PART -C

5.0 Building Services

a) Cold Water Distribution in high rise building, lay out of installation

b) Hot water supply – General principles for central plants-layout

c) Sanitation –soil and waste water installation in high rise buildings

d) 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

e) Lighting – Requirement of lighting, Measurement of light intensity

f) Ventilation
i) Methods of ventilation – Natural and artificial
ii) Systems of ventilation, problems on ventilation

g) Mechanical Services- Lifts, Escalator, Elevators – types and uses.

PART- D

6.0 Construction and earth moving equipments -

a) Planning and selection of construction equipments

b) Study on earth moving equipments like drag line, tractor, bulldozer, Power shovel

c) Study and uses of compacting equipments like tamping rollers, Smooth wheel rollers, Pneumatic tired rollers and vibrating compactors

d) Owning and operating cost – problems

7.0 Soil reinforcing techniques

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.

Part-C

: Building Services :-

=> Building services are the system install in a building to make them confortable, functional, effecient & safe.

=> Specialist building services might also includes system for bacteria & humidity control, specilist lighting, and securicity emergency power. Specialist gas distribution operation theakers & so on.

=> Building services play a central roll in contributing to the design of a building not only in terms of over all strategious & standards to be achieved but also in facade engg., the weights, sizes & location of majorplant & equipment, the position of vertical service riser, routs for distribution of horizontal services, drainage energy sources etc.

=> This means that building services design must be integrated into overall building design from a very early stage particularly on complex building project.

-> Building services might include;-

Building control systems, energy supply, energy distribution, escalators & lifts, heating, ventilation, and air conditions, lighting, water drainage & pumbing security and alarm system etc.

Cold water distribution in high rise building:-

i) Cold water system provides water for the following purpose.

1. Drinking
2. Cooking
3. Sanitary
4. Washing
5. Gardening.

On cold water distribution, the high rise building use several pumping schemes.

i) Single Zone (tank at the top will fill pumps at bottom) :-

=> The most common system used in late 1900s and early 1900s consisted of a roof tanks combined with constant speed pumps that operated by a level switch in tank.

=> When the level in tank would approach a required height, the pumps would either turn on to fill tank or turn off when the tank is full.

ii) Multiple Zone (Highzone tank & low zone tank) :-

=> If multiple zones were required multiple tanks were used. An air gap creates a pressure break bet^n the upper & lower zones.

=> The tanks must be sufficiently elevated for adequate pressure at the 1st floor connected.

iii) Multi zone cold water distribution with multiple pumps:-

=> Once the reliability of pumps & power supply was established multiple booster pumps with constant speed, pressure controls were utilized with one pump for each zone.

iv) Pressure regulating valves :-

=> Pressure regulating valves provided another means of separating the building into zones, with a pumped system supply pressure to lower zone is controlled by PRV and pump discharge pressure is set for supply to other upper zone.

v) Variable Speed pump System :-

=> Variable speed control pumps can be used which can

reduce energy consumption over the life of the system. life while increasing system life by years.

⇒ Because a constant water pressure is desired in building various control schemes can be employed to maintain desired pressure with varrying flows

iii) Basically there are 2 distribution system of cold water;

a) direct method

b) Indirect method :-

→ Down feed or gravity system (overhead faced system).

→ Hydropneumatic system (Air pressure system).

iv) ⇒ Direct method is a system where by all the sanitary fittings are supplied with cold water direct from the mains. Unfeed system usually originate from pressure boosted pumpset.

v) Gravity system where by all drinking water used in the building is supplied from the main & water used for all other purpose is supplied indirectly from cold water storage.

vi) Downfeed system usually originate from a roof top gravity tank. Here water is pumped into a large tank on top of the building & is distributed to the fixture by means of gravity.

vii) In hydropneumatic system, when pressure supplied by city water supply is not strong enough, compressed air is used to raise & push water into the system.

viii) Where hydropneumatic tanks are used for storage the tank is filled to 1/3 to 1/2 full by a float level device that controls drinking water supply source.

→ The pressure is maintain & at desired operating level by an air compressor as building used water from tank water level & air pressure drop.

→ When water level drops to 'on' setting on float level control the booster pump starts & raise water level in tank to 'off' level. The restores pressure in tanks.

→ If some captive air above water has been absorbed by the water, the air compression starts & restores the air charge, rising system pressure to normal level.

Hot water supply - General principles for central plant:-

⇒ Hot water supply as the distribution of stored heated water to consumers. The water can be heated using feeds such as coal, gas, electricity, nuclear energy etc.

⇒ It is widely used for contain sectors such as for high and residential & commercial buildings such as; medicals, hotels, manufacturing industry etc..

⇒ If a central hot water productions used the hot water is distributed from the central hot water tank to the apartments with a hot water pipe & hot water circulation pipe.

⇒ The general principle as follows are applicable -

i) Avoid installing the circulation pipe in the apartment, use only supply pipes for the users.

ii) The max^m practice in the distribution system is 600kpa.

iii) The user practice for each apartment has a min^m of 200kpa.

iv) The max^m practice for hot water storage tank is 100kpa.

⇒ Each practice zone needs a separate hot water system. It is not possible to locate the hot water storage tank in the basement because of high static practice.

⇒ In centralised system when water is heated it becomes less dense than cooler water. Because hot water rises it is drawn off from the top of storage vessel to supply various taps.

⇒ The 'cold feed' is supplied low down in the vessel thus preventing unnecessary cooling to previously heated water. At highest point in the system a vent pipe is run up to terminate with an open end just below the feed cistern lid.

⇒ The temprature at which the water is stored in the cylinder should not exceed 60°C. Some means of control the temprature should therefore be provided.

⇒ On high rise building certain precaution be observed in the design of hot & circulation water system. Each zone must be considered as a complete system with no interconnection with any other zone.

⇒ Each zone must have its own water heater, distribution piping, circulation hot water piping & circulation pump.

⇒ It is always desirable to locate the heater at the top of the system. The practice on the heater & circulation pump are subjected to are much less than at the base of the system.

Sanitation - soil & waste water installation in high rise buildings :-

⇒ In the drainage system for a multi-storey building, the drains from the plumbing fixtures are connected to vertical drain stacks that convey the waste & sewage to below the lowest floor of the building.

⇒ The fixture drain traps must be vented to prevent their water trap seal from being siphoned by negative pressure or blown out by positive pressure in the drain piping.

-> The fixture vent pipes must extend through the roof to outdoors.

=> They can be run individually or be combined into one or more vents through the roof.

-> Where buildings are over 10 storeys high, the drainage stacks require relief vent connections at specified intervals from the top and connected to a vent stack that terminates above the roof. This relieves and equalizes the pressure in the drainage stack to maintain the water seal in traps serving plumbing fixtures.

=> Where ever possible, the sanitary drainage system from a building should discharge to the public sewer by gravity.

=> All plumbing fixtures located below ground level should be pumped into the public sewer or the drainage system leading to the sewer.

=> The pump line should be as short as possible & looped up to a point not less than 0.6 meters (24 inches) above ground level to prevent back siphonage of sewage.

=> The pump discharge rate should be controlled so as not to cause scouring of the internal bore of the pump line or the drainage or sewer system into which it discharges.

=> High velocity discharge rates may also cause the flooding of adjoining plumbing fixtures or overloading of the sewer itself.

- The sump pits for sewage pumps must have sealed covers, be vented to outdoors & have automatic level controls & alarms.
- Sewage pumps in multiple dwellings & in multi-storey dwellings should be duplex, with each pump having 100% of the required pumping capacity for the building.
- Alternatively, an approved vaccum draingge system may be considered.

There are four types of plumbing system installed in a building

i) One pipe System:-

- In this system all soil & waste water discharge into one common pipe and all branch ventilating pipes into one main ventilating pipe.
- In this system only one vertical pipe shall be provided for collecting both excreta & sullage. The main pipe shall be ventilated at the top as well as a separate vent pipe shall also be provided.
- This system largely replace the two pipe system & lent itself very well in use multistorey development.

ii) Two pipe System:-

- This is the best & most efficient system of plumbing two sets of vertical pipes, one for excreta as soil pipe & another for sullage as waste pipe.
- The soil pipe as well as waste pipe shall be separately ventilated by providing separate vent pipes.
- The waste stack recieved the discharge abuitting

fitments & conveyed this to ground level where it was delivered above the water seal in trapped gully connected to drainage system.

⇒ The soil stack receives the discharge from soil appliances & delivered it direct to underground drainage system.

⇒ The waste & soil water did not combine until they reached the below ground drainage system.

iii) Single Stack System:—

⇒ This system is having a single pipe for soil, waste & vent without any separate vent pipe.

⇒ It shall only one pipe to recieve all types of waste & the same pipe shall be extended up to two meter above roof level with a conical to act as vent pipe for removal of gasses.

⇒ It reduces cost of soil & waste system. To prevent loss of trap water seals.

a) The trap water seals on the waste traps must be 76mm deep.

b) The slopes of the branch pipes are - sink & bath 18 to 19 mm/m, basin 20-120 mm/m, wc 18mm/m.

c) Vertical Stack at 200mm below the centre of the wc, branch connection.

iv) Partially ventilated single stack system:-

⇒ This is an improved form of a single stack system, where the traps of the water closets only shall be ventilated by a separate vent pipe.

⇒ This system shall have two vertical pipes as in one pipe system.

Lighting :-

=> Lighting or illumination is the daily basis use of light to achieve practical or aesthetic effects.

=> Lighting includes the use of both artificial light sources, light lamps and light fixtures as well as natural illumination by capturing day light.

=> Proper light can enhance task performance, improve the appearance of an area or have positive psycological effects on occupants.

Requirement of lighting :-

The requirements of good lightings are describes as follows;

1) Sufficiency :-

=> Light need to be sufficient to see the objects properly unsufficiency lighting cause to eye strength.

=> About an illumination that comes out from a 15-20 candels are enough as sufficient light.

2) Distributions :-

=> The efficient vision without any eye stress is occures by uniformity in light distribution.

=> Light distribution should be proper by establishing the sources of light from the left side.

=> 2 or 3 sources of light can be used from any side with 1 condition i.e it should be the same light with same intensity of light

3) Absence of glare :-

=> Glare is the high contrast of the light.

=> There should be excessive light and high intensity of light cause to glare

=> for ex :- Torch light.

=> These lights are pointed and caused to glare

4) Absence of Sharp Shadow:-

→ Shadows occur when any object take place bet? the light source & field of vision.

→ Shadows creat stress and need to be proper reading process.

→ Ex- Incandescent bulbs, it causes to creat shadiness bul florescent bulbs are proper to avoid shadows & reading.

5) steadyness :-

→ VI

The term refers to stable condition of the light. Light must be constant with constant contrast & contrast intensity.

→ Flickering lights are creating eye strength & headache

6. Colors of light :-

→ If we use red or violet lights the effective readings will not take place because the intensity of these lights are higher than normal light.

→ Day light is the sufficient immulsion needed by the eye to fulfill reading procex.

→ Artificial light need to be like day light contrast.

7. Surroundings :-

→ The term refers to the back ground field of vision. As a requirement to good lighting.

background has a major role.
⇒ The walls in the room & the ceiling creats reflections. and it is essential to accumulation of the light.
⇒ If we use glass of walls are black background it absorbs the light and there is no possibelity of reflection. So surrounding should be in a normal condition by using proper materials cause to reflection.

8. Angle of Lighting:-

⇒ Light source should be establish in a proper way that lead to effective lighting by a reflection.
⇒ If the light is established in an proper condition their should not be any reflection and the efficiency will be lost.
⇒ For effective reading light source is better to establish in left side of the wall than ceiling & other sides.

Measurement of Light Intensity:-

⇒ Light intensity refers to the strength or to the amount of light produce by specific source. It is the major of the wave length, weighted power emitted by the light source.
⇒ Measurement of the light is generally concern with the amount of use ful light falling on the surface & the amount of light emerging from the lamp & other sources

along with the colours that can be rendered by this light.

⇒ The human eye respond differently to the light from different parts of the visible spectrum. Therefore photometric measurement must take the luminosity function into account when measuring the amount of use ful light.

⇒ The basic SG unit of measurement is the "Candela" (cd) which describe the luminous intensity, all other photometric units are derived from the candela.

⇒ Luminans fore instance is a major of density of luminous intensity in a given direction.

⇒ The SG unit fore luminance is 'candela/m^2'. CGS unit of luminance is 'Stilb'.

⇒ The amount of use ful light emitted from a source or the luminous flux is measured in 'lumen (lm)'.

⇒ The SG unit of illuminans and luminous emittance being luminous power / area is measured in 'lux'.

⇒ Several measurement methods have been devloped to control the glare resulting from indoor lighting design.

⇒ The unified glare rating (UGR), the visual comfort probability, the day light glare index are some of the most well known method of measurements.

Ventilation:-

Ventilating is the process of changing or replacing the air in any place to provide high indoor air quality (i.e to control the temprature, replacing oxygen, removing moisture, smoke, heat, CO_2 & air borne bacterea etc.)

⇒ Ventilation is used to remove the unpleasant smell & excessive moisture introduce out side air to keep the interior building, air circulating & to prevent temprature of the indoor.

⇒ Ventilation include both the exchange of air to outside as well as circulation of the air with in the building. It is the most important factor for maintaing acceptable indoor air quality in the building.

Methods of Ventilation:-

⇒ The method of ventelation is categorised as 2 types.

i) Natural ventelation
ii) Artificial Ventelation

i) Natural Ventelation:-

⇒ Natural ventelation is the intentional passive flow of the out door air into a building through plant opening such as door, window etc.

⇒ It doesn't require any mechanical system to move the out door air, instead it relize entirely on passive physical phenomenon such as wind pressure

effect and stack effect.

=> Natural ventilation opening may be fixed or adjustable. Adjustable openings may be controlled by automatically controlled by occupans or combination of both.

=> Natural ventilation may be employed where presize control over the air condition & the rate of air change is not require.

=> Thus natural ventilation is usually considered suitable for residential building & small houses but it is not suitable for big offices, assembly hall, theator, auditorium, large factory, workshop etc.

=> This is very economical since no equipment is required for keeping the room ventilated rather desired ventilation is achieved by the provision of sufficient opening exposed to external air.

=> The rate of natural ventilation depends on two effect i.e

a) wind effect
b) Stack effect.

a) Wind Effect :-

=> When the winds collides with the side of a building, different amount of pressure are exerted upon different sides of building.

=> The side directly facing the wind experience the highest force of air & as a result a higher air pressure mean while the othe side experience

lower air pressure

=> This difference in pressure causes the air to move change its pace to seek equilibrium.

=> The air on the higher pressure side flows towards the air on the lower pressure side at an increase rate

=> In the ideal case, the lower pressure side is the building interior.

=> Another opening on the lower pressure side would allow the interior air to circulate outwards to the side with the lower air pressure. This would increase air movement through out the building & again accelerate the feeling of breeze

b) Stack Effect:-

=> As air gets warmer it becomes less dense. This means that warm air has a tendency to rise. This effect can be used to naturally ventelate the buildings

=> Cooler out side air is drawn into the building at a lower level, it is warmed by the source of heat within the building & then rises through the building to vent out at higher level.

=> A positive pressure area is created at the top of the building & negative pressure area at the bottom. This process can take place without any mechanical assistance, simply by introducing openings at the bottom & the top of the building. It is known as stack effect or stack ventelation.

ii) Artificial Ventilation :-

-> Artificial ventilation is the intensional fan driven flow of outdoor air into a building

-> Mechanical ventilation may be achieved in one of the following base;

i) Natural supply and mechanical exhaust of air.

ii) Mechanical supply and natural exhaust of air.

iii) Mechanical supply and mechanical exhaust of air.

=> Mechanical ventilation may include supply fans (which push out door air into a building), exhaust fans (which draw air out of the building) and there by cause equal ventilation flow into a building) or combination of both.

-> Mechanical ventilation is often provided by equipment ie also used to heat and cool a space.

=> It is suitable under those circumstances where satisfactory standard of ventilation in respect of air quantity, quality or control ability can't be obtained by natural means.

=> In this method outside air is supplied into building either by positive ventilation or by infilteration by reduction of pressure inside due to exhaust of air or by a combination of positive ventilation & exhaust of air

=> The supply of outside air by means of a mechanical device such as a fan is termed as positive ventilation where the removal of air & it's disposal to outside is termed as exhaust of air.

System of Ventilation :-

=> All the fans vents and ventilation equipments in a home work together as a ventilation system to exchange indoor & outdoor air without wasting energy

⇒ The right ventilation system for a particular house depends upon the climate & the needs of structure.

⇒ Ventilation system is catagorised into four types

i) Exhaust Ventilation system.

ii) Supply Ventilation system.

iii) Balanced Ventilation System.

iv) Energy recovery system.

i) Exhaust Ventilation System!-

⇒ Exhaust ventilation System worked by depressenising the buildings.

⇒ By reducing the inside air pressure below the out door air pressure they extract indoor air from a house ~~[illegible]~~ while make up air infilterate through leaks in the building shell and through intensional passivent.

⇒ Exhaust ventilation system are most applicable in cold climates.

⇒ In climates with warm & humid summer depressurizati can draw moist air into building wall cavities where it may condence & cause moisture damage.

⇒ This system are relatively simply & inexpensive to install

⇒ Typically exhaust System is composed of a single fan connected to a centrally located single exhaust points in the house.

⇒ One concern with exhaust ventilation system is that they may draw along with fresh air into the house.

⇒ This can especially be of concern when bath fans, range fans & clothes dryer (which also depressurise the home while they operate) are run when an

exhaust ventilation system is also operating

=> This system can also contribute to higher heating and cooling cost compare with energy ventilation recovery system because exhaust ventilation system do not temper or remove moisture from the make up air before it enters into the house

ii) Supply Ventilation System:-

=> Supply ventilation system work by pressurising the building. They use a fan to force outside air in the building while air leaks out of the building through the holes to the shell, bath and trench fans ducts and intensional vents

=> As with exhaust ventilation system supply ventilation system are relatively simple & inexpensive to install.

=> A typical system has a fan & duct system that introduce fresh air into usually one but preferable several rooms that residents occupy most

=> This system may include adjustable window or wall vents in other rooms.

=> This system works best in hot or mixed climates because they pressurise the house, they have the potential to cause moisture problems in cold climates.

=> Supply ventilation system allows better control of air that enters the house than do in the exhaust ventilation system.

=> They also allow air introduce into the house to be filtered to remove dust or to dehumidified.

=> In winter the supply ventilation system causes warm interior air to leak through randoms opening in

the exterior walls and ceilings. If the interior air is humid enough. Some moisture may condense in the parts of exterior wall where it can promot by mild-dew, mold & decay

=> Like exhaust system they do not temper or remove moisture from the air before it enters the house.

=> Thus they may contribute to higher heating & cooling cost compared with energy recovery system.

iii) Balanced Ventilation System :-

=> Balanced ventilation system is properly designed & installed, neither pressurise nor depressurise a house is required

=> Rather they introduce & exhaust approximately equal quantities of freshed out side air & polluted inside air respectively.

=> A balanced ventilation system usually has 2 fans & a duct system.

=> It facilate good distribution of fresh air by placing supply & exhaust vents in appropriate places

=> A typical balanced ventilation system is design to supply fresh air to the bed rooms & common rooms, where people spent most of the time.

=> It also exhaust air from rooms where moisture & pollutants are most often generated such as kitchen, bathroom, etc.

=> Like both supply & exhaust system balanced Ventilation system do not temper or remove

moisture from the air, before it enters the house.

=> They do however use filters to remove dust from outside air before introducing it into the house.

-> Like supply ventilation system outdoor air may be need to mixed with indoor air before delivery to avoid cold air in the winter. This may contribute to higher heating & cooling cost.

=> Balanced ventelation system are appropriate for all climates because they required 2 ducts & fan systems. They are usually more expenssive to install and operate than supply & exhaust system.

iv) Energy Recovery System:-

=> Energy recovery ventilation is the energy recovery proces of exchanging the energy content in normally exhausted building or space air & using it to treat the incoming outdoor ventelation air in residential & commercial HVAC system.

[Heating Ventilation Air Condition. HVAC]

=> During the warmer season, the system precools and dehumidifies while humidifing and preheating in the cooler season.

=> Energy recovery ventelation system usually caused more to install than other ventelation system. On general simplicity is the key to the cost

effective installation.

=> To save installation cost many sytem share existing duct work. Complex systems are not only more expenssive to install but often they also require more maintainance & consume more electric power.

=> For most houses attempting to recover all of the energy in the exhaust air well probably not be worth the additional cost. Also this type of ventelation system are not still very common. Only some HVAC contractor have enough technical expotse & experience to install them.

=> Energy recovery ventelation system operated in the cold climates must have devices to help in preventing freezing & frost formation.

=> Very cold supply air can caused frost formation in the heat exchanger which can damage it.

=> Frost build up also reduces ventelation effectiveness. Inaddition to it energy recovery ventelation system need to be clean regularly to prevent deforation of ventelation rates & heat recovery, to prevent mold and bacteria from forming on heat exchange surface.

Problems on Ventilation :-

-> In hot humid climates on condition ventilation air will deliver one pound of water each day per each CFM (Cubic feet per minute) of out door air per day on annual average basis.

[1 pound = 0.45 liter]

=> This is a great deal of moisture and it can creat serious indoor moisture & mold problems.

=> Ventilation efficiency is determined by design & lay out & it is depend upon placement & proximity of deffusers & return air outlets.

-> If they are located closely together supply air may mix with stale air decreasing the efficiency of the HVAC system & creating air quality problems.

=> System inbalances occur when the components of the HVAC system are inproperly adjusted or installed & can creat pressure difference (too much circulating air creating a draft or too little circulating air creating stagnancy).

=> Cross contamination occurs when pressure differces arrise forcing potential contaminated air from 1 zone to other uncontaminated zone. This often envolve undesired orders or VOCs (Volatile organic compound)

=> Reentry of exhaust air occurs when exhaust outlets & fresh air inlets are either too close

on preveling winds change exhaust patteren or by infiltration bet? intect & exhaust air flows.

⇒ Entrainment of contaminated outdoor air through intec flow will result in indoor air contamination. There are variety of contaminated air sources ranging from industrial effluent to vocs put off by near by construction work.

Electrical Services:-

Requirements in high rise buildings:-

The requirements of electrical services in high rise buildings are as follows:-

i) Durability:-

All the electrical instrument used in high rise building & the wiring to be used must be able to withstand the weathering action dampness etc.

Safety:-

It is the most important point to be considered the system selected should be such that even with poor work manship, no dangerous may be produced.

Appearance:-

Appearance is an important consideration from asthetic point of view, a proper position & amount give a smooth functioning & long lasting system along with nice looking.

Mechanical :-

The wireing must be protected from the damages by providing physical protection during its use in building.

Easy Functioning :-

An appliances used in the building should function easily & should not have any problem such that in future the user will not face any sudden dangerious situation which will hamper the life of occupants.

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Following are the high rise building power supply requirements.

i) General lighting & Power :-

⇒ Light for general illumination, seeing task, decorative features in hall ways, stair ways etc.

⇒ Power for appliances & office machines.

(ii) HVAC System:-

Air conditioning for temperature control, Blowers & fan

Heaters for humidity control.

(iii) Transport System:-

Elevators & escalators.

⇒ Conveyors, dumbwaiters etc.

iv) Water Pumps:-

⇒ Portable & non-portable water supply

⇒ Water sprinkler.

⇒ Fire suppression.

⇒ Pumps on drainage

⇒ Sewage ejectors.

v) Communication System:-

⇒ Intercom system.

⇒ Pabx telephone system (Private Automatic Branch exchange).

vi) Automatic Doors:-

⇒ Entrance & exist for pedistrian.

⇒ Garerage & freight.

vi) Central Computer System:-

⇒ CPU & peripherals.

⇒ Terminals

vii) Auxullaries:-

⇒ Fire suppression & alarm system.

⇒ Sound reinforcement & video facilities

⇒ Intrusion & hold on control system.

⇒ Noise making & aquastic.

⇒ Electrical installation or system are to be provided essentially in hise rise buildings.

⇒ Incorporating all by laws & codes may be devided into following system. i.e power house & power supply distribution system, lighting. water supply, air conditioning & cooling fire & lift safty solution, building management automation system.

⇒ A high rise building electrical system is composed of 100 of components, designed & assembly into a safe system.

⇒ The underground service connect the utility system to main distribution pannel (MDP) of the buildings.

⇒ MDP also contain provision for utility metering as well as instrumation for measurement of voltage & current system.

⇒ For extremly large service multiple conductors may be used usually a in large installation with private load centre, the practice is to used 208/120 V for general lighting & power & 460V for motors. This appears to be more economical & practical arrangement.

⇒ It has become prime concern of the users

as well as service provider to select & design & install electrical system of latest & appropriate technology

B) Lay out of wiring ⇒ Types of Wiring :-

⇒ Electrical wiring is a process of connecting cables & wires to the realated device such as fuse, switches, sockets, lights, fans etc. to the main distribution board in a specific structure, connecting to the utility pool for contineous power supply

⇒ There are 5 types of wiring, they are

i) Cleat wiring
ii) Casing & capping wiring
iii) Batten wiring
iv) Conduct wiring
v) Lead sheathed wiring

i) Cleat Wiring :-

⇒ In this wiring PVC or VIR (Volcanised Gridia Rubber) insulated wire are braided & compounded on walls or seilling with the help of porcelain cleat.

⇒ This ~~wiring~~ wiring system can be weather proof but it is a temporary wiring system not suitable for domestic premises.

⇒ The use of cleat wiring system, is over now a days.

Advantage:-

i) It is simple & cheap.

ii) Most suitable for temporary use.

iii) As cables & wires is in open air therefore faults can be seen & repair easily.

iv) Installation is easy & simple

v) Inspection is easy & simple

vi) Alteration & adition can be easily done.

Disadvantage:-

→ Appearance is not so good.

→ It can't be use for permanent use.

→ It is not lasting due to weather effect, wear & tear & risk of fire.

→ It can be only used on 250/440v on low temprature.

→ It can't be used in ~~temp~~ important & sensitive locations & places.

→ It is not reliable & sustainable wireing.

ii) Casing & capping wiring:-

→ The cables were carried through the wooden casing enclosers. The casing is made up of a strip of wood with parallel grooves cut lengthwise so as to accomodate VIR cables.

→ The grooves were made to separate opposite polarity. The capping used to cover the wires & cables installed & fitting in the casing.

Advantage.-

→ It is cheap

→ It is strong & long lasting

→ Customization can be easily done.

→ It is safe from oil, smoke & rain.

→ No risk of electric shock

=> Stay for long time in the field due to strong insulation of caping & casing
=> of phase & neutral wein is installed in separate slots then repairing is easy.

Disadvantage:-
=> There is a high risk of fire.
=> Not suitable in acidic, alkalies & humidity condition.
=> Costly repairing & need more material.
=> Material can't be found easily
=> White ants may damage the casing & caping of wood.

(ii) Batten Wireing:-
=> Single, double, three core TRS (Tough rubber cables with a circular oval shape cables are used. TRS cables are chemical, water, steam proof but slightly affected by lubricating oil.
=> TRS cables are run on well seasoned & straight teak wood batten with atleast thickness of 10mm.
=> The cables are held on wooden batten by means of tinned brass link clips already fixed on the batten with brass pens & spaced at an interval of 10cm for horizontal run & 15cm for vertical runs.

Advantages:-
=> Wiring installation is simple & easy
=> It is cheap & long lasting, strong
=> Repairing is easy
=> Customization can be easily done.
=> Less chance of leakage current.

Disadvantage:-
=> High risk of fire.
=> Need more cables & wires.
=> Only suitable below than 250V.

-> Heavy wire can't be used.
-> Not safe from external wear & tear & weather effect
-> can't install in humidity

ii) Conduit Wiring :-

-> In this wiring PVC cables are taken through either PVC conduit pipes or through steep conduit pipes.
-> If the conduit pipes are run on surface of the walls & ceiling it is called a surface conduit wiring. It is used in industries to connect heavy motors.
-> If the conduits are run inside the surface of the wars & ceilings & are covered with plastering it is called concealed conduit wiring
=> Concealed wiring is most popular & common method of wiring the residential buildings. The conduit wiring is the safest method of wiring & also looks beautiful.

Advantage:-

=> It is the safest wiring system.
=> Appearance is very beautiful.
=> No risk of mechanical wear & tear & fire electrical Shock.
=> Customization can be easily done.
-> Repairing & maintainance is easy
=> It is reliable, popular, sustainable, long lasting wiring system.
=> It can be used in humidity, chemical effect & smoky areas.
=> It is safe from corrosions & no rise of damage the cable insulation.

Disadvantage:-

⇒ It is expensive wiring system.

⇒ Very hard to find the defects

⇒ Installation is not easy & simple

⇒ Risk of electric shock (increase of metalic pipe without earthing system).

⇒ Very complicated to manage additional connection in future.

v) Lead Sheathed Wireing:-

⇒ This system of wireing employs conductors that are insulated with VIR & covered with an outer sheath of lead aluminium alloy containing about 95% of lead.

⇒ The metal sheath given protection to cables from mechanical damage, moisture & atmospheric corrosion.

⇒ The whole lead covering is made electrically continuous is connected to earth at the point of entry to perfect against electrolytic action due to leaking current & to provide safety in case of sheath becomes live.

⇒ The cables are run on wooden batten & fixed by means of link clips just as in TRS Wiring

Advantage:-

⇒ It is easy to fix & looks nice

⇒ It can be used in damp situation.

⇒ It can be used in situations exposed to rain & sun.

⇒ It provides protection against mechanical injury better than TRS wiring

⇒ Its life is long if proper earth continuity is maintained through out.

Disadvantage :-

⇒ It is not suitable for places where chemical corrosion may occur.

⇒ Skilled labour & proper supervision is required.

⇒ It is costlier than TRS wiring

⇒ In case of damage of insulation metalsheath becomes alive & gives shock so as to provide safety against electrical shock it is necessary that sheath is properly earthed & an earth wire is run side by side with it & all pieces are properly bonded so that not a single cover unearthed.

Fuses and their types :-

=> A fuse is an electrical or electronic device that protect the circuit from different electrical fault like over current or over load.

=> Fuses can be considered as a sacrificial element in the circuit as they act as weak link in the entire circuit.

=> The principal of fuse is based on the heating effect of the electric current.

=> A simple fuse consist of a small conductive material with low resistance & it is placed in series with circuit.

=> The cross-section area of this conducting material is designed such that it allows certain amount of current ie permitted to flow in the circuit.

=> When the current in the circuit exceed this permit value this excessive current will melt the conductive element in the fuse & opens the circuit. This will disconnect the power supply & the rest of the circuit will protected from being damage.

Types of fuses :-

The main catagory of the fuses are based on the type of circuit, they are used in i.e AC & DC fuses.

i) Dc Fuses :-

⇒ Dc fuses are available superior in size & Dc supply has a stable value over zero volts so it is tough to remove & deactivate the circuit.

⇒ There will be a chance of generation of an electric arc bet^n devolve wire.

⇒ To consume this electrodes of Dc fuses located at better distances.

ii) Ac Fuses :-

⇒ Ac fuses is slighter in size & oscilated 120 to 60 times in each & every second from least to highest. As a result there is no scope for arc generation. For this reason Ac fuses are small in size.

⇒ Ac Fuses are classified into two types.

a) HV Fuses
b) LV Fuses.

a) HV (High Voltage) Fuses :-

⇒ HV fuses are generally used in power system & they are typically rated for voltage above 1500 volt & upto 138,000 volt.

⇒ HV fuses are used to protect the transformer either small power transformer or instrument transformer.

=> The fuse part are fabricated with either copper, silver on in some cases tin is used in order to offer consistant & steady performance.

=> HV fuses are classified into 3 types They are as following.

Catridge type HRC (High rupturing capacity) Fuse:-

-> It includes two fuse elements namely low resistance & high resistance that are located parallel to each other.

=> The low resistance wire takes the usual current which is blown out as well as decrease the short circuit current through out the fault state.

Liquid type HRC Fuse:-

=> This type of fuse is packed with carbon tetra chloride also preserved at both the top of caps. Once the error occur when the flowing current surpasses away from the allowable limit and the element of the fuse is blown out.

=> The fluid of the fuse performs as an arc extinguishing standard for HRC fuse type. They may be used to protect the transformer as well as support protection to breaker circuit.

Expulsion type HV Fuse:-

=> This type of fuse are extenssively used to protect the feeders as well as transformer due to they are low priced.

⇒ It is designed for 11kV also their breaking capability is upto 250MVA.

→ This fuse includes on field open finished cylinder designed with synthetic resin bonded paper.

⇒ The elements of the fuse are position in the cylinder & tube tops are linked to appropriate equipment at every finish.

⇒ The arc generating is blown off inside covering cylinder, gases thus shaped. destroy arc

b) LV (low voltage) Fuses :-

→ Low voltage ac fuses are used for voltage less than 1000V.

⇒ LV fuses are again classified into 5 types. They are;

* Rewireable fuse (Semi enclosed type)
* Striker type fuse.
* Switch type fuse.
* Catridge Fuses (Totally enclosed types).
* Drop out fuses.

* Rewirable Fuse :-

⇒ Rewirable fuses are LV fuses which are almost used in small application like wiring in house, small scale industries & other tiny application.

⇒ These types of fuses include two essential part such as fuse, base & fuse carrier. Fuse base & fuse carrier

are fabricated with porcelain & aluminium, tinned, copper & lead respectively.

⇒ The main advantage of fuse carrier is we can simply plug & remove from the base of the fuse without risk of shock.

* Striker type Fuse:-

The striker type of fuse is employed for tripping & closing the electrical circuit. These fuses are having plenty of force as well as displacement.

* Switch type fuse:-

⇒ Basically the switch type fuse is enclosed with a metal switch & also a fuse. These fuses are mainly used in low & intermediate voltage levels.

* Cartridge type fuse:-

⇒ This type of fuse entirely closed containers & the metal contact as well. The application of this fuse mainly include LV, HV & small fuses.

⇒ These type of fuses are classified into two types. They are D-type & Link type fuses.

D-type cartridge fuse:-

⇒ It is composed of the cartridge, fuse base, cap & adaptex ring. The fuse base has the fuse cap, which is fitted with the fuse element with cartridge through the adaptex ring

⇒ The connection of circuit is finished when the tilt of the cartridge builds contact through conductor.

Link type Fuse:-

⇒ In this type of fuse the flow of current by fuse element is given under normal condition. The arc which is generated by the fuse blown is controlled

is fabricated with porcelain, ceramic & silver.

⇒ The container of the fuse element is packed with silica sand. This type of fuse is again categorized into two parts includes a blade & bolted type.

Blade & bolted type fuse:-

⇒ The knife blade type fuse is designed with plastic. This type of fuse can be simply changable in electric circuit exclusive of any load.

⇒ In bolted type fuse plates of this fuse are conducting are set to base of fuse.

* Drop out Fuses:-

⇒ The drop out fuse is an expulsion type & its main function is to protect transformers on rural distribution network.

⇒ It is also particularly useful for inaccessible sub stations where indication of fusing is of advantage.

Earthing & their Uses:-

⇒ The process of transferring the immediate discharge of electrical energy directly to the earth by the help of the low resistance wire is known as the electrical earthing.

⇒ The electrical earthing is done by connecting the non-current carrying part of the equipment or neutral of supply system to the ground.

⇒ Mostly galvanised iron is used for the earthing. The earthing provides the simple path to the leakage current.

⇒ The short circuit current of the equipment passes to the earth which has zero potential. Thus protects the system & equipment from damage.

⇒ Earthing can be devided into two types.

a) Neutral Earthing
b) Equipment Earthing

=) In neutral earthing the neutral system is directly connected to earth by the help of the GI wire. The neutral earthing is also called the sytem earthing such type of earthing is mostly provided to the system which has star winding

=) Equipment earthing is provided to the electrical equipment The non-current carrying part of the equipment like their metalic frame is connected to earth by the help of the conducting wire.

=) If any fault occurs in the apparatus the short-circuit current to pass the earth by the help of wire. Thus protect system from damage.

Uses of Earthing:-

a) Earthing keeps people safe by preventing electric shocks.
b) It prevents damage to electrical appliances & devices by preventing excessive current from running through the circuit
c) Earthing prevents the risk of fire that could otherwise be caused by current leakage
d) Earthing provides easiest path to the flow of shot circuit current even after the failure of the insulation.
e) For domestic users the common fault that occurs is due to voltage fluctuations. During voltage fluctuation proper earthing plays a key role.

Mechanical Services :-

a) Lift :-

i) Lift is a type of vertical transport equipment that efficiently moves people on good bet^n floors (levels, decks) of a building, vessels or other structure.

ii) Lift can be essential for providing vertical circulation particularly in tall building for wheel chair & non ambulant building users & for the vertical transportation of goods.

iii) Types of lift :-

There are many different types of lift which can be used in different application serving different purposes.

1) Platform lifts :-

⇒ Platform lifts can take a no. of different forms but they are usually used in low rise buildings where they will only travel a few floors at most.

⇒ This means they tend to move more slowly than passanger lifts & are often used for disabled access in buildings where most people will take stairs.

2) Passanger Lifts :-

⇒ Passanger lifts are designed to carry people and can come in a variety of forms. These lifts appear in a variety of ~~lifting~~ settings from shopping centres to private residences.

⇒ They also tend to travel faster than other lift types as they are often used in highrise buildings where passanger may be travelling through multiple floors.

⇒ These lifts can be customized with different design both inside & outside of cabin so they can lift in

with the design, style of space around it.

3) Glass lifts:-

⇒ Glass lifts are a type of passanger lift that have glass walls & doors. They can be used in any situation that a regular passanger lift would be used in but they can offer a stylish alternative.

⇒ They are often choosen for their as that is & can provide a way of maintaining the style of building whilst providing a means of transportation.

4) Evacution Lift:-

⇒ In general it is not appropriate to use lifts when there is a fire in the building because there is always the danger of people being trapped in a lift that has become immobilised as a result of fire.

⇒ However in some circumstances a lift may be provided as part of management plan for evacuting people.

5) Fire fighting lift:-

A lift designed to have additional protection with controls that enable it to be used under the direct control of fire & rescue service in fighting a fire.

⇒ A fire fighting lift is required if the building has a floor more than 18m above or more than 10m below fire service vehicle access level.

6) Service lift:-

⇒ Service lift tend to not be designed to carry passangers but usually carry goods of some description. This also means that these lifts may not have to meet the same level of standards required of passanger lift.

Dumb Waiters :-

They are often used in a kitchen setting, in hotels, bars, restaurants etc. These small lifts are used to transport food from kitchen to serving tea. They can also be used in other setting such as hospitals or offices.

Trolley lifts :-

They are designed to transport larger goods on trolley & roll cages. They are often found with-in shop setting or any environment where you may need to take deliveries & transport them between floors.

7) Disable Access lifts :-

=> Disabled access lift can take a variety of forms & can fall under many different categories whole serving the purpose of transporting those with mobility issues.

Stair lifts :-

=> Stair lifts are most commonly used in the home & provide an easy way for individuals to move up & down stairs.

=> This usually involves them sitting in a motorised seat which takes them from one level to another. This however is not suitable for individual who are confined to a wheel chair.

Step lift :-

=> Step lift can be rather simple lifts as they usually provide access when a few steps are present. This can be one or two steps or small incline inside or outside of a building.

=> The Step lift can take many forms & may be as simple as a small platform or can be something more

complex.

Passanger lift :-

=> Disable access lifts can also take the form of a passanger lift providing an enclosed space for the passanger.

b) Elevators :-

i) Elevators are devices that move people & goods vertically within a dedicated shaft that connects the floors of a building.

ii) An elevators can be defined as an electric lift which is used as vertical transportation of goods as well as people among the floors in building using bins otherwise silos.

iii) As usual there are activated with electrical motors that also to drive transaction such as hoist, otherwise pump, hydraulic fluid for raising a cylindricals piston such as jerk.

Types :-

There are 3 main type of elevators commonly used.

=> They are ; a) Hydraulic Elevator
b) Traction Elevator
c) Machine Room Less (MRL) Elevators.

a) Hydraulic Elevators :-

=> Hydraulic elevators are supported by a piston at the bottom of the elevator that pushes the elevators up as an electric motor forces oil or another hydraulic fluid into the piston.

=> The elevator descends as a value realeases the fluid from piston. They are used for low rise application of 2-3 stories & travel at max speed of 200ft/min.

⇒ They have a low initial & maintainance cost. But they use more energy than other types of elevators. A major draw back is that hydraulic fluid can sometimes leak which cause a serious environmental holaxe.

a) Convential Hydraulic Elevators :-

⇒ They have a sheave that extends below the floor of a elevator pit which accepts the retracting piston as the elevator descends.

⇒ Some configuration have telescoping piston that collapses & requirees a shallow or hole below pit. Max travel distance is approx 60ft.

b) Holeless Hydraulic Elevator :-

⇒ In this configuration telescoping pistons are fixed at the base of pit & don't require a sheave or hole below pit.

→ Telescoping piston allow upto 50ft of travel distance. Non-telescoping piston only allow about 20ft of travel distance.

c) Roped Hydraulic Elevator :-

⇒ They use a combination of ropes & a piston to move the elevator. Max travel distance is about 60ft.

2) Traction Elevators :-

⇒ Traction elevators are lifted by ropes which pass over a wheel attatched to an electric motor above the elevator shaft.

⇒ They are used for mid & high rise application & have much higher travel speed than hydraulic elevator.

⇒ Traction elevator have height restriction that are governed by the length & weight of the cables or ropes. New material that are stronger & lighter such as carbon fiber will allow traction elevators to achieve

new height.

=> It is important that traction elevator ropes & sheaves are checked for wear on a regular basis.

a) Geared Traction Elevators:-

They have a gear box that is attatched to the motor which drives the wheel that moves the ropes. Geared traction elevators are capable of travel speeds upto 500ft/min.

=> The max travel distance for a geared traction elevator is around 250 ft.

b) Gear less traction elevators:-

=> They have the wheel attatched directly to the motor. Gearless traction elevators are capable of speeds upto 2000ft/minute & they have a max travel distance of around 2000ft so they are the only choice for high rise application.

3) Machine Room Less (MRL) Elevators:-

=> They are traction elevators that don't have a dedicated machine room above the elevator shaft. The machine sits in the overwide space & is accessed from the top of elevator cab when maintenance or repairs are required.

=> The control boxes are located in a control room that is adjacent to the elevator shaft on highest landing & within around 150ft of the machine.

=> MRL elevators are comparable to geared traction elevators in terms of initial & maintainance costs but they have a relatively low energy consumption compared to geared elevators.

=> MRL elevators are becoming the most popular choice for mid rise buildings where the travel distance is upto

250ft.
=> They are energy efficient, require less space & their operation & reliability are on par with greatest traction elevators.

c) Escalators :-
=> An escalator is a moving staircase a conveyor transport device for carrying people betⁿ floors of a building.
=> The device consists of a motor driven chain of individual, linked step that move up or down on tracks allowing the step treads to remain horizontal.
=> Escalators like moving walkways are powered by constant speed alternating current motors & move at approximately 1-2ft (0.30-0.61m)/second.
=> The maxᵐ angle of inclination of an escalator to the horizontal floor level is 30° with a standard rise upto about 60ft.

Uses :-
=> They are used to move pedestrian traffic in places where elevators would be impractical. They have the capacity to move large no. of people.
=> They can be placed in same physically space one might install a staircase. They have no waiting interval. They can be used to guide people toward main exist or special exhibits.

Types :-

a) Step type Escalators :-
=> Step type escalator is one of the most common forms of escalators used today. This type of escalator is safer than most other forms of escalators.
=> Their steps are usually made up of metal. The movement of these type of escalators is upward

then flat & then downward & vice versa as well.

b) Wheel chair Escalator:-

⇒ Wheel chair accessible escalator is nothing but a normal escalator with special provision for a wheel chair on this type of escalator there is a special attendant.

⇒ If a person with a wheel chair ~~escalator is ordered~~ steps onto escalator, the escalator is put in a special mode where 3 steps level out & a platform is formed.

⇒ There after some spikes come out from the back of step closer to lower landing of wheel chair, there by preventing wheel chair along with the person to fall down.

⇒ These levels of escalators there by becomes very useful for movement of physically challenged as well as an old person within a building.

c) Spiral Escalator:-

⇒ This type of escalators have curved step giving them a fancy sort of appearance.

⇒ They look very beautiful & attractive & are only manufactured by mitsubishi since 1985.

d) Levytator:-

⇒ Levytator is the newest type of escalator. This is a free type of escalator that can curve multiple times in either upward or downward direction.

⇒ In this system there are two escalators which continously share loops of steps & can also curve differently. The steps of this escalator are also uniquely built.

Ch-06

Construction And Earth Moving Equipments

1) Planning and selection of construction equipment :-

=> Construction equipment planning & selection plays crucial role for the success of construction ~~firm~~ firm. Inadequate manual process of equipment planning & selection & subjective decission of equipment manager usually result in major losses in construction firm.

=> Equipment saves man power which is becoming costly & more demanding day by day. Equipment improves quality productivity & safety

=> To derive full benefits from the equipment there should be proper selection & good planning of its operations.

=> Construction equipments planning aims at identifying construction equipment for executing project tasks, assessing equipment performance capability, forecasting datewise requirement type of equipment & finally participating in the selection of equipment to be acquired.

=> Factors affecting selection of construction equipment are;-

1) Use of equipment available with the organisation :-
If the equipment to be selected is not used for entire life of project ie project duration is less than life of equipment & also if same type of work is not seen on future utilization, it is desirable to use available equipment.

2) Suitability for job condition with special reference to climatic & operating condition :-
The equipment selected must suit majority of

of requirements of job. Equipment selected should be capable of doing more than one function.

3) Uniformity of type :-

Uniformity in equipment facilitates easier operation & maintainance. It allows easy exchange of spare parts & operating personnel.

4) Size of equipment :-

It is always desirable to use smaller equipment due to low working cost as they have fewer moving parts.

⇒ As far choice bet^n medium & large size equipment quantity of work, initial investment will be main criteria.

5) Use of Standard Equipment :-

Standard Equipment are usually manufactured by several companies & it is available easily. Repair & spare parts are easy & they can be disposed off easily. Unit cost of producting is also less.

6) Country of Origin :-

Equipment should be imported from countries where foreign exchange facilities are easily available

7) Unit cost of production :-

The cost of running the equipment on the whole should be minimum.

8) Availability of spare parts & selection of manufacturer :-

As far as possible local labourer should be of repeate & there should be a long standing good will among various customers & care should be taken to use that after sales service & spare parts are easily available at reasonable cost.

9) Suitability of Local labour for Operation:-

As far as local labour should be preferred for operating the equipment by organising suitable training to them. Type of equipments can be breefly clasified are to use as;

Standard Equipment	Special Equipment
i) These are commonly used in projects.	i) These are used only in special cases.
ii) These are manufactured commonly & easily available from the dealer.	ii) Special order has to be placed to get such equipment These are fabricated as per requirements.
iii) Availability & delivery of these are easy & fast.	iii) Availability is difficult & delayed.
iv) Repairs & spare parts are easy to carry out. Disposal is easy	iv) Repairs & spare parts are difficult to carry out can't be disposed off easily
v) Unit cost of production is less.	v) Unit cost of production is high.

b)

Study and Uses of compacting Equipments :-

i) Smooth Wheeled Rollers :-

=) These are plain steel rollers, self propelled type, weighing from 5 to 15 tonnes & used for ordinary rolling work where deep compaction is not required, principle application being in road work.

=) These rollers may have one front & two rear wheels & rear wheels being usually larger in diameter & the front one is wider.

=) The weight of roller can be increased by using

hollow wheels which can be filled with water or sand ballast. These rollers are of usually diesel engine type.

⇒ As the roller pulled toward a wave of soil is pushed up in direction of movement & with successive passage surface soil is gradually compacted. They are effective in compacting granular soil.

ii) Sheep foot Rollers :-

⇒ For compacting earthwork in embankments & canals where compaction deep into layer of earth is required, these type of rollers are used.

⇒ The roller consist of a hollow steel drum & have projected feet or projection mounted on surface which are arranged around wheel at 100 to 300 mm c/c along the axis.

⇒ The weigh upto 15 tonnes or more & travel at a speed of 25kmph using wheel tractors for towing.

⇒ As roller moves over the surface feet penetrates the soil to produce a kneading action & a pressure to mix & compact soil from bottom to top layer with repeated passage penetration of feet decreases.

iii) Pneumatic Tyred Rollers :-

⇒ This type of roller consists of a base or platform mounted between two axles, rear of which has one more wheel than the front.

⇒ The tyres must be so arranged that the tracks of the forward wheels lie in bet^n tracks of backward wheels.

⇒ They are most suitable for compacting fine grained soil & well graded sands. The machine is self propelled & ballasting is done either water, sand, pig iron to

increase self weight.

iv) Tamping Rollers:-

→ These rollers are similar to sheep foot rollers with lugs of larger area than sheep foot rollers.

⇒ The static padfoot rollers are also called tamping rollers have static weight in range of 15 to 40 tonnes & their static linear drum loads are bet^n 30-80 kg/cm.

⇒ These rollers have high production capacity. The degree of compaction with this roller is achieved more than sheep foot roller. Density of soil achieved more uniform with this roller.

⇒ Tamping roller are best suitable for compacting cohesive soils. They consist of levelling blades to spread the material.

v) Vibrating smooth Wheeled Rollers:-

⇒ In case of vibrating smooth wheeled rollers the drums are made to vibrate by employing rotating or reciprocating mass.

⇒ They provide higher compaction level, compaction to greater depth, output is more than conventional rollers

⇒ They are expensive but in long term it becomes economical. The latest work specification for excavation recommends the use of vibratory rollers.

vi) Vibrating plate Compactors:-

⇒ Vibrating plate compactors are used for compaction of coarse soil with 4 to 8% fines. These equipments are used for small areas.

→ The usual wt. of these machines vary from 100 kg to 2 tonnes with plate areas bet^n 0.16 m^2 & 1.6 m^2.

4) Study and Uses of earthmoving equipment :-

:) The basic operation involved in the construction of any projects are - excavation, digging of large quantities of earth, moving them to distances, placement, compacting, levelling, dozing, grading, hauling etc. The equipment which perform these operation are called earth moving equipment

ii) Dragline :-

→ The dragline is so named because of its prominent operation of dragging the bucket against material to be dug.

→ Unlike power shovel it has long light crane boom and the bucket is loosely attatched to the boom through, cables. Because of this construction a dragline can dig and dump over larger distances than a shovel can do.

→ Dragline are useful for digging below its track level & handling softer materials. The capacity is indicated by size of bucket in cubic meter.

→ The basic part of dragline include boom, hoist, cable, drag cable, hoist chain, drag chain, bucket, dragline can be crawler mounted, wheel mounted or truck mounted type.

Application :-

→ It is most suitable machine for digging material.

→ It is very useful for excavating trunches when sides are permitted to establish their angle of response without shoring

→ It has long reaches.

→ It is mostly used in excavation for canals & depositing on embankment without hauling unit.

iii) Tractor :-

⇒ These are the multipurpose machine used mainly for pulling & pushing the other equipment on heavy loads. They are also used for agricultural purposes.

⇒ Tractors may be classified as crawler type and wheel type.

Crawler type tractor :-

⇒ It is a versatile equipment used to move bulldozer, scraper, wagons on rough roads. The crawler has a chain by which these tractor can be very effective even in case of loose & muddy soils. The speed of this type doesn't exceed 12kmh normally. It is not used on bituminous roads.

Wheel type tractor :-

The engine is mounted on four wheels. The main advantage is higher speed, sometimes exceeding 50kmph. It is used for long distance hauling & on good roads. It is also used for agricultural operation.

(iv) The common machine used for shaping the sub grade is grader. Graders are propelled or towed by a tractors. They are used for light & medium works. They are used for Shaping sub grade, constructing earth road, spreading loose material.

(iv) Bull dozer :-

⇒ These versatile equipment are commonly used in construction project. It is essentially a heavy steel blade which mounted on front of tractor.

⇒ They tractors can be crawler, or, wheeled tape. The heavy blade attatched to tractor pushes material from one place to another.

=> The earth moving bull dozer consist of a heavy blade & the blade is attatched to body of tractor with two arms & supporting frame.

=> Bulldozers are classified on basis of;

1- Position of blades - Bull dozers, Single dozers.

2- Based on mounting - Wheel mounted, crawler mounted

3- Based on control - cable controlled, Hydraulic controlled.

Application :-

=> For spreading earth fill.

=> For opening up plat roads through mountains & rocky terrain.

=> clearing construction site.

=> Maintaining haul roads.

=> Clearing land from trees, stumps.

=> Back filling trunches at construction sites by digging earth.

(v) Power Shovel :-

=> These are one of the most long lasting & useful class of earthmoving equipment. It is one of the basic requirement employed to excavate earth & loads to truck.

=> It may be crawler mounted or wheel mounted. Crawler mounted have low speed but effective in unstable soil. Wheel mounted shovel have higher speed & effective on ferm ground.

=> The basic parts of power shovel include truck system, cabin, rack, stick, boom foot pin, saddle block, boom, boom point sheaves & bucket.

Application:-

⇒ It is most suitable equipment for close range of work.

⇒ It is capable of digging very hard material & can remove it.

⇒ It is used in various type of jobs such as digging in gravel banks, clay pits, digging cut in road works etc.

(vi) Scrapper:-

⇒ Scrapper are result of compromise bet' best loading & best hauling machine. It is a unique machine for digging & long distance hauling of ploughable.

⇒ Scrapper are classified as crawler tractor pushed & wheel tractor pulled depending on type of tractor used to pull them. The basic parts of scraper are- bowl, apron, tail gate or ejector.

(vii) Clamp Shell:-

⇒ This machine is so named due to the resemblance of its bucket to a calm which is like a shell fish with a hinged double shell.

⇒ They are commonly used for handling loose material for removing material from coffer dams, sewer, man holes, well foundation etc.

⇒ The main features of it is vertical lifting of material from one place to another.

viii) Trenching Machine:-

⇒ They are used for excavating trenches for laying pipe lines, sewer, cables. Their operation is quick giving required depth or width.

=> They are two types.

* Wheel type
* Leader type.

(ix) Back Hoe :-

=> Back hoe is termed as hoe, back shovel, pull shovel,

=> It is generally used to excavate below the natural surface which rest. They are used to excavate trenches, pits for basement, it also removes the earth to establish natural slope.

=> The basic part of back hoe includes boom, jack boom, boom foot drum, boom sheave, stick sheave, stick bucket & bucket sheave.

d) Owing and Operating cost :-

Owing Cost :-

=> It is the total cost associated with construction equipment for owning it irrespective of the equipment is employed or not in project.

=> The ownership cost consists of following :-

a) Initial cost b) Salvage value (c) Interest cost on cost of capital investment

d) Taxes e) Insurance cost

f) Storage cost.

a) Initial Cost :-

=> Initial cost is the capital investment required to own the equipment. It includes purchase cost, sales tax, transportation cost, cost of assembly & installation of equipment.

=> If the equipment is mounted on rubber tires then tire cost is deducted from initial cost for calculating ownership cost. This is because the expected

service life of pneumatic tires is less than that of remaining of equipments.

b) Salvage Value :-

⇒ Salvage value represents expected cash in flow that will be recieved by disposing of equipment at the end of its useful life.

⇒ The estimate of salvage value can be done by referring to data obtained from past project where in same or similar equipment was used.

c) Interest cost on cost of capital of investment :-

⇒ It is the annual cost of interest charged on the borrowed money or that of capital investment to acquire the ownership of the equipment.

⇒ If equipment purchased by borrowing money from lender, then intrest cost is interest charged on borrowed amount.

⇒ If equipment purchased using construction firms own funds, then cost of capital investment is the interest charged on capital investment at interest rate equal to construction firms rate of return.

⇒ Interest cost on borrowed money or cost of capital investment can be exactly calculated by considering time value of money & using appropriate compound interest factors.

⇒ Interest cost can be calculated approximately as percentage of constant average investment over use ful life of equipment.

⇒ The annual interest is multiplied to avarage annual investment to find out annual interest cost. the average annual investment can be calculated by

finding out avarage value of equipment over useful life of equipment.

d) Taxes :-

⇒ It represents property taxes to be paid to state or central govt. . It depends on value of equipment owned & applicable tax rate for a given location.

⇒ The property tax can be calculated as percentage of avarage annual investment or percentage of book values in a given year. Generally it ranges from 2 to 5% of avarage annual investment or book value of equipment.

e) Insurance Cost :-

⇒ It represents the annual premium to be paid to insurance companies to cover the cost incurred due to accident, fire, theft etc. for construction equipment.

⇒ It can be calculated as percentage of avarage annual investment or book value in a given year. It is about 1-3% of avarage annual investment or book value of equipment.

f) Storage Cost :-

⇒ It is the cost of keeping the equipment in storage yards when it is not operating at work site. It includes rental & maintainance charge for storage yards, wages of security guards, wages of workers employed for bringing in & out of yards.

⇒ It is around 0.5-1.5% avarage annual investment or book value of equipment. The annual storage cost can be calculated for entire fleet of equipment is then proprated to individual equipment requiring storage.

Operating Cost :-

⇒ It is incurred only when the equipment is operated. The cost of equipment is influenced by various parameters namely no. of operating hours, location of job site, operating condition, category of equipment etc.

⇒ The operating cost consists of following;

a) Repair & maintainance cost
b) Fuel cost
c) cost of lubricating oil, felter & grease.
d) Tire cost
e) Equipment operator wages.
f) cost of replacing high wear items
g) cost of mobilization, demobilization & assembly

a) Repair & Maintainance cost :-

⇒ Repair & maintainance cost is incurred as the construction equipment is subjected to wear & tear due to the operation it performs. It includes the cost of replacement parts, labour charges, the cost of setting up & operating facilities to carry out major repair & maintainance operation.

⇒ It varies from one year to another over the service life of equipment however it increases with age of equipment. This cost can be calculated as percentage of the annual depreciation cost of the equipment. The hourly repair & maintainance cost can be calculated by devicing the annual cost by the no. of operating hours per year.

b) Fuel cost :-

⇒ The construction equipments are generally powered by internal combustion engines which use either gasoline (Petrol) or diesel as fuel.

⇒ The fuel consumption depends on the rated flywheel horse power (flwhp) of the engine & nature of working condition.

⇒ A gasoline engine consumes about 0.06 gal of fuel per fly wheel horse power hour where as diesel engine consumes 0.04 gal of fuel per flwhp.

c) Cost of lubricating oil, filter & greate :-

⇒ The quantity of lubricating oil, filter & greate required depends on operating hours, frequency of changes engine characteristics & working condition at the job site

⇒ The quantity of lubricating oil required by an engine is equal to amount added during complete change plus small amount added bet^n changes.

⇒ Quantity of lubricating oil required by engine can be calculated as;-

$$q_f = \frac{hp \times f \times 0.06\ lb/hp-h}{7.4\ lb/gal} + c/t$$

Where, q_f = Quantity of oil required in gal/h.

hp = Rated horse power of engine

f = Operating factor

c = Capacity of crank case in gallons.

t = No. of hours bet^n oil changes.

d) Tire Cost :-

⇒ The tire cost includes the tire repair & replacement charges. Tire repair charges can be calculated as a certain percentage of tire depreciation cost.

⇒ The hourly tire repair cost can be calculated by devicding sum of cost of a set of tires & repair charges by life of tires in hours.

e) Equipment Operator Wages :-

⇒ It includes the hourly wages & benefits paid by the company to the operators. It includes normal wages, work men's compensation insurance premium, fringe benefits, bonous etc.

⇒ It is calculated as a separate category & is added to other components of operating cost.

f) Cost of replacing high wear items :-

⇒ It represents the cost of high wear items & these items have a shorter life as compared to service life of the equipment

⇒ The high wear items includes blades, cutting edges, drill bits, bucket teeth etc The hourly cost can be calculated by devicding the unit cost by estimated life (in hours)

g) Cost of mobilization, assembly & demobilization :-

⇒ This cost includes transportation charges from one project site to another, cost required for getting road permits, unloading charges, cost of assembly at the project site etc.

⇒ The hourly cost can be calculated by devicding the total cost by no. of operating hours.

Ch-07

-: Soil Reinforcing Techniques :-

7.1 Necessity of soil reinforcing :-

⇒ In a simple terms soil reinforcement is a technique used to improve the steffness & strength of soil using geo engineering method.

⇒ A long time ago, natural fibre was used to reinforce the soil. This old technique did not have a high yield & required a lot of time for the soil to recover. In soil reinforcement different engineering techniques are used to enhance the soil strength.

⇒ Soil reinforcement is performed by placing tensile elements in the soil to enhance its natural stability & strength.

⇒ This is achieved by bringing reinforcement elements in contact with surfaces in aggregate & sub-base of soil mass.

⇒ When pressure on the soil mass causes a strain on the reinforcement, it creates a tensile load which can resist soil movement & provide additional support for increased strength.

This way a soil reinforcement system is created which provides greater shear strength than soil mass alone.

⇒ In geotechnical 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.

⇒ This type of soil is also highly susceptible to various environmental & natural factors such a high compressibility, poor shear strength, temprature changes etc.

⇒ The need for poor quality land development is increasingly necessary, given the growth of humanity & its activities.

⇒ Certain types of soil neglected because of their poor mechanical characteristics must be reinforced to ensure the stability of the buildings & the civil engineering infrastructure they are required to support.

⇒ Soil improvement techniques can increase the compactness of the existing soil either by reducing the volume of voids or by imposing vibration in the soil.

⇒ Soil reinforcement techniques themselves involve vertical or horizontal reinforcement elements in soil. The objective of all these techniques is to allow construction of a structure without excessive surface deformation or stability defects.

7.3 Use of wiremesh and geo-synthetics :-

⇒ Geo-synthetic are synthetic products used to stabilize terrain. They are generally polymeric products used to solve civil engineering problems.

⇒ This includes 8 main product categories - geotextiles, geogrid, georods, geomembranes, geo synthetic clay liner, geofoam, & geocomposites.

⇒ The polymeric nature of the products makes them suitable for use in the ground where high levels of durability are required. They can also be used

in exposed application.

Uses:-

i) Separation of soil layers:-

⇒ In order to keep the imported material separated from the insitu soil, a separating layer of geo-synthetic is laid bet^n the geotechnical entities.

⇒ This is done to keep the properties of the imported material intact which otherwise could have altered under the action of applied loads.

⇒ They are usually applied at sub grade / sub base interfaces in temporary, permanent roads, bet^n rail road blast & foundation soil, bet^n embankment fill & soft foundation soil.

ii) Filtration of Water:-

⇒ The mis management of water on site is capable of causing extreme harm, erosion of soil in a particular area is one of the most harmful repercussion that carelessness could lead.

⇒ It often result in formation of irreparable gullies hence to help prevent that from happening a geocomposite clay liner is placed underneath all hydraulic structure.

iii) Drainage Work:-

⇒ If water is not contained properly on sides an increase in water table is observed that further brings pore pressure which often require surplus amount of reinforcement of about 50%.

⇒ To avoid this geocomposite liner is installed at back of R.C structures with perforate pipe to collect water.

iv) Soil erosion Control:-

⇒ Gabions, geotextile & mattresses are used for

erosion protection. Geotexile filter & reinforcement ensure stability during saturation in the raining season & sudden draw down condition.

v) Basal Reinforcement :-

⇒ Basal reinforcement is provided at foundation level of reinforced structure.

⇒ It is provided in form of geogrid reinforcement which is laid out to counter for failure that could have occured due to undrained shear stress of foundation

vi) Soil Reinforcement :-

⇒ This technology of soil reinforcement using geo-synthetic involves labour force to cut geo grid to required length place it on site.

⇒ It allows the ~~steepest~~ steepening of slope, enabling to maintain the construction within boundaries as well as saving on earthmoving & importing of soil.

⇒ The geogrid used are high tensile polyster encased in a LLDPE coating to prevent installation damage acting as primary reinforcement. A secondary reinforcement ~~is~~ on bet^n is given by double twisted mesh.

Use of Wire mesh :-

⇒ The welded wire mesh is a metal wire screen that is made up of low carbon steel wire or stainless steel wire.

⇒ It is widely used in agricultural, industrial, transportation, horticultural & food procuring sectors. It is used in mines, gardening, machine protection & other decorations.

=> Weld mesh is a term given to the kind of barrier fencing. Welded wire fabric is also used in reinforced concrete notably for slabs.

=> Stainless steel wire mesh has several uses & benefits. They are used in the fields of agriculture, industries & construction sites. They are used in construction of swimming pools, man hole, chambers, tunnels & parking lots.

=> The welded mesh also used for variety building purposes. Sometimes with help of welded mesh airport roads are also built.

=> Steel wire mesh is used in facing system to align & shape the slope of the reinforced structure. Vegetation & fire retardant are compatible with this type of facing system. Slope at earthquake zone or at narrow & factured zone etc. Wall surface can be vegetated for natural appearance finish.

=> Wire mesh facing is an excellent solution for both permanent & temporary structure. The material & soil reinforcement connection provide superior durability against differential settlement, erosion, impact & seismic activity.

=> Advantages of using temporary wire mesh, retaining walls, are differential settlement, durability, superior finished wall alignment, efficiency & speed of construction, mechanical connection to soil reinforcement

7.3

a) Strengthening of embankments :-

=> A number of embankments are likely to exhibit poor performance after several years of operation inspite of them having been of high quality when they were

constructed.

⇒ Excessive plastic deformation, slope instability & lateral expansion of embankment shoulders, constitute a large proportion of embankment problems.

⇒ Geotextile & geogrids have been widely employed in embankment construction to reduce subgrade settlement & improve embankment stability.

⇒ However these geosynthetic materials are generally applied in new built embankment layer by layer are difficult to utilize in existing embankments & need relatively large deformation or slips along the fabric soil interfaces to mobilize their reinforcement effect.

⇒ Embankments problems can be solved by using a new prestressed reinforcement device (PRD) consists of two lateral pressure plates & a reinforcement bar.

⇒ Road & railway embankment are usually large & high earth structures which require considerable quantities of fill soil & land.

⇒ The cost of fill soil and its transport from the quarries as well as the value of land may be so high that some alternative may be considered such as designing steeper slope or using lower quality fill soil.

⇒ Geogrids allow the slope to be built at any inclination with required factor of safety. The specific surcharge loads, dynamic loads can be incorporated into design to provide safe construction.

=>Almost any locally available soil can be used for the geogrid reinforced embankment this faculity can produce very large saving in both cost & construction time

b) Slope stabilization in cutting & embankment by soil reinforcing technique :-

=> Soil reinforcement is the indusion of tensile resistant elements in soil mas to improve its overall shearing resistance.

=> Soil reinforcement technique is very cost effective for increasing the stability of natural & embankment soil slope & for reducing the earth pressures against retaining wall & abutments.

=> In situ reinforcement system include soil nailing micropiles, pinpiles, piles. Reinforced soil is applicable to situation in which the reinforcement & back fill are placed as slope or wall is constructed.

=> Common reinforcing elements includes steel strips, welded wire sheets, bar mats & meshes, geotextiles, geogrids, fibers.

=> The installation of pipe lines & other under ground structures often requires cutting a slope in protected or valuable areas. Geogrids allow improving the stability of soil, the slope can be rebuilt without using expensive consolidation technique.

=> There are many situation where shortage of space or fill material calls for the construction of embankment bunds with very steep slopes greatly in excess of naturally stable angle. Geogrid reinforced soil structure provide a safe, sound, economical solution.

=> Soil nails are steel bars, rods, cables that are driven into natural soil or soft rock slopes or are grouted into predrilled bore holes.

=> Soil nailing has been used for in situ stabilization of natural and excavated slopes for nearly 20 years. It is most effective in dense granular & low plasticity stiff silty clay soils because a top down sequential construction procedure is used.

=> The technique of soil nailing has been used mostly for stabilization of temporary excavation. There is some concern about corrosion rate of steel nails used in process.

=> However new types of nails, coating with high resistance to corrosion are being developed. Stabilization of soil slope with long pre stressed anchors is also increasing.

=> Reinforced soil structures are least expensive type of wall available. They are simple to build & often can use on site granular back fill material. They are constructed using layers of geotextile or welded wire placed in lifts 15-45cm apart in soil.

=> The effect of soil nailing is to improve the stability of slope or excavation through;

1) Increasing the normal force on shear plane & hence increase shear resistance along slip plane in friction soil.

2) Reducing driving force along slip plane both in friction & cohesive soil.