UNIT I

CONSTRUCTION TECHNIQUES

Structural Systems - Load bearing structure - framed structure - load transfer mechanism - floor system - Development of construction techniques - High rise building Technology - seismic effect - Environmental impact of materials - responsible sourcing - Eco Building (Green building) - Material used - Construction methods - Natural buildings - Passive building - Intelligent (smart) building - Meaning - Building automation - Energy efficient buildings for various zones - case studies of residential, office building and other buildings in each zones.

STRUCTURAL SYSTEMS :

A system is an assemblage formed to satisfy specific objectives & subjected to constraints and restrictions & consisting of two or more components that are interrelated as and compatible, each component being essential to the required performance of the system. The of group of components of a system may also be a system. such a group is called a

LOAD BEARING STRUCTURE

In load bearing structure, whole load supported & transferred by masonry wall. Load bearing masonry construction was the most widely used form of construction for large buildings from the 1700s to the mid-1900s. It is very rarely used today for larger buildings. From the But the smaller residential building-scale structure are being built. It is essentially consists of thick, heavy masonry walls of bricks or stone that support the entire structure including the horizontal floor slabs.

FRAMED STRUCTURE :

In RCC framed structure, whole load supported on beams & slabs & transferred through columns to footings :

- Limited storeyed building only be constructed.
- Less resistant to Earthquake
- Carpet area available is less.

LOAD TRANSFER MECHANISM

Any structure is made up of structural elements and non-structural elements. The structural elements put together constitute the 'structural system'. Its function is to resist effectively the action of gravitational and environmental loads and to transmit the resulting forces to the supporting ground, without significantly disturbing the geometry, integrity & serviceability of the structure. Most of the structural element may be considered, from the viewpoint of simplified analysis, as a one-dimensional elements. A few structural elements may require more rigorous analysis.

Floor system:

Load bearing construction is most appropriately used for building in which the floor area is subdivided into a relatively large number of rooms of small to medium sizes in which the floor plan is repeated on each.

storey throughout the height of the building. These considerations give ample opportunity for disposing load bearing walls, which are continuous from foundation to roof level and because of the modorate floor spans, are not called upon to carry undully heavy concentration of vertical load.

A cellular arrangement is one in which both internal and external walls are load bearing and in which these walls form a cellular pattern in plan

DEVELOPMENT OF CONSTRUCTION TECHNIQUES

↳ conventional construction using locally available materials such as clay wood and bamboo.

↳ stone masonry construction of structures.

↳ Brick masonry construction of structures

↳ Construction of timber structures

↳ Concrete masonry construction of structure

↳ Concrete structures with cast in situ and prefabricated structures.

HIGH RISE BUILDING TECHNOLOGY

Structural systems for tall buildings:

1. Rigid frame system
2. Braced frame & shear-walled frame Systems
3. Outrigger systems.
4. Framed tube system
5. Braced tube system
6. Bundled - tube systems

Rigid frame Systems:

Rigid frame systems are utilized in both steel and reinforced concrete construction. Rigid frame systems for resisting lateral & vertical loads have long been accepted for the design of the buildings. Rigid framing, namely moment framing is based on the fact that beam-to-column connections have enough rigidity to hold the nearly unchanged b/w intersecting components.

Braced frame & shear walled frame systems:

Rigid frame systems are not efficient for buildings taller than 20 stories, because lateral deflection due to the bending of columns causes the drift to be too large. On the other hand, steel bracing or shear walls with or without rigid frame, increases the total rigidity of the building & the resulting system is named as braced frame or shear-walled frame system.

SEISMIC EFFECT

An earthquake is defined as natural vibration of earth's crust produced by seismic forces. The focus is the place beneath the earth's surface from where an earthquake originates & the point on the earth's surface immediately above the focus is called the epicenter. On the basis of depth, the earthquake foci are generally distributed in three general depth ranges.

1. Shallow earthquakes – 60 kilometers

2. Intermediates EQK - 60 - 300 Kilometers

3. Deep seated eqk - < 300 km

The type & extent of damage to structures to structures during earthquakes depends on only on the intensity, depth of focus, duration and location of epicenter, but also on the strength of building materials, structural systems, joint details of members etc., quality of workmanship, proper anchorage of secondary elements to the main structure, and soil conditions.

Summary of main structure sources of Earthquakes

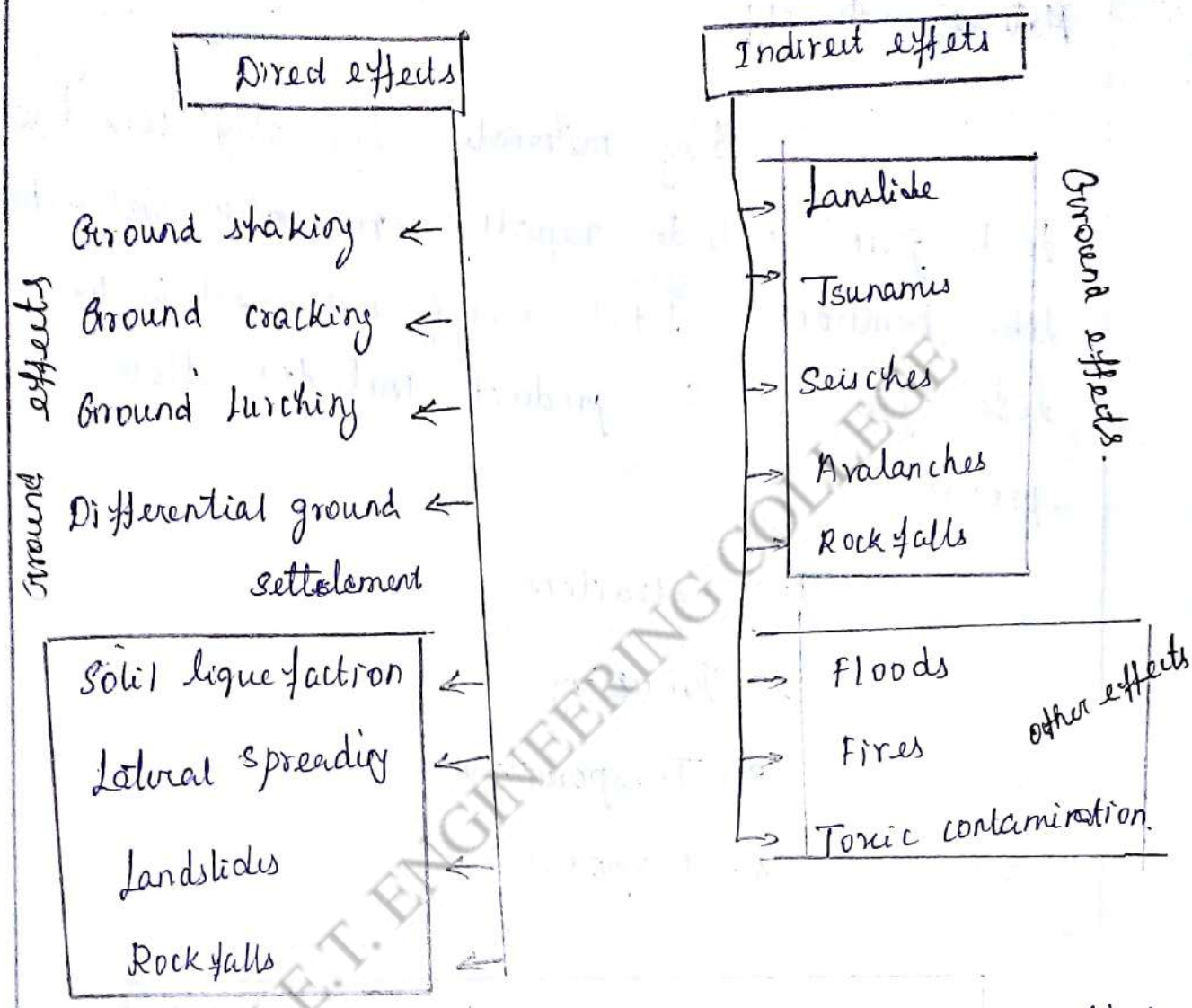
1. Orogenic movements such as mountain building

2. Subduction and plate convection followed geothermal and mechanical disturbances

3. Volcanic activity

4. Land Erosion

Earthquake Effects



During the earthquake effect an individual could be thrown out of bed at night, be unable to stand upright and be forced to kneel on the ground, fall down stairs, or even be tossed out of the swimming pool by the violent sloshing of the water.

ENVIRONMENTAL IMPACT OF MATERIALS

Materials efficiency

Building materials typically considered to be 'green' include rapidly renewable plat materials like bamboo. Total energy consumed in the life cycle of a product includes following process

1. Extraction
2. Processing
3. Transportation
4. Disposal.

Material	Embodied energy MJ/kg
Concrete	1-10
Steel	40-00
Stainless steel	57-00
Clay bricks	8-00
Terrazo Tiles	1-40
Ceramic tiles	12-0
Aluminium	230-00

RESPONSIBLE SOURCING

The construction sector is an important part of the economy, having contributed about 8% to the national GDP over the last 5 years. It also provides employments to 18 million people directly. The downside of this sector is its enormous resource & energy footprint. The impact is only set to increase with an estimated shortage of about 80 million houses during the twelfth five-year period of 2012-2017.

ECO-BUILDING:

Green building: Buildings designed considering the concepts of sustainable design and reduction of environmental impacts due to site selection, water use, energy use materials and resources, the building's impact on the environment, and indoor air quality.

Focus on green building:

(a) Efficient utilization of resources - energy, water & building

(b) Protection of occupant health and enhancement of employee productivity.

(c) Reducing waste, pollution and environmental degradation as compared to conventional building.

MATERIAL USED

The selection criteria for green building material shall be based broadly on:

- Resource efficiency
- Indoor air quality
- Energy efficiency
- Water conservation
- Affordability.

Some green building materials

- Fly ash bricks
- Autoclaved Aerated concrete
- Terrazo tiles
- UPVC windows
- Bamboo jute composite doors
- Calcium silicate tiles.

CONSTRUCTION METHODS

In this heading, new definitions & attitudes about industrialization are presented by review of new related researches with an explanatory and analytical method to extract new directions in building Industrialization included economical and social trends and sustainability approach.

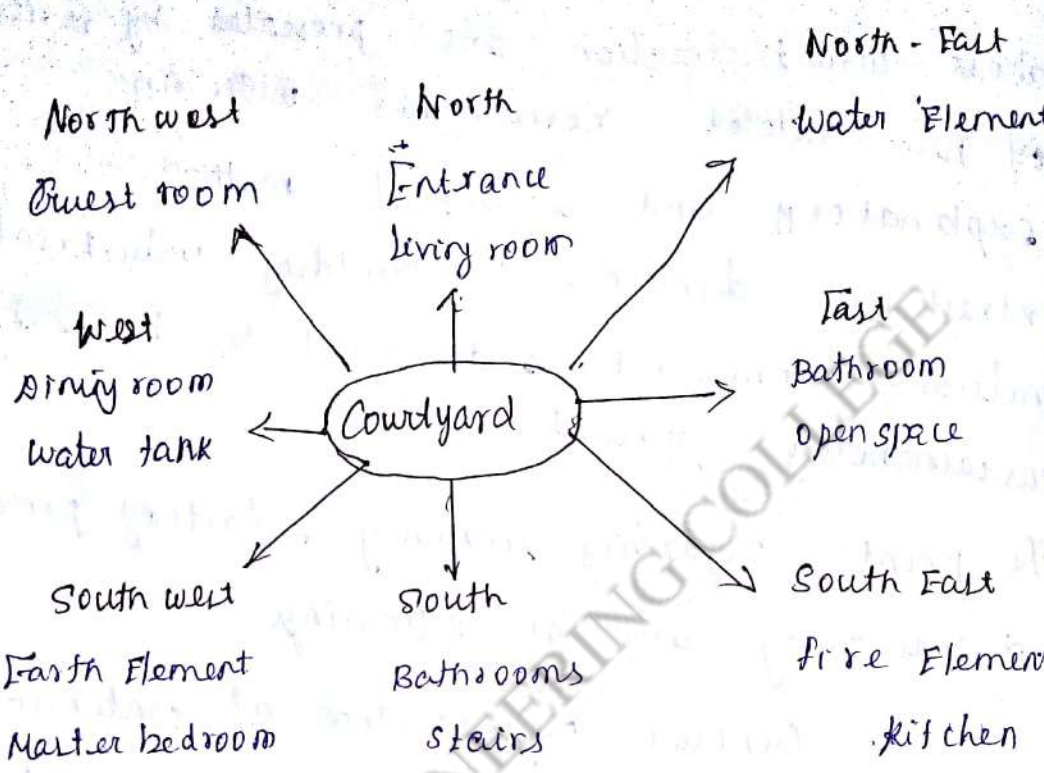
The points regarding economy, factory production and consistancy are as followings:

1. General organization of continuous production of a product applying similar knowledge & experience instead of new groups formation for each project.

2. Simplicity of process and reduction of the sum of consumed energy in each production project.

3. Working in factory leads to avoid of loss of time arising from climate conditions

NATURAL BUILDING :



Creative courtyards :

They date back to the Harappan civilization.

They are used for socialising, religious matters, and family meetings.

The purpose of the courtyard varied based on the occupation of the family as well.

In large homes, there may be as many as five or six courtyards and each had a different function.

Home is where the hearth is

Rural huts are usually not more than one room big. As soon as you enter such a house, the first thing you will notice will be the most important part of the house the kitchen. cooking & eating takes place on the floor, with the entire family sitting together for meals. They use cow dung cakes wood & bio-gas. Utensils are neatly stacked & are usually of terracotta, steel or copper.

Pretty puducherry

puduchery is famous for the colonial French & Franco-Tamil architecture. The French styled architecture is suited for this town because of the weather with its long & huge windows with helical vertical cast iron bars as grills. ornate balconies large courtyards, circular arched gates, and stucco designs. They have flat roofs, an inner courtyard with garden and colonnaded porticos that serve a double function of protection from the sun & rain.

PASSIVE -BUILDINGS

Basic principles:

Basic principles of passive design-1

The objective of this class is to find out the method of passive heating using solar geometry. study the process of passive cooling & shading as one of its methods, help understand the importance of the day lighting in design as a primary element A to study the importance of materials in sustainable design as well as the crucial element of indirect lighting.

Basic principle of passive design-2

What does passive cooling mean? As much as possible, passive cooling uses natural forces energies and heat sinkrit. Since the goal is to create thermal comfort during the summer we can do either: cool the building by removing heat from the building by finding a heat sink or by raising the comfort zone sufficiently to include the higher indoor temperature by increasing air velocity so that the comfort zone shift to higher temperature.

INTELLIGENT BUILDINGS : ENVELOPE

In addition to incorporating the major system previously described, intelligent buildings through the use of computers and communication equipment, have the ability to control the total building environment. The equipment & operating personnel can be stationed in a so-called control center (or) the equipment can be monitored & controlled remotely via a computer, modem and telephone line.

Various sensors and communication devices feeding information to & from the control center, are located in key areas throughout the building for the purpose of analyzing & adjusting the environment, delivering messages during emergencies and dispatching repair personal & security gaa guards, as needed. To conserve energy, lighting may be operated by sensors that detected people movement. HVAC may be adjusted in accordance with temperature changes. Elevators may be programmed for efficient handling of variations in traffic patterns and may be equipped with voice synthesizers to announce floor steps & give advice in emergencies.

Security centre in intelligent building

↳ Detect a break in attempt & sound an alarm

↳ Identify the point of intrusion

↳ Turn on light.

↳ Display the intruder on closer - circuite television and record observation on card reader.

↳ Notify the police

↳ Limit entry to specific spaces only to approved personnel & only at permitted times.

↳ change locks automatically.

Meaning of smart building..

* smart building components

* What distinguishes a "smart" building from normal & makes it smart-?

BUILDING AUTOMATION (BA-system)

BA System consists of system installed in building that controls & monitors building services responsible for heating, cooling ventilation, air conditioning lighting, shading, life sta safety

alarm security system and many more. ABAS aims at automating task in technologically-enabled environments. coordinating a number of electrical and mechanical devices interconnected in a distributed manner by means of underlying control networks.

Mart solutions:

are not able to inter operate with other vendors solutions without additional overheads locking costumers to spefic product lines a major issue if such lines get discontinues

are too complex to be used by non specialized personnel, whether they are end-users or system developers.

Only perform satisfactorily in the exact conditions they were tailored for not performing so well if the working environment changes thus lacking flexibility, and

do not cover all the desired functionalities expected in a BAS.

ENERGY EFFICIENT BUILDINGS FOR VARIOUS ZONES

1. climate zone maps of india
   - Cold climate
   - composite climate
   - Warm & humid climate
   - Hot & dry climate
   - Moderate climate

2. Orientation of the building in various climate zones

Orientation of the building is generally used to refer to solar orientation which is the planing of building with respect to solar access. It is guided by natural elements like sunlight & its intensity direction of the wind, seasons of the year and temperature variations. Size specific planning is very crucial for a nature friendly building and it should be oriented appropriate to the region's climate.

A building may have to take need of multiple orientation factors depending on functional requirements.

Design strategies for various climate zones:

1. Designstrategies in a cold climate

Design according to the site slopes & orientation should portal preferably be in north-south direction.

Glazing windows upto 25% floor area may be provided. Double glazing is preferable to avoid heat losses during winter nights.

Adopt Trombe walls as they are a very useful passive heating system. They require little or no effort no operate, and are ideal for cold climates

2. Design strategies in a composite climate:

Plan or site plan the building to increase the cross ventilation of the internal rooms by providing them around the courtyard.

Plan water bodies on the bigger sites, which where wherever possible, so that hot air can pass over them.

Provision of cavity walls, terrace gardens green roof, light shelves to be increased in building planning.

Design strategies in a hot & Dry climate

Longer walls of building should face north & South. Non habitat rooms can be located on outer facks to act as thermal barrier. Preferably, the kitchen should be located on leeward side of the building to avoid circulation of hot air & smell from the kitchen.

The day lighting of architectural space utilizes diffuse light from the sky dome. direct beam orientation from the sun and reflected light from openig on west side.

CASE STUDIES OF RESIDENTIAL, OFFICE BUILDINGS AND OTHER BUILDING IN EACH ZONES:

Redevelopment of property at civil lines, Delhi

Design features:

Orientation of the building to cut off solar insolation during summer and let in winter sun.

Design of sections to let in winter sun into the first-floor rooms on the north side of the house.

Terraces with skylights that admit winter sun.

Insulated walls using innorative construction Sandwich.

Roof finished with china mosaic and is insulated using 30 mm thick polyurethane board insulation above the RCC slab.

Design features :

Air heating panels designed as an integral part of the south wall.

Provide effective heat gain. Distribution of heat gain in the building through a connective loop that utilizes the stairwell as a means of distributing heated air

Double glazed windows with proper sealing to minimize infiltration.

Insulated RCC diaphragm walls on the North to prevent heat loss. & st solar chimney.

Specially designed solarium on south for heat gain.

UNIT II

CONSTRUCTION PRACTICES

Specifications, details and sequence of activities and construction co-ordination - site clearance - Marking - Earthqua Earthwork - masonry - stone masonry - Bond in masonry - concrete hollow block masonry - flooring - damp proof courses - construction joints - movement and expansion joints - precast paremerts - Building foundations - basements - temporary shed - centering and shuttering - slip forms - scaffolding - deshuttering forms - fabrication and erection of steel trusses - frames - braced domes - laying brick - weather and water proof - roof finishes - acoustic and fire protection.

SITE CLEARANCE :

Site clearance is an initial stage of any construction work. It is used to clear all the obstructs such as grass, vegetation, bushes, existing building etc. on the field & the level of the ground as per the requirements.

Activities in site clearance :

1. Identification of the boundary of the proposed land for clearance.

2. Getting knowledge about the obstructs

3. Remove or clear the existing building

4. clearing all general vegetation, tall grass bushes and all under growth.

5. Felling of trees of all series. It is included grubbing up their stumps and roots and disposes off site.

6. clearing all rubbish and unwanted material.

7. Filling hole and voids caused by removal of tree roots, existing structure with suitable hard materials.

MARKING or Setting out

Marking is the next stage to site clearance : It is used to mark the boundary line of site and fix all points of given plan. (fig)

While marking on site, the following precautions should be taken for getting accuracy.

a) plan should contain all specifications and clear dimensions.

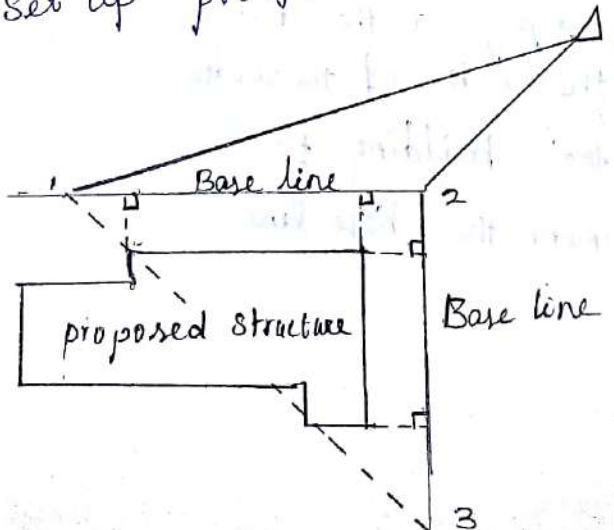
b. Site should be cleaned, most probably leveled surfaces

c. Careful selection of method of marking is needed.

d. Check the points twice from the base line.

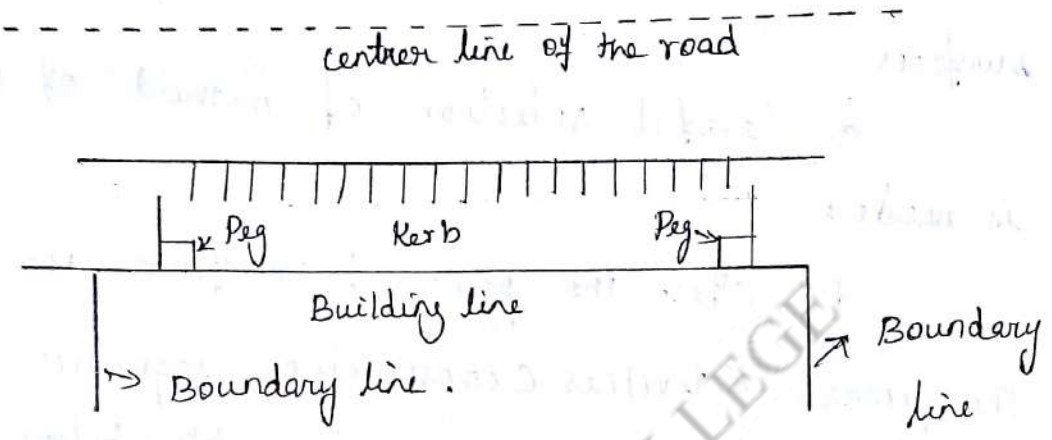
The general activities (construction sequences) of marking or setting out of site are given ~~bt~~ below.

1. ⊢> Set out the building line
2. ⊢> " base line (frontage line)
3. ⊢> " First right angle to the frontage line.
4. 3. ⊢> " Second " "
5. ⊢> " Final (back) line.
6. ⊢> Check the building setting out for square.
7. ⊢> Set up profiles and attach ranging lines.



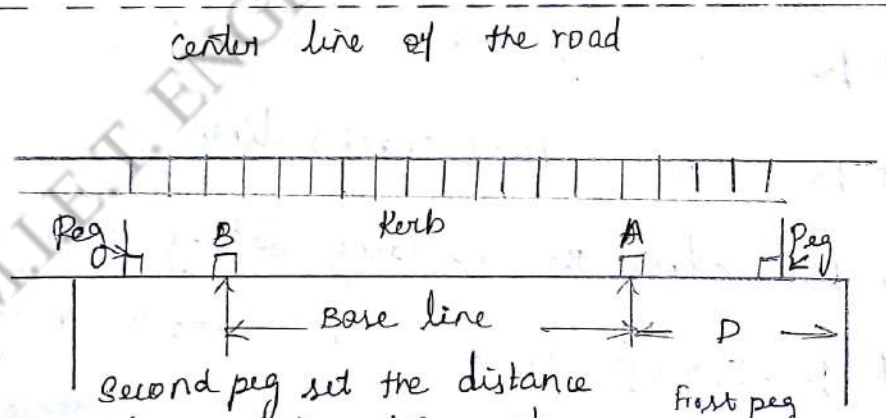
Set out the building line

Initially, assume that the building line has been stated as a distance from the kerb of a road...

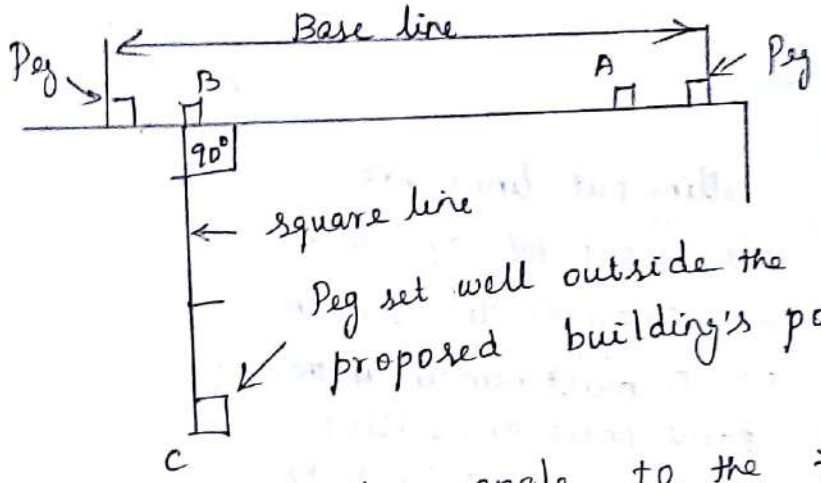


Setout the base (frontage line) line

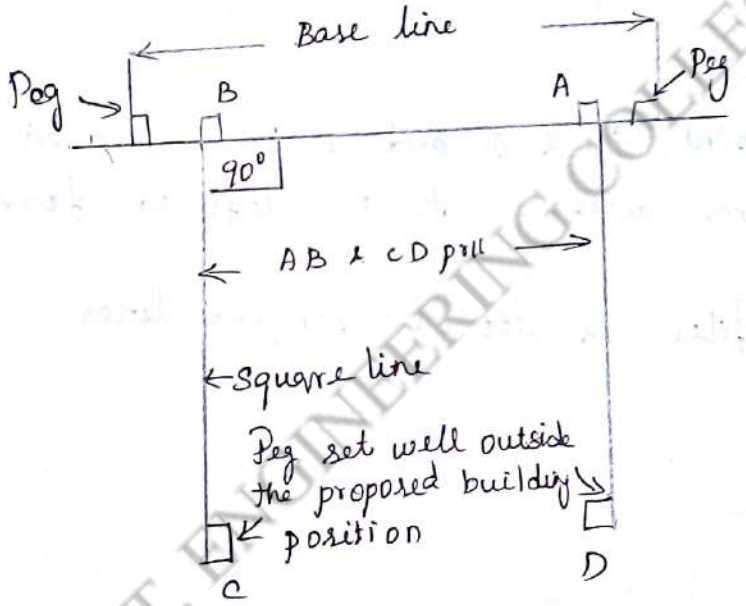
After taking the dimensions from the drawing, relating to its position, the frontage line should be set out.



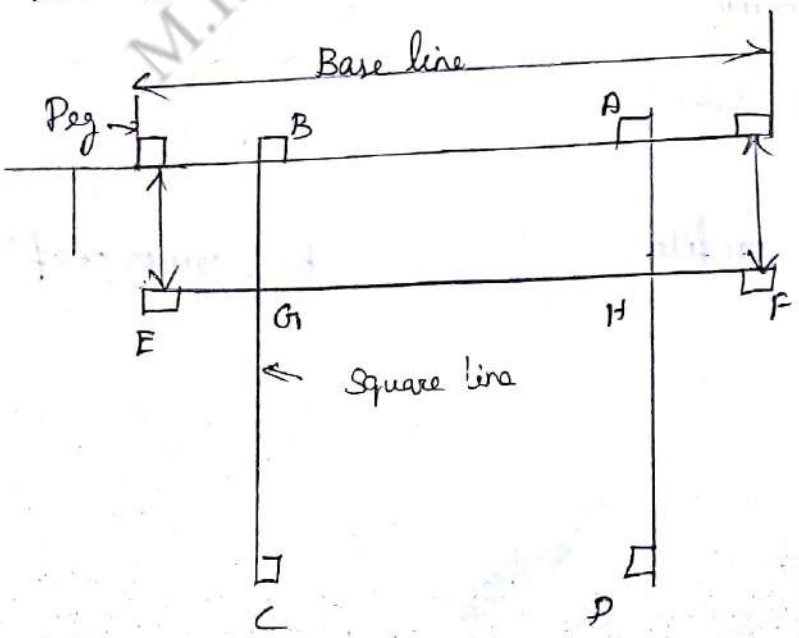
Set out the first right angle to the frontage line



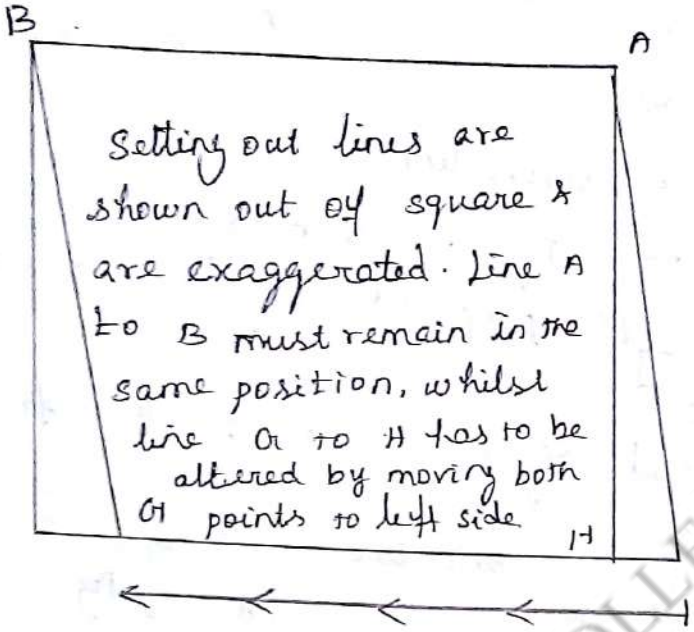
Set out the second right angle to the frontage line



Set out the final (back) line

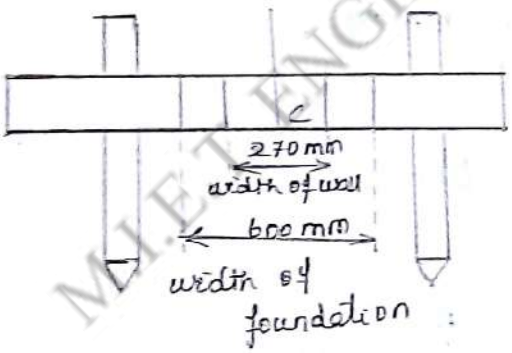


Check the building setting out for square

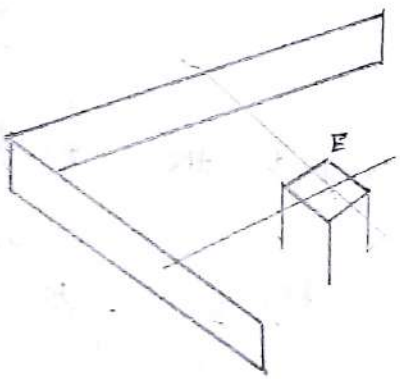


point P & G and H to be moved the same distance to the left to form true ▭le

Set up profiles & attach ranging lines



a) Single profile



b) corner profile.

EARTH WORK (excavation for foundation)

EW is the next stage of marking. After marking the excavation line & the earthwork can be started.

The general activities involved in excavation process

1. Foundation trenches are digging out
2. Bottom of foundation trenches should be perfectly leveled.
3. Water if any accumulated in the trench, should be pumped out and prevent water to enter again the trench.
4. After concreting & laid masonry the remaining portions of trenches are filled by earth soil. And it shall be compacted well.

However before starting earthwork for construction activities the following factors should be considered to complete the task in perfact manner

1. Effects of weathering condition
2. Safety precautions
3. planning.

MASONRY

Masonry is defined as the construction of building units made by stone. brick, precast, block and concrete hollow block etc. Masonry normally used for the construction of foundations, walls, columns and other similar structural component of buildings.

However, the masonry is the combination of mortar and building units.

The main functions of the masonry

Supporting loads from the superstructure

Subdividing Spaces for segregations of rooms

Providing thermal and acoustic insulation.

To give fire and weather protection.

Mortar for masonry:

Mortar is homogeneous mixture of a binder such as lime/cement with sand. Water is added to this mixture to make a paste of required consistency and it is used to bind the masonry units.

1. Lime mortar
2. Cement mortar

TYPES OF MASONRY

* Stone Masonry
* Brick masonry

STONE MASONRY :

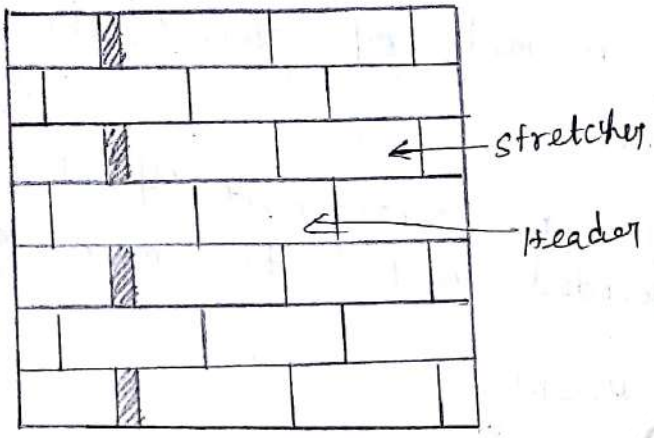
Stone masonry is made of stone / units bonded together with mortar.

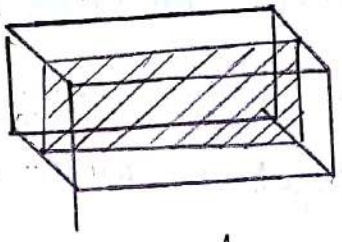
Depending upon the arrangement of the stone. It is further divided in to two main groups

1. Rubble Masonry
   a. Random Rubble masonry
   b. Square " "
   c. Polygonal " "
   d. Flint Rubble masonry
   e. Dry "
2. Ashlar Masonry
   a. Ashlar fine masonry
   b. Ashlar chamfered Masonry
   c. Ashlar facing Masonry
   d. Ashlar rough tooled masonry

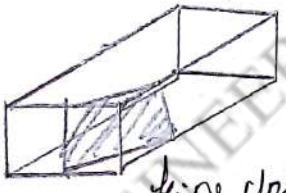
BRICK MASONRY

Brick masonry is made of brick units bonded together with mortar.

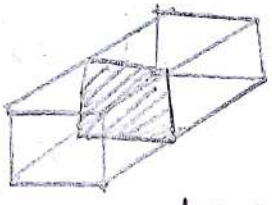




Queen closer



King closer



Half bat

Bond in brick masonry

1. Stretcher bond
2. Header bond
3. English bond
4. Flemish bond
5. Diagonal bond
6. Zig Zag bond
7. Garden wall bond

CONCRETE HOLLOW BLOCK

The concrete hollow block is a large redangular size with holes on centre of the block. The manufacturing process is slightly varied to the othe concrete blocks/ elements.

Manufacturing of concrete hollow block

1. Aggregate are properly graded.
   60 % F.A & 10 % C.A are used
2. 1:6 - cement concrete mix is maintained.
3. Mould is kept vertical.
4. proper compaction.
5. Undistributed on the moulding platform for at least 24 hours.
6. Blocks are cured by means of immersed in water for 7 days.

Use : masonry, pillar. compound wall etc.

Classification of concrete hollow block

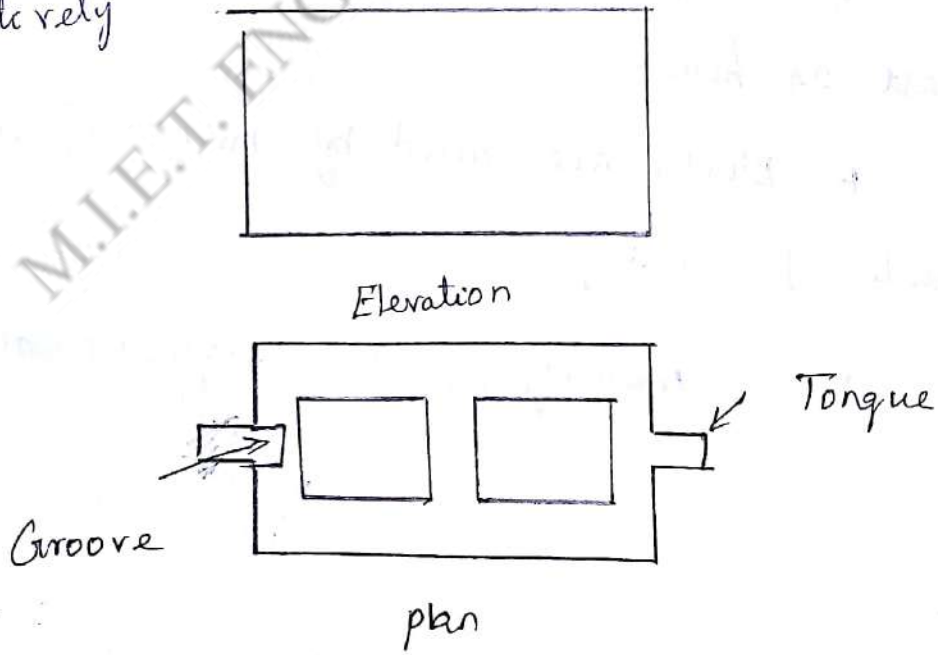
Grade A:

These are used as load bearing units and shall have a minimum block density of 1500 Kg/m^3.

These shall be manufactured for minimum average comp. strength of 3.5, 4.5, 5.5, 7.0, 8.5 10.0, 12.5 & 15. N/mm^2 respectively at 28 days.

Grade B.

These are also used as load bearing units and shall have a block density b/w 1100 Kg/m^3 and 1500 Kg/m^3. These shall be manufactured for minimum average comp. strengths of 3.5 & 5.0 N/mm^2 respectively



Concrete hollow block

FLOORING

Flooring is an important building element which is used to divide a building into different levels (floors) for creating more accommodation one above the other.

Requirements of good floor.

- It hard & smooth surface
- Adequate strength & stability against any transverse loads.
- It should be damp proof.
- Good thermal insulation capacity to maintain proper room temperature.
- Durable & easy to maintain

Types of flooring

1. Mud flooring
2. Brick flooring
3. Concrete
4. Terrazzo
5. Mosaic
6. Timber
7. Asphalt

DAMP PROOF COURSES (DPC)

One of the basic requirements in any building is that the building / structures should remain dry as far as possible. If this condition is not satisfied, it is likely that the building may become unsafe from the structural point of view. Hence, In order to prevent the entry of damp (or) wet, damp proof courses are provided at various levels of entry into a building. This is known as damp proof courses.

Causes of dampness

It is caused by defective junction b/w roof slab and parapet wall.

By defective roof covering of the pitched roof

By faulty eaves and valley gutters

By improper rain water pipe connections

By moisture from wet ground below foundation.

By splashing rain water.

By unprotected tops of walls, parapets and compound walls etc.,

Damp proofing materials

Hot bitumen

Mastic Asphalt

Bituminous felts

Metal sheet

combination of sheet belts

Stones

Bricks

Mortar

cement concrete.

Plastic sheet.

Requirements of an ideal damp proofing material.

Damp proofing material should be impermeable or very low permeability.

It should have strong adhesion (fixation ability) with substrata on it.

High resistance to abrasion and cracking.

Durable & easily available in the market.

Methods of damp proofing :

1. External wall damp proofing
2. Internal wall damp proofing
3. Air Drain " "
4. Damp proof for basement
5. Damp proof for floors
6. stepped damp proofing

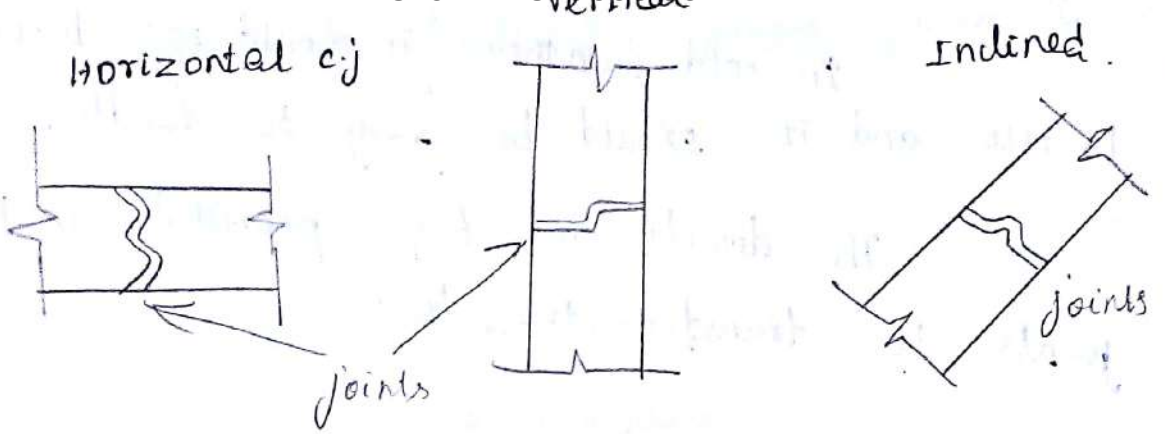
JOINTS IN CONSTRUCTION

i. construction joints
ii, Expansion / contraction joints.

i, CONSTRUCTION JOINTS :

The construction joints are provided at location where the construction is stopped either at the end of day (or) any other reason.

The provision of a construction joint becomes necessary to ensure necessary to ensure proper bond b/w the old work and forthcoming new one.



Various construction joints.

Expansion / contraction joints:

The expansion or contraction joint of building is normally occurring due to the temperature variations at site.

The joints are provided in all concrete structure of length exceeding 12 m, mainly for the following two purposes.

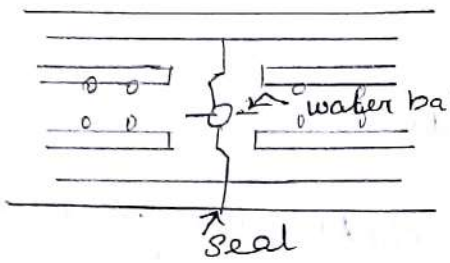
a) To allow for change in volume of concrete due to temperature.

b. To preserve the appearance & original shape of the concrete structure.

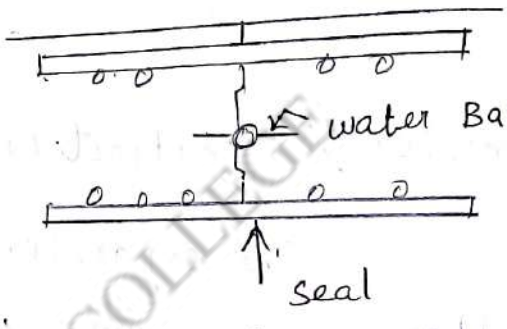
These joints generally consists of some classic Material, known as joint filler and dowels (or) keys. The joint filler should be compressible, rigid and cellular.

In cold weather, it should not become brittle and it should be easy to handle.

The dowels or keys provided in these joints to transfer the loads.



complete construction joint.



partial construction joint

PRECAST PAVEMENTS

The main difference b/w precast pavement and cast - in - situ pavement is that the precast pavement is a factory made product and then it is transported to the site, where as the cast - in - sites pavement is prepared at the site itself.

Adv:

Superior quality than other.

Not required any construction joints

The detailed requirements for precast pavements blocks are as follows

1. Visual inspection
2. Dimensions & tolerances
3. Thickness of wearing layer
4. Water absorption
5. Compressive strength

FOUNDATIONS FOR BUILDING :

The foundation is an important structural component for any kind of civil Engineering structures.

The main function of the foundation is to transfer all super structure loads to ground ~~level~~ safely.

The entire stability of the structure mainly depends on the stablity of the foundation as well as bearing capacity of the soil.

Bearing capacity of soil

Ability of soil to withstand the externally applied loads.

Ultimate bearing capacity (q_f)

foundation soil can withstand without undergoing shear failure.

Net Ultimate bearing capacity (q_n)

It is the max. extra pressure (in addition to initial overburden pressure) that a foundation, soil can withstand without undergoing shear failure.

$$q_n = q_f - q_o$$

$q_o \rightarrow$ overburden pressure at foundation level and is equal to γD for level ground without surcharge.

Safe bearing capacity (q_s)

It is the safe extra load the foundation soil is subjected to in addition to initial overburden pressure.

$$q_s = \frac{q_n}{F} + q_o$$

F – represents the factor of safety.

Allowable bearing pressure (q_a)

It is the maximum pressure the foundation soil is subjected to considering both shear failure and settlement.

The bearing capacity of soil can be improved by

↳ Increasing the depth of foundations up to hard strata.

↳ Draining the excess sub soil water

↳ Compacting the soil where the soil is in loose state.

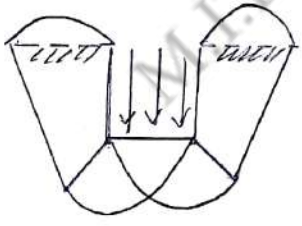
↳ Confining the soil mass.

↳ Cement grouting (Injection of cement to soil media with high pressure) for densification.

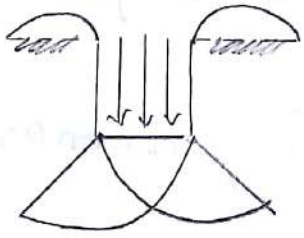
↳ chemical treatments.

MODES OF FAILURE IN FOUNDATIONS

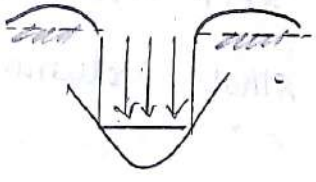
Depending on the stiffness of foundation soil and depth of foundation, the following are the modes of shear failure experienced by the foundation soil.



General shear failure



Local shear failure



Punching shear failure.

UNIT - III

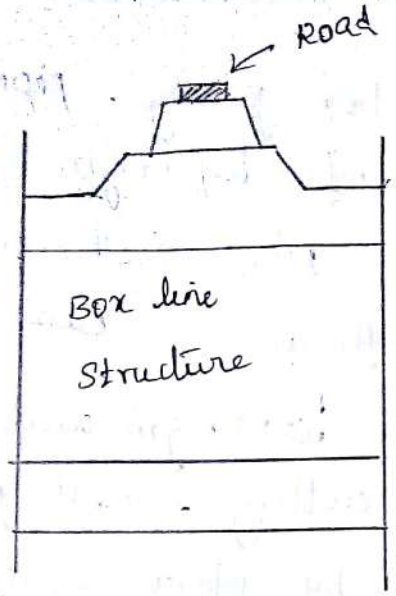
SUB STRUCTURE CONSTRUCTION

Techniques of box jacking . pipe jacking . under water construction of diaphragm walls & basemeat - Tenneling techniques - piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting - driving diaphragm walls, sheet piles - shoring for deep cutting - well points - Dewatering & stand by plant equipment for underground open excavation.

BOX JACKING TECHNIQUE

Box jacking is jacking a large precast reinforced concrete box horizontally through the ground, usually beneath a road or railroad that must not ber interrupted.

The RCC box is provided with a shield in fron called front shield which uset to push trough soil under the pushing forces of haydraulic jacking. The manual excavation is also used to cutting the soil if necessary.



Longitudinal view.

Before starting box jacking method & technique, the following imp. points are to be notes.

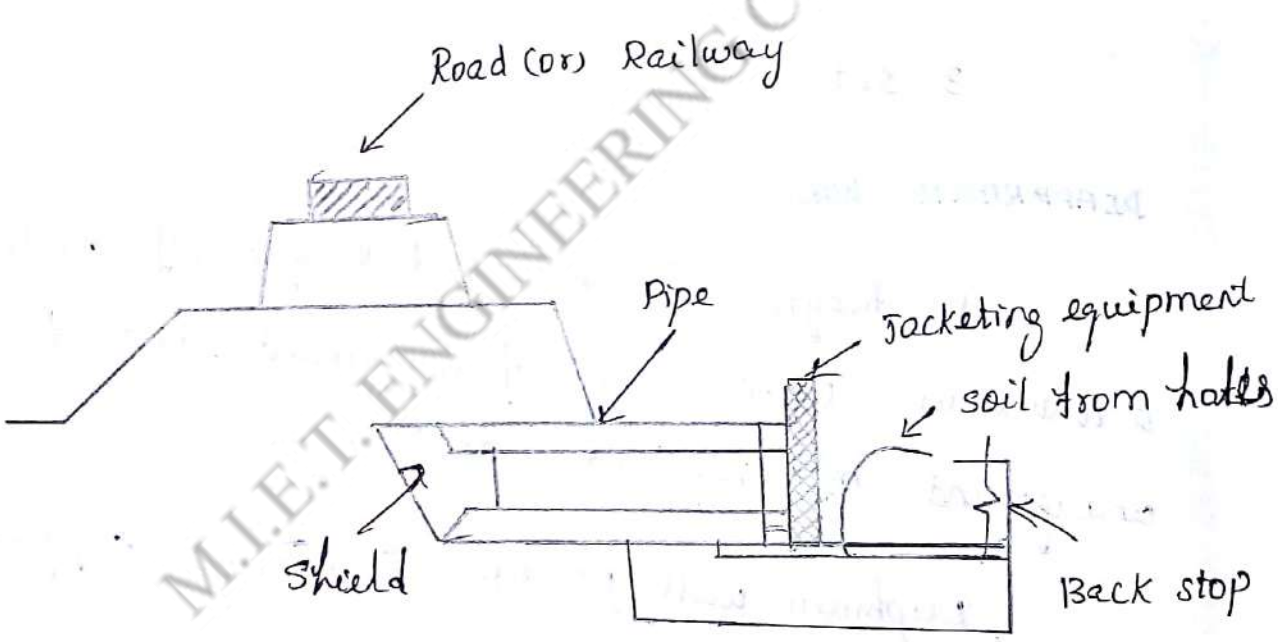
1. Layout
2. Geology
3. Backstop & Jacking pit.
4. Timing
5. Box Modification

Uses :

Canal syphons
construction of new roads
Underground floor path
A high quality maintanance free structure.

PIPE JACKING TECHNIQUE

With pipe jacking, utility lines & pipes are driven underground in segments from a starting shaft using hydraulic jacks. After the starting & target shafts designed to absorb the jacking forces have been constructed, the face is cut with a cutting shoe or under the protection of a shield tunneling machine.



Process of pipe jacking techniques

Uses:

1. It is used to convey water from one end of road to another end of road.

2. It is used to convey gas, oil etc

3. It is used to cross the cables like electricity cable, tower cable under road railway without any traffic disturbance.

The installation pipe under the soil media is carried by following three steps ...

1. Excavation
2. Back stop
3. Set.

DIAPHRAGM WALLS

Diaphragm wall is a technique of constructing a continuous R.C.C. wall from ground level to underground of required depth.

Diaphram wall provide structural support and water tightness to structures. It is especially used for basement construction. where the site is water logged in nature.

This Reinforced concrete diaphragm wall is also called slurry trench wall.

Following should be considered for the design:

1. Site plan & detailed drawing
2. Detailed subsoil investigations
3. Physical, physico-chemical & engineering properties of subsoil condition should be studied.
4. The ground water table, it is probable fluctuations & subterranean flow conditions of ground water if any should be analysed.

Equipments for diaphragm wall:

a. Trenching equipment
b. Slurry preparation & Testing Eqt.
c. Concreting equipment
d. Lifting Devices
e. General guidelines

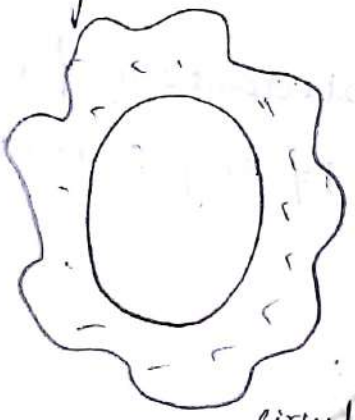
Method of construction.

1. Cast in situ diaphragm wall
2. Pre cast diaphragm wall

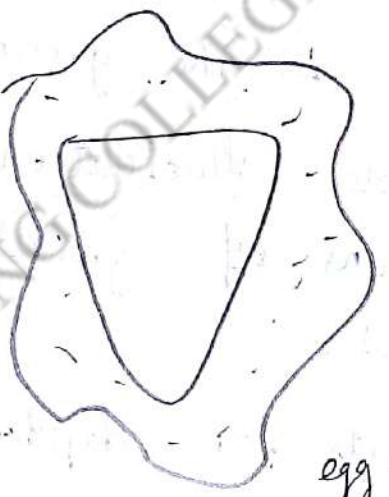
TUNNELING TECHNIQUE

Tunneling is defined as an artificial underground passage constructed without disturbing the ground surface. It is widely carried out in the construction of railway & road projects. The work involved is of a specialized and hazardous nature.

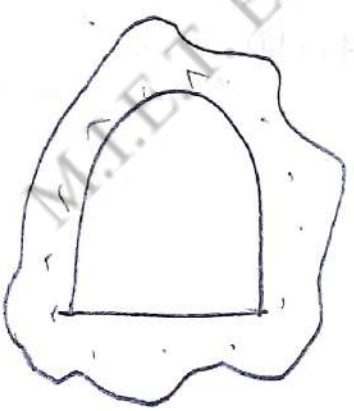
Shapes of tunnel:



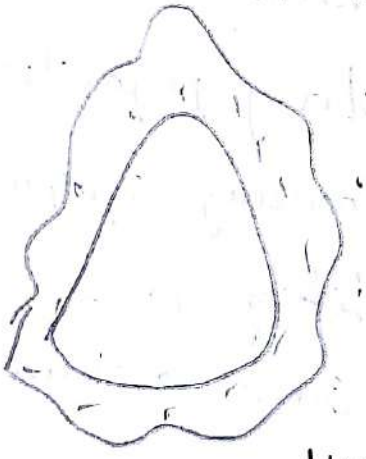
Circular tunnel



egg shaped tunnel



Vertical wall with Archtod.



Horse shoe tunnel

Necessity :

↳ To avoid long circuit routes b/w around mountain

↳ Avoid sliding of soil

↳ Avoid steep gradients in mountain

↳ Used to divert water for generation of power.

Methods of tunnelling :

1. Full face heading
2. Heading & bench method
3. Drift method
4. Pilot tunnel method.

Safety Measurements during tunnel work

↳ Safety Personnel

↳ Reporting of accidents

↳ First aid arrangements.

↳ Protective water

↳ Sanitation & drinking water

↳ Warning signals

PILING TECHNIQUES

Piles are generally driven by means of a hammer supported by crane (or) special device known as a pile driver. The hoisting engine is usually operated by team or diesel.

For satisfactory design & construction of driven cast in-situ piles the following information would be necessary:

1. Thorough site investigations by supplementary tests.
2. Nature of soil should be indicated
3. Ground water level & artesian condition
4. Results of chemical tests to ascertain the sulphate, chloride & any other deleterious chemical
5. The top levels of finished pile caps shall also be indicated separately
6. All transient loads due to seismic wind, water current, etc indicated separately.

Equipments for piling techniques

1. Pile hammer
2. Single acting steam hammer
3. Double
4. Diesel
5. Pile frame

Design consideration

1. Adjacent structures
2. Pile capacity
3. Negative skin friction
4. Structural capacity
5. Spacing of piles
6. Pile groups.
7. Factor of safety
8. Overlapping.

WELL AND CAISSONS

A caisson is a type of deep foundation which is in the shape of a hollow prismatic box.

It is constructed above the ground level and then immersed to the required depth in water as a single unit. It is a water tight chamber used for laying foundation under water in river, lakes & harbors etc..

Types of well or caissons

1, Box caissons

2, Open or well caisson

3. Pneumatic caisson

Methods to bring a tilted well to position while constructing a well foundation

1. Regulation of grabbing

2. Eccentric loading

3. Providing temporary obstructer below the cutting edge.

4. Pulling the well

5. Pushing by hydraulic jack.

SINKING COFFERDAM

Cofferdam is a temporary structure constructed to obstruct running water for the purpose of constructing the permanent sub structure without interference of water. The substructure may be pile foundation, bridge piers and well foundation.

Uses:

To faulitate pile driving operation across river.

To place grillage and raft foundation across river.

To construct foundation for pier, abutment of bridges.

Types:

1. Earthen coffer dam
2. Rock fill "
3. Crib "
4. Cellular "
5. Concrete "

General design requirements of cofferdam

1. Design flood
2. Effect of wind
3. Effect of earthquake
4. Seepage
5. Scouring
6. Obstruction to river flow during working and nonsoon seasons

CABLE ANCHORING AND GROUTING

Cable anchoring is a long and high tensile strength element used in reinforced rock masses around surface and underground mining & civil Engg excavation.

This system is very convinient and simple to use. It mainly used to resist the sliding of soil or soft rock inside the tunnel / excavated portion.

In this technique. initially cables anchored using anchoring device with required shape.

The arrangement of anchored cable is achieved by any one of the method.

1. Simple rock support / rock reinforcement
2. Pre reinforcement / Post reinforcement
3. Pre tensioned / Post tensioned reinforcement
4. Cable bolt devices with components.

SHEET PILES

Sheet piles are made of sheet of steel, timber (or) Reinforced concrete. Sheet piles are not used as a component of foundation to bear the load of a structure but it generally used for the following purposes.

1. For the construction of coffer dam.
2. For preventing the structure from shocks, vibrations etc..
3. For preventing leakage of the fine material and water
4. Protecting the foundation from corrosion.
5. Construction of retaining walls in marine structure.

Type of sheet piles.

steel sheet piles

Timer " "

Reinforced concrete sheet piles.

SHORING

Shoring is a temporary support or structure provided to an unsafe structure or to a structure undergoing alteration called a "shore" and the method of construction is called shoring.

Objectives :

It provides support to the building where the adjacent structure is to be dismantled.

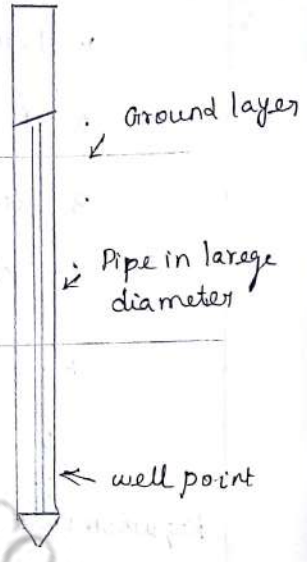
It provides support to the wall where the crack developed due to an unequal settlement of foundation.

Types :

1. Raking or inclined shoring
2. Flying or horizontal "
3. Dead or Vertical "

WELL POINTS :

A well point system can be defined as the group of bore wells provided along the trench / proposed excavation site. The entire bore well / wellpoint are connected to a common place to accumulate the underground water that disturbs the excavation process.



Suitability of well point system:

a) It is practical & effective under moist soil & hydrological conditions.

b) Site is accessible

c) Most effective in sands & sandy gravels of moderate permeability.

Design considerations:

1. The physical layout
2. Adjacent areas
3. Soil conditions
4. Permeability of the soil
5. The amount of water to be pumped.
6. Depth of impervious
7. Stratifications.

DEWATERING :

Dewatering of foundation excavation is the prows of removing water or any liquid from the foundation trenches in known as dewatering.

Methods :

1. Pumping
2. Providing sumps & side drains
3. Cement grouting
4. Chemical process or chemical grouting
5. Freezing process
6. Electro-osmosis process

Requirements for dewatering process

- Geological condition
- Spacing of boring
- Source of seepage
- Chemical properties of ground water.

STAND BY PLANT EQUIPMENT FOR UNDERGROUND OPEN EXCAVATION

Commonly the excavation is used to indicate removing the loosen soil / rock other materials for the purpose of civil Engineering works. Presently stand by plant equipments are setup for the excavation process for the following advantages.

Advantages :-

a) Work is done in quick manner.

b) Avoid dangerous condition of work

c) Achieve greater depth

d) Use unskilled manpower & work done in lower cost.

Disadvantages :

a) Involve large running and maintanance costs.

b) Require a large operating area

c) Access provision to working area

d) Less flexible in work planning

e) Idling time increases cost of work.

f) Brief description of plants.

UNIT IV

SUPER STRUCTURE CONSTRUCTION

Launching girders, bridge decks, off shore platforms - special forms for shells - techniques for heavy decks - in-situ pre-stressing in high rise structures, material handling - Erecting light weight components on tall structures - Support structure for heavy equipment and conveyors - Erection of articulated structures, braced domes and space decks.

LAUNCHING GIRDER

Launching girder is a steel or wooden structural member, used to support the super structures such as bridge deck, off shore structures etc.. The operation of launchery girder is more difficult. Proper study and local site investigations are the only way to make it easier.

Uses :

a) It is used for all type of bridge deck construction.

b. It is used in the field of pier head construction

c. It is used for off shore platform construction

d. It is used for deep foundation construction

e. It is used for lifting heavy equipment for various constructions.

The basic steps for a typical span construction are:

1. Delivery of a segment to the launching girder

2. Pick-up and winching of segment into its approximate position.

3. Application of epoxy resin to segment faces to be joined.

4. Final positioning & temporary stressing for self supporting.

5. Internal permanent post tensioning sufficient to allow placing of the next segment.

6. Repetition for further segments until completion of the cantilevers.

7. Form & stress a concrete stitch at mid-span to complete the span.

8. Launch the LG to next span.

9. final post tensioning possibly continuous

BRIDGE DECKS

Construction of bridge decks

The various bridge decks are constructed by the following constructing sequences. they are

1. Traditional (or) Technique for heave decks
2. Incremental push launching (or) Launching girder
3. Cable stayed bridges
4. Bow string Bridge.

Precautions during the construction of bridges.

a, The load local site conditions are studied, It is used to give the proper design & construction of bridges, and it includes local weathers for whole year.

b, The proposed site, soil conditions should be studied, it is used to avoid any settlement of foundations and auxiliary support etc. and it is also used to fix the depth of foundation.

c, The site of the proposed bridge should be located where materials and labour are available at cheapest rate.

d. The proper studies are carried out for velocity of flow; if velocity of flow is less than a particular value, the silting will occur.

e. The proper study or precautions carried out to form embankment on both side of bridge, it should be solid, permanent and straight.

f. The suitable precautions are taken about high flood level. This studying is used to provide the suitable height of the bridge from water bodies.

g. The bridge deck should be design for future traffic also. so the proper current traffic as well as future traffic is carried out.

h. Correct span length is provided for bridge deck. It may used to avoid any structural damage.

i. The proper finishing works are carried out to avoid any cracks on structure.

OFFSHORE PLATFORMS

Offshore platform is a structure that is constructed in the ocean (or) sea to explore (or) to product oil (or) gas from the sources found below the sea. It is dealt with the foundations in the sea.

Offshore platforms are made up of either in steel (or) concrete. Since this construction is constructed on sea water almost care should be taken to resist the structure from the corrosion problems.

Uses:

1. Oil & gas exploration
2. Navigation aid tower
3. Bridges and causeways
4. Ship loading and unloading facilities

Types of offshore platform

1. Fixed plat form
2. Compliant Tower
3. Sea star platform
4. Floatery production System

5. Tension leg platform

6. Sub base system

7. Spar platform.

FORMS OF SHELL

A shell structure is a three dimensional structure, constructed for storage of water, roof of large column free are such as complex, theatres etc.

The shell is used as special forms,

1. Roof
2. chimney
3. cooling tower.

construction sequence of shell roofs

Due to the minimum thickness, shell structures are used for special roof construction. It is used to cover large are by means of column free structure.

The following are the special forms of shell roofs.

1. Single barrel shell

↳ Butterfuly shell

↳ Multiple barrel shell

↳ North - light cylinderical shell

Adrantages :

↳ Very light form of construction to span 30.0 m shell thickness required is 60 mm.

↳ Dead load can be ~~req~~ reduced. economizing foundation & supporting system.

↳ Flat shapes by choosing certain arched shapes.

↳ Aesthetically it looks good over other forms of construction.

Disadrantages :

↳ shuttering problem

↳ Greater accuracy in formwork is required.

↳ Rise of roof may be a disadvantages.

↳ Good Labour & supervision necessary.

Design consideration of shell roof

1> Slope (shall not exceed 45° to 65°)

2> Thickness

Singly curved shell < 50mm

Doubly curved " < 40mm

3> End frames

Trarerse or end frame provided to protect the shape of the shell.

4> Reinforcement

Ø of reinforcement ⌀ < 5mm in the unthickened portion of the shell.

5> Mix proportions for concrete

Nominal mix 1:2:4 → shells of medium dimensions.

Nominal mix (by volume) 1:1.5:3 → Very large shell

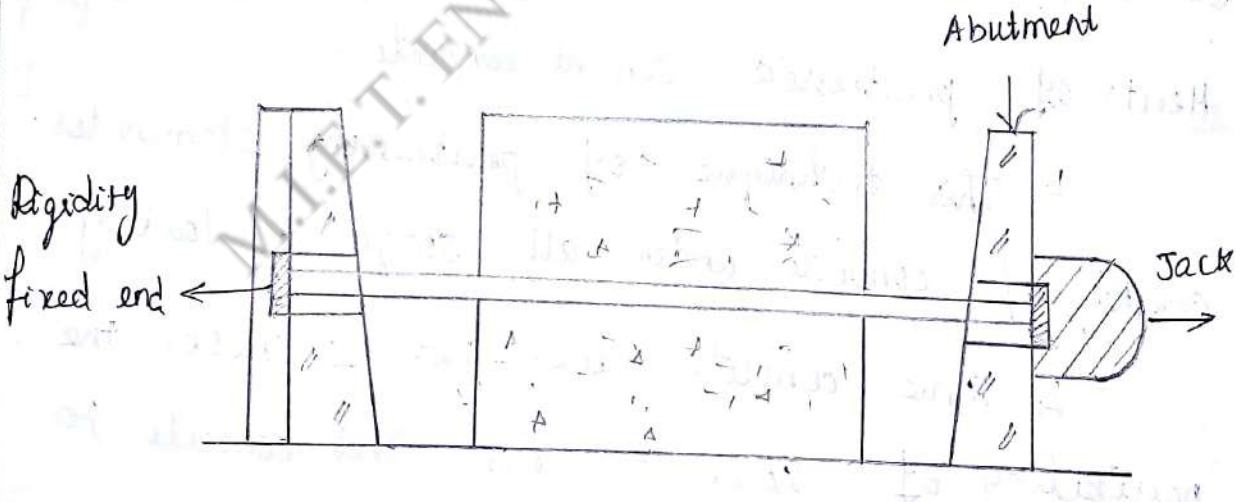
IN SITU PRESTRESSING IN HIGH RISE STRUCTURE

Prestressing is the method of increasing tensile strength of member by introducing internal stresses. For prestressing, the tendons are used to introduce stresses and suitable anchorage is used.

Prestressing of concrete member can be obtained by following two methods.

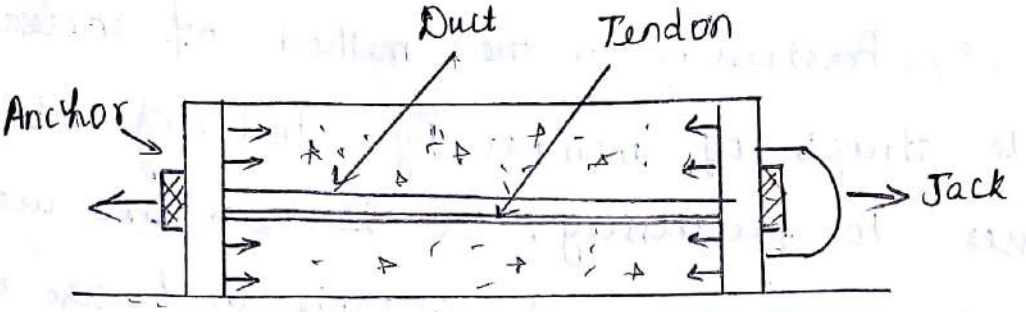
1. Pre tensioning method
2. Post tensioning method.

1. Pre tensioning method.



In the pre-tensioning system the tendons are tensioned before concreting.

2. Post tensioning Method.



Bar being pulled

Post tensioning method is one in which the reinforcement is tensioned after the concrete has fully hardened. The concrete is is first cast and leaving duct for placing the tendons. The ducts are made in a number of ways by leaving corrugated steel tube (or) by providing steel special (or) Rubber hor (or) any othe ducts ~~are~~ forming unit.

Merits of prestressed cement concrete:

↳ This technique of prestressing eleminates cracking of concrete under all stage of loading.

↳ Since concrete does not ~~&~~ crack, the possibility of steel to rust and concrete to deteriorate is minimized.

↳ Absence of cracks results in higher capacity of the structure to bear reversal of stresses, impact vibration & shock.

CONSTRUCTION SEQUENCES IN TALL BUILDING

1. Studying of local soil condition
2. Form work
3. Mixing of concrete
4. Pumping system
5. Use of admixtures.
6. Proper curing

MATERIAL HANDLING

Material handling consists of transporting, securing and stacking or protect the manufacturing product for the purpose of construction is known as material handling. In order to handle materials, large amount of equipments such as various types of conveyors, cranes and trucks and labor are involved.

classification of material handling

1. Transport Equipment
2. Positioning Equipment
3. Unit load formation Equipment
4. Storage Equipment
5. Identification & control Equipment.

ERECTION OF LIGHT WEIGHT COMPONENT OF TALL STRUCTURE

- The light weight components are transported and stacked.

The suitable scaffolding & temporary supporting structures are made to establish the light weight component.

Lifting & placing to the system to ensure stability during erection.

Aligning and permanently connecting the member by bolting, riveting or welding, concreting.

Connecting all necessary claddings

Removing all scaffolding or supporting structure.

The following precautions are taken.

Well trained workers are used for erection process, because minor mistake can cause serious effects.

Proper material handling should be carried out such that it can minimize the storage requirements.

cleaning process should be carried out on the surface of the elements.

Proper verification should be made to avoid irregular shape of members.

Proppper scaffolding should be avoid any structural failure during erection. process.

The surface treatments should be made by means of proper finishing work.

SUPPORT STRUCTURE FOR HEAVY EQUIPMENT AND CONVEYORS

The supporting structure is used to indicate any structure used to support a working platform. including plant and equipmend. A safe resting surface is required for supportiny structures. The supporting structure should be strong enogh. rigid & stable. The supportiny structure and its platforms will be affected by the following factors.

1. Uneven surface of the plotforms.
2. Application of over load to supporting Structure.

ERECTION OF ARTICULATED STRUCTURES

An articulated structure is defined as a structure connected / constructed by joints. Articulated structures are very useful for the construction of mega structure. In general by connection only, we can make the mega structure. The general construction sequences of erection

↳ A traffic management plan is developed and implemented

↳ Activities of all contractors are being coordinated and supervised.

↳ The ground surface or supporting structure is suitable for plant (EWP, mobile scaffolding) to operate safely.

↳ Weather conditions are continually monitored particularly potentially hazardous situations like high or strong winds & electrical storms.

At least one of the erection crew or another person who remains on site throughout erection process.

The builder should ensure that the accuracy of each contractor's work is within the tolerance of the level or position nominated by the erection engineer or relevant standared.

Any modification to the building layout also need to checked by the builder for approval by the erection engineer.

Only start the erection of member or sub-assembly when equipment to ensure the structures stability is available & being used.

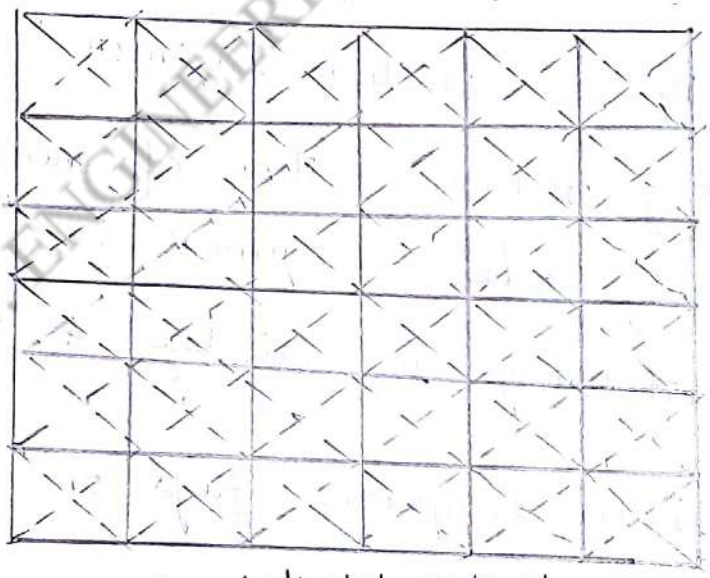
Ensure temporary guys or braing or securely anchored.

check the fittings for the support of columns during erection, to ensure adequate structural capacity for the erection conditions.

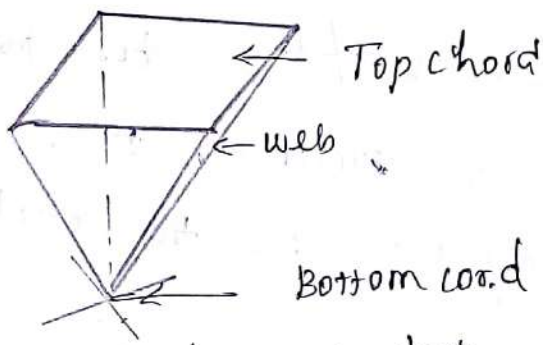
ERECTION PROCESS OF SPACE DECK

If the length of the area to be roofed is more than twice the breadth, it is more economical to span one way. If the area is nearer square, the more economical solution, theoretically, is to span two ways. The rectangular area can be divided into square or near square areas with lattice girder & then two way spanning structure can be installed in the sub divided roof.

1) Cantilever method

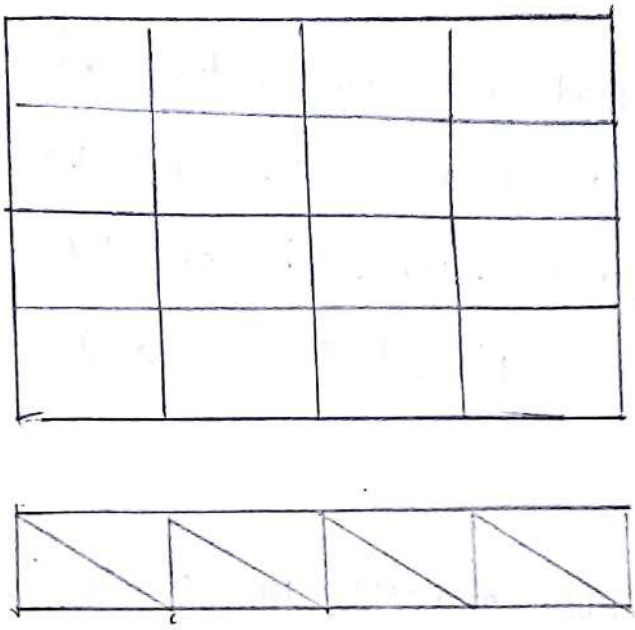


2. Lift slab method.



3. Pyramid unit for space deck

1. Cantilever Method :



In this method, the structure is erected starting from a support point & a section or strip of the structure is erected to span b/w two adjacent supports with the help of movable scaffolding. Once part of the structure is stabilized the rest of the structure is assembled by adding seperate pieces or units to already erected structure.

2. Lift slab Method :

In this method, the entire spatial structure is assembled on ground and lifted to the final location using cranes or other heavy lifting equipment. This method is usually upto 200 ft weighing upto 2000 kips have been erected Using this method.

UNIT V

CONSTRUCTION EQUIPMENT

Selection of Equipment for earthwork - earthmoving operations - types of earthwork equipment - Tractors, motor graders, scrapers, front end waders, earthmovers - Equipment for foundation & pile driving. Equipment for compaction batching and mixing & concreting - Equipment for compaction, batching and mixing and concreting - Equipment for material handling & erection of structures - Equipment for dredging, trenching, tenneling.

SELECTION OF EARTHWORK FOR EQUIPMENTS FOR EARTHWORK

The following factors are considered before selecting the earthwork equipment

Size of the job

Larger volumes of excavation will require larger excavators, or smaller excavators in greater number.

Activity time constraints

Storage of time for excavation may force contractors to increase the size or, numbers of equipment for activities related to excavation.

Availability of equipment

Productivity of excavation activities will diminish if the equipment used to perform them is available but not the most adequate.

Cost of transportation of equipment

It is depends on the size of the job, the distance of transportation. and the means of transportation.

Type of excavation:

Principal types of excavation in building projects are cut & fill, excavation massive, and excavation for the elements of foundation.

Soil characteristics

The type & condition of the soil is important when choosing the most adequate equipment since

each piece of equipment has different outputs for different soils.

Geometric characteristics of elements to be excavated

Functional characteristics of diff. types of equipments are makes such considerations necessary.

space constrains.

The performance of equipment is influenced by the spatial limitations for the movement of excavators.

EARTH MOVING OPERATIONS

Earthmoving is an important constructional activity that includes site preparation, excavation, embankment construction, backfilling, dredging, preparing base course, sub base and sub grade compaction & road surfacing. The types of equipment used & the environmental conditions will affect time required to complete a given amount of work. Before preparing estimates, choose the best method of operation and the type of equipment to use.

Each piece of equipment is specifically designed to perform certain mechanical tasks. The following are main earthmoving operation.

1. Selection of earthmoving equipment.
2. Excavation of required height & volume.
3. Disposal of excavated materials.

TYPES OF EARTHWORK EQUIPMENT

1. Tactor
2. Dozer
3. shovel excavator
4. clam shell excavator (or) front end loader
5. Trench cutter
6. Scraper

Tractor:

Tractor is an important road machinery which is used for different types of works in connection with the earthwork. This equipment is a self-propelled machine which is used mainly to exert a powerful force for pulling other machine.

In the engineering sense, the tractors can be divided in to three types.

1. Engineering tractor
2. Front loader
3. Backhoe loader
4. Road tractor

2. Dozer

Dozers are used for various operations of earthworks such as cutting and filling. The major components of a bulldozer are the blade & the ripper. The ripper can be identified as the extended device at the bulldozer rear. Rippers contain only on shank, or can be in grouping of two or more that are called as multiple shank rippers.

1. A straight blade (S-.blade) which is short and has no lateral curve

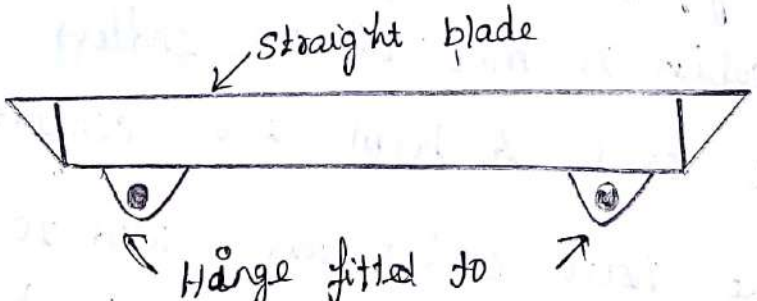


Fig. Straight blade.

2. A Universal Blade ("U - Blade") which is tall and much curved, and has large side wings to carry more materials

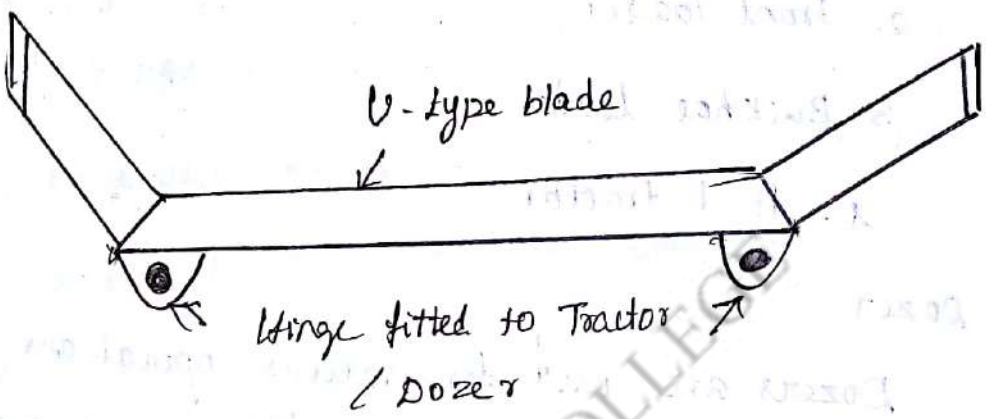


Fig. Universal blade

Dozers are three types

1. Bul Dozer 2. Angle Dozer 3. Tree Dozer

3. Shovel Excavator

Shovel excavator is otherwise called motor grader. The general arrangement of shovel excavator is shown in fig. 1.1 consists of wheel, operating cabin, hoist cable, pulley, boom- dipperrod and bucket. The working cabin is mounted on endless steel wheel. The hoist cable & boom are connected by cabin.

The hoist cables are used to control the bucket & it is used to surround by the bucket.

The shovel is used for excavating earth & loading it in truck for transporting to required places. They are capable of excavating all types of earth except solid rock. They may be mounted on crawler track.

Generally (usually) this shovel can be classified into three types

1. Power shovel excavator
2. Back hoe shovel excavator
3. Front shovel excavator
4. clam shell excavator or front end loader.

Clam shell excavator is generally used for handling loose material such as sand, gravel, aggregate, coal. It is also used for the vertical lifting of materials from the one location to another. The bucket may be of fetched or without teethed. The fetched buckets are used for digging hardend soil. Mostly this kind of excavator is widely used for re-handling of materials, and this requires fairly accurate dumping & disposal of materials.

5. Trenching Machine

Trenching machines are successfully employed for excavating trenches for laying water pipe line, Gas pipe, oil pipe, sewer pipe and telephone cables etc.

Types:

1. Wheel type trenching Machine
2. Ladder type trenching machine.

6. Scraper:

This equipment consists of large bucket called scraper & it attached to a tractor. Its capacity varies from $3 m^3$ to $9 m^3$. The scraper has a cutting edge or blade at the bottom & it is possible to dig earth to a depth 250 mm. During the forward movement the blade cuts the ground & the loosened earth is collected in the body of scraper.

Type:

1. Single engine scraper
2. Twin engine scraper
3. Auger scraper.

EQUIPMENTS FOR FOUNDATION

Equipments for shallow foundation works.

1. Tractor
2. Dozer
3. Shovel Excavator
4. Trenching Machine.

Equipments for pile foundations

1. Piling frame
2. Leader
3. Trestle guides
4. Pile hammer
5. Piling vibrator

Piling frame.

The main function of piling frame is to give perfect alignment from the stage of first pitching in position to its final penetration.

Leader:

The leader or leads is a solid structure which is supported by a stayed mast to provide the required stability & is also used to give the proper alignment to the pile.

Trestle guide

Trestle guide is a structure, it is also used to support a pile driving by means of guides in the form of a moveable trestle.

Pile hammer

Pile hammer is an important equipment used in the pile driving process. The hammer is nothing but is a solid steel mass which is operated by various methods.

1. Drop hammer
2. Single acting hammer
3. Double acting hammer
4. Diesel hammer
5. Vibrator hammer

EQUIPMENT FOR CONCRETE MANUFACTURING PROCESS

1. Equipment for compaction of concrete

Immediately after placing the concrete in position, it should be properly compacted to get uniform density. The main object of compaction is to remove all air voids of the concrete.

Types of Vibrator

1. Needle vibrator
2. Surface vibrator
3. Shutter vibrator
4. Vibrator table.

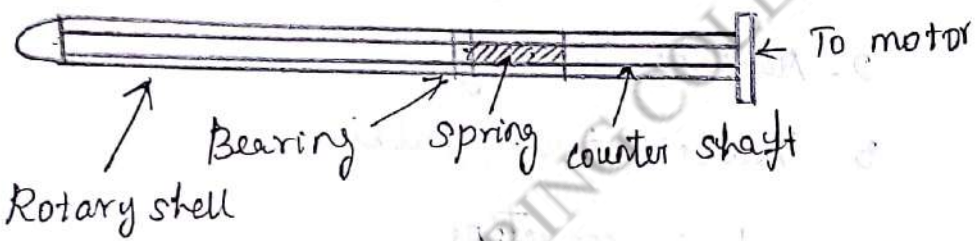


Fig. Needle vibrator.

2. Equipment for batching

A concrete batching plant is very important equipment for the concrete construction. With the help of concreteg batching plant concrete used for the construction is produced by proper mixing of all the ingredients like sand, gravel, water & cement & then transported to the concrete construction site ready to be poured for use.

Equipment for mixing & concreting of concrete

Through mixing of materials is essential for production of uniform concrete. The thorough mixing should ensure that the mass become homogenous, uniform in colour & consistency. They are two methods adopted for mixing concrete.

1. Hand Mixing
2. Machine mixing
3. Transit truck mixing

Precautions during concreting

All gears, chains and rollers of concrete mixers shall be adequately guarded to prevent danger.

Concrete mixer skips shall be protected by side railings to prevent workers from passing under them & operators shall make sure before lowering the skip that all workers are in the clear.

Hoppers into which a person could fall and revolving plates of trough or batch type mixers shall be adequately guarded by grating.

Types of compaction equipment (compactors) for soil

1. Wheeled compactor
2. Vibrating Road roller
3. Plate compactor
4. Tamper

Factors affecting → a, compactive effort
b. Moisture content
c, soil type
d, Layer thickness
e, Contact pressure
f, Number of roller passes
g. Speed of rolling

factors influencing compaction process

1. Type of material
2. Compactive effort
3. Layer thickness
4. Method of compaction
5. Water / Moisture content
6. Contact pressure
7. Speed of compaction

EQUIPMENT FOR MATERIAL HANDLING

Material handling deals with the conveying or moving the construction materials from one place to another and it is extensively used in the field of construction. The following are the various types of conveyors

1. Belt conveyer
2. chute "
3. Wheel "
4. Roller "
5. Magnetic bell "
6. Bucket conveyor
7. Trolley "
8. Sortation conveyor

1. Belt conveyor

These are used to convey, handle and transport construction materials such as sand, cement concrete, earth etc. The materials are transported with a continuous flow at high speeds, and it can be used for long distances.

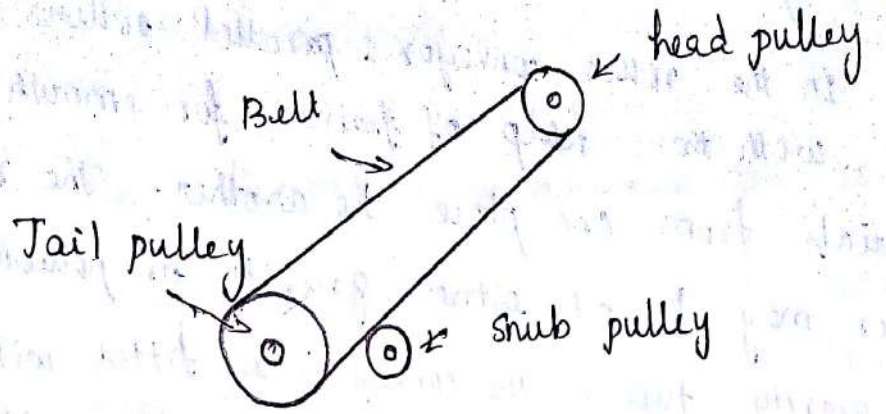


Fig: Belt conveyor.

2. Chute conveyor

This type of conveyor is mainly used to link the two material handling devices and used to convey the construction materials between two floors. This conveyors is considered as the inexpensive mode of material handling. By using chute conveyor, it cannot able to handle heavy weighted materials and difficult to control position of the items.

3. Wheel conveyor

The general arrangement of wheel type conveyor is shown in fig. It is made up of series of skate wheels mounted on a shaft or axle. Depending on the materials weight and nature, the wheel spacing slope for gravity are provided.

4. Roller conveyor :

In the roller conveyor, parallel rollers are provided with the help of frames for smooth transfer of materials from one place to another. The roller conveyor may be of either gravity or powered type. In the gravity type, the conveyors is fitted with slight slope and the materials are moving with gravity force where as in the powered roller conveyor system electrical motor is used to rotate the rollers with the help of steel chains.

EQUIPMENT USED FOR ERECTION OF STRUCTURES

In order to raise and shift heavy materials from one place to another, the cranes are employed in the construction of large projects. The cranes are mobile & a mobile crane can be used for various other useful purposes. The general characteristics of cranes are.

- Used to move loads over variable paths within a restricted area.
- Used when there is insufficient flow volume such that the use of a conveyor cannot be justified.

↳ Provide less flexibility in movement than industrial structure trucks.

↳ More flexibility in movement than conveyors.

↳ Loads handled are more varied with respect to their shape & weight than thoose handled by a conveyor.

↳ Most cranes utilize hoists for vertical movement although manipulators can be used if precise positioning of load is required.

1. Derrick Crane

It is essentially consists of wheels for slewing or revolving, hoisting cable, supporting cables, winch & counter weight. It is used for open site & it possesses a very long reach.

2. Mobile crane:

The mobile crane mounted on pneumatic typed truck or wheeled tractor is formed as mobile cranes. These are suitable for rough terrain.

Uses: To load & unload the materials easily

To work as trencher is to dig downward into

EQUIPMENT USED FOR DREDGING :

The dredging is defined as the increasing the depth of any water body by excavation is known as dredging.

1. Bucket ladder Dredger.

The buckets are provided with suitable cutting edge to facilitate digging. The materials brought up by the bucket are either dropped directly into hoppers provided on the vessel or conveyed to the barges standing alongside the vessel.

2. Dipper Dredger

Dipper dredger consists of a pontoon carrying a frame in which a revolving boom is fixed. The dipper stick connect the buckets and boom. The bucket is dredged by releasing & pulling the hoist cable.

3. Grab Dredger

The grab dredger essentially consists of a grab suspended from cable. The grab is open in normal position. on being lowered to the bottom, the grab dig into the mud & by suitable arrangement, the grab is closed and the material thus caught in the grab is lifted up & disposed off.

Hydraulic dredger:

Hydraulic dredger essentially consists of sand pumps which excavates and transport the bed material in one operation. The suction pipe is provided at bottom with a cutter for hard material. This type of dredger also known as the suction dredger.

EQUIPMENT USED FOR TUNNELING:

Tunnels are constructed for making underground railways and highways. It is also used to carry fluids from one point to another. In general the construction of tunnels is carried out by following three activities.

1. Drilling the surface & making holes on it.
2. Fill up the explosives & filling
3. Removing the materials (mucking)

The drilling of rock is a major issue during tunneling. Normally the following types of equipments are used for drilling & making the holes

1. Rock drill with hammering
2. Rock drill with percussive
3. Rotary drills
4. Auxiliary tools.

SAFETY MEASURES :

As discussed in this chapter, various equipments / machineries are used for various purposes such as earth moving, lifting the construction materials & hostry. As per the Indian standarzed code (IS 7293 - 1974), some of the important general safety measures are given & it should be followed during the handling of the construction equipments

↳ The driver shall be adequately protected from the weather by a cabin which, if enclosed, shall be provided with windows that give unrestricted maximum possible view & is well ventilated.

↳ The windows shall be provided with toughened safety glass & wipers.

↳ The driver's seat shall be provided, if necessary, with fencing, guard rails & toe boards to prevent danger.

↳ Emergency means of escape incase of fire or any accident shall be provided.

↳ No unauthorized person shall ride on the earth moving machinery.