Module-IV

Mechanized Construction: Introduction, general consideration, plants for earthwork- tractor, bulldozer, ripper, scraper, face shovel, backhoe, dragline, clamshell etc., roller, plants for transportation, movement and handling- derrick, crane, hoist, concrete mixers and pumps, scaffolding , Building items: Plastering & pointing- its purpose, various types, construction procedures, advantages and disadvantages, suitability of each, Damp proof course (DPC), Anti-termite measures and treatment, Construction joints-need and materials used, Plumbing and electrification- various types of fittings and laying procedure.

Introduction

Execution of project activities should be planned to achieve completion in time by mechanized construction.

A construction project is of two types,

1- linear project i.e. a traditional way
2- fast tracked project i.e. design and construction work are set on parallel work

In both the case cost of construction should not exceed the budget, quality of work should confirm the specifications, drawing, codes and execution has to be in time scheduled.

The selection of type of construction equipment to be deployed depends on particular project size, its topography, earth materials, earthwork involved etc.

EARTH MOVING CONSTRUCTION EQUIPMENTS

Earth moving operation involves,

- Loosening the materials to turn it into workable state
- Digging of matwrial
- moving from one location to dumplocation
- dumping of material

The construction equipment for earth moving fall under two categories

- fixed position type (shovels, backhoes, draglines etc.)
- moving type (bulldozers, loaders, scrapers, graders, trenchers etc.)

shovel

Backhoe

Drag lines

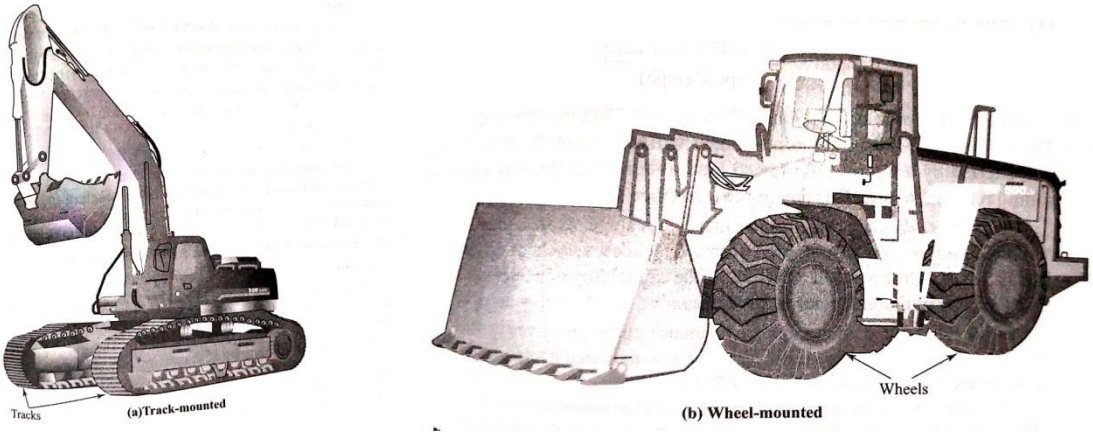
bulldozer

loader

trencher

TRACTOR

A tractor is wheel- mounted (wheeler) or track-mounted (crawler) as shown in figure which is attached to many moving construction/agricultural equipments as a **power unit** for moving.



A tractor comprises

- Engine
- Clutch
- Flexible coupling
- Transmission
- Rear axle mechanism

- The engine converts thermal energy into mechanical power. Heat engines used are combustion engines as combustion takes place within the cylinder. The driveline comprises the clutch, flexible coupling, transmission (gearbox or hydraulic) and rear axle. Driveline is a set of mechanism that transmits the torque developed by the engine to the driving wheels.
- The clutch serves to disconnect or connect the power of engine shaft to operator when changing gear or when starting tractor from rest.
- The flexible coupling incorporates elastic elements that allow connecting the clutch shaft and transmission drive shaft.
- Transmission makes it possible to change the driving torque and running speed by engaging different pairs of gears.
- The rear axle mechanism increases the driving torque and transmits it to the driving wheels or tracks.

In two wheel drive, the rear/ drive wheels and tyres are much larger than the front ones, which are provided for only supporting and streering. Heavy duty rear tyres are required in all types of construction work, heavy front tyres are deployed only for front loader equipments. Four wheel drive has enough traction for all kinds of construction work but less than that of track mounted drives.

Drawbar is provided for attaching fully mounted or semi-mounted implements to the tractor. The drawbar comprises heavy steel with pins or bolts. It is fastened under the centre of the tractor and can be extended backward across a support bracket. It can swing horizontally.

A tractor is used as the prime mover by applying its power at the rim of its drive wheel as a tangential force known as rimpull. The rimpull is the tractive effort available between the tyres of the drive wheels and the ground surface to propel the vehicle or construction equipments without causing any slippage.

$$Rimpull = \frac{375 \times HP \times Efficiency}{Speed}$$

Rimpull is **expressed in pounds** where 375 is the conversion factor. The efficiency of most tractors will range from 80-85%.

While rubber-tyred equipment performance are given by manufacturers in form of rimpull versus ground speed, tracked-mounted tractor performance curves are given in form of drawbar pull versus groundspeed.

BULLDOZER

A bulldozer is a short-range tractor equipped with a front dozing blade which can be raised or lowered by hydraulic control and is used for digging and pushing. The front pusher blade of a bulldozer is a massive structure that has a rectangular base and back with two push arms. The back of the blade is reinforced with welded ribs and box section to make it rigid both longitudinally and cross wise. The leading edgeof the base is a flat blade of harden steel which projects ahead of and below the rest of the blade.

The front of blade is called mouldboard and is concave and sloped back. As the blade is pushed into the ground, the knife cuts and breaks up the soil that is pushed up the curve of the mouldboard.

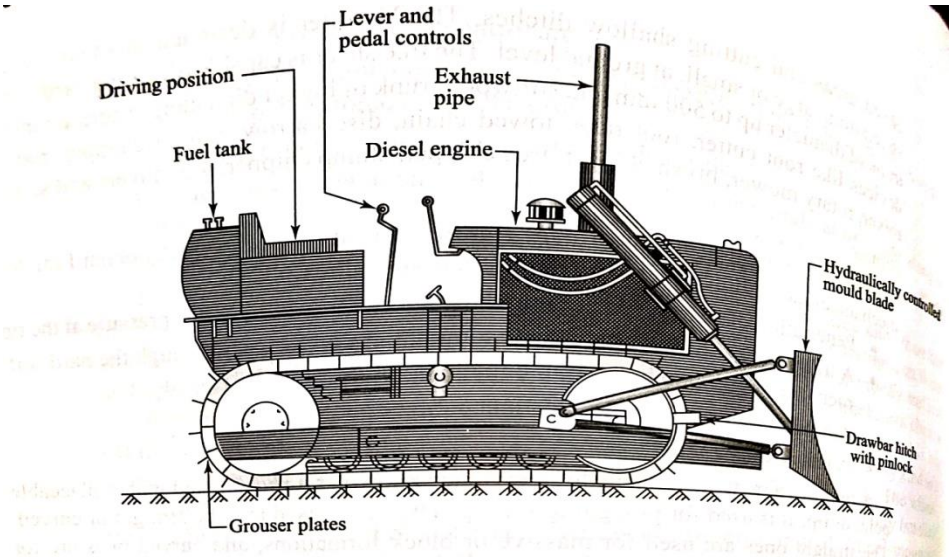
Bulldozers are used for-

- Cutting bushes, trees etc.
- Stripping of topsoil that is unsuitable as fill material
- Opening up pilot roads through hilly and rocky terrain
- Shallow excavation
- Grading

- Spreading
- Backfilling trenches and pits
- Compacting fill

In earth moving three operations of a bulldozer are-

- Cutting in layers
- Moving to a distance of 100m
- Placing/levelling



The output of a track-mounted or wheel-mounted dozer varies with the soil type and prevailing conditions at the locations of operation. The control of the blades on most dozers is hydraulic. Otherwise, winch and cable control system is used. The weight and power of the tractor determines its ability to push-higher value of kW per metre of the blade means more cutting power.

The advantages of winch and cable control are- simplicity of installation, operation, repairing etc. the advantages of hydraulic control are- capability of producing high downward pressure on the blades, in addition to its dead weight to force in to ground.

Track mounted dozers cannot move over a paved roads because of damage this would cause on the roads. They should not be allowed to move over finished formation surface also.

Big powerful dozers are costly to operate and maintain, so it not worth to keep a bigger one site for occasional use. A dozer of such huge power as 746 kW and 45m^3 blade capacity is available in market.

RIPPER

- A ripper is fitted with dozer (bull dozer) at the rear for excavation work in rocky or hard soil.

The ripping action requires Penetration of a strong ripper into the hard soil or rock by down pressure.

- A ripper is a metal (high tensile steel) blade known us a shánk fitted with replaceable point or tip.

- The shank used may be straight or curved. The straight ones are used for massive or block formations, and curved one bedded or laminated rock or road pavements.
- The number of shanks to be attached could be one to five or more depending on the nature of existing soil and required excavation depth. In most cases, the ripping operation is started with one shank.
- The depth of ripping done with trailed rippers is normally up to 0.4 to 0.5 m, and with tractor mounted rippers up to 1.5-2.0 m.

SCRAPER

Scrapers are generally cost-efficient earthmoving equipment when the haul distance is too long for bulldozers and yet too short for trucks. This distance generally ranges from 100-3000 m.
Scrapers are used for

- Surface stripping
- Excavating
- Loading with pusher
- Hauling
- Dumping
- Spreading or levelling

The single engine wheeled scraper is perhaps the most common type of scraper. It consists of a bowl, an apron that drops over a load of earth for transport that relies on hydraulics to get rid of a load once you have successfully moved it.

For better performance of scrapers the following points are focused

- Hard ground should be loosened by ripping or blasting
- Scraper's movement is to be planned to take full advantage
- It need properly maintained tack road called *haul road*

Scrapers generally **used** where cutting of channels, formation of dams and embankments with smooth and accurate level stripping overburden in pit operations are involved.

A scraper is used for continuous operation of cutting/loading, hauling and dumping/ filling. It comprises: A power unit such as a tractor-the prime mover and a large open scraper bowl.

Cutting should be started along the periphery of cutting area and work toward the filling area. Cut areas should be properly graded and loose materials should be pushed into scraper bowls for removal.

Filling operation is to be done maintaining a convex formation so that the scrapers lean inwards thus reducing the possibility of slipping of scraper.

Different types of scraper based on coupling with power unit are-

- Towed or crawler type-two axle scraper bowl towed by a crawler power unit
- Self propelled two axle type

- Self propelled three axle type

Demerits of scrapers

- Comparatively short
- Drop in output with increasing haulage distance, size of lumps and flooding of excavated rocks

FACE SHOVEL

A face shovel is characterized by considerable digging force generated by momentum. It is basically a power unit like a crawler or wheel-mounted tractor with a cable (wire-rope) or hydraulically controlled bucket (with/without teeth) mounted in front of it.

It is earthmoving equipment used primarily to excavate earth face; manoeuvre the excavated materials to a point of disposal for dumping into spoil heap or transport.

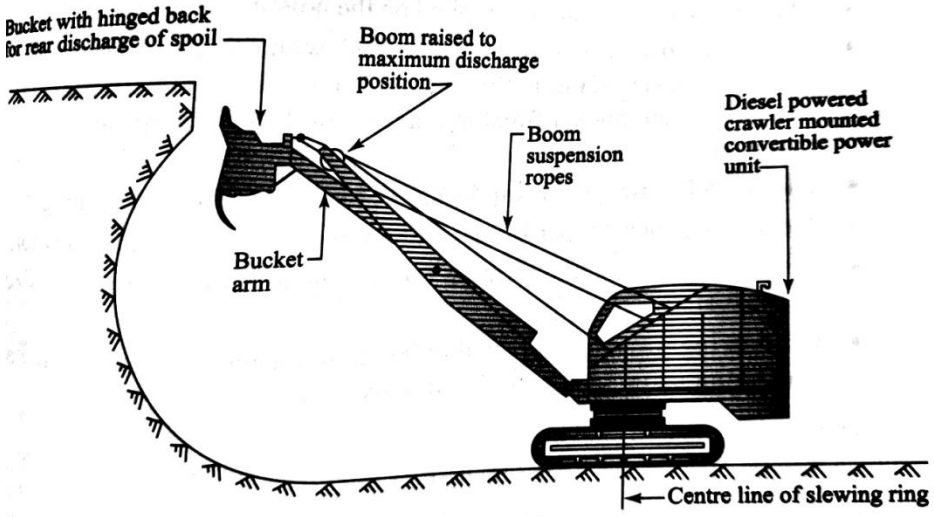
Its **major advantage** is its high output and ability to excavate without loosening in all classes of soils except solid rock. Its digging action is cyclic, that is, discontinuous.

Shovels are used for

- Stripping top soil
- Cutting/scooping up
- Moving/manoeuvring
- Loading (dumping/discharging) into transport/conveyor
- Tree clearing/stump uprooting

A shovel comprises

- Heavy steel deck to carry engine, pumps, attachments, controls and cabin. The upper unit is supported by rollers and is rotated by a vertical gear.deck mounted drum are fitted with spools for cables or hydraulic pumps to rotate and stop the deck by clutches and breaks.



B. 13.6 Face shovel

Shovels are versatile construction equipment deployed to perform more than earthmoving jobs.

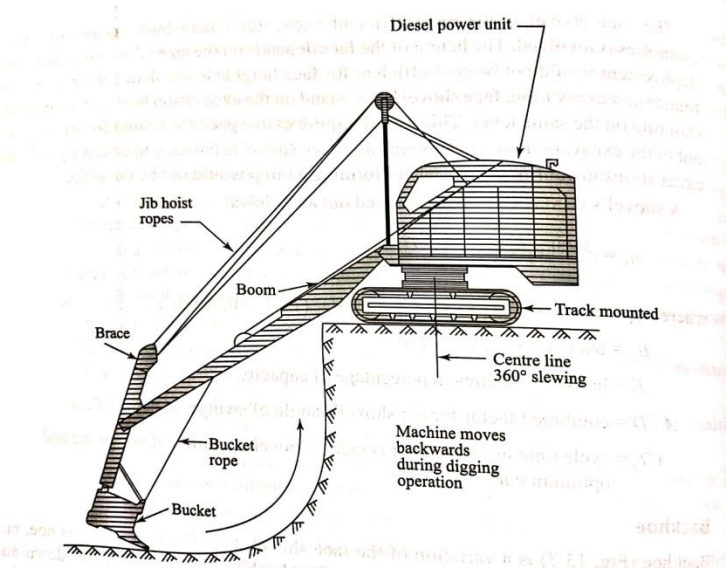
The working cycle of a shovel is as follows:

- ✓ A shovel is driven to the correct position, near the face of the earth excavated using the main hoist power mechanism
- ✓ Its bucket is lowered and positioned at the toe with the teeth pointing in excavation face although it can work a limited height of excavation face
- ✓ It must stand on firm level ground when working
- ✓ Its momentum is used to force the bucket bite into the earth heap for filling to bucket using the secondary hoist and this action can be carried out simultaneously with the main hoist for powerful digging
- ✓ At the same time, tension is applied on the hoisting line to pull the bucket up Where the earth heap is of sufficient depth with respect to the bucket size and soil type, the bucket would be filled as it reaches the top of the heap the shovel is swung with the bucket filled to manoeuvre it to discharge at the point of dump transport
- ✓ The shovel is swung back to bring the bucket into further digging A cycle is generally performed without moving the shovel as a whole
- ✓ A shovel works on one location for as long as required, moving its position only as excavation proceeds
- ✓ For moving the shovel to another location, the move has to be undertaken slowy care being taken to ensure that it does remain on firm base

BACKHOE

Backhoe is a variation of the face shovel. The backhoe moves its bucket down and towards the operator to carry out excavation below the equipment mounting. In other words, a shovel may be converted into a backhoe by replacing the bucket along with the fasteners and attachments.

A backhoe is often equipped with goose neck boom/jib to ase its digging depth. A backhoe is designed to dig much deeper than face shovel.



Backhoes are used generally for excavating below the ground level on which they are positioned.

They are used for

- Earthwork in excavation in trenches, foundations and basements requiring precise control of depths
- Deep excavation in confined area
- Direct dumping on trucks at close range
- Handling pipelying, trench installing

A backhoe comprises:

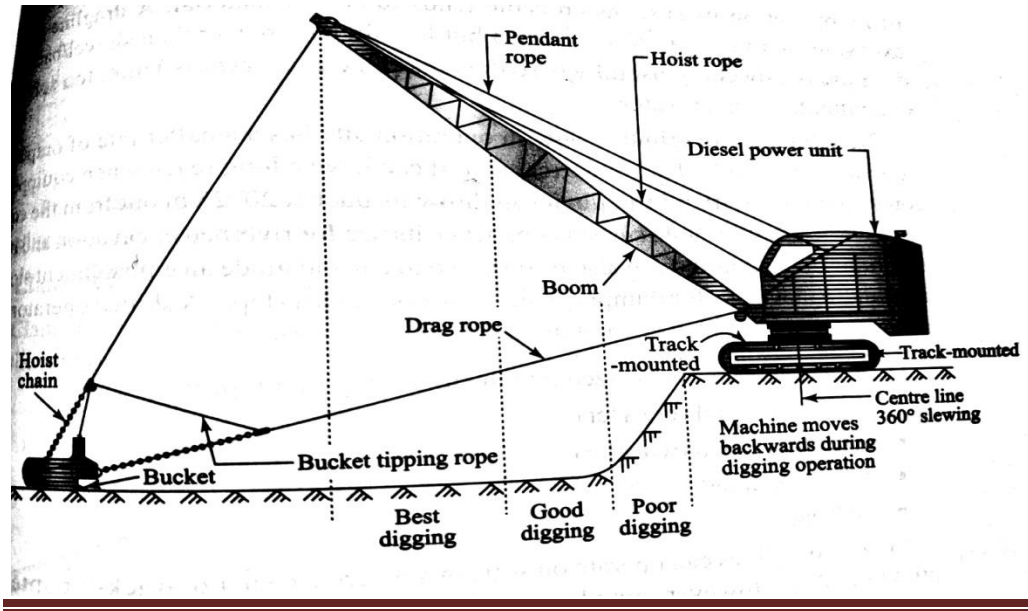
- Heavy steel deck- to carry engine, pumps, attachment, control and cabin
- Cabin- a set of equipment for bucket control
- Boom- boom angle between 30-60 degree
- Bucket-with or without bucket
- Hoist lines
- Power unit like diesel engine or electric mortar

DRAGLINE

A dragline is fitted with long crane for greater reach and drag bucket for excavation in loose and soft soils below its standing level and loading the same into hauling units.

A dragline can be positioned on firm ground while excavating materials from a pit, canal or ditch.

If there is any possibility of depositing the excavated materials along a canal or ditch or nearby pit, then it would be possible to carry out both excavation and disposal in single operation if boom length is sufficiently long.



Depending on operating restrictions, outputs of dragline excavator would vary from 30 to 80 bucket loads per hour. Draglines have greater digging reach but less digging power than shovel/ backhoe.

A dragline stands on firm ground and its bucket digs below its level even under water.

Drag lines are deployed for

- ✓ Cutting ditches with sloping sides
- ✓ Excavating drainage and irrigation canals
- ✓ Dredgeing silted up river/canal beds
- ✓ Sand and gravelpit production
- ✓ Strip mining

Even though a drag line is slow in operation, and has smaller rate of output than an equivalent hydraulic backhoe excavator, it can have a long reach when equipped with a long jib/boom.

With a 15m jib, it can throw its bucket 20-25m out from equipment because of flexible cable suspension. Hence it is used for river bed excavation and bank side trimming.

ROLLERS

Earth on excavation becomes loose and bulky. Filling earth materials, therefore, needs to be compacted to prevent distortion, settlement and softening. The extent of possible compaction of any filling depends on the type of soil material and moisture content.

Compaction of cohesive soils would be relatively slow process under sustained loading: Different types of construction equipment have been developed to obtain satisfactory compaction in different types of soils, and surface finishes such as tar macadam etc. The different compacting machineries are classified into the following distinct ways:

- Static weight
- Vibration
- Kneading action
- Impact force

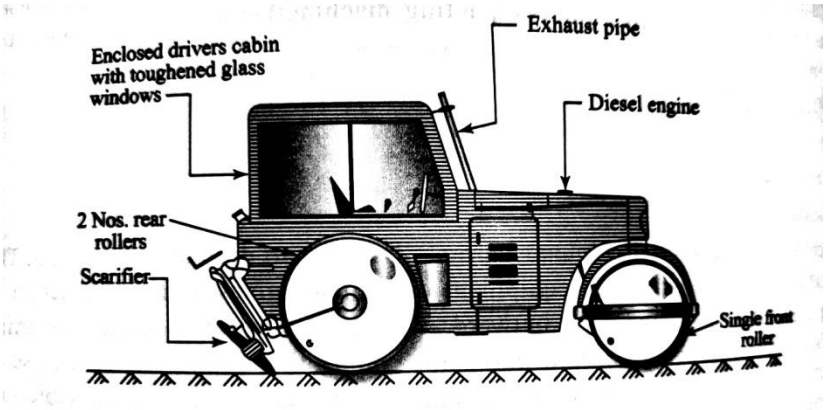
Consolidating operation by rollers rely on the dead weights or vibration in case of light weight rollers. Deadweight can be as high as 16 tonnes or more.

Static weight rollers

Single-axle smooth wheel rollers are used for compaction of soil by self-weight/deadweight

The single-axle roller comprises a frame and smooth steel cylinder loaded with sand or water to increase deadweight. As the roller is pulled ahead, ay soil is pushed up in the direction of movement. With successive passes over the surface, the roller gradually effects compaction of soil.

Three-wheeled (smooth wheel) loaders are used for compacting bituminous materials on road surface operations and negotiation of bends and curves without causing irregular folds or creases. The three-wheeled roller comprises a wide front roller and two narrower rear rollers in tandem and predominantly used for compacting bituminous materials on road surfacing operations using deadweight.



Pneumatic-tyre rollers

Pneumatic-tyre rollers are used for rolling base course and filling for large earthwork involving loamy soil texture. The pneumatic tyre roller is designed as construction equipment that combines the kneading action with static weight.

The rollers have two axles with odd number of tyres like seven (four front and five rear) or nine (four front and five rear) right up to nineteen (nine front and ten rear).

Sheep's foot roller

These are used for highly cohesive soil materials, but most effective in sandy soil with clay binder and also used for kneading the soil particles by high pressure.

Vibratory roller

Vibration generated in a machine-part that is in contact with the ground produces a rapid series of impacts causing pressure waves that penetrate the soil setting its particles in motion. The combined effect of this motion and the weight exerted by the machine-part would initiate rearrangement of the soil particles forcing them into a compact structure with minimum of voids.

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Vibratory rollers are used for compacting and consolidating granular soils and compacting bed materials in small areas.

The vibratory roller comprises a roller drum with one or more eccentric weight inside the drum. Vibration is produced by rapid rotation of axle carrying eccentric weights. The eccentrically rotating weight applies a centrifugal force. The maximum depth up to which filling can be compacted would depend on the total dynamic load comprising the static load plus centrifugal force. On this basic principle, different types of vibratory rollers are manufactured. The weight of self-propelled vibratory rollers varies between 500 kg to 5 tonnes.

PLANTS FOR TRANSPORTATION, MOVEMENT AND HANDLING

WIRE ROPES (CABLES)

Wire rope is the simplest device that is used for lifting materials or plants or machineries. A rope is used for lifting operation in conjunction with pulley block.

Wire ropes are made of metal wires-individual carbon-steel wires, twisted together as a strand and these are twisted together around steel core to form rope of cable.

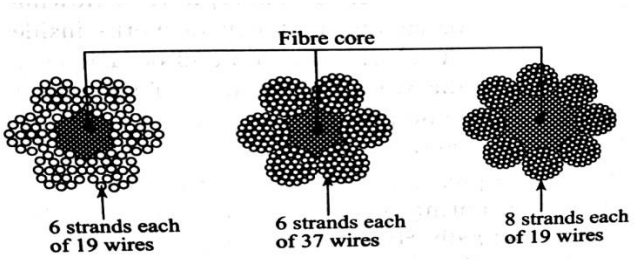
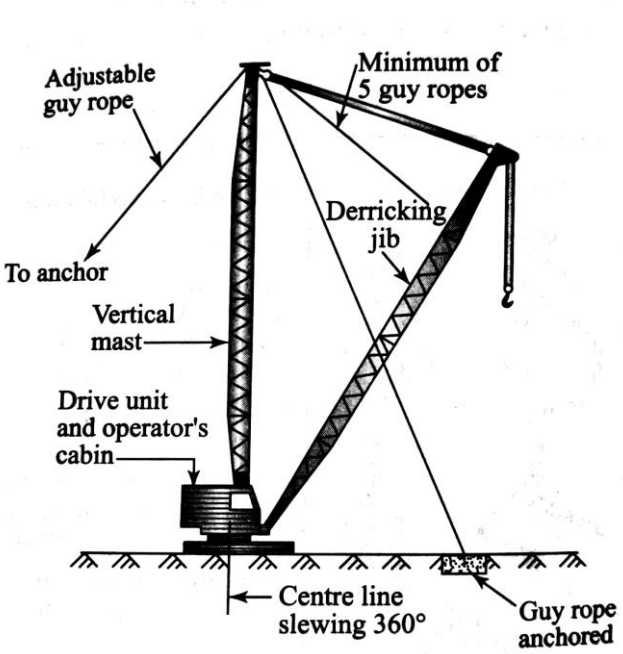


Fig. 13.18 Wire ropes

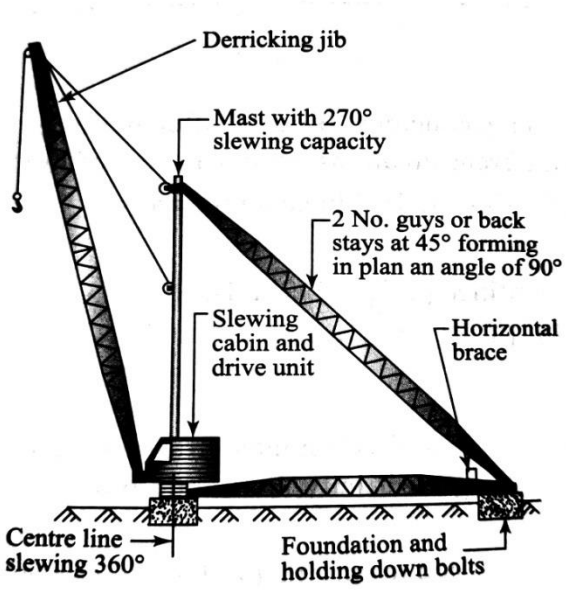
The load carrying capacity of the rope depends on its diameter and the number of wires it is made of. A6 x 19 rope means ad and each and of 19 wires. Wire rope is made up with a safety factor five.

Guyed derrick



This simple and inexpensive non-mobile construction equipment comprises single lattice mast and jib. The mast stands vertically on solid bearing and is stabilized by at least five anchored guy ropes. Deployment of guyed derrick would be cost-effective if its use is required over a long period of time.

SCOTCH DERRICK



The Scotch or stiff-leg derrick is preferred over guyed derrick for heavy lifting over long and high reaches. It comprises a vertical slewing mast, a luffing jib and two rope drums. Two fixed lattice members called stays support the mast, which is usually made of steel plates. The mast is

free to rotate on bearings at its top and bottom supports. Two stays are fixed to the top of the slewing mast at an angle of 45°. Horizontal stays (struts) connect the bottom of the mast with the bases of the 45° inclined stays thus forming triangular frame of the lattice stabilizing members. The mast, therefore, is capable of slewing 270° due to inclined stays.

CRANE

Track-mounted crane

Crawler cranes can move around most unfavourable sites. The weight of the crane plus load in case of a crawler crane is spread over a large bearing area under wide and long tracks. Crawler cranes are advantageously deployed for lifting and shifting small to medium category loads like concrete, reinforcing steel, fabricated steel, formwork, equipment etc.

A crawler crane is built in three sections as follows:

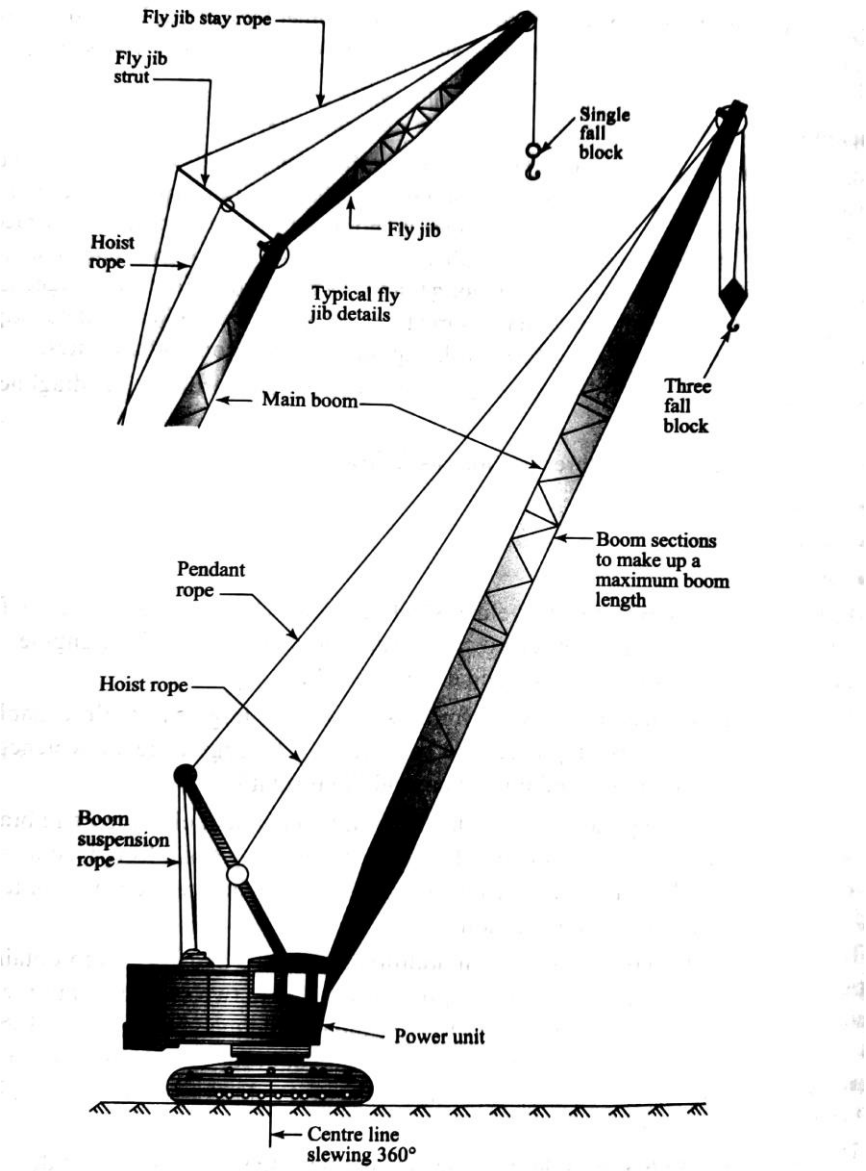
- Base frame
- Superstructure
- Jib

The base frame is fabricated of welded steel sections. The two machine axles form part of the base frame. This fabricated frame supports the weight of the engine, gear system, winches, controls, cabin, jib and counterweight.

The superstructure has a revolving frame sitting on a large turntable capable of slewing 360°. This frame is supported on a base frame. The engine, gears, winches and counterweight are accommodated on and around the turntable.

The two winches comprise two rope drums with independent clutching and braking facilities. The winch with its drum near the jib is for lowering and lifting load using its hook. The rear winch is used for luffing the jib. The winches rely on mechanical or hydraulic system for power transmission.

The jib is of lattice construction with additional sections and fly jibs to obtain the various lengths and capacities. The basic jib is assembled in two sections. Intermediate sections may be added to extend jib lengths.



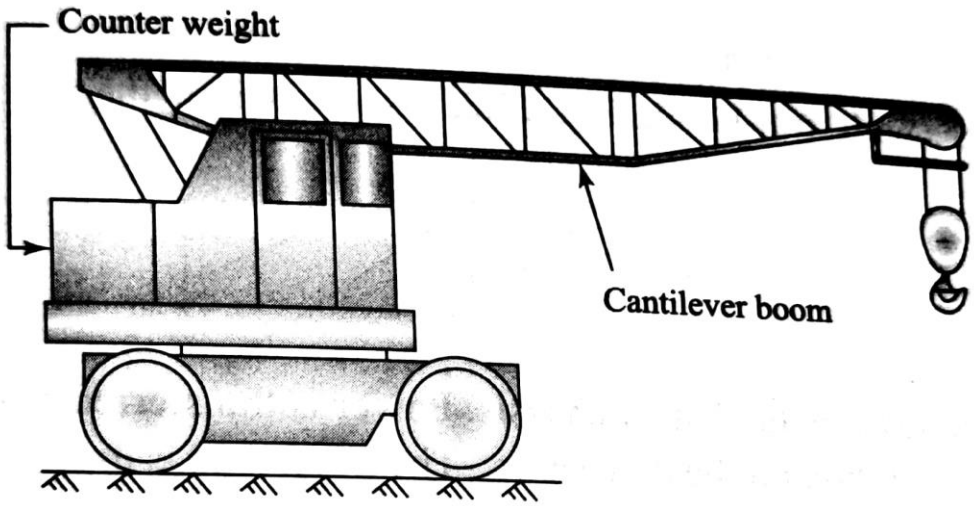
Because of constraints, straight jibs often cannot be extended beyond a limit. In such cases, a fly jib can be attached at the end of the straight jib. The fly jib is of similar lattice construction as the main jib. The length of the fly jib is adjusted to suit the job requirement.

Wheel mounted cranes

A wheel mounted self propelled crane has advantage of mobility.

Wheel mounted crane with strut boom- is also built with base frame, superstructure, boom

The base frame comprises of welded steel. Power is transferred to wheels via the gear system. The boom and winches including the rope drum are arranged in same way as are done in case of track mounted crane.

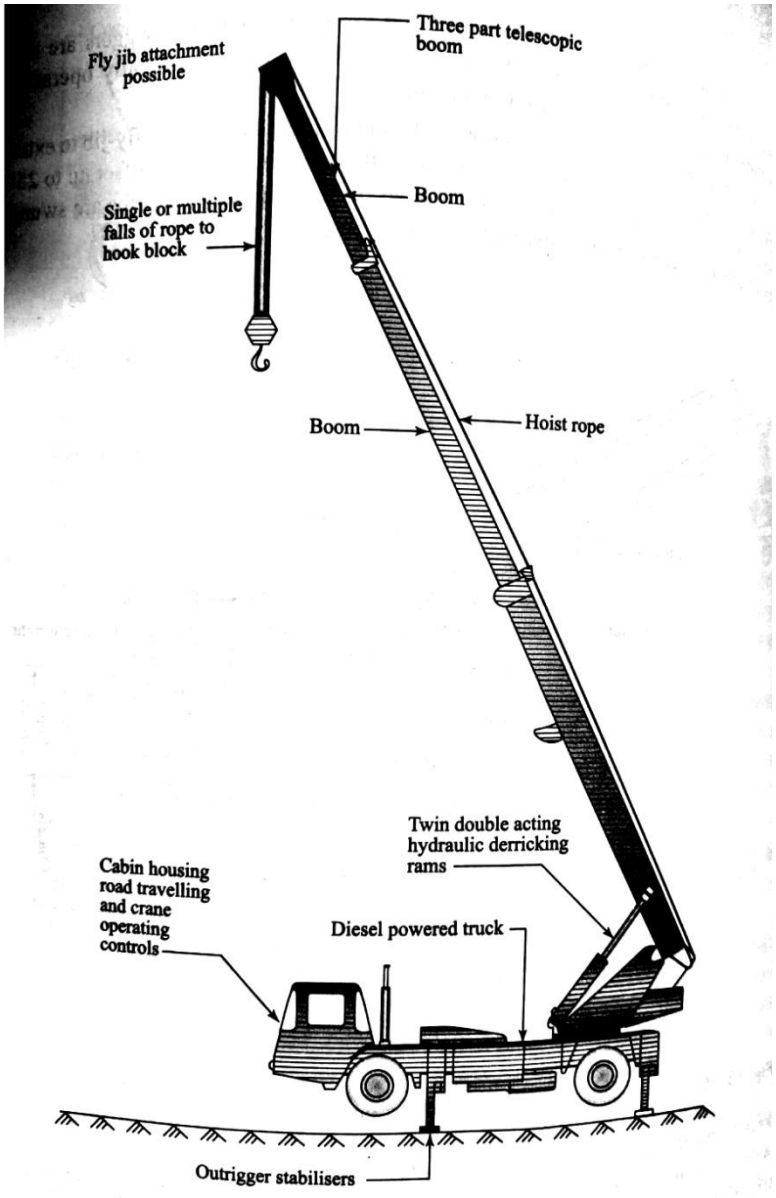


Wheel mounted crane with cantilever boom- is pivoted on specially designed truck at much higher position on the superstructure compared to wheel mounted crane with strut-boom. It provides greater clearance for handling bulky loads.

Self-propelled telescopic boom crane- is more versatile and can easily move from site to site at 20- 30km/hr. The telescopic action of the boom is very flexible. The chassis (base frame) comprises two side hollow steel beams connected at the two ends by similar hollow crossbeams. A diesel engine is mounted on the chassis at the rear of the vehicle. The engine drives a rigidly mounted rear axle through a torque converter and power-shift gearbox.

The front and the rear wheels may have independent steering controls. Modern chassis has hydraulic cylinders attached between the chassis and wheel hubs for steering control. Both two-wheel (rear axle) and four-wheel drive vehicles are available. Four-wheel drives are for deployment on rough terrain. The front wheels are used for steering.

Truck mounted telescopic boom crane-comprises two universal beam with integral outrigger boxes, power unit, transmission system, cabin, boom, counterweight and hoist.



It is similar to self-propelled telescopic boom crane except for the counter weight, which is placed at a lower position to improve travelling stability.

HOIST

The hoist is used as vertical elevator to transport personnel and materials quickly by means of moving level platform in the construction of massive structures like dams, power station buildings, cooling towers, chimney etc.

Hoists can be used in combination with tower cranes to speed up construction work at high elevations by reducing lifting time involved in tower crane operation.

Hoists can be effectively used both in high-rise and low-rise construction where deployment of tower cranes may not be cost-efficient. Hoists

A hoist is not a costly device. Its maintenance cost is also low. Hoists are, therefore, widely used lifting devices.

Its disadvantage compared to a tower crane is that it can lift materials up to a platform. Further arrangement is needed for lifting or shifting from the platform.

The hoists are basically of two forms

- **Mobile hoists**
- **Static hoists**

The mobile hoist comprises a base frame, a winch powered by motor and two mast sections. All mobile hoists should be positioned on a firm level base and jacket to ensure stability. A mobile hoist is may be of 24m. But it's lifting height for250-1000kg materials is15m.

Static hoist consists of mast or tower with the lift plat form. The static hoist are installed at site for long period of time. Hoists are very useful for lifting materials to different floors. Hoists in combination with concrete pumps can be better utilized in the construction of tall chimney, lift shafts, cooling towers etc.

SCAFFOLDING

Scaffolding is temporary erection of timber or steel to facilitate construction, to allow hoisting or standing of materials or men etc.

In construction work scaffolding will be necessary till the permanent structure becomes self supporting, hence called as the 'false work'.

Scaffolding is erected along the outside perimeter of the building or structure preferably on level ground. Pressure on soils distributed evenly by placing each upright tube /pole on base plates over sole plates so that the load is distributed evenly on the ground.

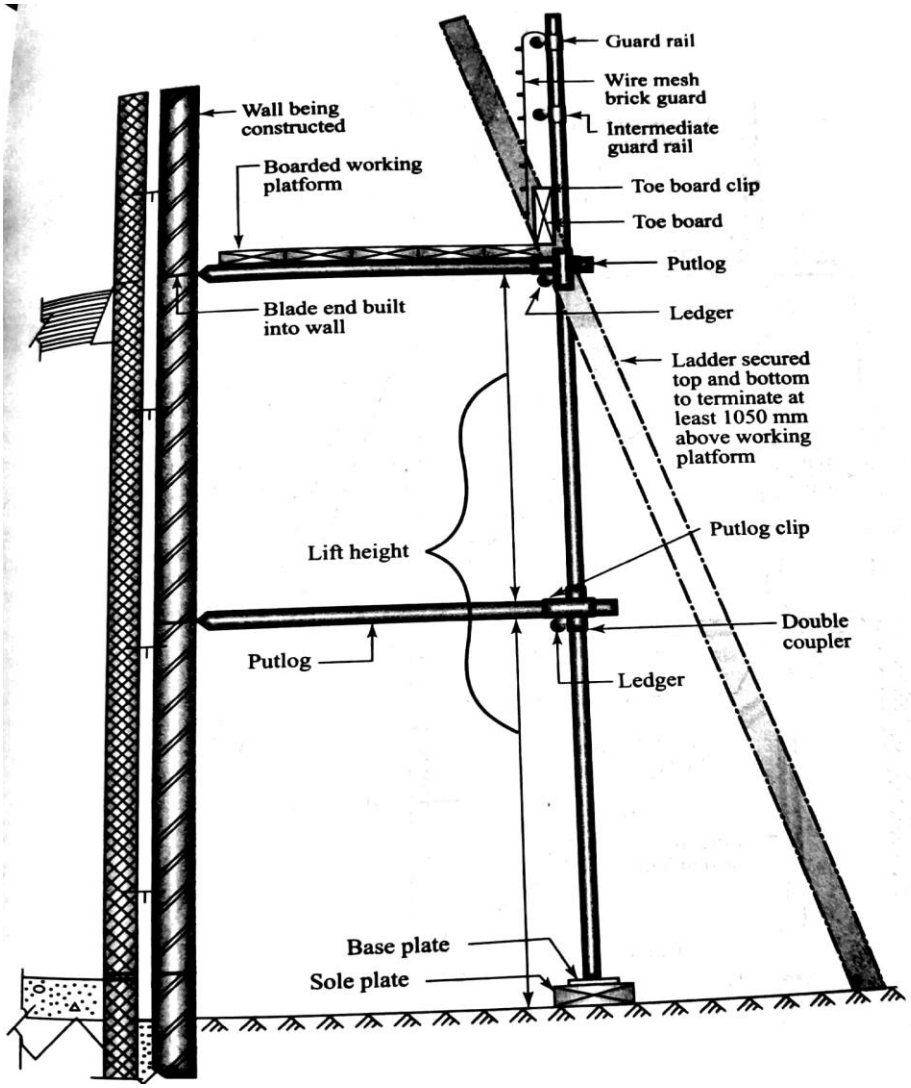
The top of the upright is fitted with head or cap plates for supporting form work for slab or platform.

Single row upright

A single row upright scaffolding pipes are joined together by ledgers. Putlogs are connected by the ledgers and masonry wall under construction for stability. The platform for raising masonry wall would need a ladder.

Double row upright

When two row of upright are erected the scaffolding become independent and self standing. The scaffolding structure under construction is further strengthened by cross bracing as required.



Truss out scaffold

In truss out scaffold the platform frame is made independent of the building or structure under construction. This type of scaffold is used where erection of conventional scaffold from ground level is not desirable.

Mobile scaffold

The working platform can be easily moved on wheels to different working position mainly for work on ceiling or maintenance work.

Suspended scaffold

The size of platform should be less then 2.5m ×2.5m. This type of scaffold is suspended from the main structure by means of wire rope or steel chain. It should be made of a cradle like platform for temporary access to face of building for cleaning or maintenance.

PLASTERING

Plastering is the process of covering rough surfaces of walls, columns, ceilings and other building components with thin coat of plastic mortars to form a smooth durable surface. The coating of plastic material (i.e. mortar) is termed as plaster.

Purpose of Plastering is

(1) To protect the external surfaces against penetration of rain water and other atmospheric agencies.
(2) To give smooth surface in which dust and dirt cannot lodge.
(3) To give decorative effect.
(4) To conceal inferior materials or defective workmanship.

- The plaster material should fulfill the following requirements:

(1) It should adhere to the background, and should remain adhered during all variations in seasons and other atmospheric conditions.
(2) It should be bard and durable.
(3) It should possess good workability
(4) It should be possible to apply it during all weather conditions
(5) It should be cheap
(6) It should effectively check penetration of moisture.

- The selection of **type of plaster** depends upon the following factors

1. Availability of binding materials.
2. Durability requirements.
3. Finishing requirements.
4. Atmospheric conditions and variations in weather.
5. Location of surface (ie. exposed surface or interior surfaces)

Types of plaster

1. Lime mortar

Lime used for plastering may be either fat lime or hydraulic lime.

Howerer, fat lime is preferred since it yields good putty after slaking. Hydraulic lime contains particles which slake very slowly as it comes in contact with atmospheric moisture, such slaking may even continue for 6 to 8 months. If unslaked particles remain in such surface gets damaged.

Hydraulic lime yields harder and stronger surface. If hydraulic lime is used for plastering, it should be ground dry with sand. It is then left for the other hand, is slaked 2 to 3 weeks and then reground before use.

Fat lime on the other hand is slaked wet. The mix proportion (lime: sand) varies from 1: 3 to 1:4 for fat lime and 1:2 for hydraulic lime.

2. Cement mortar

Cement mortar is the best mortar for external plastering work since it is practically non-absorbent. It is also preferred to lime plaster. Cement mortar is much stronger than lime mortar, The mix proportion (cement:sand) may vary from 1: 4 to 1 : 6. Sand used for plastering should be clean e and angular. Before mixing water, dry mixing is thoroughly done. When water mixed, the mortar should be used within 30 minutes of mixing.

3. Lime-cement mortar

Lime-cement mortar contains properties of both the lime mortar as well as cement mortar. Cement mortar as such does not possess sufficient plasticity. Addition of lime to it imparts plasticity, resulting in smooth plastered surface. Mix proportions generally used are (cement: lime: sand) 1:1:6 , 1: 1: 8 or 1: 2 : 8.

Procedure

Preparation of background

- For plastering new surfaces, all masonry joints should be raked to a depth of 10 mm in brick masonry and 15 mm in stone masonry for providing key to the plaster. All mortar droppings and dust, and laitance (in case of freshly laid concrete) should be removed with the help of stiff wire brush. Any unevenness is levelled before rendering is applied.
- For finishes applied in three coats, local projections should not be more than 10 mm. For two coat plaster, these limitation is 5mm respectively.
- The surface should be washed with clean water and kept damp uniformly to produce optimum suction. In no case the surface should be kept soaked with water so as to cause sliding of mortar before it sets
- If plaster to be applied on old surface, all dirt, oil, paint etc. should be cleaned off. Loose and crumbling plaster layer should be removed to its full thickness and the surface of the background should be exposed and joints properly raked.

Lime plaster procedure

Lime plaster is applied either in three coats or in two coats.

(a) In the 3-coat plaster, the first coat is known as rendering coat, second coat in known as floating coat and the third coat is known as setting coat or finishing coat.

In rendering coat, the mortar is force applied with mason's trowel and pressed well into joints and over the surface. The thickness of coat should be such as to cover all inequalities of the surface: normal thickness 12 mm. The surface is left to set at least for 7 days. During this period, the surface is cured.

In floating coat, the rendering coat is cleaned off all dirt, dust and other loose mortar dropping. It is lightly wetted. Patches 15 cm x 15 cm or strips 10 cm wide are applied at suitable. The mortar is then thrown with mason's trowel, spread and rubbed to the required plain surface with wooden float. It is then cured to set completely for at least 10 day.

In finishing coat, for lime-sand mortar the finishing is applied immediately after the floating coat. The finishing coat consists of cream of lime applied with steel trowel and rubbed and finished smooth. It is left for 1 day, and then curing is done for at least 7 days.

In the case of lime-surkhi mortar, the finishing coat is applied 7 days after the floating coat, after cleaning the surface of all dirt, dust and mortar droppings and after fully wetting the surface of previous coat. The finishing coat is rubbed hard and finished smooth.

(b) In the case of 2 coat plaster, the rendering coat is a combination of the rendering floating coats of three-coat plaster and is done under one continuous operation except that the scratching of rendering coat, as specified in the three-coat plaster, is not done. The total thickness may be about 12 mm. The finishing is then applied in a manner similar to the three-coat plaster.

Cement plaster and cement-lime plaster

Cement plaster is applied either in two coats or in three coats, the former being more common. For inferior work, single coat plaster is sometimes provided.

(a) In two-coat plaster

1. The background is prepared by racking the joint to a depth of 20 mm, cleaning the surface and well-watering it.
2. The first coat or rendering coat of plaster is applied, the thickness being equal to the specified thickness of plaster less 2 to 3 mm.
3. Plaster is maintained by fixing dots of 15 cm x 15 cm size. Two dots are so formed in vertical line, at a distance of about 2 m, and are plumbed by means of a plumb bob.
4. The rendering coat is kept wet for at least 2 days, and then allowed to dry completely
5. The thickness of final or finishing cost may vary between 2 and 3 mm.
6. Before applying the final coat, the rendering coat is damped evenly.
7. The final coat is applied with wooden floats to a true even surface and finished with steel trowel. As far as possible, the finishing coat should applied starting from top towards bottom and completed in one operation to eliminate joining marks.

(b) In three-coat plaster

1. The procedure is similar to two coat plaster except the intermediate coat of floating coat. The thickness of rendering coat, floating coat and finishing coat are kept 9-10mm, 6-9mm and 2-3mm.
2. The finishing coat may be applied about 6 hours after the application of floating coat.

The term pointing is applied to the finishing of mortar joints in masonry. In exposed masonry, joints are considered to be the weakest and most vulnerable spots from which rain water or dampness can enter. Pointing consists of raking the joints to a depth of 10 to 20 mm and filling it with better quality mortar in desired shape Mortar.

POINTING

Pointing is done with the following mortar mixes :

(i) Lime mortar 1 : 2 mix (1 lime : 2 sand or surkhi) (ii) Cement mortar 1 : 3 mix (1 cement: 3 sand)

The mortar for lime pointing is made with fat lime, by grinding it with sand or surkhi in a mortar mill.

Preparation of surface

In new work, all joints are raked down to a depth of 20mm while the mortar is still soft. In old work, all loose pointing mortar on surface are removed. The joints and surface are cleaned and then wetted.

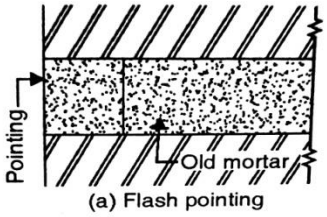
Method of pointing

1. After preparing the surface mortar is carefully placed in desired shape in these joints.
2. A small trowel is used for placing the mortar in the joint
3. The mortar is pressed to bring perfect contact between the old interior mortar of the joint and new mortar.
4. The pointed surface is kept wet for at least a week or till it sets after application

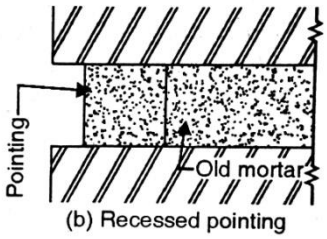
Types

1. Flush pointing

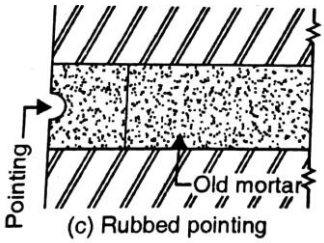
This type of pointing is formed by pressing mortar in the raked joint and by fishing off flush with the edge of masonry units. The edges are neatly trimmed with trowel and straight edge. It does not give good appearance. However, the painting is more durable since it does not provide any space for the accumulation of dust, water etc. Due to this reason, flush pointing is extensively used.



(a) Flash pointing



(b) Recessed pointing



(c) Rubbed pointing

2. Recessed pointing

The pointing is done by pressing the mortar back from the edges by 5 mm or more. The face of the pointing in kept vertical, by a suitable tool. The pointing gives very good appearance.

3. Rubbed pointing

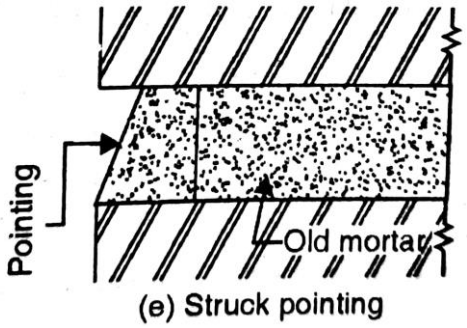
This pointing is a modification of flush pointing by forming a groove at its mid height.

4. Beaded pointing

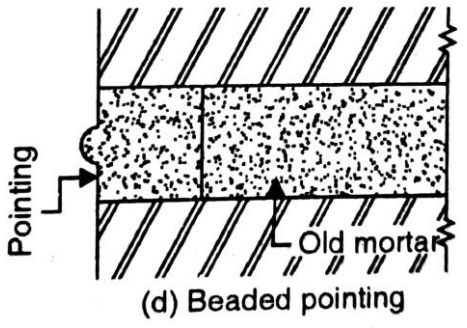
This is the special type of pointing formed by a steel or iron with a concave edge

5. Struck pointing

Here face of pointing is kept inclined.



(e) Struck pointing



(d) Beaded pointing

DAMP PROOF COURSE

Causes of dampness

The basic requirement of a building is that it should remain dry or free from moisture travelling through walls, roofs or floors. Dampness is the presence of hygroscopic or gravitational moisture. Dampness gives rise to unhygienic condition, apart from reduction in strength of structural components of the building.

Following are various **causes of dampness** in buildings.

- Moisture rising up the walls from ground

All the structures are founded on soils, and the sub-structure is embedded into it. If the soil is pervious, moisture constantly travels through it. Even in the case if impervious soils, lot of soil moisture may be present. This moisture may rise up into the wall and the floor through capillary action. Ground water rise will also result in moisture entry into the building through walls and floor.

- Rain travel from wall tops

If the wall tops are not properly protected from rain penetration, rain will enter the wall and will travel down. Leaking roofs will also permit water to enter.

- Rain beating against external walls

If balconies and chajja projections do not have proper outward slope, water will accumulate on these and could ultimately enter the walls through their junction. This moisture travel would completely deface interior decoration of the wall.

- Condensation

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

- Miscellaneous causes

Moisture may also enter due to the following miscellaneous causes

(i) Poor drainage at the building site.

(ii) Imperfect orientation: Walls getting less sunlight and heavy showers may remain damp;

ii) Imperfect roof slope.

(iv) Defective construction : Imperfect wall jointings, joints in roof, defective throating etc

(v) Absorption of water from defective rain water pipes.

Effects of dampness

The following are the ill effects of entry of dampness:

1. Dampness gives rise to breeding of mosquitoes and create unhealthy living condition

2 Travel of moisture through walls and ceiling may cause unsightly patches

3. Moisture travel may cause softening and crumbling of plaster, especially lime plaster

4. The wall decoration (i.e. painting etc.) is damaged, which is very and costly to repair.

5. Continuous presence of moisture in the wall may cause efflorescence resulting in disintegration of bricks, stones, tiles, etc., and consequent reduction in strength

6. The flooring gets loosened because of reduction in the adhesion when moist enters through the floor.

7. Timber fittings, such as doors, windows, wardrobes etc., coming contact with damp walls, damp floors etc., get deteriorated because of warping, buckling dry-rotting etc. of timber.

8. Electrical fittings get deteriorated, giving rise to leakage of electricity and consequent danger of short circuiting.

9. Floor coverings are damaged. On damp floors, one can not use floor coverings

10. Dampness promotes and accelerates growth of termites.

11. Dampness along with warmth and darkness breeds germs of dangerous diseases such as tuberculosis, neuralgia, rheumatism etc. Occupants may even be asthmatic.

12 Moisture causes rusting and corrosion of metal fittings attached to walls, floors and ceilings.

Methods of damp proofing

Following methods are adopted to make a building damp proof:

(1) Use of damp proofing course (D.P.C.) : membrane damp proofing.
(2) Integral damp proofing.
(3) Surface treatment.
(4) Cavity wall construction
(5) Guniting.
(6) Pressure grouting.

1. Membrane damp proofing: Use of D.P.C.

This consists of introducing a water repellent membrane or damp proof course (D.P.C.) between the source of dampness and the part of building adjacent to it. Damp proofing course may consist of flexible materials such as bitumen, mastic asphalt, bituminous felt, plastic or polythene sheets, metal sheets, cement concrete etc. Damp proofing course may be provided either horizontally or vertically in floors,

2. Integral damp proofing

This consists of adding certain water proofing compounds of materials to the concrete mix, so that it becomes impermeable. These water proofing compounds may be in three forms:

(i) Compounds made from chalk, talk, fullers earth, which may fill the voids of concrete under the mechanical action principle.

(ii) Compounds like alkaline silicates, aluminium sulphate, calcium chlorides, etc.which react chemically with concrete to produce water proof concrete.

(ii) Compounds, like soap, petroleum, oils, fatty acid compounds such as stearates of calcium, sodium, ammonia etc. work on water repulsion principle. When these are mixed with concrete, the concrete becomes water repellent.

3. Surface treatment

The surface treatment consists of application of layer of water repellent substances or compounds on these surfaces through which moisture enters. The use of water repellent metallic soaps such as calcium and aluminium oletes and stearates are much effective against rain water penetration. Pointing and plastering of the exposed surfaces must be done carefully, using water proofing agents

like sodium or potassium silicates, aluminium or zinc sulphate, barium hydroxide and magnesium sulphates etc. It should be noted that surface treatment is effective only when the moisture is superficial and is not under pressure. Sometimes, exposed stone or brick wall face may be sprayed with water repellent solutions.

4. Cavity wall construction

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

5. Guniting

This consists of depositing under pressure, an impervious layer of rich cement mortar over the exposed surfaces for water proofing or over pipes, cisterns etc. for resisting the water pressure. Cement mortar consists of 1:3 cement sand mix, which is shot on the cleaned surface with the help of a cement gun, under a pressure o 2 to 3 kg/cm^2. The nozzle of the machine is kept at a distance about 75 to 90 cm from the surface to be united. The mortar mix of desired consistency and thickness can be deposited to get an impervious layer. The layer should be properly cured atleast for 10 days.

6. Pressure grouting

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

ANTI-TERMITE TREATMENT

Terimites, popularly known as white ants cause considerable damage to wood work, furnishings etc. of buildings. Anti-termite treatment is therefore necessary so that damages can be reduced.

Anti-termite treatment may be divided into two categories (1) Pre-construction treatment (2) Post-construction treatment.

(1) Pre-construction treatment

This treatment is started right at the initial stage of construction of building. Pre-construction treatment can be divided into three operations:

(i)Site preparation

(ii) Soil treatment

(iii) Structural barriers.

Site preparation

This operation consists of removal of stumps, roots, logs, waste fibrous matter from the soil at the construction site. This is essential since the termites thrive on these materials

Soil treatment

The best and only reliable method to protect building against termites is to apply a chemical treatment to the soil at the time of construction of the building. This should be done in such a way that a complete chemical barrier is created between the ground from where the termites come and damage wood work in the building.

Physical structural barriers

Continuous impenetrable physical structural barriers may be provided continuously at plinth level to prevent entry to termites through walls. These barriers may be in the form of concrete layer or metal layer. Cement concrete layer may be 5 to 15 cm thick. It is preferable to keep the layer projecting about 5 to 7.5 cm internally. Metal barrier may consist of non-corrodible sheets of copper or galvanised sheet and iron of 0.8 mm thick.

(2) Post-Construction treatment

As stated earlier, the termites, even after entering the building, maintain their contact with their nest or colony in the ground, through shelter tubes or tunnels lined with soil. This fact is well utilised in the anti-termite treatment. It is essential to carry out inspection to estimate the magnitude of spread of termites in the building, and to detect the points of entry of termites in the building. These points may be in near vicinity of columns, basements, steps leading from ground, bathrooms and lavatories, leaking pipes, drains etc. and the places where wood work is embedded in the ground.

Types of joints in concrete constructions

Construction joints are stopping places in the process of concrete pouring. Construction joints are required because it is impractical to place concrete in a continuous operation, except for every small structures. These are normally required in construction works because there is limited supply of concrete in batching plants in a single day and the size of concrete pour may be too large to be concreted in one go. These joints are installed to break up the structure into smaller units in accordance with the production capacity. For monolithic concrete, a good construction joint might be a bonded surface that provides a water tight surface.

Various kinds of joints are,

1. Construction Joints
2. Expansion Joints
3. Contraction Joints
4. Isolation Joints

Construction joints must be designed in order to allow displacements between both sides of the slab but, at the same time, they have to transfer flexural stresses produced in the slab by external loads. Construction joints must allow horizontal displacement right-angled to the joint surface that is normally caused by thermal and shrinkage movement. At the same time they must not allow vertical or rotational displacements.

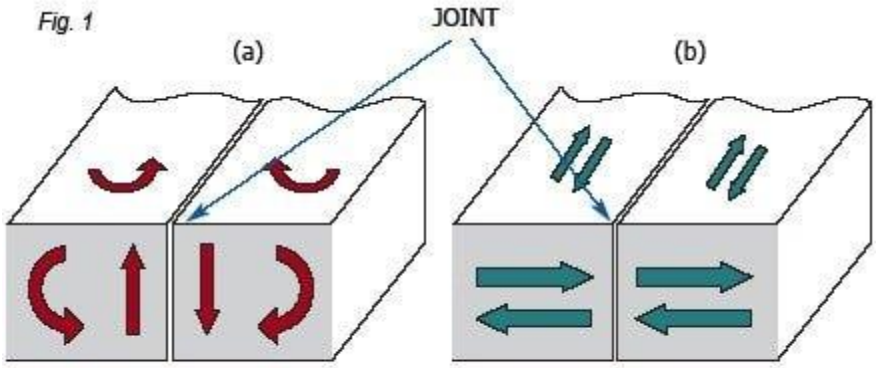


Figure 1 – Relative movements which must be (b) allowed and (a) not allowed by a con-struction joint for concrete slabs

Expansion joints

The concrete is subjected to volume change due to many reasons. So we have to cater for this by way of joint to relieve the stress. Expansion is a function of length.

Contraction Joints

Contraction joint is formed by creating a plane of weakness. Some or all the reinforcement may be terminated on either side of plane.

Isolation Joints

Joints that isolate the slab from a wall, column or drain pipe are called isolation joints.

Different **materials for different join**ts are specified below.

- Joint filler: Bitumen, bitumen containing cellular materials, cork strips, rubber, mineral fibre, expanded plastic, pith, coconut, etc. are the usual joint filler materials. Joint filler should be compressible material tightly fitted in the gap.
- Sealing compounds- Mastic or Hot-applied bituminous sealing compound is mostly used for the purpose.

- Water bars: the function bars are to seal the joints against passage of water. Water bars may be made of rubber, P.V.C., G.I. sheet, copper or aluminium sheets. G.I. Water bar should not be used under corrosive conditions.

PLUMBING SERVICES

The services like water supply, drainage, sanitation etc. are sometimes known as plumbing services. Plumbing is a general term indicating the practice, materials and fittings used in the installation or maintenance of all piping, fittings, appliances and other appurtenances used in connection with water supply system as well as sanitary and storm water drainage system within a building and its connection with any point of public disposal.

Plumbing water supply system comprises of water supply and distribution pipes, taps, valves, storage tanks etc., while plumbing drainage system consists of wash basins, water closets, urinals traps, soil waste pipes, vent pipes, septic tanks etc.

Kind of fittings-

Elbows- are used to change direction of a pipeline

Tee connects 3 pipelines

Cross connect 4 pipelines

Coupling are used to connect straight section pipes

Reducers are used to connect straight pipes with different sections

Cap is used to close the end of a pipe

Plug is used to close the opening in a fitting

Bushing is used to reduce the size of an opening


90 DEGREE L
45 DEGREE L
T
REDUCING T
90 DEGREE STREET L
DROP-EAR L
REDUCING T
90 DEGREE REDUCING L
Example of some pipe accessories needed for water distribution system