

-Tyre cost is include repair & replacement charges. These cost are very difficult to estimate because of the variability in tired wire with project site condition & operator skill.

Replacement of high wire items :-

The cost of replacing those items that have very short service lives with respect to machine service live can be a sustainable operating cost.

POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER:

Q-1 On which factor selection of equipment depends on :

Ans : The selection of equipment depends on

*Availability of equipment

*Utility of equipment

*Production cost of equipment

*Useful life of equipment

*Durability of project etc.

Q-2 What are the functions of dragline & bull dozer ?[2014-s,2012]

Ans : Dragline is one type of excavator, which is used for digging at or below the operating level.

A bull dozer is a very useful equipment & can be used on the construction work for following purposes:

*To clear the site at work

*To prepare pilot road through mountains hard ground etc.

Q-3 Where & why vibrating compactors are used ?[2014-s,2017-s]

Ans : Vibratory compactors are used at the construction work site, this type of compactors is the most suitable for course grained soils.

Q-4 What is drag line ?2019-s]

Ans : Drag line is one type of excavator, which is used for digging at or below the operating level.

POSSIBLE LONG TYPE QUESTIONS

Q-1Briefly describe the classification of bulldozers & its uses.

Q-2 Enumerate different earth moving & compacting equipments including their specificuses.[2013-s,2014-s]

Q-3 Describe different earthmoving & compacting equipments indicating their specific use& draw the sketches.[2017-s]

Q-3 Write short notes on :[2016-s]

***Smooth wheel roller**

***Vibrating compactors**

***Bulldozer**

Q-4 Distinguish between lift, escalators, & elevators indicating their types & uses.[2017-s]

Q-5 Explain any five types of construction equipments.[2018-w]

Q-6 Explain various kinds of earth moving equipment.[2018-s]

Q-7 Describe the owning cost in details.[2018-w]

CHAPTER NO :-7

SOIL REINFORCING TECHNIQUES

Learning objective

7.1 Necessity of soil reinforcing.
7.2 Use wire mesh and geo-synthetics.
7.3 Strengthening of embankments, Slope stabilization in cutting and embankments by soil reinforcing techniques.

7.1 NECESSITY OF SOIL REINFORCING :

Soil reinforcing is the act of improving soil strength to enable its support or can try more load.

-Reinforced soil is the technique where tensile element are placed in the soil to improve the stability & control deformation.

-To be effective , the reinforcement must intersect potential failure surface in the soil mass.

-Soil reinforcement may be made with a number of material :

a) oven geo-textile polymer

b) Geo-grid of polyethylene

c) Polyester & fibre glass

d) Steel strips

e) Weld wire mesh

Reinforced soil structure fall broadly into three classes

a) Mechanically stabilized earthwork
b) Reinforced slopes & embankment

c) Reinforced foundation.

Selection of reinforcement should include an evaluation of candidate products for serviceability during construction.

7.2 USE WIRE MESH & GEO-SYNTHETICS :-

Geo-synthetics are synthetic product used to stabilized terrain of these four material can be combined with another synthetic material. (i.e. deformed plastic sheets or steel cables) or even with soil.

Use of core fibres for sustainable development :-

In the context of sustainable development which is a balancing act between the fulfilment of human needs & the protection of the natural environment, the use of natural fibres such as coir in geo-technical application is desirable.

-Reinforcing the soil with coir fibres geo-textiles is a cast effective solution to the ground /soil improvement problem.

-The effects of fibre parameters on the strength, stiffness & compressibility behaviour of soil where studied in detail.

-The effect of coir fibres on swell response of expansive black cotton soil was also studied in terms of percentage swell/time variation for various fibre contents.

-Results showed that conclusion of fibres increases strength, stiffness, reduces the compressibility & swell potential.

-The evaluation of hydraulic behaviour of coir fibre reinforced soil is another area in which studies were carried in detail.

-It is observed that addition of fibres reduces the seepage velocity of plain soil considerably & thus increase the piping resistance.

Geo-cell reinforced foundation :-

The behaviour of geo-cell reinforced foundation bed was studied in detail in which the efficiency of geo-cell reinforcement was brought-out in different foundation bed such as sand beds, soft clay beds & sand overlying soft clay beds.

-Extensive instrumentation was done to obtain real behaviour of the reinforced foundation bed which include strain gauge to measure the accumulated strain in the geo-grid material& earth pressure cells to measure the normal pressure transferred to the sub-grade soil.
-Model load test were also conducted to evaluate the potential benefits of providing geo-cell reinforced sand mattress over clay bed with a continuous circular void.

Soil nailing :-

Soil nailing is one of the extensively used techniques for stabilizing vertical cuts in India & work of Indian institute of science significantly contributed to this development.

-A few case studies & analytical results which have been published are described as follows :

-In one of the case studies, a vertical cut supporting a masonry retaining wall in a hilly terrain (total height =13m) was stabilized using this techniques.

-Calculation showed that the vertical cuts was just marginally safe in the existing

Condition; hence, soil nailing was used for improvement of stability.

7.3 STRENGTHENING OF EMBANKMENTS, SLOPE STABILIZATION IN CUTTING AND EMBANKMENTS BY SOIL REINFORCING TECHNIQUES

Strength of embankment :-

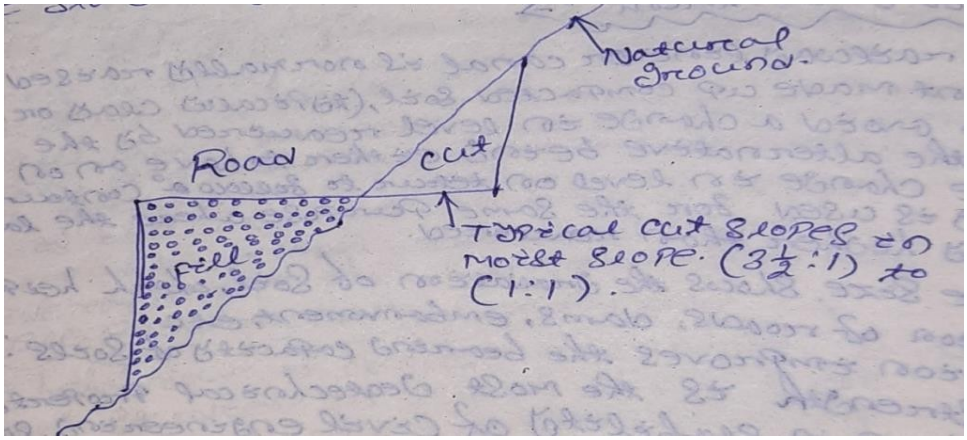
A road, railway line or canal is normally raised on to an embankment made of compacted soil (typically clay or rock based) to avoid a change in level required by the terrain the alternatives being either to have an on acceptable change in level on detour to follow a contour, a cutting is used for the same purpose where the land is originally higher than required.

-particle size shows the gradation of soils, which helps in construction of roads, dams embankments etc.

-Compaction improves the bearing capacity of soils.

-Shear strength is the most important geo-technical property of soils, help in stability of civil engg. Structures on or below the earth.

Slope stabilization :-



On soil covered slopes, soil is constantly moving down slope due to gravity. Slope angle, water, climate & slope material contribute to the movement.

-The field of slope stability includes the stability of slope of earth & rock-fill dams, slope ofother type of embankments, excavated slopes, & natural slopes in soil soft rock.

-Slope stability is typically evaluated in a geology or geo-technical engineering study.

-Land slides & failed road cuts & fill can be a major source of sediment, they can close the road or require major repairs & they can increase road maintenance cost.

-Over steep fill slopes commonly formed by side casting loose fill material, may continue to ravel with time & difficult to stabilize.

-The rocks fill can be stable with a slope ideally fills should be constructed with a 2:1 or flatter slope to promote growth vegetation & slope stability.

-Slope failure or land slides typically occur where a slope is over-steep, where fill material is not compacted where cuts in natural soils or zones of weak material.

-Good road location can often avoid land slide areas & reduce slope failures.

-Why failures do occur, the slide area should be stabilized by removing the slide material, flattering the slope, adding drainage or using structures.

-Failures that occur typically impact road operations & can be costly to repair.

-A wide range of slope stabilization measures is available to the engineer to solve slope stability.

POSSIBLE SHORT TYPE QUESTIONS WITH ANSWER:

Q-1 What do u mean by soil reinforcing ?[2019-s,2016-s]

Ans : Soil reinforcing is the act of improving soil strength to enable its support or carry more load. Reinforced soil is the technique where tensile element are placed in the soil to improve stability & control deformation to be effective the reinforcement must intersect potential failure surface in the soil mass.

Q-2 What do u mean by reinforcing ?[2016-s]

Ans : Strengthening concrete, plaster or mortar by embedding steel rods or wire mesh init is known as reinforcing.

Q-3 Define soil nailing ?[2018-s]

Ans : Soil nailing is one of the extensively used techniques for stabilizing vertical cuts inIndia & work at Indian institute of science significantly contributed to this development.

Q-4 Why soil reinforcing is essential ?[2018-w]

Ans : In geo-technical engineering, soil is restored & reinforced with the distribution of minerals & soil nutrients.

-Soil reinforcement is necessary in lands where chances of erosion are high. It is particularly useful in areas with soft soil as it can't provide adequate support to any construction or building.

POSSIBLE LONG TYPE QUESTIONS

Q-1 Write short notes on any two :[2016-s,2017-s,2018-w,2019-s]

i) Wire mesh

ii) Geo-synthetics

iii) Slope stabilization

Q-2 Write the uses of wire mesh & geo-synthetics in soil reinforcing techniques.[2018-w]

Q-3 Describe various soil reinforcing techniques.[2018-w]